FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF TECHNOLOGY

IN

FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

CURRICULUM & SYLLABI

(2019 -2020)

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

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COIMBATORE 641 021 INDIA

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Eachanari Post, Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

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

REGULATIONS
(2019)

CHOICE BASED CREDIT SYSTEM

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FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING/TECHNOLOGY

REGULAR PROGRAMME

REGULATIONS 2019
CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2019-2020 and applicable to the candidates admitted to B.E./B.Tech. during 2019-2020 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. (Bio-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.

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. Degree Programme.

Eligibility criteria for admission in the first semester are given in the table below.

SL. NO.	PROGRAMME	ELIGIBILITY CRITERIA
1.	B.E. Automobile Engineering	Diploma in Automobile Engineering / Mechanical Engineering / Metallurgy / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design
2	B.E. Biomedical Engineering	Diploma in Electrical and Electronics Engineering / Electronics and Communication Engineering / Computer Science Engineering / Mechatronics Engineering / Computer Technology / Instrumentation Technology
3	B.E. Civil Engineering	Diploma in Civil Engineering / Sanitary Engineering / Civil and Rural Engineering
4	B.E. Computer Science and Engineering	Diploma in Computer Engineering / Electrical Engineering / Electronics Engineering / Electrical and Electronics Engineering / Electronics and Communication Engineering / Electronics and Telecommunication Engineering / Information Technology / Computer Science / Instrumentation and Control Engineering / Electronics and Instrumentation
5	B.E. Electrical and Electronics Engineering	Diploma in Electrical Engineering / Electronics Engineering / Electrical and Electronics Engineering / Electronics and Communication Engineering / Electronics and Telecommunication Engineering / Information Technology / Computer Science / Instrumentation and Control Engineering / Electronics and Instrumentation
6	B.E. Electronics and Communications Engineering	Diploma in Electronics Engineering / Electronics and Communication Engineering / Electrical Engineering / Instrument Technology / Electronics with specialization in Instrumentation / Electrical and Electronics Engineering / Information Technology / Computer Science / Instrumentation

		and Control Engineering / Electronics and Telecommunication Engineering
7	B.E. Mechanical Engineering	Diploma in Mechanical Engineering / Metallurgy / Automobile Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-Conditioning / Production Engineering / Tool and Die Design
8	B.Tech. Bio-Technology	Diploma in Chemical Engineering / Leather Technology / Petrochemical Engineering
9	B.Tech. Chemical Engineering	Diploma in Chemical Engineering / Petrochemical Engineering / Chemical Technology / Petroleum Engineering / Polymer Technology / Plastic Technology / Sugar Technology / Pulp and Paper Technology
10	B.Tech. Food Technology	Diploma in Food Technology / Chemical Engineering / Leather Technology / Petrochemical Engineering

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 the 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. Biomedical 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 the 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 in 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

Choice Based Credit System (CBCS) is introduced for students admitted in the academic year 2017-2018. 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 enables students to undergo additional courses. CBCS is applicable to Full Time Undergraduate and 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 and 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 hard core 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 the semester. The maximum number of students to be registered in each course shall depend on the availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in the previous semester is not allowed.

4.2. Each course is normally assigned a 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.

4.4. The minimum credits required for the award of the degree shall be as specified below.

PROGRAMME	MINIMUM CREDITS
B.E./B.Tech.	160*

* Minor variation is allowed.

4.5. The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is 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 a few courses may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

5.1. The prescribed duration of the programme shall be

PROGRAMME	MINIMUM NO. OF SEMESTERS	MAXIMUM NO. OF SEMESTERS
B.E./B.Tech. (Higher Secondary 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 the 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 the 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 weightage used for each assessment. In the case of practical courses (laboratory/drawing/ project work/seminar, etc.) the breakup of marks for each experiment/exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the classroom 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 (HOD). 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. Wherever 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:

SL. 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
Continuous Internal Assessment: TOTAL		40

* Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 hours
Part-A	1 to 9 two mark questions, uniformly covering the two units of the syllabus. All the 9 questions are to be answered. **(9 × 2 = 18 marks)**
Part-B	Question 10 to 12 will be of either or type, covering two units of the syllabus. Each question may have subdivision. **(3 × 14 = 42 marks)**

PATTERN OF TEST QUESTION PAPER (Test III)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 hours
Part-A	Part A will be online Examination. 20 objective type questions covering all the 5 units. **(20 × 1 = 20 marks) (Online examination)**
Part-B	21 to 25 two mark questions, uniformly covering the five units of the syllabus. All the 5 questions are to be answered. **(5 × 2 = 10 marks)**
Part-C	Question 26 to 30 will be of either or type, covering five units of the syllabus. Each question may have subdivision. **(5 × 14 = 70 marks)**

PRACTICAL COURSES:

SL. NO.	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model Examination	15
5.	Viva-voce (Comprehensive)	10
Continuous Internal Assessment: TOTAL		40

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

INTEGRATED THEORY AND PRACTICAL COURSES:

The Continuous Internal Assessment for Integrated Theory 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:

SL. NO.	ATTENDANCE %	MARKS
1	91 and above	5
2	81 – 90	4
3	76 – 80	3

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 the 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
Maximum Marks	100
Duration	3 hours
Part-A	Part A will be online Examination. 20 objective type questions covering all the 5 units. **(20 × 1 = 20 marks) (Online examination)**
Part-B	21 to 25 two mark questions, uniformly covering the five units of the syllabus. All the 5 questions are to be answered. **(5 × 2 = 10 marks)**
Part-C	Question 26 to 30 will be of either or type, covering five units of the syllabus. Each question may have subdivision. **(5 × 14 = 70 marks)**

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 100 marks. There will be two tests, the first covering 50% of the 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 (COE) 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 the 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 monitor their course.

13.4.1. A student shall study at least one online course from Swayam 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 an absolute mark basis. However, for the purpose of reporting the performance of a candidate letter grades, each carrying a certain number of points will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

LETTER GRADE	MARKS RANGE	GRADE POINT	DESCRIPTION
O	91 – 100	10	OUTSTANDING
A+	81 – 90	9	EXCELLENT
A	71 – 80	8	VERY GOOD
B+	66 – 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 – 60	5	AVERAGE
D	50 – 54	4	PASS
RA	< 50	–	REAPPEARANCE
AB	–	0	ABSENT

14.2. GRADE SHEET

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

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

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

iii. The Cumulative Grade Point Average (CGPA) of all courses enrolled from the 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.

$$\text{GPA} = \frac{\sum(\text{Number of Credits} \times \text{Grade Points})}{\sum\text{Number of Credits}}$$

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

14.3. REVALUATION

Revaluation and re-totalling are allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects

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

14.4. TRANSPARENCY AND GRIEVANCE COMMITTEE

A student may get the Photostat copy of the answer script on payment of prescribed fee if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HOD, the Dean of another Faculty nominated by the University), HOD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the COE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay the 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 B.E. (Honors)/B.Tech. (Honors). If, he/she has passed all the courses in the first appearance and holds/maintains a CGPA of 8. He/She has to take an additional 20 credits by studying online courses through Swayam. Such a candidate is eligible for the award of B.E. (Honors)/B.Tech. (Honors). However, is he/she fails in securing 20 additional credits but maintains CGPA of 8 and above is not eligible for Honors degree but eligible for First Class with Distinction.

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

16.4. 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 a 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 an extraordinary situation, the candidate may apply for an additional break of study not exceeding another one year by paying the prescribed fee for the 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, an 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'.

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 behaviour 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.

B.TECH FOOD TECHNOLOGY

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide students with a strong base of theoretical and practical knowledge of food processing and technology.
2. To implement the knowledge and skills to find workable solutions to troubleshoot the challenges involved in the food processing and its related sectors.
3. To exhibit ethical attitude, leadership, interdisciplinary skills, adapt to current trends through lifelong learning and to serve the society.

PROGRAMME OUTCOMES (POs)

a. **Engineering Knowledge:** Ability to apply knowledge of mathematics, sciences and engineering to overcome challenges in food and its related sectors

b. **Problem analysis:** Applying the key principles of mathematics, natural science and engineering science to identify, formulate and analyze solutions for engineering problems

c. **Design/Development of Solutions:** Design and develop a durable solution to address various issues in manufacturing, sustainability, and food safety by using recent food technology concepts.

d. **Investigations of Complex Problems:** Use research based knowledge and research methods, including design of experiments, analysis and interpretation of data.

e. **Modern Tool Usage:** With the use of the advanced scientific tools and modern engineering, develop the food processing technology for the benefits of mankind.

f. **The Engineer and Society:** Understand the impact of engineering solutions in a global and societal context

.

g. **Environment and Sustainability:** Impart the principles of waste management / byproduct utilization to develop value added products for a sustainable environment.

h. **Ethics:** Demonstrate knowledge of professional and code of ethical conduct.

i. **Individual and Team Work:** Play as an effective individual or active member or leader in diverse multidisciplinary forum.

j. **Communication:** Communicate effectively in both verbal and written forms.

k. **Project Management and Finance:** Proact with knowledge of process economics and financial management to design and manage projects.

l. **Life-long Learning:** Realize the need to engage in learning activities throughout their life.

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

- Acquire a detailed knowledge of food science, food processing and preservation technology.
- Apply skills of food technology to design and develop methods to produce quality, nutritious and safe food products.
- Innovate ideas to develop economic food products and cost effective preservation methods to fulfill the societal needs and for sustainable development.

Food Technology (PEO-PO mapping)

	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓	✓	✓					✓		
2		✓	✓	✓		✓	✓	✓				
3				✓					✓		✓	✓

Food Technology (PEO-PSO mapping)

	i.	ii.	iii.
1	✓	✓	
2	✓	✓	
3		✓	✓

KARPAGAM ACADEMY OF HIGHER EDUCATION

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

FACULTY OF ENGINEERING

B.Tech (FOOD TECHNOLOGY)

COURSE OF STUDY AND SHCEME OF EXAMINATION

(2019 BATCH ONWARDS)

SEMESTER I

Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
19BTFT101	Mathematics-I	2,3	a,b,e,h,k	3	1	0	4	40	60	100
19BTFT141	Chemistry-I	3	a,b,c,e,f, h,k	3	1	3	6	40	60	100
19BTFT142	Basic Electrical Engineering	2,3	a,b,d,h,k	3	1	2	5	40	60	100
19BTFT111	Engineering Graphics &Design	1,2	a,h,i	1	0	4	3	40	60	100
			Semester Total	10	3	9	18	160	240	400

SEMESTER – II

Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
19BTFT201	Mathematics-II	2,3	a, b, e, h, k	3	1	0	4	40	60	100
19BTFT202	English	3	i, j, k	2	0	2	3	40	60	100
19BTFT241	Engineering Physics	2,3	a,c,e,h,k	3	1	3	5	40	60	100
19BTFT242	Programming for problem solving	1	a, b, c	3	0	4	5	40	60	100
19BTFT243	Food Chemistry	1,2	a, b, f	3	1	3	6	40	60	100
			Semester Total	14	3	12	23	200	300	500

SEMESTER - III										
Course code	**Course Title**	**Objectives & outcomes**		**Instruction hours / week**			**Credits**	**Maximum Marks**		
		PEOs	**POs**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
								40	**60**	**100**
19BTFT301	Mathematical Transforms and Partial differential Equations	1,2	a, b	3	1	0	4	40	60	100
19BTFT302	Fluid Mechanics	1,2	a, b, c, d, e	3	0	0	3	40	60	100
19BTFT303	Food Microbiology	1,2	a, d, f, l	2	1	0	3	40	60	100
19BTFT304	Food Process Calculations	1,2,3	a, b, c, d ,e ,f, l	3	0	0	3	40	60	100
19BTFT305	Thermodynamics	1,2	a. b, c, d	3	0	0	3	40	60	100
19BTFT306	Food Biochemistry and Human Nutrition	1,2	a, b, h, l	3	0	0	3	40	60	100
19BTFT311	Food Microbiology Laboratory	1,2,3	a, d, e, f, i, l	0	0	4	2	40	60	100
19BTFT312	Food Biochemistry Laboratory	1,2,3	a, b, d, e, f, i, l	0	0	4	2	40	60	100
19BTFT351	Constitution of India	3	h, l	1	0	0	-	100	-	100
			TOTAL	18	2	8	23	420	480	900

SEMESTER – IV										
Course code	**Course Title**	**Objectives & outcomes**		**Instruction hours / week**			**Credits**	**Maximum Marks**		
		PEOs	**POs**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
								40	**60**	**100**
19BTFT401	Probability and Biostatistics	1,2	a, b	3	1	0	4	40	60	100
19BTFT402	Engineering properties of Food Materials	1,2	a, b, c, e	3	0	0	3	40	60	100
19BTFT403	Heat and Mass Transfer	1,2	a, b, d, e	3	0	0	3	40	60	100
19BTFT404	Food Analysis	1,2,3	a, b, c, d, e, g, l	3	0	0	3	40	60	100
19BTFT405	Unit Operations in Food Processing	1,2,3	a, b, c, d	3	0	0	3	40	60	100
19BTFT406	Environmental Studies	1,2,3	f, g, h, l	3	0	0	3	40	60	100
19BTFT411	Food Analysis Laboratory	1,2	a, b, c, d, e, g, i, l	0	0	4	2	40	60	100
19BTFT412	Fluid Mechanics and Heat Transfer Laboratory	1,2	a, b, d, e, i	0	0	4	2	40	60	100

			TOTAL	18	1	8	23	400	480	800
SEMESTER - V										
Course code	**Course Title**	**Objectives & out comes**		**Instruction hours / week**			**Credits**	**Maximum Marks**		
		PEOs	**POs**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
								40	**60**	**100**
19BTFT501	Bakery and Confectionary Technology	1,2	b, d, e, g, l	3	0	0	3	40	60	100
19BTFT502	Refrigeration, Air conditioning and Cold Storage Construction	1,2	a, b, c, d, l	3	0	0	3	40	60	100
19BTFT503	Cereals and Pulses Technology	1,2	a, b, c, d, l	3	0	0	3	40	60	100
19BTFT504	Meat, Poultry and Fish Processing	1,2	a, b, d, e, f, g	3	0	0	3	40	60	100
19BTFT505	Fruits and Vegetable Processing Technology	1,2	a, b, c, d, e, f, g, l	3	0	0	3	40	60	100
19BTFT5E-	Professional Elective - I	-	-	3	0	0	3	40	60	100
19BTFT511	Food Enzymology Laboratory	1,2	a, b, d, i, l	0	0	4	2	40	60	100
19BTFT512	Food Product Laboratory - I	1,2	a, b, c, d, e, i	0	0	4	2	40	60	100
19BTFT551	Food Industry Waste Management / Byproduct Utilization	1,2,3	a-l	0	0	1	-	100	-	100
			TOTAL	18	0	9	22	420	480	900
SEMESTER – VI										
Course code	**Course Title**	**Objectives & out comes**		**Instruction hours / week**			**Credits**	**Maximum Marks**		
		PEOs	**POs**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
								40	**60**	**100**
19BTFT601	Food Additives	1,2	a, b, c, i, k	3	0	0	3	40	60	100
19BTFT602	Food Safety Regulations	1,2	b, c, d, e, f, g	3	0	0	3	40	60	100
19BTFT603	Dairy Technology	1,2	a, b, c, d, e, f, g, l	3	0	0	3	40	60	100
19BTFTOE-	Open Elective - I	-	-	3	0	0	3	40	60	100
19BTFT6E-	Professional Elective - II	-	-	3	0	0	3	40	60	100
19BTFT6E-	Professional Elective – III	-	-	3	0	0	3	40	60	100
19BTFT611	Food Product Laboratory-II	1,2	a , b, c, d, e, i	0	0	4	2	40	60	100
19BTFT612	Food Additives and Quality Control Laboratory	1,2	b, c, e, f, i	0	0	4	2	40	60	100
19BTFT651	Technical Presentation and Seminar	1,2,3	i, j	0	0	1	-	100	-	100
			TOTAL	18	0	9	22	420	480	900

Summer Internship / Mini Project– During Summer Vacation – Non credit course

SEMESTER - VII

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
19BTFT701	Professional Ethics, Principles of Management and Entrepreneurship Development	1,2	f, g, h	3	0	0	3	40	60	100
19BTFT702	Process Economics and Plant Layout Design	1,2	a, f, g, k, l	3	0	0	3	40	60	100
19BTFT703	Food Packaging Technology	1,2	a, b, c, d, e, h, l	3	0	0	3	40	60	100
19BTFTOE-	Open Elective-II	-	-	3	0	0	3	40	60	100
19BTFT7E-	Professional Elective - IV	-	-	3	0	0	3	40	60	100
19BTFT711	Food Packaging Laboratory	1,2	a, b, c, d, h, i, l	0	0	4	2	40	60	100
19BTFT791	Project Work Phase - I	1,2,3	a-l	0	0	4	2	40	60	100
			TOTAL	15	0	8	19	280	420	700

SEMESTER –VIII

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
19BTFT8E-	Professional Elective - V	-	-	3	0	0	3	40	60	100
19BTFT8E-	Professional Elective – VI	-	-	3	0	0	3	40	60	100
19BTFT891	Project Work Phase II	1,2,3	a-l	0	0	18	9	120	180	300
			TOTAL	6	0	18	15	200	300	500

TOTAL CREDITS	**165**

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	-	6	**3.64**
2.	Basic Sciences (BS)	10	9	4	7	-	-	-	-	30	**18.18**
3.	Engineering Sciences-Common(ES)	8	5	6	3	-	-	-	-	22	**13.33**
4.	Professional Subjects- Professional Core (PC)	-	6	13	13	19	13	8	-	72	**43.64**
5.	Professional Electives (PE)	-	-	-	-	3	6	3	6	18	**10.91**
6.	Open Electives (OE)	-	-	-	-	-	3	3	-	6	**3.64**
7.	Project Work (PW)	-	-	-	-	-	-	2	9	11	**6.66**
8.	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	-	-
Total Credits										165	**100%**

Professional Elective - I

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
	SEMESTER - V									
19BTFT5E01	Food Preservation Principles	1,2,3	a, c, d, l	3	0	0	3	40	60	100
19BTFT5E02	Beverage Processing Technology	2,3	a, b, d, f, g	3	0	0	3	40	60	100
19BTFT5E03	Nonthermal Techniques in Food Processing	1,2	a, c, d, l	3	0	0	3	40	60	100
19BTFT5E04	Instrumental Analysis of Foods	1,2	a, b, d, e	3	0	0	3	40	60	100
19BTFT5E05	Production Technology of Fruit Crops	1,2	e, g, i, j, l	3	0	0	3	40	60	100
19BTFT5E06	Production Technology of Vegetable Crops	1,2	e, g, i, j, l	3	0	0	3	40	60	100

Professional Elective – II & III

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
	SEMESTER - VI									
19BTFT6E01	Radiation Preservation and Processing of Food Products	1,3	a, c, d, l	3	0	0	3	40	60	100
19BTFT6E02	Plantation Products and Spice Processing Technology	2,3	a, b, d, l	3	0	0	3	40	60	100
19BTFT6E03	Sanitation in Food Industries	2,3	b, d, g, i, j, l	3	0	0	3	40	60	100
19BTFT6E04	Industrial Safety and Hazard Analysis	2,3	b, d, g, i, j, l	3	0	0	3	40	60	100
19BTFT6E05	Milling Technology	2,3	a, c, e, f, l	3	0	0	3	40	60	100
19BTFT6E06	Technology of Legumes and Oilseed Processing	1,3	a, b, c, d, l	3	0	0	3	40	60	100
19BTFT6E07	Milk and Milk Products Technology	2	a,c, f, i, k, l	3	0	0	3	40	60	100

19BTFT6E08	Design and Formulation of Foods	1	a,b, c, e	3	0	0	3	40	60	100
19BTFT6E09	Design of Food Process Equipment	1,2 ,3	a, b, c, d, e, g, l	3	0	0	3	40	60	100
19BTFT6E10	Food Colorants and Flavorants	1	a, g, l	3	0	0	3	40	60	100
19BTFT6E11	Process Control for Food Engineers	1,2	a, b, d, e	3	0	0	3	40	60	100
19BTFT6E12	Postharvest Technology	1,2	a, b, c, d, e, f, g, l	3	0	0	3	40	60	100
19BTFT6E13	Crop Processing Technology	2, 3	a, e, l	3	0	0	3	40	60	100

Professional Elective - IV

Course code	**Course Title**	**Objectives & out comes**		**Instruction hours / week**			**Credits**	**Maximum Marks**		
		PEOs	**POs**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
								40	**60**	**100**
	SEMESTER –VII									
19BTFT7E01	Lipid Processing Technology	1, 3	a, b, c, d, l	3	0	0	3	40	60	100
19BTFT7E02	Role of Nanotechnology in Food Processing	1, 3	a, b, d, g, i	3	0	0	3	40	60	100
19BTFT7E03	New Product Development and Sensory Science	2	a, b, d, f, l	3	0	0	3	40	60	100
19BTFT7E04	Marketing Management and International Trade	1, 2, 3	b, h, i, j, l	3	0	0	3	40	60	100
19BTFT7E05	Supply Chain Management	1,3	a, d, f, g, h, i, j	3	0	0	3	40	60	100

Professional Elective – V & VI

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
	SEMESTER –VIII									
19BTFT8E01	Functional Foods and Nutraceuticals	1,2	a, b, d, f, l	3	0	0	3	40	60	100
19BTFT8E02	Food Biotechnology	1,3	a, b, e, f	3	0	0	3	40	60	100
19BTFT8E03	Protein Chemistry and Technology	1,2	a, b, d, e, i, l	3	0	0	3	40	60	100
19BTFT8E04	Advanced Drying Technology	1, 3	a, b, c, e, l	3	0	0	3	40	60	100
19BTFT8E05	Food Fermentation Technology	1,3	a, b, d, g	3	0	0	3	40	60	100
19BTFT8E06	Extrusion Technology	1,2	a, c, e, f, l	3	0	0	3	40	60	100
19BTFT8E07	Sugar Technology	1,3	a, b, c, f	3	0	0	3	40	60	100
19BTFT8E08	Food Allergy and Toxicology	2	a, b, f, g	3	0	0	3	40	60	100
19BTFT8E09	Waste Management in Food Industries	1,2,3	a, b, f, l	3	0	0	3	40	60	100
19BTFT8E10	Total Quality Management	2,3	a, b, d, g, f, i, l	3	0	0	3	40	60	100
19BTFT8E011	Food Storage and Logistic Management	1,2 ,3	a, b, c, d, e, g, l	3	0	0	3	40	60	100

Open Electives I & II (offered by Food Technology)

Course code	Course Title	Instruction hours / week			Credits	Maximum Marks		
		L	T	P		CIA	ESE	Total
						40	60	100
Open Electives								
19BTFTOE01	Processing of Food Materials	3	0	0	3	40	60	100
19BTFTOE02	Nutrition and Dietetics	3	0	0	3	40	60	100
19BTFTOE03	Ready to Eat Foods	3	0	0	3	40	60	100
19BTFTOE04	Agricultural Waste and Byproducts Utilization	3	0	0	3	40	60	100

OPEN ELECTIVES
COURSES OFFERED BY OTHER DEPARTMENTS

SUB. CODE	TITLE OF THE COURSE	L	T	P	C	CIA	ESE	TOTAL
SCIENCE AND HUMANITIES								
19BTSHOE01	Solid Waste Management	3	0	0	3	40	60	100
19BTSHOE02	Green Chemistry	3	0	0	3	40	60	100
19BTSHOE03	Applied Electrochemistry	3	0	0	3	40	60	100
19BTSHOE04	Industrial Chemistry	3	0	0	3	40	60	100
19BTSHOE05	Technical Writing	3	0	0	3	40	60	100
19BTSHOE06	Geophysics	3	0	0	3	40	60	100
19BTSHOE07	Engineering Acoustics	3	0	0	3	40	60	100
19BTSHOE08	Industrial Mathematics – I	3	0	0	3	40	60	100
19BTSHOE09	Industrial Mathematics – Ii	3	0	0	3	40	60	100
19BTSHOE10	Fuzzy Mathematics	3	0	0	3	40	60	100
19BTSHOE11	Mathematical Physics	3	0	0	3	40	60	100
19BTSHOE12	Linear Algebra	3	0	0	3	40	60	100
COMPUTER SCIENCE AND ENGINEERING								
19BECSOE01	Internet Programming	3	0	0	3	40	60	100
19BECSOE02	Multimedia and Animation	3	0	0	3	40	60	100
19BECSOE03	PC Hardware and Trouble shooting	3	0	0	3	40	60	100
19BECSOE04	Java Programming	3	0	0	3	40	60	100
ELECTRICAL AND ELECTRONICS ENGINEERING								
19BEEEOE01	Electric Hybrid Vehicle	3	0	0	3	40	60	100
19BEEEOE02	Energy Management & Energy Auditing	3	0	0	3	40	60	100
19BEEEOE03	Programmable Logic Controller	3	0	0	3	40	60	100
19BEEEOE04	Renewable Energy Resources	3	0	0	3	40	60	100
ELECTRONICS AND COMMUNICATION ENGINEERING								
19BEECOE01	Real Time Embedded Systems	3	0	0	3	40	60	100
19BEECOE02	Consumer Electronics	3	0	0	3	40	60	100
19BEECOE03	Neural Networks and its Applications	3	0	0	3	40	60	100
19BEECOE04	Fuzzy Logic and its Applications	3	0	0	3	40	60	100
AUTOMOBILE ENGINEERING								
19BEAEOE01	Automobile Engineering	3	0	0	3	40	60	100
19BEAEOE02	Two And Three Wheeler Technology	3	0	0	3	40	60	100
19BEAEOE03	Vehicle Maintenance	3	0	0	3	40	60	100
19BEAEOE04	Modern Vehicle Technology	3	0	0	3	40	60	100
CIVIL ENGINEERING								
19BECEOE01	Housing Plan And Management	3	0	0	3	40	60	100
19BECEOE02	Building Services	3	0	0	3	40	60	100
19BECEOE03	Repair And Rehabilitation Of Structures	3	0	0	3	40	60	100
19BECEOE04	Computer Aided Civil Engineering Drawing	3	0	0	3	40	60	100

MECHANICAL ENGINEERING								
19BEMEOE01	Computer Aided Design	3	0	0	3	40	60	100
19BEMEOE02	Industrial Safety and Environment	3	0	0	3	40	60	100
19BEMEOE03	Transport Phenomena	3	0	0	3	40	60	100
19BEMEOE04	Introduction to Biomechanics	3	0	0	3	40	60	100
CHEMICAL ENGINEERING								
19BTCEOE01	Energy management in chemical industries	3	0	0	3	40	60	100
19BTCEOE02	Fertilizer technology	3	0	0	3	40	60	100
19BTCEOE03	Industrial wastewater treatment	3	0	0	3	40	60	100
19BTCEOE04	Solid and hazardous waste management	3	0	0	3	40	60	100
BIOMEDICAL ENGINEERING								
19BEBMEOE01	Robotics In Medicine	3	0	0	3	40	60	100
19BEBMEOE02	Virtual Reality And Augmented Reality	3	0	0	3	40	60	100
19BEBMEOE03	Artificial Organs And Implants	3	0	0	3	40	60	100
BIOTECHNOLOGY								
19BTBTOE01	Bioreactor Design	3	0	0	3	40	60	100
19BTBTOE02	Food Processing and Preservation	3	0	0	3	40	60	100
19BTBTOE03	Basic Bioinformatics	3	0	0	3	40	60	100
19BTBTOE04	Fundamentals of Nanobiotechnology	3	0	0	3	40	60	100
FOOD TECHNOLOGY								
19BTFTOE01	Processing of Food Materials	3	0	0	3	40	60	100
19BTFTOE02	Nutrition and Dietetics	3	0	0	3	40	60	100
19BTFTOE03	Ready to Eat Foods	3	0	0	3	40	60	100
19BTFTOE04	Agricultural Waste and Byproducts Utilization	3	0	0	3	40	60	100

19BTFT101 **MATHEMATICS – 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 gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

Course Outcomes

1. Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
2. Improved facility in algebraic manipulation.
3. Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
4. Understanding the ideas of differential equations and facility in solving simple standard examples.

UNIT I - DIFFERENTIAL CALCULUS

Representation of functions, New functions from old functions, Limit of a function, Limits at infinity, Continuity, Derivatives, Differentiation rules, Polar coordinate system, Differentiation in polar coordinates, Maxima and Minima of functions of one variable.

UNIT II - FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives, Homogeneous functions and Euler's theorem, Total derivative, Differentiation of implicit functions, Change of variables, 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 III - INTEGRAL CALCULUS

Definite and Indefinite integrals, Substitution rule, Techniques of Integration, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions, Improper integrals.

UNIT IV - MULTIPLE INTEGRALS

Double integrals, Change of order of integration, Double integrals in polar coordinates, Area enclosed by plane curves, Triple integrals , Volume of solids, Change of variables in double and triple integrals.

UNIT V - DIFFERENTIAL EQUATIONS

Method of variation of parameters, Method of undetermined coefficients, Homogenous equation of Euler's and Legendre's type, System of simultaneous linear differential equations with constant coefficients.

SUGGESTED READINGS

1. Hemamalini. P.T, (2014&2017) Engineering Mathematics, McGraw Hill Education (India) Private, Limited, New Delhi.
2. James Stewart, (2008), Calculus with Early Transcendental Functions, Cengage Learning.
3. Narayanan S. and Manicavachagom Pillai T. K., (2007) Calculus Volume I and II, S. Viswanathan Publishers Pvt. Ltd.
4. Erwin kreyszig, (2014), Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
5. B.S. Grewal, (2014), Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
6. Ramana B.V, (2010), Higher Engineering Mathematics, 11th Reprint. Tata McGraw Hill New Delhi.
7. Jain R.K. and Iyengar S.R.K, (2007), Advanced Engineering Mathematics , 3rd Edition, Narosa Publications.
8. Bali N., Goyal M. and Watkins C, (2009), Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd).
9. Greenberg M.D., 5th Reprint, (2009). Advanced Engineering Mathematics, 2nd Edition,5th Reprint Pearson Education.
10. O'Neil, P.V, Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd

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Semester-I

19BTFT102 **CHEMISTRY-I** **7H-6C**

(Theory & Lab.)

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

End Semester Exam:3 Hours

(i) Concepts in chemistry for engineering 3 1 0 4

Course Objective

- To understand the terminologies of atomic and molecular structure
- To study the basics of Periodic properties, Intermolecular forces
- To study about spectroscopic technique
- To understand the thermodynamic functions
- To comprehend the basic organic chemistry and to synthesis simple drug.

Course Outcomes:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise bulk properties and processes using thermodynamic considerations.
5. List major chemical reactions that are used in the synthesis of molecules.

UNIT I - Atomic and molecular structure

Schrodinger equation. Particle in box solutions and their applications. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity. Introduction to Crystal field theory.

UNIT II - 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. Potential energy surfaces of H_2F and HCN and trajectories on these surfaces.

UNIT III - Spectroscopic techniques and applications

Spectroscopy (Principles and Instrumentation only).Electronicspectroscopy.Vibrational and

rotational spectroscopy. Applications. Surface characterization techniques. Diffraction and scattering. Fluorescence and its applications in medicine.

UNIT IV - Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT V - Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

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

- 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

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
4. Synthesize a small drug molecule and analyse a salt

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 mixure 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 the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Semester-I

19BTFT103 **BASIC ELECTRICAL ENGINEERING** **6H-5C**

(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 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

1. To understand and analyse basic electric and magnetic circuits.
2. To study the working principles of electrical machines and power converters.
3. To introduce 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, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

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, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

SUGGESTED READINGS

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

(ii) Laboratory

Course Objective

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.

Course Outcomes (Cos)

At the end of this course, students will demonstrate the ability

1. To understand and analyze basic electric and magnetic circuits.
2. To study the working principles of electrical machines and power converters.

LIST OF EXPERIMENTS

1. Experimental verification of electrical circuit problems using Ohms law and Kirchoff's law.
2. Measurement of electrical quantities – voltage, current, power & power factor in R load.
3. Speed control of DC shunt motor
4. Draw the equivalent circuit of single phase Transformer by conducting OC &SC Test.
5. Measurement of energy using single phase energy mete

SUGGESTED READING

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

Semester-I

19BTFT111 ENGINEERING GRAPHICS AND DESIGN 5H-3C

Instruction Hours/week: L:1 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

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, Epicycloid, 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.

Semester-II

19BTFT201	**MATHEMATICS – II**	**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 develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as fluid dynamics and flow of the electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

Course Outcomes:

The students will learn:

1. To evaluate complex integrals using the Cauchy integral formula and the residue Theorem
2. To appreciate how complex methods can be used to prove some important theoretical results.
3. To evaluate line, surface and volume integrals in simple coordinate systems
4. To calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
5. To use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

UNIT I - MATRICES

Eigen values and Eigenvectors of a real matrix, Characteristic equation, Properties of eigen values and eigenvectors, Cayley-Hamilton theorem, Diagonalization of matrices , Reduction of a quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms. Simple Problems using Scilab.

UNIT II - VECTOR CALCULUS

Gradient and directional derivative, Divergence and Curl, Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral, Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems, Verification and application in evaluating line, surface and volume integrals.

UNIT III - ANALYTIC FUNCTION

Analytic functions, Necessary and sufficient conditions for analyticity, Properties, Harmonic conjugates, Construction of analytic function, Conformal mapping, Mapping by Functions w =z+c, cz, 1/z, z^2 , Bilinear transformation.

UNIT IV - COMPLEX INTEGRATION

Line integral, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singularities, Residues, Residue theorem, Application of residue theorem for evaluation of real integrals, Use of circular contour and semicircular contour with no pole on real axis.

UNIT V - LAPLACE TRANSFORMS

Existence conditions, Transforms of elementary functions, Transform of unit step function and unit impulse function, Basic properties, Shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Inverse transforms, Convolution theorem , Transform of periodic functions, Application to solution of linear ordinary differential equations with constant coefficients.

SUGGESTED READINGS

1. Hemamalini. P.T, (2014&2017), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
2. Erwin kreyszig, (2014), Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
3. B.S. Grewal, (2014), Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
4. Ramana B.V, (2010),Higher Engineering Mathematics, Tata McGraw Hill.
5. Glyn James, (2007), Advanced Modern Engineering Mathematics, Pearson Education.
6. Jain R.K. and Iyengar S.R.K, (2007), Advanced Engineering Mathematics , 3rd Edition, Narosa Publications.
7. Bali N., Goyal M. and Watkins C, (2009), Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd).
8. O'Neil, P.V, (2007),Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd.

Semester-II

19BTFT202 **ENGINEERING PHYSICS** **7H-5C**

(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 Objective:

- To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

Course Outcomes

1. Familiarize in properties of matter.
2. Thorough knowledge in basic physics concepts relevant to different branches of Engineering and Technology.

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 - ACOUSTICS AND ULTRASONICS

Classification of sound - loudness and intensity - standard intensity and intensity level - decibel - reverberation - reverberation time - derivation of Sabine's formula - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - industrial applications – Non-destructive testing- pulse echo system through transmission and reflection modes – scan displays.

UNIT III - THERMAL PHYSICS

Thermal expansion - thermal stress - expansion joints - bimetallic strips – thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law- Thermodynamics – laws of thermodynamics- concept of entropy- change of entropy in reversible and irreversible processes – refrigeration.

UNIT IV - APPLIED OPTICS

Introduction – emission and absorption process- Einstein's coefficients derivation. Types of LASER - CO_2, 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 V - SOLID STATE 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, Surface defects.

SUGGESTED READINGS

1. Gaur R.K. and Gupta S.L, (2003), Engineering Physics, Dhanpat Rai Publications.
2. Palanisamy P.K, (2006), Engineering Physics, Scitech Publications (P) Ltd.
3. ArumugamM , (2000),Engineering Physics, Anuradha Publications.
4. Sankar B.N., Pillai.S.O**,** (2007),Engineering Physics**,** New Age International**.**
5. Rajendran.V, (2009),Engineering Physics, Tata McGraw-Hill.

(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 and 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 thermoe.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 the velocity of sound and compressibility of liquids

10. Determination of Band gap of a semiconductor.

11. Spectrometer- Determination of wavelength using grating.

12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

Semester-II

19BTFT203	**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

- 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

Students undergoing this course 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.

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

SUGGESTED READINGS

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

Semester-II

19BTFT204 PROGRAMMING FOR PROBLEM SOLVING 7H-5C

(Theory & Lab)

Instruction Hours/week: L:3 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

- Identify and understand the working of key components of a computer program.
- Identify and understand the various kinds of keywords and different data types of C programming
- Understand, analyze and implement software development tools like algorithm,
- pseudo codes and programming structure
- Study, analyze and understand the logical structure of a computer program, and different construct to develop a program in "C" language

Course Outcomes

The course will enable the students

1. To formulate simple algorithms for arithmetic and logical problems
2. To translate the algorithms to programs (in C language)
3. To test and execute the programs and correct syntax and logical errors
4. To implement conditional branching, iteration and recursion
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach
6. To use arrays, pointers and structures to formulate algorithms and programs
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems
8. To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

Unit I – Introduction to Programming, Arithmetic expressions and precedence

Introduction to Programming-Flowchart / pseudocode, compilation, Variables including data types, Arithmetic expressions and precedence.

Unit II – Conditional Branching and Loops

Conditional Branching – Loops writing and evaluation of conditionals and consequent

branching, Iteration and loops.

Unit III – Arrays and Basic Algorithms

Arrays1-D,2-D,Character arrays and Strings **Basic Algorithms**: Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity.

Unit IV – Function and Recursion

Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.

Unit V - Structure, Pointers and File Handling

Pointers, Structures including self-referential structures e.g., linked list, notional introduction, File handling in C.

SUGGESTED READINGS

1. E. Balagurusamy,(2017) Computing Fundamentals and C Programming, 5th Edition, TMH Education
2. E. Balaguruswamy (2017), Programming in ANSI C, 7th Edition, Tata McGraw-Hill,
3. Byron Gottfried (2017), Schaum's Outline of Programming with C, 3rd Edition, McGraw-Hill
4. Brian W. Kernighan and Dennis M. Ritchie,(2015) The C Programming Language, 2nd Edition, Prentice Hall of India

(ii) Laboratory

Course Objectives

- To provide an awareness to Computing and C Programming
- To know the correct and efficient ways of solving problems
- To learn to develop algorithm for simple problem solving
- To analyze loops, vector operations
- To learn pointers and structures and file handling

Course outcomes

1. To formulate the algorithms for simple problems
2. To translate given algorithms to a working and correct program
3. To be able to correct syntax errors as reported by the compilers
4. To be able to identify and correct logical errors encountered at run time
5. To be able to write iterative as well as recursive programs
6. To be able to represent data in arrays, strings and structures and manipulate them through a program
7. To be able to declare pointers of different types and use the mind defining self-referential structures.
8. To be able to create, read and write to and from simple text files.

LIST OF EXPERIMENTS

Tutorial 1: Problem solving using computers:
Lab 1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5:1DArrays: searching, sorting:
Lab 5:1DArray manipulation
Tutorial 6:2D arrays and Strings, memory structure:
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numericalintegration):

Lab 8and 9: Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls:
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

Semester-II

19BTFT205 **FOOD CHEMISTRY** **7H-6C**

(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

- Outline the properties of biomolecules and its reactions involved.
- State the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition
- Practice the effective use of food composition tables and databases.
- Infer the physical and chemical properties of foods
- Analyze the food proteins, carbohydrates and lipid composition

Course Outcomes

1. Describe the various classifications, properties, applications and analysis of carbohydrates.
2. Summarize the conformations, properties and functional role of proteins.
3. Explain the classification, chemistry, sources and applications of lipids.
4. Illustrate the structure, types, stability and degradation of important biomolecules.
5. Evaluate the natural and synthetic food colourants, flavors, aromas and other antinutritional components.
6. Demonstrate the use of food composition tables and databases.

UNIT I - CARBOHYDRATES

Simple Sugars: mono and disaccharides, Hygroscopcity & 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 dextrins; 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 ;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

A. 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 processing

B. MINERALS & VITAMINS

Mineral & vitamin content of foods- Food and Pharmaceutical grades; stability & degradation foods.

C. 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.

D. OTHER COMPONENTS

Naturally occurring toxic substances (trypsin inhibitors, phytins, tannins, oxalates, goitrogen, toxic amino acids, glucosinolates, aflatoxins), protease inhibitors, bioactive components: phytates, polyphenols, saponins, phytoestrogens etc.

UNIT V - FOOD GROUPS & COMPOSITION

Food groups, proximate composition, methods of evaluation & labelling - food composition tables, food composition databases: USDA Database, UK Database.

(ii) Laboratory

Course objectives

- Examine the quality specifications of food components
- Analyze the various functional properties of food substances
- Inspect the chemical and thermal properties of food components

Course outcomes

1. Test the levels of gluten and peroxide content in the given food sample.
2. Investigate the various properties of oils.
3. Experiment the functional properties of proteins, lipids and carbohydrates.
4. Measure the viscosities of the given food sample.
5. Theorize the effect of heat on proteins.
6. Evaluate the enzymatic browning of foods..

LAB COMPONENTS

1. Estimation of Viscosity of foods
2. Properties of solutions- sugar & salt
3. Preparation of emulsions
4. Foaming properties of proteins
5. Solubility, specific gravity and Refractive index of oils
6. Oxidative rancidity of fats
7. Effect of heat on proteins
8. Iso-electric precipitation of casein, Effect of rennin on milk proteins
9. Gelling properties of starch
10. Study of gluten formation
11. Enzymatic Browning in foods

SUGGESTED READINGS

1. Belitz, H.-D., Grosch, W., and Schieberle, P. (2004). Food Chemistry. 3rd Edition. Springer - Verlag.
2. Meyer., and Hoagland, L. (1987). Food Chemistry. CBS Publishers.
3. DeMan., and John, M. (1999). Principles of Food Chemistry. 3rd Edition. Springer.
4. Chopra, H.K., and Panesar, P.S. (2010). Food Chemistry. Narosa Publications.
5. Vaclavik, V. A., and Christian E. W. (2003). Essentials of Food Science. 2nd Edition, Kluwer Academic. Springer.
6. Weaver, C.M., and Daniel, J.R. (2005). The Food Chemistry Laboratory – A Manual for Experimental Foods. Dietetics & Food Scientists. 2nd Edition. CRC Press.

Semester-III

19BTFT301 **MATHEMATICS-III** **4H-4C**

(Transforms and Partial Differential Equation)

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. Understand how 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. Understand the mathematical principles on 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., ManicavachagomPillay.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", 3rd Edition, Pearson Education, 2007.
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.

B.TECH FOOD TECHNOLOGY **2019-2020**

Semester-III

19BTFT302 **FLUID MECHANICS** **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

- Outline the concepts of fluid mechanics.
- Discuss the pressure variations in fluids and measurement devices.
- State the fluid statics on variable surface conditions.
- Practice the equations of motion and kinetics of fluid flow.
- Analyze the flow of fluids in various geometries of pipes.

Course Outcomes

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

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.

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. 9th Edition. Laxmi Publications, New Delhi.
2. Modi, P.N., and Seth, S.M. (2007). A Text book of Fluid Mechanics and Hydraulic Machines. Standard Book House. New Delhi.
3. Som, S.R., and Biswas, (2007). Introduction to Fluid Mechanics and Fluid Machines. 2nd Edition. Tata McGraw Hill.

B.TECH FOOD TECHNOLOGY **2019-2020**

Semester-III

19BTFT303 **FOOD MICROBIOLOGY** **3H-3C**

Instruction Hours/week: L:2 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

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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.

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, 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. (2008). Food Microbiology. 3rd Edition. RSC Publishing.
2. Frazier, W.C., and Dennis, C.W. (2014). Food Microbiology. 5th Edition. Springer. The Mc Graw-Hill Companies.
3. Jay, J.M. (2005). Modern Food Microbiology. 4th Edition. CBS Publishers and Distributors Pvt. Ltd.

19BTFT304 **FOOD PROCESS CALCULATIONS** **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

- Assess the basic units, dimensions and basic related functions involved in food process engineering.
- State the various law governing the gases and vapors
- Calculate the material balance and law of conservation of energy.
- Analyze problems in Energy balance in heat exchangers.
- Define the types, properties and agitation processes in fluids

Course Outcomes

1. To enumerate the units and dimensions of various physical quantities.
2. To express the laws and theory of gases and vapors.
3. To calculate the material balance in food processing units.
4. To validate 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 - UNIT AND DIMENSIONS

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.

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, Raoults law.Psychrometry-Humidity,Relative Humidity,Saturation Humidity,Wet and Dry Buld Temperature-Dew Point –Psychrometric Chart Readings.

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. Toledo, T.R. (2007). Fundamentals of Food Process Engineering. 3rd Edition.CBS publications, New Delhi.
2. Smith, P.G. (2011). Introduction to Food Process Engineering. 2nd Edition. Springer.
3. Singh, R.P. and Heldman, R.D. (2004). Introduction to Food Engineering. Academic Press – Elsevier India Private Ltd. New Delhi.
4. Bahtt., and Thakore, S.B. (2004). Stoichometry. 5th Edition. Mc Graw-Hill. New York.

Semester-III

19BTFT305 **THERMODYNAMICS** **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

- 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.
- Expqalin the working principle of carnot, vapor compression, vapor absorption and air refrigeration systems.

Course Outcomes

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.

19BTFT306 **FOOD BIOCHEMISTRY AND HUMAN NUTRITION** **4H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Explain the digestion, absorption and metabolic pathways of carbohydrates
- Describe the digestion, absorption, synthesis and metabolic pathways of fatty acids, proteins, and amino acids
- Outline the important aspects of food relating to nutrition
- Summarize the diets suitable for managing specific nutritional disorders
- Categorize the nutrients for different age groups, and sports people

Course Outcomes

1. Discuss the digestion, absorption and metabolic pathways of carbohydrates.
2. Understand the digestion absorption synthesis and metabolism of amino acids and proteins.
3. Infer the digestion absorption synthesis and metabolism of fatty acids.
4. Understand the basic principles and overall concepts of food relating to nutrition.
5. List the diets suitable for managing nutrition related disorder.
6. Outline the nutritional requirements for different age groups, sports, pregnancy.

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

UNIT IV-NUTRITIONAL DISORDERS

Dietary management – Fever, overweight, under weight and obesity, burns, CVD, cancer, skin care, diabetes, inborn errors of metabolism

UNIT V-SPECIALIZED NUTRITION

Nutritional requirement for infants, preschool and school children, adolescence, geriatric, sports and fitness, adults, pregnancy and lactation

SUGGESTED READINGS

1. Nelson, D.L., and Cox, M.M. (2017). Lehninger Principles of Biochemistry. 7th Edition. W.H. Freeman Company.
2. Voet, D., Voet, J.G., and Pratt, C.W. (2016). Fundamentals of Biochemistry Life at the Molecular Level. 5th Edition. John Wiley and Sons.
3. Eastwood, M., (2003). Principles of Human Nutrition. 2nd Edition. Blackwell Publishing Company.
4. Roday, S. (2012). Food Science and Nutrition. 2nd Edition. Oxford Higher Education/ Oxford University Press.
5. Shubhangini, A.J. (2015). Nutrition and Dietetics. 4th Edition. McGraw Hill education.

Semester-III

19BTFT311 **FOOD MICROBIOLOGY 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 Objectives

- Explain the working principle of microscopes and sterilization techniques.
- Outline the preparation of media for the cultivation of microorganisms.
- Identify the isolated strains using staining techniques and biochemical tests.
- Conduct staining techniques and practice various staining methods.
- Apply various biochemical test to identify micro organisms in contaminated food

Course Outcomes

1. Use aseptic technique to properly handle microorganisms to avoid contamination.
2. Apply 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. Assess the quality of water and milk.

LIST OF EXPERIMENTS

1. Microscopy
2. Sterilization techniques
3. Pure culture techniques
4. Staining methods
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

Semester-III

19BTFT312 **FOOD BIOCHEMISTRY LAB** **4H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Test the protein content present in the given food sample.
- Estimate the amount of carbohydrate in the food materials.
- Analyze the content of ash and ascorbic acid present in the given foods.
- Experiment the lipid extraction and measure the percent of cholesterol in the given sample.
- Practice the calculations based on measuring protein quality indices.

Course Outcomes

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. Measure 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

Semester-III

19BTFT351 **CONSTITUTION OF INDIA** **1H-0C**

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

End Semester Exam:3 Hours

Course Objectives

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.
- Understand
- structure and function of Central and State Government.
- Basic knowledge in Indian society, political party.
- Understand 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. Understand the functions of the Indian government.
2. Understand and abide the rules of the Indian constitution.
3. Understand 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 – StateLegislature – 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,

Semester-IV

19BTFT401 **PROBABILITY AND STATISTICS** **4H-4C**

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

End Semester Exam:3 Hours

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. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
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. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.
6. To expose statistical methods designed to contribute to the process of making the judgements.

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 – 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.

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, 4 th 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 Unni krishnapillai, 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.

Semester-IV

19BTFT402 ENGINEERING PROPERTIES OF FOOD MATERIALS 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

- Describe the physical properties of food materials
- Explain the rheology of food and use of viscometer and texture analyzer in food industry.
- Impart 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

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. Sahin, S., and Sumnu, S.G. (2007). Physical Properties of Foods. Springer. USA.
2. Mohsenin, N.N. (1990).Thermal Properties of Food & Agricultural materials. Gordon and Reach science publishers.
3. Rao, M.A., and Rizvi, S.S.H. (2014). Engineering Properties of Foods. 4th Edition Mercel Dekker Inc. New York.
4. Lewis, M.J. (2006). Physical properties of foods and food processing systems. Wood head publishing Cambridge, UK.
5. Rehman, S. (2009). Food Properties Hand book. 2nd Edition. CRC press inc. New York.

19BTFT403 **HEAT AND MASS TRANSFER** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Define laws of heat conduction and theories of insulation.
- Evaluate the different modes of convection heat transfer.
- Assess the different modes of radiation heat transfer.
- State the types of heat exchanger and their applications in food industry.
- Summarize the diffusion mass transfer.

Course Outcomes

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. Analyze 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

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

SUGGESTED READINGS

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

Semester-IV

19BTFT404 **FOOD ANALYSIS** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Instruct the sampling and proximate analysis of food substances
- Discuss the physical, chemical, quality standards and adulterants of lipids, protein and carbohydrate
- Summarize the different spectroscopic techniques involved in food analysis
- Explain the various chromatographic methods employed in analysis of foods
- Outline the techniques on electrophoresis, refractometry and polarimetry in food analysis

Course outcomes

1. Test the proximate composition of the given food sample
2. Determine the physical, chemical and quality standards of lipids, proteins and carbohydrates
3. Investigate the adulterants in the given food commodities
4. Examine the composition of foods using spectroscopic methods
5. Analyze 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 physicaland 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- specfic 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 aflaotoxins, 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. Suzanne, S.N. (2017). Food Analysis. 5th Edition .Springer.
2. Wood, R., Foster, L., Damant, A., and Pauline, K. (2004). Analytical Methods for Food Additives.1st Edition. CRC Woodhead Publishing.
3. Pomeranz., Yeshajahu., and Meloan, E.C. (2004). Food Analysis: Theory and Practice. 3rd Edition, Springer.
4. Nollet., Leo, M.L. (2004). Handbook of Food Analysis. 2nd Edition, Vol. 1-3. Marcel Dekker.
5. Hurst., Jeffrey, W. (2008). Methods of Analysis for Functional Foods and Nutraceuticals. 2nd Edition. CRC Press.

Semester-IV

19BTFT405 UNIT OPERATIONS IN FOOD PROCESSING 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- Discuss the various types of equipments involved in drying and dehydration.
- State the operations involved in mechanical separations.
- Define the various attributes of evaporators in food processing.
- Assess the role of milling equipments in size reduction.
- Outline the agitation and types of impellers employed in mixing.

Course Outcomes

1. Explain the models involved in the moisture and its measurements.
2. Investigate 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, D.G. (2009). Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi.
2. Geankoplis, C.J. (2018). Transport Processes and Separation Processes Principles. 5th Edition Prentice Hall India, New Delh.
3. McCabe, L.W., Smith, J.C. and Harriot, P. (2004). Unit Operations of Chemical Engineering. 7th Edition .McGraw Hill International Edition, Singapore.
4. Earle, R.L. (2003).Unit Operations in Food Processing. 2nd Edition. Pergamon Press. UK.

19BTFT406 **ENVIRONMENTAL STUDIES** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.

Course Outcomes (COs)

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, GrasslandEcosystem, 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 and industrial 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 andits 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 projectaffected persons.Disaster management (floods, earthquake, cyclones and landslides).EnvironmentalMovements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Roleof Indianand 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. AnubhaKaushik., 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& CompanyPvt. 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.,andSunakar Panda. (2004). Fundamentals of Environmental Studies (2nded.). 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.

19BTFT411 **FOOD ANALYSIS 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 Objectives

- Experiment the saponification and iodine value of lipids
- Estimate the reducing sugar, iodine content and iron content in the given food sample
- Determine the swelling ratio and extract release of meat
- Analyze the curcumin, gingerol, and fat content in the food commodities
- Discuss the nitrogen estimation by Kjeldhal nitrogen analyzer

Course Outcomes

1. Test the iodine content in iodized salt
2. Examine the saponification and iodine value of lipids
3. Analyze 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

Semester-IV

19BTFT412 FLUID MECHANICS AND HEAT TRANSFER LAB 4H-3C

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

End Semester Exam:3 Hours

Course Objective

- Experiment the various flow measuring equipments involved in food industries.
- Determine the pressure drop at various columns
- Conduct experiment on heat exchanger and their applications in food industry.
- Evaluate the filtration efficiency using continuous rotary filtration
- Determine the heat transfer through composite wall

Course Outcomes

1. Calculate the discharge coefficient of fluids at various conditions
2. Perform the experiment on flow of fluids
3. Asses the pressure drop across different columns
4. Demonstrate the heat transfer equipments 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

19BTFT501 BAKERY AND CONFECTIONARY 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

- Impart knowledge on principles of baking bread and cake
- Understand the steps involved in the production of biscuits and cookies
- Discuss the various types of sugar and flour based confectionary products
- Understand the working of equipments used in baking processes
- Outline the packaging materials and quality control systems applied in food industry

Course Outcomes (COs)

1. Discuss the rheology and chemistry of ingredients used in baking and confectionary
2. Outline the overall preparation process involved in the production of breads, cakes, biscuits and cookies
3. Assess the faults and remedies of baking processes
4. Understand the technique and methods involved in the various types of confectionary products
5. Illustrate the equipments 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 – breads poilage 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. Patten, M. (2018). The Basic Basics Baking Handbook. Grub Street Publishing.
2. Clements, C. (2019).The Cook's Guide To Baking, Practical Handbook. South water.
3. Chakraverty, A. (2018). Post Harvest Technology of Cereals, Pulses and Oilseeds.3rd Edition. Oxford and IBH Publishing Co. Calcutta.

19BTFT502 REFRIGERATION, AIR CONDITIONING AND COLD STORAGE CONSTRUCTION
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

- Impart knowledge on various concepts behind refrigeration of food
- Discuss the various aspects of cold storage
- Explain the overall attributes of air conditioning in food industries
- Describe food freezing and equipment involved..
- Illustrate the cold chain management in small and large scale refrigerators

Course Outcomes

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

Semester-V

19BTFT503 **CEREALS AND PULSES TECHNOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- State the processing of major cereals like paddy, maize etc.
- Review the milling techniques of cereals and pulses.
- Outline the byproducts obtained during processing along with their uses.
- Understand the production of value added products from maize
- Impart knowledge on various aspects of milling of pulses

Course Outcomes

1. Evaluate the basic composition and structural parts of food grains.
2. List the various methods used for 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 equipments 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 RiceMilling equipments – paddy milling -Dehusking of paddy - Engelberg Huller, Under runner disc shellers, rubber roll sheller and Centrifugaldehusker-Paddy Separators – Satake and Schule Designs – Rice Polishers - Cone polishers and othertypes - Bran and Brokens separators - Rice mill yields and loss due to brokens at differentstages 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 - Branand Fibre separation - Gluten and Starch Separation - Equipment used - Starch conversion into other value added products – AcidHydrolysis, 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. Sahay, K.M., and Singh, K.K. (2015). Unit operations of Agricultural Processing. 2nd Edition.Vikash Publishing house PVT Ltd. Delhi.
2. Chakraverty, A. (2018). Post Harvest Technology of Cereals, Pulses and Oilseeds. 3rd Edition Oxford and IBH Publishing Co, Calcutta.
3. Kulp, K., and Pante, P.J. (2000). Handbook of Cereal Science and Technology. 2nd edition. Mercel Dekker, USA.

19BTFT504 **MEAT, POULTRY AND FISH PROCESSING** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Discuss the meat composition, structure, chemistry and microbial safety of meat
- Outline the various methods involved in the slaughtering and carcass processing of meat
- Summarize the variety of meat products, equipments employed and safety of meat processing plant
- Explain the overall processing of poultry meat and their products
- Review the processing of different marine based products

Course Outcomes:

1. Enumerate the chemical composition, structure, color, flavor, and microbial safety of meat.
2. Outline the slaughtering, carcass processing methods and equipments used for processing meat.
3. Apply the technological ideas in preparation of various types of meat products and design of equipments used for processing meat.
4. Audit 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 andRed Meat, Description of animal fat and its modifiers, description of bone and its modifiers; Post mortemmuscle 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. (2001). Meat Science and Applications. 1st Edition.Marcel Dekkar Inc. New York.
2. Guerrero, S., and Hui, Y.H. (2010). Handbook of Poultry Science Technology. 1st Edition Volume-1& 2. Wiley Publishing.
3. Balachandran, K.K. (2002). Post Harvest Technology of Fish and Fish Products. Daya Publishing House, New Delhi.

19BTFT505 FRUITS AND VEGETABLES PROCESSING TECHNOLOGY 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- Describe the processing of fruits and vegetables by chemical methods.
- Outline the preservation of fruits and vegetables by drying and dehydration.
- Discuss the various unit operations and fermented processes involved in fruits and vegetables.
- Illustrate the canning and bottling operations in fruits and vegetables.
- State the set of parameters influencing the aseptic processing of fruit juices.

Course Outcomes

1. Relate the nutritionally important fruits and vegetables.
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. (2015). Hand Book of Vegetable Preservation and Processing. 2nd Edition. Mercel Dekker, New York.
2. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V and Ramaswamy, H.S. (2003). Hand book of Post-harvest Technology. Marcel Dekker Press, USA.
3. Verma, L.R., and Joshi, V.K. (2000). Post Harvest Technology of fruits and vegetables. Indus Publishing Co, NewDelhi.
4. Fellows, P. (2016). Food processing Technology: Principles and Practice. 4th Edition .Wood Head publishing Limited, Cambridge, England.
5. Brennan, G.J. (2006).Food Processing Hand book. Wiley, Weinheim, Germany.

Semester-V

19BTFT511 **FOOD ENZYMOLOGY LAB** **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

- Determine the optimized pH and temperature of amylase enzyme
- Estimate the time study and enzyme kinetics of the amylase enzyme
- Determine the optimized pH and temperature of Protease enzyme
- Estimate the time study and enzyme kinetics of the protease enzyme
- Demonstrate the enzyme immobilization method using various enzymes

Course Outcome

1. Recognize the various applications of enzymes in food processing
2. Infer the importance of each of the factors that affect enzyme activity
3. Apply the same to maximize enzyme action
4. Analyze when a problem arises and give a suitable and logical solution
5. Evaluate enzymes from different sources and select the right one depending on the type of food / condition
6. Evaluate and characterize the new sources of enzymes

List of experiments

1. Characterization of enzyme amylases – optimization of pH
2. Characterization of enzyme amylases – optimization of temperature
3. Characterization of enzyme amylases – varying enzyme
4. Characterization of enzyme amylases – time study / enzyme kinetics
5. Characterization of enzyme proteases – optimization of pH
6. Characterization of enzyme proteases – optimization of temperature
7. Characterization of enzyme proteases – varying enzyme
8. Characterization of enzyme proteases – time study / enzyme kinetics
9. Characterization of enzyme substrate ratio varying substrate
10. Studies on enzyme immobilization

Semester-V

19BTFT512 **FOOD PRODUCT LABORATORY I** **4H-3C**

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

End Semester Exam:3 Hours

Course Objective

- List the ingredients needed for preparations of food products.
- Calculate the quantity of ingredients for preparations of food products
- Prepare different types of flour based products
- Develop products from fruits and vegetables
- Perform cost analysis for the developed products

Course Outcome

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. Formulate the ingredients for preparing variety of fruit and vegetable based products
5. Analyze the cost of the developed products
6. Conduct 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

19BTFT551 FOOD INDUSTRY WASTE MANAGEMENT/BY PRODUCT UTILIZATION 3H-1C

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

End Semester Exam:3 Hours

Course objective

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

Course Outcome

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

19BTFT601 **FOOD ADDITIVES** **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

- Explain the basic concepts of food additives
- Outline the types, chemical properties, levels of addition and toxicity of acidulants
- Discuss the types, chemical properties, levels of addition and toxicity of humectants
- Outline the types, chemical properties, levels of addition and toxicity of fat substitutes and replacers
- Summarize the types, chemical properties, levels of addition and toxicity of sweeteners, chelating agents, antibrowning agents and nutritional additives

Course Outcomes

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. Understand the level of addition of preservatives within the permissible limits.
5. Apply 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, LD-50 value, 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 AND 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, P.C.K., and Mehta, B.M. (2015). Handbook of Food Chemistry. 1st Edition Springer-Verlag Berlin Heidelberg.
2. Velisek, J. (2014). The Chemistry of Food. Ist Edition .Wiley-Blackwell Publishing.
3. Smith, J., and Shum, L.H. (2011). Food Additives Data Book. 2nd Edition Wiley-Blackwell Publishing.
4. Brannen, A.L., Davidson, P.M., Salminen, S., and Thorngate, J.H. (2002). Food additives. 2nd Edition, Revised and Expanded. Marcel Dekker Inc. USA.

Semester-VI

19BTFT602 **FOOD SAFETY REGULATIONS** **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

- State the functions, responsibilities and concepts of various food regulatory bodies
- Define the overall functions and responsibilities of food authority of India
- Describe the need, limitations and standards for labeling of various food products
- Outline the importance and implementation of HACCP in food industries
- Review the safety, regulations and guidelines of packing water

Course Outcomes

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. Understand the implement of HACCP system in the food industries
5. Assess the safety, regulations and guidelines of packing water
6. Review the US and EU guidelines and standards governing the food safety and quality

UNIT I - FOOD REGULATIONS

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 Procedures

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. Government of India. (2006). Guide to the Food Safety and Standards Act. Tax-mann Allied Services Pvt. Ltd..
2. Barach, J.T. (2017). FSMS and Food Safety Systems: Understanding and implementing the rules. .1st Edition Wiley.
3. Fortin, N.D. (2016). Food Regulation. 2nd Edition .Wiley.
4. Shaw, I.C. (2018). Food Safety: The science of keeping food safe. 2nd Edition .Wiley-Blackwell Publishing..
5. Mariott, N.G., Schilling, M.W., and Gravani, R.B., (2018). Principles of Food Sanitation. 6th Edition.Springer.

Semester-VI

19BTFT603 **Dairy Technology** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Review the physico-chemical and functional properties of milk constituents.
- Explain the construction and working of dairy processing equipments
- Summarize the process involved in packaging and storage of milk.
- Outline the production of milk and milk based products.
- Study working principle and construction of equipments like spray drier, drum drier

Course Outcomes

1. Infer the physical, chemical and functional properties of milk.
2. Perform the qualitative tests on milk quality.
3. List the dairy processing equipments for specific applications.
4. Illustrate the processes involved in packaging and storage of milk.
5. Understand the processes involved in the production of 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. (2012). An Introduction to Dairy Technology. Pragun Publication,.
2. NIIR Board. (2013) Modern Technology of Milk Processing and Dairy Products. 4th Edition. NIIR Project Consultancy Services.
3. Ahmad, T. (2016) Dairy Plant Engineering and Management. Kitab Mahal Publishers. New Delhi,.
4. De, S. (2016). Outlines of Dairy Technology. 23rd impression.Oxford University Press. New Delhi.
5. Walstra, P., Wouters, J.T.M., Geuris, T.J. (2005). Dairy Technology. Taylor& Francis.

Semester-VI

19BTFT611 **Food Product Laboratory II** **4H-2C**

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

End Semester Exam:3 Hours

Course Objective

- 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

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

Semester-VI

19BTFT612 Food Additives and Quality Control 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

- Explain the Chemistry of the additives added to food
- State the importance of additives in maintaining or improving food quality
- Understand newer additives with improved safety standards.
- Investigate the properties of toxicity data of various food additives.
- Use food additives in food industries

Course Outcomes

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. Examine the Adulterants present in the solid and Liquid food.
5. Apply the principles of food additives to study the toxicity
6. List the different types of additives which are safe and economically benefit.

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 capsacin
8. Estimation of salt in pickled products
9. Identification of adulterants in solid foods
10. Identification of adulterants in liquid foods

Semester-VI

19BTFT651 **Technical Presentation and Seminar** **1H-0C**

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

End Semester Exam:3 Hours

Course Objectives:

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

Course Outcomes:

1. To get familiarize in the teaching presentation skills.
2. 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.

Semester-VII

19BTFT701 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:

- 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:

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 IENGINEERING ETHICS

Senses of 'Engineering Ethics' – variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self–interest – customs and religion – 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, 2nd 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.

19BTFT702 PROCESS ECONOMICS AND PLANT LAYOUT DESIGN 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- 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

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 Timmerhaus. (2017). Plant design and Economics for Chemical Engineers. 5th Edition. McGraw Hill,.
2. Rudd, D.F., and Watson, C.C. (2013). Strategy of Process Engineering. John Wiley & Sons Inc.
3. Maroulis, Z.B. and Saravacos, G.D. (2003). Food Process Design. Marcel Dekker Inc,.
4. Towler, G. and Sinnott, R.K. (2012). Chemical Engineering design principles, practice and Economics of Plant and Procese. 2nd Edition. Elsevier.

19BTFT703 **FOOD PACKAGING 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

- Describe the functions of packaging along with the influence of various factors on food.
- Explain 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

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 different packaging materials, their manufacturing process and equipment involved.
4. Compile various closures and sealing mechanisms for different packaging materials.
5. Select 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, Poyvinylidene 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_2 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. (2011). Food and Beverage Packaging Technology. 2nd Edition.Wiley-Blackwell Publishing.
2. Coles, R., Dowell, D.M., Kirwan, J. (2009). Food Packaging Technology. Black Well Publishing Ltd.
3. Robertson, L.G. (2016). Food Packaging Principles & Practice. CRC Press.
4. Yam, Y.K., and Lee, S.D. (2012). Emerging Food Packaging Technologies: Principles and Practice. Wood head Publishing Ltd.
5. Han, H.J. (2016). Innovations in Food Packaging. 2nd Edition. Biogreen Elsevier India.

19BTFT711 FOOD PACKAGING TECHNOLOGY LAB 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

- 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

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 and alcohol as stimulant
10. Shelf-life testing of edible coated food materials
11. Determination of the water vapor Transmission rate of the given packaging material.

Semester-VII

19BTFT791 **PROJECT WORK PHASE I** **4H-2C**

Instruction Hours/week: L:0 T:0 P:6 **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 work 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-VII

19BTFT891 **PROJECT WORK PHASE II** **18H-9C**

Instruction Hours/week: L:0 T:0 P:24 **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 ELECTIVES

B.TECH FOOD TECHNOLOGY **2019-2020**

Semester-V

19BTFT5E01 **FOOD PRESERVATION PRINCIPLES** **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

- Understand the principle and different aspects of canning
- Explain the importance of water activity and temperature in food preservation.
- Understand the methods of fermentation, hurdle technology, minimal processing and non-thermal techniques in food preservation
- Discuss the ionizing radiation, role of preservatives and lactic acid bacteria in food preservation
- Outline the role of packaging materials in food preservation.

Course Outcomes (COs)

1. Infer the principle and thermal process calculations involved in food canning operation.
2. Understand the significance of food preservation
3. Acquire knowledge on the principles of preservation techniques.
4. Carry out the preservation of foods by ionizing radiation.
5. Relate the different types of packaging and Packaging materials.
6. Discuss the various food preservatives and their techniques

UNIT I INTRODUCTION

Introduction to food preservation – objectives and techniques of food preservation canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods

UNIT II WATER ACTIVITY

Water activity of food and its significance in food preservation; dehydration and drying of fooditems; IMF; Low temperature preservation: cold storage, cold chain, freezing (including cryogenic freezing)

UNIT III PRESERVATION BY FERMENTATION

Preservation by fermentation: curing and pickling; Hurdle technology, Non-thermal (e.g. high pressure processing) and minimal processing technologies

UNIT IV IONIZING RADIATION

Ionization radiation; Use of preservative in foods: chemical preservative, biopreservatives,

antibiotics, lactic acid bacteria

UNITV-FOOD PACKAGING

Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials

SUGGESTED READINGS

1. Subbulakshmi, G., and Udipi, A.S. (2006). Food Processing and Preservation.1st Edition New Age Publications.
2. Hui, Y.H. (2015). Handbook of Vegetable Preservation and Processing. 2nd Edition. Marcel Dekker.

Semester- V

19BTFT5E02 BEVERAGE PROCESSING TECHNOLOGY 3H-3C

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

End Semester Exam:3 Hours

Course Objective

- Understand the role of ingredients in beverages.
- Discuss the processes involved in the production of carbonated beverages
- Explain the overall processes, packaging techniques and water used in the production of non-carbonated beverages.
- Understand the complete processes employed in the production of alcoholic beverages.
- Discuss the sanitation, quality control and regulatory measures followed in beverage processing industries.

Course Outcome

1. Outline the ingredients employed in the beverage production
2. Illustrate the overall processes in the carbonated beverage production
3. Relate the processes and the type of water used in the production of non-carbonated beverages
4. Recommend the packaging materials suitable for the packing of non-carbonated beverages
5. Infer the steps and methodologies employed in the production of alcoholic beverages.
6. Summarize the sanitation, quality control and regulatory measures mandated in the beverage processing industries.

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. Jagan,L., Rao, M., and Ramalakshmi, K. (2011). Recent trend in Soft beverages. Woodhead Publishing India Pvt Ltd.
2. Boulton, Christopher., and Quain, D. (2008). Brewing yeast and fermentation. John Wiley & Sons.
3. Hui, Yiu, H. (2004). Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.

Semester- V

19BTFT5E03 NON-THERMAL TECHNIQUES IN FOOD PROCESSING 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- Discuss the principles, applications and effect on foods of high pressure processing
- Understand the principle, types, effects and limitations of radiation processing of foods
- Explain the complete processes of osmotic dehydration of foods
- Demonstrate the ohmic heating and ultrasound processing of foods
- Summarize the application of pulsed light and hurdle technology in food processing

Course Outcomes

1. Illustrate the overall processes involved in the high pressure processing of foods
2. Outline the multiple aspects of radiation processing of foods
3. Assess the principle, mechanism, applications and limitations of osmotic dehydration of foods
4. Infer the application of ultrasound in processing and preservation of food
5. Discuss the basics, electrical properties and treatment of foods using ohmic heating technology
6. Understand the overall processes of pulsed light and hurdle technology in food processing

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).

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

Semester- V

19BTFT5E04 **INSTRUMENTAL ANALYSIS OF FOODS** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Understand the basics of various techniques available for the analysis of a food commodity
- Discuss the various spectroscopy techniques applied in the compositional analysis of foods
- Explain the principles and classification of chromatography techniques
- Understand the different types of separation techniques
- Explain the chemically sensitive semiconductor devices and rapid microbiological methods

Course Outcomes

1. Apply the instrumental techniques learnt towards the analysis of food materials
2. Illustrate the spectroscopic techniques in the analysis of foods
3. Outline the principles and classification of chromatography techniques
4. Infer the various types of separation techniques
5. Discuss the different types of chemically sensitive semiconductor devices
6. Understand the application of rapid microbiological methods

UNIT 1- CONCEPTS AND METHODS OF FOOD ANALYSIS

Concepts of food analysis; Rules and regulations of food analysis Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foodsMethods of analysis: Proximate constituents: Total fat, crude fiber, protein,moisture, minerals analysis; adulterations.

UNIT II- PRINCIPLES AND METHODOLOGY INVOLVED IN ANALYTICAL TECHNIQUES

Spectroscopy, ultraviolet visible, infrared spectroscopy atomic absorption and emission, florescence mass spectroscopy Food compositional analysis and applications in the food industry.

UNIT III- CHROMATOGRAPHY

Principle of chromatography, classifications, (Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method)gas-liquid, high performance liquid chromatography; Ion chromatography and others

UNIT IV-SEPARATION TECHNIQUES

Dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation, iso-electric focusing.

UNIT V-CHEMICALLY SENSITIVE SEMICONDUCTOR DEVICES AND RAPID MICROBIOLOGICAL METHODS

Chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, amperometric, potentiometric and; Acoustic sensors

Rapid microbiological methods: Overview, Conductance/impedance techniques for microbial assay; chemosensors, biosensors, immunosensors

SUGGESTED READINGS

1. Nieisen, S.S. (2017). Food Analysis Laboratory Manual, 3rd Edition. Springer, NY, USA.
2. Otles, S. (2009). Handbook of Food Analysis Instruments. 1st Edition. CRC Press, Boca Raton, FL, USA.
3. Sun, W.D. (2018). Modern Techniques for Food Authentication. Elsevier Inc., Burlington, MA, USA.
4. Nieisen, S.S. (2017). Food Analysis, 5th Edition. Kluwer Academic, New York, USA.

19BTFT5E05 PRODUCTION TECHNOLOGY OF FRUIT CROPS 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

- Discuss the principles and cultivation techniques of tropical fruits
- Explain the overall aspects of papaya, sapota and guava cultivation
- Understand the techniques of lime, orange and jack fruit cultivation
- Discuss the overall scenario of fruit cultivation in arid zone areas
- Explain the techniques involved in the cultivation of typical arid zone fruits

Course Outcome

1. Illustrate the principles and cultivation of tropical fruits
2. Outline the techniques employed in the cultivation of papaya, sapota and guava cultivation
3. Discuss the various techniques and methodologies involved in the production of lime, orange and jack fruit cultivation
4. Infer the multiple aspects of fruit cultivation in arid zone areas
5. Summarize the overall steps involved in the production of typical arid zone areas
6. Discuss the post harvest handling and economics of fruit cultivation

UNIT I-PRINCIPLES AND CULTIVATION OF TROPICAL FRUITS

Mango and banana-Scope and importance of tropical fruits cultivation – overview: global, national and regional levels – area, production and export potential– horticultural zones of India and Tamil Nadu with emphasis on tropical fruits- GAP- organic production - composition and uses – origin and distribution – species and cultivars - climate and soil requirements - species and varieties - cropping systems propagation techniques - planting systems and planting density - after care – training and pruning – water management, macro and micronutrient management, weed management – special horticultural techniques - use of plant growth regulators - production constraints - physiological disorders – post harvest handling - economics of production.

UNIT II-TROPICAL FRUITS- PAPAYA, SAPOTA AND GUAVA

Composition and uses – origin and distribution – species and cultivars – climate and soil requirements, cropping systems- varieties - propagation techniques – planting systems and planting density - after care – training and pruning - water management, macro and micronutrient management, weed management – GAP - organic production - special horticultural techniques – sex

forms and pollination - use of plant growth regulators - production constraints - physiological disorders - pre and post-harvest handling - economics of production.

UNIT-III-TROPICAL FRUITS

Acid lime, sweet orange and jack fruit: Composition and uses – origin and distribution – species and cultivars – climate and soil requirements, cropping systems- varieties - production constraints - propagation techniques - planting systems and planting density - after care – training and pruning - water management, macro and micronutrient management, weed management - GAP - organic production - special horticultural techniques - use of plant growth regulators - physiological disorders - pre and post-harvest handling – economics of production.

UNIT IV-ARID ZONE FRUITS

Aonla, ber, pomegranate and date palm: Dryland horticulture – importance and scope in India and Tamil Nadu- distribution of arid and semi-arid zones in India and Tamil Nadu; Composition and uses – origin and distribution – species and cultivars - climate and soil requirements – varieties - cropping systems and intercropping – crops suitable for dry land system – spacing and planting patterns for rainfed horticultural crops- in situ grafting and budding techniques – alternative land use systems – mulching - soil and moisture conservation methods – chemical application – anti-transpirants – management of nutrients, water, weeds and problem soils – training and pruning methods – physiology of flowering – regulation of cropping – top working and rejuvenation – use of plant growth regulators – post harvest handling – economics of production.

UNIT V-ARID ZONE FRUITS - CUSTARD APPLE, JAMUN, BAEL, WOOD APPLE AND MANILA TAMARIND

Composition and uses – origin and distribution – species and cultivars – climate and soil requirements – varieties - cropping systems and intercropping – crops suitable for dry land system – spacing and planting patterns for rain fed horticultural crops- in situ grafting and budding techniques – alternative land use systems – mulching – soil and moisture conservation methods – chemical application – anti-transpirants – management of nutrients, water, weeds and problem soils – training and pruning methods – physiology of flowering – crop regulation – top working and rejuvenation – use of plant growth regulators – post harvest handling – economics of production.

SUGGESTED READINGS

1. Bose, T. K., Mitra, S. K., and Sanyal, D. (2001). Fruits: Tropical and Subtropical. Volume I. 3rd edition. Naya Udyog, Calcutta.
2. Chattopadhyay, T. K. (2012). A Text Book of Pomology (Vol 1-3). Kalyani Publishers. New Delhi.

19BTFT5E06 PRODUCTION TECHNOLOGY OF TROPICAL VEGETABLE CROPS 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

- Discuss the principles and cultivation techniques of tropical vegetable crops
- Explain the overall aspects of production of solanaceous vegetables and bhendi
- Understand the techniques involved in the production of bulbous and cucurbitaceous vegetable crops
- Discuss the overall scenario of fabaceous vegetables and greens
- Explain the techniques involved in the production of tuber crops

Course Outcome

1. Illustrate the principles and cultivation of tropical vegetable crops
2. Outline the techniques employed in the production bhendi and solanaceous vegetable crops
3. Discuss the various techniques and methodologies involved in the production of bulbous and cucurbitaceous vegetable crops
4. Infer the multiple aspects of greens and fabaceous vegetable production
5. Summarize the overall steps involved in the production of tuber crops
6. Discuss the chemicals, growth regulators and various constraints of vegetable crop production

UNIT I-OVERVIEW OF VEGETABLE CULTIVATION

Area, production, world scenario, industrial importance, exports potential of tropical vegetable crops – institutions involved in vegetable crops research. Classification of vegetable crops - Effect of climate, soil, water and nutrients on vegetable crop production and their management– cropping systems. Vegetable production in nutrition garden, kitchen garden, truck garden, market garden, roof garden, floating garden – types of vegetable farming and contract farming- rice fallow cultivation, river bed cultivation, rain fed cultivation, organic farming – GAP in vegetable production – export standards of vegetables.

UNIT II-SOLANACEOUS VEGETABLES AND BHENDI

Composition and uses – area and production- climate and soil requirements – season-varieties and hybrids – seed rate- nursery practices-containerized transplant production and transplanting – preparation of field-spacing-planting systems-planting- water and weed management-nutrient requirement-fertigation-nutrient deficiencies physiological disorders- use of chemicals and growth

regulators-cropping systems-constraints in production-harvest yield crops. Tomato, brinjal, chilli and bhendi.

UNIT III-BULBOUS AND CUCURBITACEOUS VEGETABLE CROPS

Composition and uses area and production- climate and soil requirements – season - varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting– water and weed management – nutrient requirement – fertigation - nutrient deficiencies – physiological disorders – sex expression - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield. Onion, ash gourd, pumpkin, bitter gourd, snake gourd, ribbed gourd, bottle gourd, watermelon, musk melon, coccinia, cucumber and gherkin.

UNIT IV-FABACEOUS VEGETABLE CROPS AND GREENS

Composition and uses- origin and distribution- area and production- climate and soil requirements – season - varieties and hybrids - seed rate – preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation - nutrient deficiencies – physiological disorders- use of chemicals and growth regulators - cropping systems – constraints in production harvest – yield. Cluster beans, cowpea, lab-lab, moringa, chekurmanis, palak, basella and amaranth.

UNIT V-TUBER CROPS

Composition and uses- origin and distribution- area and production- climate and soil requirements – season - varieties and hybrids - seed rate –preparation of field - nursery practices and transplanting – spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation - nutrient deficiencies – physiological disorders- use of chemicals and growth regulators - cropping systems – - constraints in production – virus elimination in cassava- harvest – yield. Cassava, sweet potato, colocasia, vegetable coleus, amorphophallus, edible dioscorea, and yam bean.

SUGGESTED READINGS

1. Hazra, A.P., Chattopadhyay, K. K., and S. Dutta. (2011). Modern Technology in Vegetable Production. New India Publishing Agency. New Delhi.
2. Swarup, V. (2014).Vegetable Science and Technology in India. Kalyani Publishers.New Delhi.
3. Singh, P.N. (2016). Basic Concepts of Vegetable Science. 2nd Edition. International Book Distributing Co. New Delhi.

19BTFT6E01 **RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS** **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

- Understand the basics of radiation chemistry.
- Explain the nature and features of radiation chemistry of food components.
- Discuss the principles and functions of microwave in food processing.
- Explain the characteristics and functions of infra red radiation in food processing.
- Discuss the principles of radio frequency heating.

Course Outcomes

1. Outline the features of electromagnetic radiation and its basic chemistry.
2. Interpret the various concepts related to radiation chemistry of food components.
3. Infer the basic knowledge of microwaves and its application in food processing.
4. Discuss the functions of infra red radiation in food processing.
5. Understand the principles of radio frequency heating.
6. Explain the basics of preservation through radiation and food processing.

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. Richardson, P. (2001). Thermal Technologies for Food Processing. Wood head Publishing Limited.CRC Press.
2. Isabel, C.F.R. (2017). Food Irradiation Technologies" 1st Edition. Royal Society of chemistry.
3. Regier, M. (2005). The microwave processing of foods. Wood head Publishing.

19BTFT6E02 **PLANTATION PRODUCTS AND SPICE PROCESSING TECHNOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Understand the chemistry and technology of coffee.
- Explain the chemistry and technology of tea.
- Outline the basic views on the chemistry and technology of cocoa and its products.
- Understand the views on chemistry of major spices and its technology.
- Explain the chemistry and technology of minor spices.

Course Outcomes

1. Understand the chemistry and manufacturing of coffee.
2. Outline the views on tea production and its chemistry.
3. Infer the basic knowledge on manufacturing of cocoa products and its chemistry.
4. Outline the manufacturing of major spices and its chemistry.
5. Discuss the production of minor spices and chemistry behind its production.
6. Explain the various opportunities of plantation products and spice processing.

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, Chilli, mint, and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavor identicals - 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. (2004). Hand book of herbs and spices. Volume 2. Wood head publishing Ltd. E-Book.
2. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V., and Ramaswamy, H.S. (2010). Handbook of post-harvest technology – cereals, fruits, vegetables, tea and spices. (Special Indian Reprint). Marcel Dekker Inc. New York.

Semester- VI

19BTFT6E03 **SANITATION IN FOOD INDUSTRIES** **3H-3C**

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

End Semester Exam:3 Hours

Course Objective

- Discuss the regulations and laws of sanitation practices as control measures in different food industry.
- Understand the basic view on allergens to sanitation relationship.
- Explain the application of cleaning compounds and sanitizers as control measures.
- Outline the basic view on sanitary design and construction for food processing.
- Outline the good laboratory practices and HACCP role in sanitation.

Course Outcomes (COs)

1. Understand the basics of sanitation practices in food industry.
2. Infer the basic knowledge on sanitation and its allergens relationship.
3. Interpret the control measures by using cleaning compounds and sanitizers.
4. Outline the sanitary processing and its construction in food processing.
5. Understand the concepts of HACCP and safety laboratory practices.
6. Summarize the basics of sanitation in various food industry.

UNIT I-SANITATION AND FOOD INDUSTRY

Sanitation, sanitation laws, regulations, and guidelines, establishment of sanitary Practices. Foodborne bioterrorism: Potential risks and protection measures for bioterrorism The Relationship of microorganisms to sanitation: Microbial growth in relation to spoilage and food borne out breaks and its control measures.

UNIT II -RELATIONSHIP OF ALLERGENS TO SANITATION

Food allergens and its control measures Food contamination sources: Sources of contamination, contamination foods, protection against contamination Personal hygiene and sanitary food handling: Personal hygiene, employee hygiene, sanitary food handling, role of employee supervision, employee responsibility.

UNIT III -CLEANING COMPOUNDS AND SANITIZERS

Classification, selection of cleaning compounds and sanitizers, handling and storage, precautions Pest and Rodent Control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management

UNIT IV -SANITARY DESIGN AND CONSTRUCTION FOR FOOD PROCESSING

Site selection, site preparation, building construction considerations, processing and design considerations, pest control design, Waste product handling: solid waste and liquid waste management

UNIT V -ROLE OF HACCP IN SANITATION

Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices.

SUGGESTED READING

1. Cramer, M.M. (2013). Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press. Boca Raton. FL.F USA.
2. Mitchell, R., and Gu, J.D. (2010). Environmental Microbiology. 2nd Edition. John Wiley & Sons, Inc. Hoboken. New Jersey. USA.

19BTFT6E04 INDUSTRIAL SAFETY AND HAZARD ANALYSIS 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

- Understand the basic principles of food safety.
- Explain the food quality control and labeling.
- Discuss about the hazard analysis in food industry.
- Understand the consequences of contaminants and additives in food.
- Explain the causes and control measures of food allergy.

Course outcomes

1. Outline the basic concepts of food safety in food industry.
2. Interpret the measures of food quality control and labeling of food products.
3. Infer the basics of HACCP and its analysis in food industry.
4. Discuss the various sources and consequences of contaminants and additives in food.
5. Outline the basics of food allergy.
6. Summarize the food industrial safety features and its hazard analysis.

UNIT I-FOOD SAFETY

Principles of food safety - Historical developments - indicators of risk - risk analysis – risk management - causes of major failure - clothing and personal hygiene - source of contamination -test for food safety.

UNIT II-QUALITY CONTROL AND FOOD LABELING

Introduction to quality control - definition. Aspects of quality - Quality control tools. Quality control chart - Quality factors in food - Nutritional labeling - Specification - Rules and Regulations - need for food plant sanitation -- cleaning and cleaners - Water supply- Good Manufacturing Practice.

UNIT III-HAZARD ANALYSIS - HACCP

HACCP - History definition - preliminary task - principles - hazard analysis - record keeping - HACCP implementation and maintenance. General principle of microbial risk – assessment - hazard determination - HACCP worksheet. Critical Control Point - identification of critical points in the process - Methods by which obstacles can be overcome.

UNIT IV-METAL CONTAMINANTS AND ADDITIVES

Metal contaminants- Sources of health hazard of metallic contaminants - Assessment of food safety - General and acute toxicity - Mutagenicity and carcinogenicity. Additives (Intention - direct) -

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

UNIT V-FOOD ALLERGY

Food allergy, food intolerance, contaminants of processed foods, solvent residue, contaminants of smoked foods. Cleaner production is food industry-fruit and vegetable processing, sea food processing, brewing and wine processing.

SUGESTED READINGS

1. Lelieveld, Y.M.H. (2013). Food Safety Management.1st Edition. Academic Press.
2. Kumar, D.A., Kumar R. A., Sharma. (2019). HACCP: Application and Its Challenges. I K International Publishing House Pvt. Ltd.
3. Flanagan. S. (2014). Handbook of Food Allergen Detection and Control. Woodhead Publishing.

19BTFT6E05 **MILLING TECHNOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Discuss about the structure and properties of grains and cereals
- Summarize milling process and equipments used for rice
- Extrapolate the process of milling and separation of wheat and corn
- Outline the steps in involved in milling of pulses along with equipments
- Explain about the properties of oil seed and their extraction and refining techniques

Course Outcomes

1. Understand the importance of grains and cereals along with storage
2. Understand the byproducts obtained from rice milling and its wastes.
3. Acquire detailed knowledge of Wheat and corn milling and its waste utilization
4. Understand the techniques and processes involved in pulse milling
5. Learn about the extraction, separation and refining of oil seed milling.
6. Emphasize the various processing methods involved in converting raw material into quality food products

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

SUGGESTED READINGS

1. Delcour, A.J., Hoseney R.C. (2010). Principles of Cereal Science and Technology.3rd Edition. Amer Assn of Cereal Chemists.
2. Khader, Vijaya., and Vimala, V. (2007). Grain Quality and Processing, Agrotech Publishing. Udaipur.
3. Sahay, K.M., and Singh, K.K. (2015). Unit operations of Agricultural Processing. 2nd Edition. Vikas Publishing House. New Delhi.

19BTFT6E06 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

- Discuss about the nutritional value and future roles of legumes and oil seeds.
- Know the importance of milling at different scale of operations
- Explain the methods of cooking, nutritional value and significance of dhal and soyabean
- List the equipments involved in oil seed milling processes.
- Discuss about the use of oil seeds meals in protein products and byproducts

Course Outcomes

1. Understand the composition, nutritional values and classification of oil seeds and legumes
2. Identify the problems affecting milling and develop new methods in different scale of operations
3. Understand the importance of dhal, soyabean and their byproducts
4. Gain Knowledge about the principles and working of oil seed milling equipments
5. Interpret the use of higher protein products and their byproducts
6. Understand and identify the specific processing technologies used for legumes and oil seeds and the various products derived from these materials.

UNIT I INTRODUCTION TO LEGUMES AND OILSEEDS

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 MILLING

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 DHAL AND SOYBEAN PROCESSING

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 OIL SEED PROCESSING

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 OILMEALS

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. Singh, G., Sekhon, S.H., Kolar S.J., and Ali, M. (2005). Pulses. Agrotech Publishing Academy. Udaipur.
2. Chakraverty, A. (2008). Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Sahay, K.M., and Singh, K.K. (2015). Unit Operations of Agricultural Processing. 2nd Edition. Vikas Publishing House Pvt. Ltd. Noida.

Semester- VI

19BTFT6E07 **MILK AND MILK PRODUCTS 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

- Know the need and importance of dairy industry
- Examine the adulterations, authentication and quality evaluation of milk
- Discuss about the various types of milk and their properties along with manufacturing process
- Discuss about the manufacturing, packaging and storage of dairy products
- Understand the compositional and technological aspects of milk and its products

Course Outcomes (COs)

1. Understand the significance of milk and hygienic milk processing
2. Know about the testing, authentication and quality evaluation of milk
3. Impart the microbial culture in the fermented dairy products
4. Discuss the different methods for the manufacturing, packaging and storage of fat rich dairy products
5. Summarize the manufacturing, packaging and storage of fermented and indigenous milk products
6. Explain the techniques and technologies of testing and processing of milk into various milk products and by products.

UNIT I INTRODUCTION

Milk production and consumption- India and Worldwide - Status and scope of dairy industry in India- Fluid Milk - Definition of milk, composition, factors affecting composition of milk, types of milk and nutritive value of milk- Basis for pricing of milk-Good hygienic practice in milk processing: Principal hazards, cleaning and disinfection in a dairy industry, definitions, cleaning and disinfection agents and processes.

UNIT II QUALITY ANALYSIS AND EVALUATION

Testing the authenticity of milk and milk products: Detection of foreign fats, milk of other species, water, non-milk proteins. Methods of examination and Quality evaluation, Adulteration and its detection. Microbiology of milk: Milk as a substrate for bacteria, spoilage micro organisms, pathogenic micro organisms, sources of contamination, hygienic measures.

UNIT III TYPES OF MILK AND ITS PROPERTIES

Milk processing- Concentrated milk, condensed milk, evaporated milk, UHT processed milk, flavored, sterilized milk, dried milk, Soy milk, Imitation milk, whole and skimmed milk powder - Method of manufacture, packaging and storage, defects and their control. Instantization of milk and milk products, flow ability, dustiness, reconstituability, dispersability, wet ability, sink ability and appearance of milk powders. Judging and grading of milk and its products.

UNIT IV FAT RICH DAIRY PRODUCTS

Frozen dairy products- Ice-cream- Kulfi- manufacture, packing and storage. Fat rich dairy products - Cream, ghee and margarine- Method of manufacture, packaging and storage. Cheese byproducts- Casein and its derivatives- Whey powder, protein concentrates and isolate- utilization, Infant milk production

UNIT V FERMENTED AND INDIGENOUS MILK PRODUCTS

Fermented milk – principles- Processing- practices of manufacture, packaging- storage and marketing Fermented milk products- dahi, cultured butter milk, acidophilus milk, yoghurt, shrikhand and probiotic milk based products. Technology of Indigenous dairy products – Present status, method of manufacture of khoa, burfi, kalakand, gulabjamun, rosogolla, chhana, paneer,, lassi etc..

SUGGESTED READING

1. Tomar, S. (2012). An Introduction to Dairy Technology. Pragun Publication.
2. NIIR Board. (2013). Modern Technology of Milk Processing and Dairy Products.4th edition.NIIR Project Consultancy Services.
3. Ahmad, T. (2016). Dairy Plant Engineering and Management. Kitab Mahal Publishers. New Delhi.
4. De, S. (2006). Outlines of Dairy Technology.23rdimpression. Oxford University Press. New Delhi.
5. Walstra, P., Wouters, J.T.M., Geuris, T.J. (2005). Dairy Technology. Taylor & Francis.

19BTFT6E08 **DESIGN AND FORMULATION OF FOODS** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Explain the importance of nutrition and nutritive value of different foods in relation with health
- State and illustrate the terms, principles and steps involved in menu planning
- Explain the vital role of geriatric and therapeutic balanced diet in human life
- Understand the methods involved in the measurement and estimation of energy requirements in individuals.
- State the concepts of nutraceuticals designing and Anti-nutritional factors

Course Outcomes (COs)

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. Plan therapeutic diets for diseases like diabetes, and CHD
5. Understand the overall terms and methods applied in the measurement and estimation of energy.
6. Discuss the concepts of anti-nutritional, functional and special foods.

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 READING

1. Gopalan, C., Ramshastri, B.V., Balasubramaniam, S.C. (2011). Nutritive Value of Indian Foods Nation Institute of Nutrition, Hyderabad.
2. Roday, S. (2012). Food Science and Nutrition. 2nd Edition. Oxford Higher Education/Oxford University Press.
3. Shubhangini, A.J. (2015). Nutrition and Dietetics. 4th Edition. McGraw Hill education.

Semester- VI

19BTFT6E09 DESIGN OF FOOD PROCESS EQUIPMENT 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:

- Emphasis the types of materials used in the food processing equipments.
- Discuss about the materials and designing of different storage vessel.
- Explain the importance of reaction vessel and their deskining techniques.
- Explain the materials and designing of heat exchanger and evaporators.
- Discuss the importance of dryers in food processing industries .

Course Outcome:

1. Point out the materials suitable for the construction of equipments.
2. List out the vessels used for the food storage.
3. Categorize the different types reaction vessel used for different purposes.
4. Understand the importance of heat exchanger in the designing of food processing equipments.
5. Understand the significance of dryers in food processing.
6. Understand the basic for design and develop equipments used in food Processing operations.

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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 READING

1. Maroulis, Z.B., and Saravacos, G.D. (2003). Food Process Design, Marcel Dekker Inc.
2. Joshi, M.V. (2016).Process Equipment Design. 5th Edition Macmillan India Ltd.
3. Coulson, J.M., and Richardson, J.F. (2017). Chemical Engineering. 7th Edition. Butterworth-Heinemnn. Elsevier.

Semester- VI

19BTFT6E10 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

- Explain different food colors.
- Explain properties and application of food colors
- Describe different food flavors and its application
- Explain the applications of food colors and its emerging techniques
- Describe the Quality control techniques and regulations involved in colors and flavors

Course Outcomes (COs)

1. Discuss the synthetic and natural food colors
2. Outline the importance of food colors and their applications in different fields
3. List the various food flavors and their applications
4. Infer the applications of food coloring and its advancement
5. Outline the regulations involved in the safer use of colors and flavors in foods
6. Discuss the importance of food colorants and flavorants

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 flavour 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 READING

1. Andrew, J., Taylor, J.A., and Linforth, S.T. R. (2010). Food Flavour Technology, Blackwell Publishing Ltd.
2. Bhattacharya, S. (2015).Conventional and Advanced Food Processing Technologies. Wiley Publishers.

19BTFT6E11 PROCESS CONTROL FOR FOOD ENGINEERS 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- Understand the fundamentals of sensors and control concepts.
- Discuss the concepts of system analysis and control.
- Summarize the working of various sensors.
- Understand the mathematical model for a system
- Explain the basics in control schemes of particular system.

Course Outcomes

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 t 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. Coulson, J.M. and Richardson, J.F. (2017). Chemical Engineering. 7th Edition. Butterworth-Heinemnn. Elsevier.
2. Nagoorkani, A. (2012). Control Systems. 2nd Edition. RBA publications.

Semester- VI

19BTFT6E12 **POST HARVEST 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

- Discuss the basics of postharvest storage practices
- Outline the postharvest losses of different food grains
- Understand the proper separation and storage practices
- Discuss various constraints of milling and their economy
- Explain different methods used for material handling systems

Course Outcomes

1. Apply their knowledge of post harvest storage practices
2. Acquire knowledge on reduction of post harvest losses
3. Develop new methods for the storage of food grains
4. Analyze the different methods of milling and their economical importance
5. Interpret the methods of material handling systems
6. Extrapolate the post harvest technology practices

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. Chakraverty,A., and Singh, P.R. (2014). Post Harvest Technology and Food Process Engineering.CRC Press. Boca Raton.FL.USA.
2. Sahay, K.M. and singh, K.K. (2015). Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.

Semester- VI

19BTFT6E13 **CROP 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

- Explain the moisture content estimation and gain knowledge on post harvest of food grains
- Summarize the proper practices of shelling, threshing, cleaning and drying
- Discuss the techniques and methodologies involved in rice and pulses processing and storage
- Understand the various traditional and recent storage practices
- Discuss the food waste management system and production of useful products

Course Outcomes (COs)

1. Create awareness about the processing of major cereals like paddy, maize etc.
2. Discuss the practices of shelling, threshing, cleaning, grading and drying
3. Understand the different types of methods used for rice and pulse processing technology
4. Discuss the factors to be considered for proper storage of food grains.
5. Outline the sources and classification of various industrial waste materials.
6. Understand the concepts involved in the conversion of waste into value added products.

UNIT I Engineering Properties and Moisture Content

Post harvest losses in field crops – optimum stage of harvest, properties of grains – physical, thermal, electrical and aerodynamic properties, moisture content – measurement – direct and indirect methods– moisture meters, equilibrium moisture content – equilibrium relative humidity, relationship and isotherm models, methods of determination.

UNIT II Threshing, Shelling, Cleaning, Grading and Drying

Threshing – threshers, types, cleaning and grading – principles, types, efficiency of separation, performance index, shelling and decortication – principles, maize sheller, husker sheller, groundnut decorticator and castor sheller, psychrometry – properties of air – water vapour mixture, grain drying– principles, types, heat sources, performance of dryers.

UNIT III Rice and Pulses Processing

Rice processing – parboiling, drying, dehusking, polishing, modern rice mill machineries – construction details and adjustments, layout of modern rice mills, manufacture of beaten rice, expanded rice and puffed rice, traditional and improved methods, processes and equipments, material handling equipment – types, construction and working – pulse milling – wet and dry method.

UNIT IV Storage

Storage of food grains – factors affecting storage, traditional methods, types – bag and bulk storage, storage structure, storage losses – estimation, storage of grains in large bins, modified atmosphere storage of grains – facilities, construction, operation and maintenance

UNIT V Waste Utilization

Waste materials, sources and classification – crop residues, farm and industrial wastes and byproducts, utilization – production of paper and paperboards, particle board, fuel briquettes - production of fibre, activated carbon, furfural and adhesive from tamarind kernel powder.

SUGGESTED READINGS

1. Chakraverty, A. (2018). Post Harvest Technology of cereals, pulses and oilseeds. 3rd Edition. Oxford & IBH publishing & Co. Pvt. Ltd., New Delhi.
2. Sahay, K.M. and K.K. Singh. (2015). Unit operations in Agricultural Processing. 2nd Edition. Vikas Publishing House Pvt. Ltd., New Delhi.

Semester-VII

19BTFT7E01 **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

- Define the physical and chemical properties of fats and oils.
- Outline the different methods of extraction processes of oil.
- Explain the oil refining processes and associated steps.
- Summarize the various types of packaging materials and methods employed in the packaging of oil.
- State the industrial applications, quality regulations and standards mandated for oil processing industries.

Course Outcomes

1. Infer the functions, physical and chemical properties of fats and oils
2. Interpret the various methods applied to the extraction of oils
3. Classify the steps involved in the oil refining processes
4. Choose an appropriate packaging material for oil packing
5. Identify the suitable storage conditions for improving the shelf life of oils
6. Assess the applications, quality standards and regulations followed in the oil processing sectors.

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 – tinplate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches – packaging for Vanaspati and ghee changes during storage of oil –rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.

UNIT V - 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. Gunstone, F.D., (2008). Oils and Fats in Food Industry. Blackwell Publishing, United Kingdom.
2. Brien, R.D.O. (2008). Fats and oil. CRC Press.
3. Brech, .G.S. (2008). Hand book of Industrial oil and fat Products. CBS Publishers & Distributors. New Delhi.

19BTFT7E02 ROLE OF NANOTECHNOLOGY IN FOOD PROCESSING 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- Provide a basic understanding of Nanotechnology in food
- Impart knowledge on various synthesis and characterization techniques involved in Nanotechnology
- Explain the various concepts of Cryogenics in Food Processing
- Discuss the applications of Nanotechnology in the field of food technology
- Elaborate the use of cryogenics in food processing industries

Course Outcomes (COs)

1. Understand the fundamentals of Nanotechnology and Cryogenics in the food processing industries
2. Interpret the use of nanomaterials and their nanostructures in food processing sector.
3. Understand the properties of nanomaterials and its synthesis.
4. Exemplify the cryogenic properties and cryogenic techniques in food preservation and storage.
5. Acquire knowledge about current trends and future aspects of Nanotechnology in food processing.
6. Elucidate the applications of Cryogenics in Food Industries.

UNIT I BASICS OF NANOTECHNOLOGY AND NANOSTRUCTURES IN FOOD

Background- Evolution of new technologies in the food sector- Public perception of nanotechnology food products-Properties of nanomaterials - Nanomaterials for food applications-Nano-sized food ingredients and additives in relation to digestion of food-Natural nanostructures in food-Naturally occurring food nano substances and nanostructure-Designing food nanostructures.

UNIT II NANOMATERIALS AND SYNTHESIS METHODS

Nanomaterials- Physical properties – mechanical and optical properties- Magnetic and size dependent properties of nanomaterials- Electrical conductivity and photoluminescence properties of nanomaterials- Method of nanomaterials synthesis-mechanical, gas phase and physical vapor deposition-Chemical Synthesis-Nanoparticle size determination by X-ray diffraction technique and dynamic light scattering method for colloidal nanoparticle- Manipulation of nanomaterials by

transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Use of Infra red and magnetic resonance spectroscopy in nanoscience

UNIT III INTRODUCTION TO CRYOGENICS

Cryogenics and its applications- Properties of cryogenic fluids- Properties of materials at cryogenic temperature- Gas-Liquefaction and Refrigeration Systems- Gas Separation- Cryocoolers- Cryogenic Insulations- Vacuum Technology- Instrumentation in Cryogenics- Liquid storage and transfer systems- Cryostat design- Dilution Refrigerator and Adiabatic Demagnetization

UNIT IVAPPLICATIONS OF NANOTEECHNOLOGY IN FOOD PROCESSING

Nanotechnology in Food Preservation-Nanoemulsion - Nanodispersions -Nanocapsules - Association colloids - Nanocoatings. Nanostructure multilayer emulsions – Biopolymeric nanoparticles - Nano packaging – Nanoplastic – Nanocomposites – Active packaging – Intelligent packaging – Biodegradable Nano packaging - Nanofibers – Nanosensors. Ethical issues in nanotechnology – socio-economic issues – Benefits, challenges and future of nanotechnology.

UNIT VAPPLICATIONS OF CRYOGENICS IN INDUSTRIES

Advances in Cryogenics- Vortex tube and applications- Pulse tube refrigerator- Cryogenic Engine for space vehicles- Cryogenic Applications- gas industry- cryogenic fluids- space research- Cryobiology- food processing- chemical processing- cryogenic power generation, medicine, analytical physics and chemistry

SUGGESTED READING

1. Chaudhry,Q., Castle, L., and Watkins, R. (2010). Text book on Nanotechnologies in food. RSC Nano science and Nano technology. Published by the Royal society of chemistry.
2. Hester,R.E., and Harrison, R.M. (2007). Nanotechnology, Consequences for Human Health and the Environment.

Semester- VII

19BTFT7E03 **New Product Development and Sensory Science** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Explain about the importance and applications of sensory analysis.
- Illustrate the methods and different types of test used for sensory analysis.
- Create a different knowledge on assessors and its role on sensory valuation.
- State the basic concepts of product development along with their success and failures .
- Outline the processes involved in product development.

Course outcomes

1. Relate the applications of sensory analysis.
2. Identify the methods used for various sensory evaluation.
3. Understand the aassessors role in sensory test.
4. Understand the basic concepts of product development.
5. Explain the process of product development
6. Discuss the various strategies involved in the new product development process.

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. Morten, M.(2015). Sensory evaluation techniques Stone Herbert; Sensory evaluation practices. 5th Edition.CRC Press.
2. Schaffner, D. J., Schroeder, W. R., Earle, M. D. (2003).Food Marketing: An International Perspective. 2nd Edition. McGraw Hill.
3. Varela, P., Ares, E.G. (2014). Novel Techniques in Sensory Characterization and Consumer Profiling, CRC Press.

Semester- VII

19BTFT7E04 Marketing Management and International Trade 3H-3C

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

End Semester Exam:3 Hours

Course objectives

- 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

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 life Cycle, New product development process Product brand, packaging, services decisions,

Marketing channel decisions. Retailing, wholesaling and distribution, Pricing decisions, Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry, Promotion-mix decisions, Advertising, how advertising works, deciding advertising objectives, Advertising budget, Advertising message, media planning, personal selling, publicity, sales, promotion. World consumption of food: Patterns and types of food consumption across the globe

UNIT IV- INTERNATIONAL MARKETING AND TRADE

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 India 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. Kotler, P., Keller, K.L., Abraham Koshy, A., Jha, M. (2013). Marketing Management: A South Asian Perspective, 14th Edition. Pearson Education.
2. Daniels, J., Radebaugh, L., Brigham, Daniel Sullivan, D., (2015). International Business, 15th Edition. Pearson Education.
3. Aswathappa. (2008).International Business. Tata McGraw-Hill Education, New Delhi.

B.TECH FOOD TECHNOLOGY **2019-2020**

Semester- VII

19BTFT7E05 **SUPPLY CHAIN MANAGEMENT** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- Understand the various concepts of food marketing system
- Explain the different constraints involved in the marketing research
- Discuss the innovations in food chains, quality and safety standards in the retail management.
- Explain the important key areas relating to supply chain management in food processing industries
- Understand the overall concepts of globalization and logistics

Course Outcomes (COs)

1. Outline the important concepts and approaches of food marketing system
2. Illustrate the various attributes of marketing research
3. Assess the multivariate techniques involved in market research
4. Understand the innovations in food chains, quality and safety standards in the retail management.
5. Discuss the multiple strategies of supply chain management system in food industries
6. Infer the important concepts of globalization and logistics

UNIT I FOOD MARKETING

Food Marketing System- Process, Growth, Role and Economic importance - Basic marketing concepts and approaches - marketing functions - Market Structure, Conduct and Performance - organizational issues. Concept, Forms of food supply chain, Factors affecting the chain – Supply Chain Partnerships - Contracts, Strategic Alliances.

UNIT II MARKETING RESEARCH

Food Consumption and Marketing- Preferences, Demography, consumption and expenditure patterns. Analyzing agricultural and food sectors: Agricultural commodity sectors, Food Processing and Manufacturing - Location, structure and problems, Innovation. Wholesaling and Retailing in food - International Food Market & Agribusiness Marketing: Trends, International Competitiveness, Barrier to trade, Porter's framework, Risk management and futures market, Marketing and Market

Research: Consumer behavior and market research, Survey analysis and multivariate techniques in market research

UNIT III RETAIL MANAGEMENT

Sourcing and procurement, Purchase management - Innovations in Food Chains, Quality Management, Private Food Quality and Safety Standards, Food safety and the supply chain.

UNIT IV SUPPLY CHAIN MANAGEMENT

Integrated Materials Management - Alternative Inventory models - Transportation - Network design - Supply Chains for Perishables. Warehouse Management - procedures, storage structures, cost of storage, insurance and issues. Information Technology and Supply Chain, Traceability, Identity, Preservation issues in the Food System - Retail supply chain management, Changes in Retail, Food Delivery.

UNIT V GLOBALIZATION

Supply chain strategy at the firm - Efficient Consumer Response - Measurement of consumer response - Experimental Economics Approach - Globalization and logistics: Addressing global competitiveness.

SUGGESTED READINGS

1. Chopra,S., Meindl, P. (2004). Supply Chain Management: Strategy, Planning, and Operation, 2nd Edition. Prentice Hall,.
2. Kotabe, M., and Helsen, K. (2001). Global Marketing. 2nd Edition. New York: Wiley.
3. Lysons, K. (2005). Brian Farrington Purchasing and Supply Chain Management. Prentice Hall.

Semester- VIII

19BTFT8E01 **Functional Foods and Nutraceuticals** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Discuss the historical reviews, teleology, models, classification and sources of nutraceuticals
- Explain the role of flavonoids and carotenoids as antioxidant agents
- Understand the metabolism, mechanism, sources and analysis of omega-3 fatty acids and CLA
- Summarize the health implications of lycopene, garlic, olive oil, nuts, prebiotics and probiotics
- Discuss the various aspects of herbs, stability testing, marketing strategies and regulatory issues in nutraceutical and functional foods

Course outcomes

1. Illustrate the historical, technological aspects and classification of nutraceuticals
2. Outline the significance of flavanoids and carotenoids as antioxidants
3. Assess the potential health benefits, sources, mechanism of action and metabolism of omega-3 fatty acids and CLA
4. Infer the multiple aspects of consuming lycopene, garlic, olive oil, nuts, prebiotics and probiotics as a nutraceutical
5. Understand the role of herbs as a nutraceutical and conduct the accelerated shelf life testing of various nutraceuticals and functional foods
6. Assess the marketing strategies and regulatory issues in nutraceutical and functional food market

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 - ω – 3 fish oils and their role in Glycemic control- ω –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., Shahidi, F., and Ho, C.T. (2007). Asian Functional Foods. CRC/Taylor & Francis.
2. Watson, Ross, R. (2007). Functional Foods and Nutraceuticals in Cancer Prevention. Blackwell Publishing.
3. Gibson, G.R., and Willams, C.M. (2011). Functional Foods: Concept to Product. 2nd Edition. Wood head Publishing.

Semester- VIII

19BTFT8E02 **Food Biotechnology** **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

- Understand the role of biotechnology in various food processing applications
- Explain the production of metabolites, flavors, colors, protein rich foods and preservatives using biotechnological methodologies
- Discuss the various downstream processing techniques
- Explain the molecular diagnostic tools and methods applied to detect pathogens, pesticides and toxins in the raw materials and food.
- Summarize the application and classification of biosensors and discuss the social, ethical and safety aspects of GM foods

Course Outcomes

1. Outline the biotechnological applications in the various food processing sectors
2. Illustrate the production of various biotechnologically derived food products.
3. Understand the importance of downstream processing techniques in biotechnology and food processing
4. Infer the different types of molecular diagnostic tools, assays and methods in the detection of pathogens, pesticides and toxins in the raw materials and food
5. Understand the classification and applications of biosensors
6. Discuss the ethical, social, and safety aspects of production and consumption of GM foods

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, acidic 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., Polak J., and Bielecki, Tramper, S. (2000). Food Biotechnology. Elsevier Science Publishing Company. New Delhi.
2. Joshi, V.K. and Pandey, A. (1999). Biotechnology -Food Fermentation. Volume. I &II. Education Publishing. New Delhi.
3. Gutierre, Gustavo, F. (2003). Food Science and Food Biotechnology.CRC Press. New York.
4. Singh, B.D. (2014). Biotechnology - Expanding Horizons. Kalyani Publishers. New Delhi.
5. Watson, J.D.(2013).Molecular Biology of the Gene. 7th Edition. Benjamin Cummings. San Francisco.USA

Semester- VIII

19BTFT8E03 **Protein Chemistry and Technology** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Understand the basics of amino acids, chemical reactions, interactions with EM radiations and elucidation of proteins
- Discuss the methods and techniques applied to determine the structure of protein
- Explain the principles, methods and technological constraints involved in protein engineering
- Understand the mechanism, structure, digestibility, functionality and application of animal and marine derived proteins
- List the composition, functional properties and applications of plant derived proteins

Course outcomes

1. Illustrate the basics, chemistry, interactions with EM radiations and elucidation of amino acids and proteins
2. Outline the methods and tools involved in the structural determination of proteins
3. Understand the principles, methods and technological constraints involved in protein engineering
4. Discuss the overall scenario of derived proteins
5. Infer the molecular, functional, structural properties and applications of marine derived proteins
6. Summarize the composition, properties, functional properties and food applications of plant based proteins

UNIT I - BASICS OF AMINO ACIDS AND PROTEIN CHEMISTRY

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to posttranslational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis. Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II - PROTEIN ARCHITECTURE

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine (Basics only) Basics of Super-secondary structure: Alpha-turn-alpha, beta-

turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

UNIT III - PROTEIN ENGINEERING

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, *de novo* protein design.

UNIT IV - BASICS OF THE PROPERTIES OF FOOD PROTEINS – ANIMAL AND MARINE SOURCES CASEINS AND WHEY PROTEINS

Caseins – Heterogeneity and Molecular properties – caseins micelles – Mechanism of stabilization – Structure models – Structure of whey proteins and improvement of functionality Muscle proteins– Structure and functionality – Application of muscle proteins in foods Sea weed proteins – Protein content and functionality, digestibility of algal proteins – applications to food systems.

UNIT V - BASICS OF THE PROPERTIES OF FOOD PROTEINS – PLANT SOURCES

Composition, Properties and functional properties of soya, rapeseed, peanut. Leaf as a protein source – Basic and Food applications of rubisco.

SUGGESTED READINGS

1. Voet,D. Voet, J.G., and Pratt, C.W. (2016). Fundamentals of Biochemistry Life at the Molecular Level. 5th Edition. John Wiley and Sons.
2. Moody, P.C.E. and Wilkinson, A.J. (2009). Protein Engineering. IRL Press.Oxford.UK.

Semester- VIII

19BTFT8E04 **Advanced Drying 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

- Understand the principles and engineering aspects of drying
- Explain the principles, types and working of drum, rotary, foam mat and osmotic dehydration of foods
- Understand the overall aspects of spray drying of foods
- Discuss the principle, instrumentation and applications of fluidized, pneumatic, flash and freeze drying of food materials
- Explain the novel drying methods employed in food industries

Course outcomes

1. Outline the basic principles and various engineering aspects of drying techniques
2. Understand the types, principles and working of drum, rotary, foam mat and osmotic dehydration of foods
3. Illustrate the principle, working, instrumentation and application of spray drying
4. Understand the principle, instrumentation and applications of fluidized, pneumatic, flash and freeze drying of food materials
5. Infer the application and engineering aspects of special drying techniques
6. Explain the key scenario of dehydration of foods using novel dryers and cyclic pressures

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. Singh, R.P., and Heldman, D.R. (2014).Introduction to Food Engineering. 5th Edition Academic Press.
2. Kudra, T., and Majumdar, A.S. (2009).Advanced Drying Technologies. 2nd Edition. Marcel Dekker Inc., New York.
3. Mujumdar, A.S. (2014). Handbook of Industrial Drying. 4th Edition. CHIPS, India.

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Semester- VIII

19BTFT8E05 **Food Fermentation Technology** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Understand the benefits, nutritive value, and microorganisms associated with the fermentation processes
- Practice the preparation and culture maintenance of bacteria, yeast and mold
- Explain the production of different types of fermented products
- Discuss the production processes of fermented drinks and fermented vegetables
- Understand the production of yeast, enzymes, proteins, fats and HFCS

Course outcomes

1. List the overall benefits, nutritive value, and microorganisms involved in the fermentation processes
2. Prepare and maintain the cultures of bacteria, yeast and mold for fermentation processes
3. Develop the different types of fermented dairy products
4. Understand the processes involved in the production of fermented drinks
5. Illustrate the overall steps employed in the production of fermented vegetables
6. Outline the different set of processes followed in the production of yeast, enzymes, proteins, fats and HFCS

UNIT I - INTRODUCTION TO FERMENTATION

Definition - benefit of fermentation - nutritive value of fermented foods - microbial changes in fermented foods - micro organism - proteolytic, liploytic 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 (SCP) and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin), HFCS(High Fructose Corn Syrup)

SUGGESTED READINGS

1. Prabir, K., Sarkar, M.J. Nout,R. (2014). Handbook of Indigenous Foods Involving Alkaline Fermentation.1st Edition.CRC press.
2. De, S. (2006). Outlines of Dairy Technology.23rd impression. Oxford University Press. New Delhi.
3. Frazier W.C., and Westoff, C.D. (2014). Food Microbiology.5th Edition. Springer. The Mc Graw-Hill Companies.
4. Jay, M.J. (2005).Modern Food Microbiology.4th Edition.CBS Publishers and Distributors Pvt. Ltd.

Semester-VIII

19BTFT8E06 **Extrusion 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

- Explain the basics principles, types and uses of extrusion cooking
- Understand the importance of pre-conditioning and de-volatilization of raw materials
- Discuss the constructional, operational and working of single and twin screw extruders
- Summarize the nutritional, functional and sensory properties of extruded food products
- Discuss the application of extrusion technology in the production and development of new product

Course outcomes

1. Outline the principles, types and uses of extrusion cooking
2. Illustrate the importance of pre-conditioning and de-volatilization of raw materials
3. Infer the constructional, operational and working of single and twin screw extruders
4. Assess the nutritional, functional and sensory properties of extruded food products
5. Understand the techniques of cold extrusion cooking
6. Apply the new extrusion technology concepts for the preparation of new products

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. (2001).Thermal Technologies in Food processing. Wood head Publishers. Cambridge.CRC Press.
2. Guy, R. (2001). Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge.
3. Maskan. (2011). Advances in Food Extrusion Technology. Special Indian Edition. Taylor & Francis.

Semester-VIII

19BTFT8E07 **Sugar 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

- Explain the various pre-processing operations applied from field to industry for sugar manufacturing
- Understand the crushers, types, extraction methods, accumulators, theories of cane juice extraction
- Discuss the clarification methods and agents used in the clarification of cane juice
- Understand the filtration and evaporation processes and its types used in cane sugar industry
- Summarize the unit operations, by-product utilization and production of sugar other than sugarcane.

Course outcomes

1. List the pre-processing stages of sugar production from field to industries
2. Discuss the crushers, types, extraction methods, accumulators, theories of cane juice extraction
3. Outline the different methods and clarifying agents used in the clarification of cane juice
4. Illustrate the various types of filtration and evaporation processes involved in sugar industries
5. Choose the important unit operations applied in the sugar processing sectors
6. Discuss the probabilities of by-product utilization and production of sugar from beet, palm and coconut

UNIT I – PRE PROCESSING OPERATIONS

Sugarcane - Constituents - Harvesting indices - Cane cutting - Manual, Mechanical - Transportation - loading - Unloading - Cane conveyor - Washing - Shredders – Types.

UNIT II – JUICE EXTRACTION

Crushing - Crushers - Types, Crushing efficiency - Extraction of juice - methods, Accumulators - types - Maceration - Theory of cane diffusivity - different diffuser - ring diffuser - weighing of juice.

UNIT III – CANE JUICE CLARIFICATION

Clarification - methods - clarifying agent - bleaching agent - Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice - CO2 P2O5 and its importance

UNIT IV –FILTRATION AND EVAPORATION PROCESS IN CANE INDUSTRY

Filtration of mud - Filter types - filter press, rotary vacuum filter - Rapi - Floc process. Filter cake washing. Evaporation - Evaporation rate - types of evaporators used in cane sugar industry - Cleaning of evaporators - Entrainment separator - methods - Boiling in Vacuum pan - Footing magma - Massecuite . A,B,C - Mother liquor, Molasses A,B,C Molasses exhaustibility

UNIT V –SUGAR PRODUCTION

Crystallization - Super saturation - Crystallizers type - batch and continuous. Centrifuge - types. Drying of sugar - conveyors for sugar - by-product from sugar mills - utilization.sugar production from beet, palm and coconut.

SUGGESTED READINGS

1. Lal, R.B., and Mathur. (1972).Hand book of cane sugar technology. Oxford and IBH publishing company New Delhi
2. McCabe, W.L., Smith, J.C., and Harriot, P. (2004).Unit Operations of Chemical Engineering.7th Edition. McGraw Hill International Edition. Singapore.
3. Cruees, W.V. (2009).Technology of wine making food science. Agrobios Publishers

19BTFT8E08 **Food Allergy and Toxicology** **3H-3C**

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

Course objectives

- Understand the basics of food toxicology, types of hazard and allergic resources
- Explain the chemistry of food allergens and disorders along with metabolism
- Discuss the types of natural food toxicants, factors influencing, absorption and excretion of toxins
- Summarize the different methodologies of toxicant determination in food samples
- Discuss the probabilities of the formation of toxins during food processing

Course outcomes

1. Outline the basics of food toxicology, types of hazard, immune and allergic resources
2. Infer the chemistry of food allergens and food disorders associated with metabolism
3. Categorize the types, factors influencing, absorption and excretion of toxins
4. Understand the toxicant determination methodologies in food samples
5. Discuss the food safety and risk benefit indices of human exposure to toxicants
6. Aware of formation of toxins during food processing

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 mechanismof 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. William, H.I., and Winter, K C. (2001).Food Toxicology.CRC Press.
2. Alluwalia., and Vikas. (2007). Food Hygiene and Toxicology. Paragon International Publishers.
3. Shibamoto, yuki T., and Bjeldanzes, L.F. (2009). Introduction to Food Toxicology. 2nd Edition. Academic Press.

Semester-VIII

19BTFT8E09 **Waste Management in Food Industries** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Explain the types, characterization and need for treating food industrial wastes
- Discuss the impact of various food processing industrial wastes on environment
- Summarize the different technologies and processes employed in treating food industrial waste water
- Review the multiple aspects of solid waste management in food industries
- Understand the laws, acts, regulatory issues in international and national scenario of food industrial waste management

Course outcomes

1. Understand the importance of treating waste generated from the food processing sectors
2. Categorize the types of wastes obtained from different food processing industries
3. Illustrate the principles of chemical and physical treatments employed in the managing waste water from food industries
4. Outline the principles of biological treatments applied in the treating of food industry waste water
5. Infer the overall scenario of solid waste management in food industries
6. Discuss the role of national and international agencies, implementation of laws and acts to prevent or minimize the pollution and its impact on environment

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 , vermi-composting. 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. Arvanitoyannis, S.I. (2008). Waste Management for the Food Industries. Academic Press.
2. Jogdhand, S.N. (2010). Environmental Biotechnology: Industrial Pollution Management.3rd Edition. Himalaya Publishing House. New Delhi.
3. Wang, L.K., Hung, Y.T., Lo, H.H., and Yapijakis, C. (2006). Waste Treatment in the Food Processing Industry.CRC press. Taylor and Francis Group.

Semester-VIII

19BTFT8E10 **Total Quality Management** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Understand the basic concepts of total quality management and appreciate its importance in today's business environment.
- Explain the TQM principles related to customer and supplier issues
- Discuss the TQM tools, concepts, methodologies and applications in quality management
- Understand the concepts, functions and performance measures applied in managing quality
- Discuss the need for implantation of various ISO standards in achieving good quality

Course outcomes

1. Outline the need of implementing quality management systems in food processing sectors
2. Infer the quality statements related to customer and supplier issues
3. Assess the tools, concepts, methodologies and applications in improving the quality
4. Discuss the overall aspects of quality related functions, and concepts of quality management
5. Explain the reasons and methods used in bench marking processes
6. Illustrate the importance of implementing ISO standards in quality management

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. Besterfiled, Dale, H. (2006). Total Quality Management. 4th Edition, Pearson Education Asia.
2. Evans., James, R., and Lindsay, W.M. (2005). The Management and Control of Quality.6th Edition South-Western (Thomson Learning).
3. Oakland, J.S. (2003). TQM – Text with Cases.3rd Edition. Butterworth – Heinemann.
4. Suganthi,L., and Samuel, A. (2006).Total Quality Management. PHI.
5. Charantimath, P.M. (2011). Total quality management, 2nd Edition.PearsonEducation.

Semester-VIII

19BTFT8E11 **Food Storage and Logistic Management** **3H-3C**

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

End Semester Exam:3 Hours

Course objectives

- Explain the concepts, objectives, types and cycles in logistics
- Discuss the concepts, objectives and types of inventory management system and material handling in industries
- Understand the overall concepts and objectives in material storage system in industries
- Explain the complete stages of logistic packaging and transportation
- Discuss the various concepts, objectives, systems and phases in customer service and logistics outsourcing

Course outcomes

1. Outline the concepts, objectives, types and cycles in logistics management system
2. List the concepts, objectives, types and terminologies of inventory management system
3. Understand the concepts, objectives, principles, types and equipments employed in material handling
4. Infer the various concepts, objectives and principles in material storage system and store house operations in industries
5. Understand the order of stages in logistic packaging and transportation
6. Discuss the complete scenario of customer service and logistics outsourcing

UNIT I- Concept of Logistics

Concept of Logistics: Introduction, Objectives, Concept of Logistics, Objectives of logistics, Types of logistics, Concept of Logistics Management, Evolution of Logistics, Role of Logistics in an Economy, Difference between Logistics and Supply Chain Management, Logistics and Competitive Advantage, Logistics Mix, Logistics in Organised Retail in India Integrated Logistics: Introduction, Objectives, Concept of Integrated Logistics, Inventory flow, Information flow, Operational Objectives of Integrated Logistics, Barriers to Integration, Organisation structure, Measurement system, Inventory ownership, Information technology, Knowledge transfer capability, Logistical Performance Cycle, Logistics performance cycle, Manufacturing support performance cycle, Procurement performance cycle

UNIT II INVENTORY MANAGEMENT

Introduction, Objectives, Concept of Inventory, Types of Inventory, Concept of Inventory Management, Importance of inventory management, Objectives of inventory management, Different Types of Inventory Costs, Inventory Performance Measures, Inventory turnover ratio (ITR),

Framework of performance indicators, Inventory Planning Measures, Economic order quantity (EOQ), Reorder point, Safety stock, Supplier-managed inventory Material Handling: Introduction, Objectives, Concept of Material Handling, Objectives of material handling, Principles of material handling, Equipment Used for Material Handling, Points to be Considered While Handling Materials, Role of Material Handling in Logistics

UNIT III MATERIAL STORAGE SYSTEM

Introduction, Objectives, Concept of Material Storage System, Unit Load Storage, Storage principles, Storage design and its benefits, Storage Methods Storehouse Operations and Control: Introduction, Objectives, Storehouse Operations and its Objectives, Daily Activities of Stores, Organizing a Store, Store Location and Layout, Selecting appropriate storage system, Centralization, Decentralization and variety reduction of stores, Store Housekeeping, Stores Accounting

UNIT IV LOGISTICAL PACKAGING AND TRANSPORTATION

Logistical Packaging: Introduction, Objectives, Concept of Logistical Packaging, Design Consideration in Packaging, Types of Packaging Material, Packaging Costs Transportation: Introduction, Objectives, Transportation System, Transportation Infrastructure, Different Modes of Transportation, Freight Management, Factors Affecting Freight Cost, Transportation Network, Containerisation

UNIT V CUSTOMER SERVICE AND LOGISTICS OUTSOURCING

Customer Service: Key Element of Logistics: Introduction, Objectives, Concept of Customer Service, Attributes of customer service, Different phases of customer services, Customer Service for Competitiveness, Value- Added Logistical Service Logistics Outsourcing: Introduction, Objectives, Concept of Logistics Outsourcing, Catalyst for logistics outsourcing, Benefits of logistics outsourcing, Issues in logistics outsourcing, Third-Party Logistics, Fourth-Party Logistics, Selection of Logistics Service Provider, Logistics Service Contract, Outsourcing-Value Proposition Logistics Information System: Introduction, Objectives, Concept of Logistics Information System (LIS), Importance of LIS, Principles of designing LIS, Logistics Information Architecture, Application of Information Technology in Logistics and Supply Chain Management

SUGGESTED READINGS

1. Chopra,S., Meindl,P. (2004). Supply Chain Management: Strategy, Planning, and Operation, 2nd Edition. Prentice Hall,
2. Sanders, N.R. (2012). Supply chain management: A global perspective. Wiley Publications.
3. Scott, C., Lundgren, H., and Thompson,P., (2011). Guide to Supply Chain Management, Springer Verlag.

19BESHOE01/19BTSHOE01 **3H-3C**

SOLID WASTE MANAGEMENT

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

End Semester Exam:3 Hours

Course Objectives:

- To make the students conversant with basics of Solid wastes and its classification.
- To make the student acquire sound knowledge of different treatments of solid wastes.
- To acquaint the student with concepts of waste disposals.
- To develop an understanding of the basic concepts of Hazardous waste managements.
- To acquaint the students with the basics of energy generation from waste materials.

Course Outcome:

1. Outline the basic principles of Solid waste and separation of wastes (K)
2. Identify the concepts of treatment of solid wastes(S)
3. Identify the methods of wastes disposals.(S)
4. Examine the level of Hazardousness and its management. (S)
5. Examine the possible of the energy production using waste materials. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I SOLID WASTE

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNIT II WASTE TREATMENT

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III WASTE DISPOSAL

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classficaition, Types, Methods &Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

UNIT IV HAZARDOUS WASTE MANAGEMENT

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediaiton, risk assessment.

UNIT V ENERGY GENERATION FROM WASTE

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, Energy recovery systems. Biological & Chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

Total: 45

Suggested Readings:

1. Dara.S.S,Mishra.D.D, A Text book of Environmental Chemistry and Pollution Control, S.Chand and Company Ltd., New Delhi.2011.
2. Naomi B. Klinghoffer and Marco J. Castaldi,Waste to Energy Conversion Technology (Woodhead Publishing Series in Energy),Woodhead Publishing Ltd., Cambridge, UK,2013.
3. Frank Kreith, George Tchobanoglous,Hand Book of Solid Waste Management- 2nd edition, McGraw Hill Publishing Ltd., Newyork,2002.
4. Shah, L Kanti, Basics of Solid & Hazardous Waste Management Technology, Prentice Hall (P) Ltd.,
5. New Delhi.1999.
6. www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste.
7. http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/
8. www.alternative-energy-news.info/technology/garbage-energy/
9. nzic.org.nz/ChemProcesses/environment/

19BESHOE02/19BTSHOE02 **3H-3C**

GREEN CHEMISTRY

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basics information on catalysis.

COURSE OUTCOMES:

1. Outline the basic principles of green chemistry (K)
2. Examine the different atom efficient process and synthesis elaborately (S)
3. Apply the concepts combustion of green technology (S)
4. Identify and apply the concepts of renewable energy(S)
5. Apply the concepts of green catalysts in the synthesis (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II ATOM EFFICIENT PROCESSES

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air.Green chemistry for clean technology-Significance of

green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV RENEWABLE RESOURCES

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V CATALYSIS IN GREEN CHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

Total: 45

Suggested Readings:

1. Sanjay K. Sharma, Ackmez Mudhoo, Green Chemistry for Environmental Sustainability, CRC Press , London, 2010
2. Ahluwalia V. K. and M.Kidwai, New Trends in Green Chemistry 2nd edition, Anamaya publishers., New Delhi,2007.
3. Dr. SunitaRatan, A Textbook of Engineering Chemistry, S.K. Kataria and Sons., New Delhi.,2012.
4. MukeshDoble. Ken Rollins, Anil Kumar,Green Chemistry and Engineering, 1st edition, Academic Press, Elesevier., New Delhi.2007.
5. Desai K. R., Green Chemistry, Himalaya Publishing House, Mumbai., 2005.
6. Matlack A. S., Introduction to Green Chemistry.,Marcel Dekker: New York,2001.
7. http://www.organic-chemistry.org/topics/green-chemistry.shtm
8. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
9. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.htm
10. http://www.epa.gov/research/greenchemistry/
11. http://www.amazon.in/Green-Chemistry-Catalysis

19BESHOE03/19BTSHOE03 **3H-3C**

APPLIED ELECTROCHEMISTRY

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

End Semester Exam:3 Hours

Objectives:

- To make the students conversant with the information on electrochemical material.
- To make the student acquire sound knowledge of conducting polymers.
- To acquaint the student with concepts of Energy storage devices.
- To develop energy storage devices.

Course Outcomes:

1. Outline the basic principles of chemistry in electrochemical material (K)
2. Examine the properties of conducting polymers(S)
3. Apply the concepts of electrochemistry in storage devices.(S)
4. Identify the concepts of storage devices and its applications. (S)
5. Apply the suitable materials for the manufacturing of storage devices. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I METAL FINISHING

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning.

UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS

lectropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNIT III BATTERIES AND POWER SOURCES-I

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV BATTERIES AND POWER SOURCES-II

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V ELECTROCHEMICAL MATERIAL SCIENCE

Solar cells- Preparation of CdS/Cu_2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics

TOTAL :45

Suggested Readings:

1. Cynthia G. Zoski,Hand Book of Electrochemistry, Academic Press, Elesevier., UK,2007.
2. D.Pletcher and F.C.Walsh, Industrial Electrochemistry, Chapman and Hall, London, 1990.
3. M. Barak, Electrochemical Power Sources, I.EEE series, Peter Peregrinius Ltd, Steverage, U.K.1997.
4. Bruno Scrosati, Applications of Electroactive Polymers, Chapman & Hall, London, 1993.
5. K.L. Chopra and I. Kaur,Thin Film Devices and their Application,Plenum Press, New York.1983.
6. M.M.Baizer, Organic Electrochemistry, Dekker Inc. New York, 1983.
7. http://www.anoplate.com/finishes/
8. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
9. http://inventors.about.com/od/sstartinventions/a/solar_cell.htm

19BESHOE04/19BTSHOE04 **3H-3C**

INDUSTRIAL CHEMISTRY

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

End Semester Exam:3 Hours

Course Objectives:

- To make the students conversant with cement and lime and its uses.
- To make the student acquire sound knowledge of abrasives and refractories.
- To acquaint the student with concepts of inorganic chemicals.
- To develop an understanding of the basic concepts explosives.
- To acquaint the students with the basics of agriculture chemicals.

Course Outcomes:

1. Outline the basic chemistry of cement and lime (K)
2. Examine the uses of abrasives and refractories (S)
3. Identify the usage of the inorganic chemicals. (S)
4. Identify the concepts of explosives and smoke screens(S)
5. Identify the usage of the agriculture chemicals(S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I CEMENT AND LIME

Manufacture of Portland cement – settling of hardening of portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydraulic lime.

UNIT II ABRASIVES AND REFRACTORIES

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

UNIT IIIINORGANIC CHEMICALS

Common salt and soda ash – manufacture – different grades – products – alkalis – Na_2CO_3, caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage.

Hydrochloric acid – manufacture – absorption – uses, sulphur and sulphuric acid – extraction of sulphur – manufacture of H_2SO_4 – chamber – contact processes – industrial uses.

UNIT IV EXPLOSIVES

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gas mask.

UNIT V AGRICULTURE CHEMICALS

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

Total: 45

Suggested Readings:

1. Harikrishan, Industrial Chemistry, Goel Publishing House, Meerut., 2014.
2. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut., 2000.
3. B.N.Chakrabarty, Industrial Chemistry, Oxford and IBH Publishing CO. New Delhi.1998.
4. James A. Kent, Hand Book of Industrial Chemistry, 9th edition, Van Nostrand Reinhold, New York.1992.
5. R.N. Sherve, Chemical Process Industries, McGraw-Hill, Kugakuisha Ltd., Tokyo.1984.
6. S.D. Shukla and G.N. Pandy, A Text book of Chemical Technology, Vikas Publishing
7. House (P) Ltd, New Delhi.1979.
8. http://en.wikipedia.org/wiki/Cement
9. http://www.hon.ch/HONselect/Selection/D01.html
10. http://fas.org/man/dod-101/navy/docs/fun/part12.htm
11. http://toxics.usgs.gov/topics/agchemicals.html

19BESHOE05/19BTSHOE05 **3H-3C**

TECHNICAL WRITING

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Develop abilities to write technically and expressively,
- Recognize writing as a constructive, meaningful process,
- Practice using reading strategies for effective writing.
- Design effective technical documents for both print and digital media
- Identify the qualities of good technical writing

COURSE OUTCOMES:

Students undergoing this course are able to

1. Construct simple sentences, correct common grammatical errors in written English.
2. Build confidence in English language by imbibing lexical and syntax rules.
3. Enrich their reading ability for effective writing.
4. Minimize word, sentence, and paragraph length without sacrificing clarity or substance
5. Familiarize with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
6. Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

UNIT – I BASICS OF WRITING

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer's block – Prioritizing for effective writing– Avoiding plagiarism.

UNIT – 2 PARAGRAPHS AND ESSAYS

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

UNIT – 3 LETTERS, MEMOS AND EMAIL

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

UNIT – 4 THE ART OF CONDENSATION AND TECHNICAL PROPOSALS

Steps to Effective précis writing – Guidelines – Technical Proposals – Types of Proposals – Characteristics – Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /Film Review – Travelogue – Dialogue Writing.

UNIT – 5 REPORTS AND RESEARCH ARTICLES

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

SUGGESTED READINGS:

1. V.N. Arora & Lakshmi Chandra, Improve Your Writing: Revised First Edition, OUP, New Delhi. 2014.
2. David Morley, The Cambridge Intro. to Creative Writing, CUP, New Delhi.2010.
3. Graham King, Collins Improve Your Writing Collins; First edition, UK 2009
4. Crème, P. and M. Lea.Writing at University: A guide for students.OUP, New Delhi.2003
5. http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/http://www.nyu.edu/classes/keefer/brain/net2.html
6. https://www.udemy.com/technical-writing-and-editing/
7. http://techwhirl.com/what-is-technical-writing/

19BESHOE06/19BTSHOE06 **3H-3C**

GEOPHYSICS

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

End Semester Exam:3 Hours

Course Objective:

- To inculcate the basics of brief history of Earth sciences (K)
- To divulge knowledge on the basics of structure of earth and earth's gravitational field.(S)
- To disseminate the fundamentals of magnetic field and thermal distribution of earth(K)
- To introduce the concepts of seismology and seismic waves (S) .
- To impart the basic knowledge of oceans (K)

Course Outcome:

1. gain knowledge on the basics of history of Earth sciences.
2. acquire knowledge on concepts of structure of earth and earth's gravitational field.
3. have adequate knowledge on the concepts of magnetic field and thermal distribution of earth
4. obtain knowledge on the basics of seismic waves.
5. understand the basics of oceans and properties of sea water.
6. apply the knowledge gained from this course to solve the relevant propblems in engineering stream.

UNIT I ORIGIN OF EARTH

A brief history of the development of Earth Sciences . An overview of Geophysical methods and their essential features, Problems of inversion and non-uniqueness in Geophysics, Origin & evolution of Solar system, Earth and Moon structure,.Kepler's law of planetary motion, A review of the Earth's structure and composition

UNIT II STRUCTURE OF EARTH

Chemical composition of Earth, Rheological behavior of crust and upper mantle, viscoelasticity and rock failure criteria, Geochronology: Radiometric dating and their advantages, meaning of radiometric ages, Major features of the Earth's gravitational field and relationship with tectonic processes in the crust and upper mantle, concept of isostasy, mathematical concept of Airy and Pratt hypotheses of isostasy

UNIT III MAGNETIC FIELD AND THERMAL DISTRUBUTION OF EARTH

Origin of geomagnetic field, polar wandering, secular variations and westward drift, reversals of geomagnetic field, sun spot, solar flares, geomagnetic storms, sea-floor spreading, Paleomagnetism and its uses, Thermal history of the Earth, sources of heat generation and temperature distribution inside the earth, convection in the mantle

UNIT IV SEISMOLOGY

Earthquake seismology, Earthquakes and its classifications, Global seismicity and tectonics, Earth's internal structure derived from seismology, Earthquake mechanism and Anderson's theory of faulting, Continental drift and plate tectonics: its essential features, present day plate motions, Triple junctions, oceanic ridges, Benioff zones, arcs, hot spots, Mantle Plume, Mountain building, origin of Himalaya, Geodynamics of Indian subcontinent.

UNIT V OCEANS

Physical properties of seawater and methods of determination, distribution of salinity in the oceans, factors affecting salinity, water masses and water type, TS Diagram, Circulation of currents in major ocean waves. Tides: Dynamical and equilibrium theory of tides. Marine pollution, steps to control marine pollution, Laws of seas, Coastal zone management

Total: 45

Suggested Readings:

1. B.F. Howell, Introduction to Geophysics, McGraw-Hill, 2007.
2. W. Lowrie, Fundamentals of Geophysics, Cambridge University Press, 2007.
3. J.A. Jacobs, R.D. Russel, Physics and Geology, McGraw-Hill.2002.
4. www. ocw.mit.edu
5. www.physicsclassroom.com
6. www.nptel.ac.in
7. www.physics.org

19BESHOE07/19BTSHOE07 **3H-3C**

ENGINEERING ACOUSTICS

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To disseminate the fundamentals of acoustic waves. (K)
- To inculcate the characteristics of radiation and reception of acoustic waves. (K)
- To divulge knowledge on the basics of pipe resonators and filters.(S)
- To introduce the features of architectural acoustics.(S)
- To impart the basic knowledge of transducers and receivers.(K)

COURSE OUTCOME:

1. Develop the idea of the fundamentals of acoustic waves.
2. Apply the concepts of radiation and reception of acoustic waves.
3. Explain the basic ideas of pipe resonators and filters.
4. Illusrate the basics of architectural acoustics..
5. Illustrate the transducers and receivers and its applications in various electronic devices.
6. Apply the knowledge inputs of the course for engineering applications.

UNIT I INTRODUCTION

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves - Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales.Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence –method ofimages.

UNIT IIRADIATION AND RECEPTION OF ACOUSTIC WAVES

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line sourceradiation impedance - Fundamental properties of transducers.Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

UNIT III PIPES RESONATORS AND FILTERS

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

UNIT IV ARCHITECTURAL ACOUSTICS

Sound in endosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

UNIT V TRANSDUCTION

Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker– horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

Total: 45

Suggested Readings:

1. LawerenceE.Kinsler, Austin R.Frey, Fundamentals of Acoustics, John Wiley & Sons, 4th edition 2000.
2. F. Alton Everest & Ken Pohlmann, Master Handbook of Acoustics, McGraw Hill Professional, 6th edition 2014.
3. www.acousticalsociety.org
4. www.acoustics-engineering.com
5. www.nptel.ac.in
6. www. ocw.mit.edu

19BESHOE08/19BTSHOE08 **3H-3C**

INDUSTRIAL MATHEMATICS – I

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

End Semester Exam:3 Hours

OBJECTIVES:

- To develop analytical skills for solving engineering problems
- To teach the students the basic concepts of LPP,
- To learn the techniques to solve transportation and Assignment problems
- To make the students to study about the Integer Programming and Network Analysis
- Analyse the results and propose recommendations to the decision-making processes in Management Engineering

INTENDED OUTCOMES:

- To define and formulate linear programming problems and appreciate their limitations.
- To solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
- To be able to build and solve Transportation Models, Assignment Models,
- To construct linear integer programming models and discuss the solution techniques.
- To formulate and solve problems as networks and graphs.
- To be able to solve problems in different environments and develop critical thinking

UNIT I LINEAR PROGRAMMING PROBLEM

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method .

UNIT II TRANSPORTATION PROBLEM

Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

UNIT III ASSIGNMENT PROBLEM

Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

UNIT IV INTEGER PROGRAMMING

Integer Programming Problem – Gromory's fractional cut Method – Branch Bound Method

UNIT V NETWORK ANALYSIS

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

Total : 45

Suggested Readings:

1. HamdyTaha. A., Operations Research, Prentice – Hall of India Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, New Delhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, New Delhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. www.nptel.com

19BESHOE09/19BTSHOE09 **3H-3C**

INDUSTRIAL MATHEMATICS – II

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

End Semester Exam:3 Hours

OBJECTIVES:

- To kindle analytical skills for solving engineering problems
- To impact the knowledge about inventory models
- To learn replacement models and simulation models
- To provide techniques for effective methods to solve nonlinear programming and decision making.
- To analyse the results and propose recommendations to the decision-making processes in Management Engineering

INTENDED OUTCOMES:

The students will

1. To be able to solve simple models in Inventory problems and Replacement problems.
2. To understand different queuing situations and find the optimal solutions using models for different situations.
3. Simulate different real life probabilistic situations using Monte Carlo simulation technique.
4. To be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
5. **Convert** and **solve** the practical situations into replacement models.
6. To understand how to model and solve problems using non integer programming.

UNIT – I INVENTORY MODELS

Economic order quantity models-techniques in inventory management-ABC analysis.

UNIT – II NON LINEAR PROGRAMMING

Khun-tucker conditions with non-negative constraints- Quadratic programming- Wolf's modified simplex method.

UNIT – III SIMULATION MODELS

Elements of simulation model -Monte Carlo technique – applications. Queuing model: problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models.

UNIT -IV DECISION MODELS

Decision Analysis – Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

UNIT -V REPLACEMENT MODELS

Models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

Total : 45

Suggested Readings:

1. HamdyTaha. A., Operations Research, Prentice – Hall of India Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, New Delhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, New Delhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. www.nptel.com

19BESHOE10/19BTSHOE10 **3H-3C**

FUZZY MATHEMATICS

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Be able to understand basic knowledge of fuzzy sets and fuzzy logic
- Be able to apply basic knowledge of fuzzy operations.
- To know the basic definitions of fuzzy relations
- Be able to apply basic fuzzy inference and approximate reasoning
- To know the applications of fuzzy Technology.

COURSE OUTCOME:

1. To gain the main subject of fuzzy sets.
2. To understand the concept of fuzziness involved in various systems and fuzzy set theory.
3. To gain the methods of fuzzy logic.
4. To comprehend the concepts of fuzzy relations.
5. To analyze the application of fuzzy logic control to real time systems.
6. The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

UNIT I FUZZY SETS

Fuzzy Sets : Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh's Extension Principle

UNIT II OPERATIONS ON FUZZY SETS

Operations on Fuzzy Sets Operations on [0,1] – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNIT III FUZZY RELATIONS

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNIT IV FUZZY MEASURES

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

UNIT V FUZZY INFERENCE

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

Total : 45

Suggested Readings:

1. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic : Theory and Applications, Prentice Hall of India, New Delhi,2003.
2. Zimmermann H.J. Fuzzy Set Theory and its Applications, Kluwer Academic publishers, USA.2001.
3. Michal Baczynski and BalasubramaniamJayaram, Fuzzy Implications, Springer-Verlag publishers, Heidelberg,2008
4. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman publishers, USA,1998.

19BESHOE11/19BTSHOE11 **3H-3C**

MATHEMATICAL PHYSICS

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To know the fundamentals of Tensors.
- To know the series solutions to differential equations.
- To introduce the concepts of special functions.
- To study about Calculus of variations and integral equations
- Be familiar with the main mathematical methods used in physics.

COURSE OUTCOME:

1. Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.
2. Learn about special type of matrices that are relevant in physics and then learn about tensors.
3. Get introduced to Special functions like Bessel, Legendre , Hermite and Laguerre functions and their recurrence relations
4. Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.
5. Students will master in calculus of variations and linear integral equations.
6. The students will have the knowledge on Mathematical Physics and that knowledge will be used by them in different engineering and technology applications.

UNIT I TENSORS

Definition of tensor - rank, symmetric tensors, contraction, quotient rule - tensors with zero components, tensor equations, metric tensors and their determinants - pseudo tensors

UNIT II DIFFERENTIAL EQUATIONS-SERIES SOLUTIONS

Series Solution : Classification of singularities of an ordinary differential equation - Series solution-Method of Frobenius - indicial equation - examples

UNIT III SPECIAL FUNCTIONS

Basic properties (Recurrence and Orthogonality relations, series expansion) of Bessel, Legendre ,Hermite and Laguerre functions – Generating Function

UNIT IV CALCULUS OF VARIATIONS

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

UNIT V LINEAR INTEGRAL EQUATIONS

Introduction – conversion of a linear differential equation to an integral equations and vice versa – conversion of boundary value problem to integral equations using Green's function – solution of aintegral equation – integral equations of the convolution type – Abel's integral equations –integro– differential equations – integral equations with separable kernels – solution of Fredholm equations with separable kernels.

Total : 45

Suggested Readings:

1. Dr. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.2013.
2. Murray R Spiegel, Seymour Lipschutz, Dennis Spellman, Vector Analysis, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010
3. Stephenson, G, Radmore, P.M, Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press India Pvt. Ltd., New Delhi,1990.
4. Andrews, Larry C. Special Functions of Mathematics for Engineers, Oxford Science publishers, New Delhi,1997.
5. www.mathcentre.ac.uk
6. www.mathworld.
7. wolfram.com
8. www.nptel.ac.in

19BESHOE12/19BTSHOE12 **3H-3C**

LINEAR ALGEBRA

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To introduce the basic concepts of vector space
- To know the fundamentals of linear Algebra
- To solve system of linear equations
- To study about the linear transformations
- To introduce the concepts of inner product spaces

COURSE OUTCOMES:

The student will be able to

1. To explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
2. To apply the fundamental concepts in their respective engineering fields
3. To visualize linear transformations as matrix form
4. To recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
5. To articulate the importance of Linear Algebra and its applications in branches of Mathematics

UNIT I VECTOR SPACES

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

UNIT II EIGEN VALUES AND EIGEN VECTORS

Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

UNIT III SYSTEM OF LINEAR EQUATIONS

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss–Seidel method, convergence criteria.

UNIT IV LINEAR TRANSFORMATIONS

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors - Diagonalization

UNIT V INNER PRODUCT SPACES

The Dot Product on R^n and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

Total : 45

Suggested Readings:

1. Kreyszig,E, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.,2014.
2. Anton and Rorres, Elementary Linear Algebra, Applications version, Wiley India Edition, New Delhi,2012.
3. Jim Defranza, Daniel Gagliardi, Introduction to Linear Algebra with Application, Tata McGraw-Hill, New Delhi.2008.
4. wolfram.com
5. www.sosmath.com
6. www.nptel.ac.in
7. www.mathworld.

		L	T	P	C
19BECSOE01	**INTERNET PROGRAMMING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the Java programming language and explore its current strengths and Weaknesses
- To study the way that object-oriented concepts are implemented in the Java programming language
- To write working Java code to demonstrate the use of applets for client side programming

COURSE OUTCOMES:

- Learn the basic concepts& techniques of java.
- Learn the advanced concepts of java.
- Generate an application based upon the concepts of java & advance java.
- The way that exceptions are detected and handled in the Java programming language
- Working of Java code that demonstrates multiple treads of execution

UNIT I Introduction (9)

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNIT II HTML (9)

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNIT III PERL (9)

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable,

comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets- Container Class, Components, Applet Life Cycle, Update method, Applications.

UNIT IV Client-Server programming (9)

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT V Internet Telephony (9)

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP- Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Total Hours: 45

TEXT BOOKS:

1. Paul Deitel, Harvey Deitel and Abby Deitel, "Internet and World Wide Web-How to Program", 5th Edition, 2011.

2. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.

REFERENCES:

1. Rahul Banerjee, Internetworking Technologies, An Engineering Perspective, PHI Learning, Delhi, 2011.

2. Robert W. Sebesta, "Programming the World Wide Web", Pearson Education, 2016

		L	T	P	C
19BECSOE02	**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.

COURSE OUTCOMES:

- To enable the students to develop their creativity
- To impart the fundamental concepts of Computer Animation and Multimedia.
- To understand about various latest interactive multimedia devices, the basic concepts about images and image formats.
- To understand about data compression techniques, image compression techniques like JPEG, video compression techniques like MPEG, and the basic concepts about animation.
- To develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.

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:

1. Computer Graphics, Multimedia and Animation-Malay K. Pakhira,PHI Learning PVT Ltd,2010

REFERENCES:

1. Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)

2. Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Publication.

3. Encyclopedia of Multimedia and Animations-Pankaj Dhaka, Anmol Publications-2011

19BECSOE03	PC HARDWARE AND TROUBLE SHOOTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Assemble/setup and upgrade personal computer systems
- Perform installation, configuration, and upgrading of microcomputer hardware and software.
- Install/connect associated peripherals.

COURSE OUTCOME:

- Identify the main components for the PC.
- Learn about power supplies and the skills to trouble-shoot various power-related problems.
- Have an idea about the processor generations used in PCs starting from the first Intel generations to current CPU families. Also, students will familiarize themselves with terms that are directly related to processors such as: caching, multi-threading, Dual-core technology, multi-processing, and pipelining. Computer faults that are related to CPU problems will also be familiar to students.
- Familiarize themselves with PC memories such as RAM and ROM devices. This includes RAM types, RAM upgrading, ROM BIOS, and the CMOS chip.
- Know about motherboards and the various technologies connected to main boards such as Chipsets, Buses, and various BIOS types. Terms such as PCI, ISA, AGP, MCA, POST, Bootstrap loader, IDE controllers, Regulators, Heat sinks, and others will be familiar to the students.
- Learn how to prepare a HDD for storing data, installing Windows OS and various programs. This will be combined with the knowledge about disk technologies and the IDE systems. Students will learn skills such as installing IDE HDDs, high-level Formatting, and HDD partitioning using a variety of tools.

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UNIT I Introduction (9)

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques– Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC and User.

UNIT II Peripheral Devices (9)

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

UNIT III PC Hardware Overview (9)

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

UNIT IV Installation and Preventive Maintenance (9)

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

UNIT V Troubleshooting (9)

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROM Problems.

Total Hours: 45

TEXT BOOK:

1. B. Govindarajalu, "IBM PC Clones Hardware, Troubleshooting and Maintenance", 2/E, TMH, 2002.

REFERENCES:

1. Peter Abel, Niyaz Nizamuddin, "IMB PC Assembly Language and Programming", Pearson Education, 2007
2. Scott Mueller, "Repairing PC's", PHI, 1992

19BECSOE04	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.

COURSE OUTCOMES:

- Identify classes, objects, members of a class and relationships among them needed for a specific problem
- Demonstrate the concepts of polymorphism and inheritance
- Be aware of the important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Be able to use the Java SDK environment to create, debug and run simple Java programs

UNIT I INTRODUCTION TO JAVA (9)

Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism.- Objects and classes in Java – defining classes – methods - access specifiers – static members –constructors – finalize method

UNIT II PACKAGES (9)

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy –polymorphism – dynamic binding – final keyword – abstract classes

UNIT III I/O STREAMS (9)

The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/O Streams - Graphics programming – Frame – Components – working with 2D shapes.

UNIT IV EXCEPTION HANDLING (9)

Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – introduction to Swing – Model-View-Controller design pattern –buttons – layout management – Swing Components – exception handling – exception hierarchy – throwing and

catching exceptions.

UNIT V MOTIVATION FOR GENERIC PROGRAMMING (9)

Motivation for generic programming – generic classes – generic methods – generic code and virtual machine – inheritance and generics – reflection and generics - Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers.

TEXT BOOK:

1. Cay S. Horstmann and Gary Cornell Core Java: Volume I – Fundamentals Sun Microsystems Press 2008

REFERENCES:

1. K. Arnold and J. Gosling The JAVA programming language Third edition, Pearson Education, 2009
2. Timothy Budd Understanding Object-oriented programming with Java Updated Edition, Pearson Education 2002
3. C. Thomas Wu An introduction to Object-oriented programming with Java Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2008

WEBSITES:

1. http://elvis.rowan.edu/~kay/cpp/vc6_tutorial/
2. http://www.winprog.org/tutorial/msvc.html
3. http://www.tutorialized.com/tutorials/Visual-C/1
4. http://www.freeprogrammingresources.com/visualcpp.html

19BEEEOE01 ELECTRIC HYBRID VEHICLE 3 0 0 3

OBJECTIVES

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To understand and gain the knowledge about various energy storage devices.

INTENDED OUTCOMES

- At the end of the course the student will be understand the concept of electric hybrid vehicle and its energy storage schemes.

UNIT I INTRODUCTION 9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS 9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT IIIELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV ENERGY STORAGE **9**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its

analysis, Hybridization of different energy storage devices.

UNIT VENERGY MANAGEMENT STRATEGIES **9**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

TOTAL: 45 HOURS

TEXT BOOK

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Iqbal Hussein	Electric and Hybrid Vehicles: Design Fundamentals	CRC Press – 2nd edition	2010

REFERENCES

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design	Standards media – 2nd edition	2009
2	James Larminie, John Lowry	Electric Vehicle Technology Explained	Wiley – 2nd edition	2012

19BEEEOE02 ENERGY MANAGEMENT AND ENERGY AUDITING 3 0 0 3

OBJECTIVES

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.

INTENDED OUTCOMES

- At the end of the course the student will be able to understand the concept of energy efficient motors, economic crisis and energy management.

UNIT I ENERGY MANAGEMENT 9

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

UNIT II ECONOMIC ASPECTS AND ANALYSIS 9

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

UNIT III BASIC PRINCIPLES OF ENERGY AUDIT 9

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT IV ENERGY EFFICIENT MOTORS 9

Electric Motors: Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

Energy conservation: Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS 9

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice- lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLCs.

TOTAL: 45 HOURS

TEXT BOOK

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Murphy W.R. and G.Mckay Butter worth	Energy Management	Heinemann Publications	2007

REFERENCES

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	John.C.Andreas	Energy Efficient Electric Motors	Marcel Dekker Inc Ltd – 3rd edition	2005
2	W.C.Turner Steve Doty	Energy Management Handbook	Lulu Enterprises, Inc. - 8th Edition Volume II	2013

19BEEEOE03 PROGRAMMABLE LOGIC CONTROLLER L T P C 3 0 0 3

OBJECTIVES

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To understand the principles of PID.

INTENDED OUTCOMES

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.

UNIT I INTRODUCTION 9

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT II PLC PROGRAMMING 9

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT III REGISTERS AND PLC FUNCTIONS 9

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT IV DATA HANDLING FUNCTIONS **9**

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and

Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT V PID PRINCIPLES **9**

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TOTAL: 45 HOURS

TEXT BOOKS

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	JR Hackworth and F.D Hackworth – Jr	Programmable Logic Controllers – Programming Method and Applications	Pearson	2006

REFERENCES

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	John Webb and Ronald A Reiss	Programmable Logic Controllers – Principle and Applications	Fifth edition, PHI	2004
2	W.Bolton	Programmable Logic controller	Elsevier Newnes Publications, 5th Edition	2009

WEBSITE

http://www.mikroe.com/old/books/plcbook/chapter1/chapter1.htm,- Introduction to programmable Logic controller

19BEEEOE04 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.

TOTAL: 45 HOURS

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 – 3rd edition	2015

WEBSITES

www.energycentral.com
www.catelelectricpowerinfo.com

19BEECOE01 Real Time Embedded Systems **3H-3C**

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 students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To study about task management
- To learn about semaphore management and message passing
- To study about memory management

COURSE OUTCOMES

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

1. Understand overview of embedded systems architecture
2. Acquire knowledge on embedded system, its hardware and software.
3. Gain knowledge on overview of Operating system
4. Discuss about task Management
5. Gain knowledge about semaphore management and message passing.
6. Gain knowledge about memory management.

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM

Introduction- Embedded systems description, definition, design considerations & requirements-Overview of Embedded System Architecture (CISC and RISC)-Categories of Embedded Systems-embedded processor selection & tradeoffs- Embedded design life cycle -Product specifications-hardware / software partitioning- iterations and implementation- hardware software integration – product testing techniques–ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW

Introduction–Advantage and Disadvantage of Using RTOS–Multitasking–Tasks-Real Time Kernels – Scheduler- Non-Preemptive Kernels – Preemptive Kernels – Reentrancy- Reentrant Functions–Round Robin Scheduling- Task Priorities- Static Priorities– Mutual Exclusion– Deadlock– Inter task Communication–Message Mailboxes–Message Queues- Interrupts- Task Management–Memory Management-Time Management–Clock Ticks.

UNIT-III TASK MANAGEMENT

Introduction-µ C/OS-II Features-Goals ofµ C/OS-II-Hardware and Software Architecture–Kernel Structures: Tasks–Task States–Task Scheduling–Idle Task–Statistics Task–Interrupts Under µC/OS-II – Clock Tick-µ C/OS- II Initialization. Task Management: Creating Tasks–Task Stacks–StackChecking–Task'sPriority–SuspendingTask– esumingTask.TimeManagement: Delaying a Task–Resuming a Delayed Task–System Time. Event Control Blocks-Placing a Task in the ECB Wait List–Removing a Task from an ECB wait List.

UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING

Semaphore Management: Semaphore Management Overview– Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox –Deleting Mailbox–Waiting for a Message box–Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue– Deleting a Message Queue–Waiting for a Message Queue–Sending Message to a Queue– Flushing a Queue.

UNIT-V MEMORY MANAGEMENT

Memory Management: Memory Control Blocks–Creating Partition-Obtaining a Memory Block– Returning a Memory Block. Getting Started withµ C/OS-II–Installingµ C/OS-II–Portingµ C/OS-II: Development Tools–Directories and Files– Testing a Port -IAR Workbench withµ C/OS-II-µ C/OS- II Porting on a 8051CPU– Implementation of Multitasking- Implementation of Scheduling and Rescheduling –Analyze the Multichannel ADC with help ofµ C/OS-II.

SUGGESTED READINGS

1. Floyd JeanJ. Labrosse Micro C/OS–II The Real Time Kernel CMPBOOKS 2009
2. David Seal ARM Architecture Reference Manual.Addison-Wesley 2008
3. Steve Furbe, ARM System-on-Chip Architecture, Addison-Wesley Professional, California 2000.
4. K.V.K.K.Prasad Embedded Real-Time Systems: Concepts, Design & Programming Dream Tech Press 2005.
5. Sriram V Iyer, Pankaj Gupta Embedded Real Time Systems Programming Tata Mc Graw Hill 2004

19BEECOE02 **Consumer Electronics** **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

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study various telephone networks
- To discuss about the working of home appliances

COURSE OUTCOMES

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

1. Understand working of various type of loud speakers
2. Acquire knowledge on various types of picture tubes
3. Demonstrate the working of various optical recording systems
4. Distinguish various standards for color TV system
5. Acquire knowledge on various telecommunication networks
6. Demonstrate the working of various home appliances

UNIT-I LOUDSPEAKERS AND MICROPHONES

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters – Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

UNIT-II TELEVISION STANDARDS AND SYSTEMS

Components of a TV system–interlacing–composite video signal. Colour TV– Luminance and Chrominance signal; Monochrome and Colour Picture Tubes- Color TV systems– NTSC, PAL, SECAM- Components of a Remote Control.

UNIT-III OPTICAL RECORDING AND REPRODUCTION

Audio Disc– Processing of the Audio signal–readout from the Disc –Reconstruction of the audio signal– Video Disc–Video disc formats- recording systems–Playback Systems.

UNIT-IV TELECOMMUNICATION SYSTEMS

Telephone services-telephone networks–switching system principles–PAPX switching–Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems.

UNIT-V HOME APPLIANCES

Basic principle and block diagram of microwave oven; washing machine hardware and software;

Components of air conditioning and refrigeration systems.

SUGGESTED READINGS

1. S.P. Bali Consumer Electronics Pearson Education 2007
2. J.S.Chitode Consumer Electronics Technical Publications 2007
3. Philip Hoff, Philip Herbert Hoff Consumer Electronics for Engineers Cambridge University Press 1998

Semester-__

19BEECOE03 **Neural Networks and its Applications** **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

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network

COURSE OUTCOMES

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

1. Understand the basic concepts of neural networks and its applications in various domains
2. Gain knowledge about learning process in Neural Networks
3. Apply perception concept in design
4. Design using ART phenomena
5. Gain knowledge on SOM concepts
6. Ability to develop the use of Soft Computing to solve real-world problems

UNIT-I INTRODUCTION TO NEURAL NETWORKS

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT-II LEARNING PROCESS

Error– correction learning– memory based learning- hebbian learning-competitive learning-Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT-III PERCEPTION

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

UNIT-IV ATTRACT OR NEURAL NETWORK AND ART

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

UNIT-V SELF ORGANIZATION

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning

Ballistic Arm Movements.

SUGGESTED READINGS

1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH 2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications PHI, New Delhi 2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/Prentice Hall 1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold 1989.
6. Freeman J.A, S kapura D.M Neural networks, algorithms, applications, and programming techniques AdditionWesley 2005.

Semester-__

19BEECOE04 **Fuzzy Logic and its Applications** **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

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models

COURSE OUTCOMES

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

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real- world problems
- Design fuzzy based model for any application

UNIT-I BASICS OF FUZZY LOGIC

Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

UNIT-II THEORY OF APPROXIMATE REASONING

Linguistic variables, Fuzzy proportions, Fuzzy if-then statements, inference rules, compositional rule of inference-fuzzy models

UNIT-III FUZZY KNOWLEDGE BASED CONTROLLERS

Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzy fiction and de fuzzy fiction procedures–Design of Fuzzy Logic Controller

UNIT-IV ADAPTIVE FUZZY CONTROL

Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model based controller.

UNIT-V FUZZY BASED SYSTEMS

Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

SUGGESTED READINGS

1. D .Diankar ,H. Hellendoom and M .Rein frank An Introduction to Fuzzy Control Narosa Publishers India 1996
2. G.J. KlirandT.A. Folger Fuzzy Sets Uncertainty and Information PHI IEEE 1995
3. Timothy J. Ross Fuzzy Logic with Engineering Applications McGraw Hill1997
4. George. J Klir and Bo Yuan Fuzzy Sets and Fuzzy Logic Prentice Hall, USA 1995.

Semester-__

19BEECOE05 **Principles of Modern Communication System** **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

- To provide students with an overview of communication systems
- To provide an overview on mobile communication
- To make students to have a better understanding on satellite and radar communication

COURSE OUTCOMES

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

1. Understand past, present and future trends in mobile communication.
2. Gain knowledge about mobile cellular communication
3. Understand various standards in use for wireless communication and its application.
4. Demonstrate some basic application of GPS.
5. Gain knowledge about RADAR working and its applications
6. Demonstrate how a simple radar system works and its applications.

UNIT I THE EVOLUTION OF ELECTRONIC COMMUNICATION

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNIT II MOBILE CELLULAR COMMUNICATIONS

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNIT III WIRELESS COMMUNICATION

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNIT IV SATELLITE COMMUNICATION

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V RADAR & NAVIGATION

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

SUGGESTED READINGS

1. S.Haykin, ―Communication Systems, 4/e, John Wiley 2007
2. B.P.Lathi, ―Modern Digital and Analog Communication Systems, 3/e, Oxford University Press,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson Education India, 2010
4. Vijay. K. Garg, ―Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
5. T.Pratt, C. Bostian and J.Allnutt; ―Satellite Communications, John Wiley and Sons, Second Edition., 2003
6. M. I .Skolnik ―Introduction to Radar Systems, Tata McGraw Hill 2006.
7. Myron Kyton and W.R.Fried ―Avionics Navigation Systems, John Wiley & Sons 1997.

19BEAEOE01 AUTOMOBILE ENGINEERING 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:

- To impart the knowledge on constructional details and principle of operation of various automobile components.
- To learn the function and working of various components in transmission and drive lines.
- To study the concept and working of steering and suspension systems in an automobile.
- To give the knowledge on wheels, tyres and brakes of automobiles.
- To provide the information on current and future trends in automobiles.

Course Outcomes:

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

- Demonstrate the operating principles and constructional details of various automobile components.
- Explain the function and working of components in transmission and drive lines.
- Identify and explain the types of steering system and suspension system.
- Classify and describe the types of wheels, tyres and brakes of automobiles.
- Discuss the current and future trends in the automobiles.

Contents:

UNIT I ENGINE AND AUXILIARY SYSTEMS

Classification of engines – construction and working of four-stroke spark ignition (SI) engine and compression ignition (CI) engine – construction and working of two-stroke SI and CI engine – firing order – carburettor – fuel injection systems – battery – dynamo – alternator – starting motor – lighting system – ignition system.

UNIT II TRANSMISSION SYSTEMS

Requirements of transmission system – flywheel – clutch – types of clutch – construction of single and multi-plate clutches – need, types and construction of transmission gear box – universal joint – propeller shaft – need, types and construction of differential – four wheel drive.

UNIT III STEERING AND SUSPENSION SYSTEMS

Principle of steering – steering linkages – types of steering gear box –power steering – suspension systems – need and types – independent suspension – coil spring, leaf spring, torsion bar and air suspension – shock absorbers.

UNIT IV WHEELS AND BRAKES

Wheels and tyres – construction – types and specifications – tyre wear and causes – brakes – need – braking distance – types – mechanical, hydraulic and pneumatic brakes – power brake – parking brake – redundant braking system.

UNIT V CURRENT AND FUTURE TRENDS

Anti-lock Braking System (ABS) – brake assist – Electronic Brakeforce Distribution (EBD) – airbags – automatic high-beam control – backup cameras – defogger – electric vehicles – hybrid vehicles – autonomous vehicles – vehicle-to-vehicle communication – vehicle tracking – alternative fuels.

Suggested Readings:

1. Kirpal Singh, Automobile Engineering Volume 1, Standard Publishers, New Delhi, 2019.
2. Sethi H M, Automobile Technology, Tata McGraw-Hill, New Delhi, 2003.
3. William H Crouse and Donald L Anglin, Automotive Mechanics, Tata McGraw-Hill, New Delhi, 2006.
4. Srinivasan S, Automotive Mechanics, Tata McGraw-Hill, New Delhi, 2003.
5. Ganesan V, Internal Combustion Engines, McGraw-Hill Education, New Delhi, 2012.

19BEAEOE02 TWO AND THREE WHEELER 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:

- To impart the technical knowledge on construction and working of power train and drive train of two and three wheeler vehicles.
- To familiarize with the maintenance procedures of engine and subsystems of two and three wheelers.

Course Outcomes:

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

- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission, steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
- Explain the servicing of two and three wheelers.

Contents:

UNIT I INTRODUCTION

History of two and three wheelers – classification and layouts of two wheelers – classification and layouts of three wheelers – main frame for two wheelers and types – main frame for three wheelers and types.

UNIT II INTERNAL COMBUSTION ENGINES

Classification of engines – selection criteria of engine for two and three wheelers – design considerations for two and three wheeler engines – construction and working of two-stroke and four-stroke engines – fuel feed system – lubricating system – cooling system – scavenging system – cranking system – kick start and auto-start mechanisms.

UNIT III TRANSMISSION, STEERING AND SUSPENSION SYSTEMS

Clutch – single plate, multiple plate and centrifugal clutches – primary reduction – gear box – gear shifting mechanisms – automatic transmission – final drive and differential for three wheelers – steering geometry – steering column construction – steering system for three wheelers – front and rear suspension systems – spring and shock absorber assembly.

UNIT IV WHEELS, TYRES AND BRAKES

Spoked wheels, pressed steel wheels and alloy wheel – tyre construction – tyre with tube and tubeless tyre – theory of brake action – drum and disc brakes – brake links layout for front and rear wheels – mechanical and hydraulic brake control systems – anti-lock braking system.

UNIT V TWO AND THREE WHEELERS CASE STUDY

Case study of mopeds, scooters, motor cycles, sports bikes, auto rickshaws, pickup vans, delivery vans and trailers – servicing – factors affecting fuel economy and emission.

Suggested Readings:

1. Dhruv U Panchal, *Two and Three Wheeler Technology*, PHI Learning, New Delhi, 2015.
2. Ramalingam K K, *Two Wheelers and Three Wheelers: Theory, Operation and Maintenance*, Scitech Publications, Chennai, 2017.
3. Irving P E, *Motorcycle Engineering*, Veloce Enterprises, USA, 2017.
4. Dennis Bailey and Keith Gates, *Bike Repair and Maintenance for Dummies*, John Wiley & Sons, USA, 2009.

19BEAEOE03 ***VEHICLE MAINTENANCE*** 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:

- To understand the need for vehicle maintenance and its importance.
- To familiarize the maintenance procedure for various components of an automobile.

Course Outcomes:

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

- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering, suspension, wheel and brake maintenance.
- Explain the fault diagnosis in the electrical and air conditioner systems.

Contents:

UNIT I MAINTENANCE OF RECORDS AND SCHEDULES

Need for maintenance – preventive and breakdown maintenance – requirements of maintenance – preparation of check lists – inspection schedule – maintenance of records, log sheets and other forms – safety precautions in maintenance – workshop layout, tools and equipment.

UNIT II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE

General engine service – dismantling of engine components – engine repair – service of basic engine parts, cooling and lubricating system, fuel system, intake and exhaust system – engine tune-up.

UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE

General checks, adjustment and service of clutch – dismantling, identifying, checking and reassembling transmission, transaxle – road testing – removing and replacing propeller shaft – servicing of cross and yoke joint, and constant velocity joint – rear axle service points – removing axle shaft and bearings – servicing differential assemblies – fault diagnosis.

UNIT IV STEERING, SUSPENSION, WHEEL AND BRAKE MAINTENANCE

Inspection, maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering, worm type steering, power steering system – inspection, maintenance and service of MacPherson strut, coil spring, leaf spring, shock absorbers – wheel alignment and balance –

removing and fitting of tyres – tyre wear and tyre rotation – inspection, maintenance and service of hydraulic brake, drum brake, disc brake, parking brake – bleeding of brakes.

UNIT V ELECTRICAL AND AIR CONDITIONER MAINTENANCE

Maintenance of batteries, starting system, charging system and body electrical – fault diagnosis using scan tools – maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator – replacement of hoses – leak detection – air conditioner charging – fault diagnosis – vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Readings:

1. Tim Gilles, *Automotive Service: Inspection, Maintenance, Repair*, Cengage Learning, USA, 2015.
2. Philip Knott and Adam Roylance, *An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles*, EMS Publishing, UK, 2010.
3. James D Halderman and Curt Ward, *Advanced Engine Performance Diagnosis*, Pearson, USA, 2016.
4. Ed May and Les Simpson, *Automotive Mechanics Volume 1*, McGraw-Hill Australia, 2006.
5. James E Duffy, *Modern Automotive Technology*, Goodheart-Willcox, USA, 2017.
6. Service manuals of various OEMs.

19BEAEOE04 MODERN VEHICLE 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:

- To impart the knowledge on trends in vehicle power plants.
- To learn about the various advanced driver assistance systems.
- To study the working of advanced suspension and braking systems in an automobile.
- To give the information about motor vehicle emission and noise pollution control.
- To provide the knowledge of vehicle telematics.

Course Outcomes:

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

- Distinguish and describe the various modern vehicle power plant systems.
- List and explain the various driver assistant mechanisms.
- Identify and explain the working of advanced suspension and braking systems.
- Apply the knowledge of motor vehicle emission and noise pollution control.
- Describe the vehicle telematics and its applications.

Contents:

UNIT I TRENDS IN POWER PLANTS

Hybrid vehicles – stratified charged / learn burn engines – hydrogen engines – battery vehicles – electric propulsion with cables – magnetic track vehicles.

UNIT II DRIVER ASSISTANCE SYSTEMS

Adaptive cruise control – intelligent speed adaptation – lane departure warning systems – traction control systems – driver drowsiness detection system – collision avoidance systems – hill descent control – anti spin regulation – parking assistance systems – night-vision systems – pedestrian detection.

UNIT III SUSPENSION, BRAKES AND SAFETY

Interconnected air and liquid suspensions – hydrolastic suspension system – hydragas suspension – closed loop suspension – indirect floating calliper disc brake – self energising disc brake – anti-skid braking system – retarders – regenerative braking – auto emergency braking – crumple zone – safety cage – airbags – seat belts – head rests.

UNIT IV EMISSION AND NOISE POLLUTION CONTROL

Engine emissions – types of catalytic converters – open loop and closed loop operation to the oxidizing catalytic converter – evaporative emission – internal and external noise – identification of noise sources – noise control techniques – adaptive noise control.

UNIT V VEHICLE TELEMATICS

Building blocks of vehicle telematics system – Global Positioning System (GPS) and Geographic Information System (GIS) for vehicle tracking – automotive navigation system – road recognition system – wireless vehicle safety communications – Usage Based Insurance (UBI).

Suggested Readings:

1. Ljubo Vlacic, Michael Parent and Fumio Harashima, Intelligent Vehicle Technologies, Butterworth-Heinemann, UK, 2001.
2. Ronald K Jurgen, Navigation and Intelligent Transportation Systems, SAE International, USA, 1998.
3. Heinz Heisler, Advanced Vehicle Technology, Butterworth-Heinemann, UK, 2002.
4. James E Duffy, Modern Automotive Technology, Goodheart-Willcox, USA, 2017.
5. William B Ribbens, Understanding Automotive Electronics, Butterworth-Heinemann, UK, 2017.
6. Bosch Automotive Handbook, Robert Bosch, Germany, 2018.

19BEAEOE05 FLEET MANAGEMENT 3H-3C

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

End Semester Exam:**3 Hours**

Course Objectives:

- To impart the knowledge on personnel management, selection process, training methods and motor vehicle act.
- To plan the vehicle routes, scheduling of vehicles and fare structure.
- To design the vehicle maintenance systems.

Course Outcomes:

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

- Apply the knowledge of personnel management and analyze the selection process and training methods.
- Apply the motor vehicle act in terms of registration and describe the various vehicles and conduct the test of competence to drive.
- Construct a fare structure and analyze the methods of fare collection.
- Analyze the vehicle parts, supply management and data processing.
- Demonstrate an electronically controlled vehicle maintenance system and analyze the work scheduling.

Contents:

UNIT I INTRODUCTION

Personnel management – objectives and functions of personnel management – psychology, sociology and their relevance to an organization – selection process: job description, employment tests, interviewing, introduction to training objectives, methods of training, training procedure and psychological tests.

UNIT II MOTOR VEHICLE ACT

Schedules and sections of the motor vehicle act – traffic signs, fitness certificate, registration requirements, permit, insurance and constructional regulations – description of vehicle: goods carrier, tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles – spread over, running time, test of competence to drive.

UNIT III SCHEDULING AND FARE STRUCTURE

Route planning – scheduling of transport vehicles – preparation of timetable – preparation of vehicle and crew schedule – principal features of operating costs for transport vehicles – fare structure and method of drawing up of a fare table – methods of fare collection.

UNIT IV VEHICLE PARTS, SUPPLY MANAGEMENT AND BUDGET

Cost of inventory – balancing inventory cost against downtime – parts control – bin tag systems – time management – time record keeping – budget activity and capital expenditures – classification of vehicle expenses – fleet management and data processing – data processing systems – computer controlling of fleet activity.

UNIT V MAINTENANCE

Scheduled and unscheduled maintenance – preventive maintenance – evaluation of Preventive Maintenance Inspection (PMI) programme – work scheduling – overtime – breakdown analysis – control of repair backlogs – cost of options – electronically controlled vehicle maintenance system.

Suggested Readings:

1. Robert P Currie, Michelle B Currie and George M Keen, *Fleet Management*, Wandering Brothers Publishing, USA, 2006.
2. John Dolce, *Fleet Management*, McGraw-Hill, 1884.
3. SCC Editorial, *Motor Vehicles Act, 1888*, Eastern Book Company, New Delhi, 2018.
4. Rex W Faulks, *Bus and Coach Operation*, Butterworth-Heinemann, UK, 1887.
5. John E Dolce, *Analytical Fleet Maintenance Management*, SAE International, USA, 2009.

19BECEOE01 HOUSING PLAN AND MANAGEMENT 3 0 0 3 100

COURSE OBJECTIVES

- To examine the role and tasks of basic housing policies and building bye laws
- Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
- Analyze the Innovative construction methods and Materials
- Analyze city management strategies and strengthen the urban governance through a problem solving approach

COURSE OUTCOME

The students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNIT I INTRODUCTION TO HOUSING 9

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL 9

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

TOTAL HRS : 45

TEXT BOOKS

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 2002.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 2001.

REFERENCES

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.

19BECEOE02 BUILDING SERVICES 3 0 0 3 100

COURSE OBJECTIVES

- Defining and identifying of eng. services systems in buildings.
- The role of eng. services systems in providing comfort and facilitating life of users of the building.
- The basic principles of asset management in a building & facilities maintenance environment
- Importance of Fire safety and its installation techniques

COURSE OUTCOME

The students will be able to
1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

UNIT I MACHINERIES 9

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS 9

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNIT III PRINCIPLES OF ILLUMINATION & DESIGN 9

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilization factor – Depreciation factor – MSCP – MHCP –Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS **9**

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNIT V FIRE SAFETY INSTALLATION **9**

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

TOTAL HRS : 45

TEXT BOOKS

1. E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York, 2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.

REFERENCES

1. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
2 A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London, 2005.
3 National Building Code.

19BECEOE03 REPAIR AND REHABILITATION OF STRUCTURES 3 0 0 3 100

COURSE OBJECTIVES

- To learn various distress and damages to concrete and masonry structures
- To know the influence of corrosion in durability of structures
- To understand the importance of maintenance of structures
- To study the various types and properties of repair materials
- To learn various techniques involved in demolition of structures

COURSE OUTCOME

By the end of this course students will have the capability/knowledge of

- Various distress and damages to concrete and masonry structures
- Durability of structures and corrosion mechanism
- The importance of maintenance of structures, types and properties of repair materials etc
- Assessing damage of structures and various repair techniques
- Modern technique and equipment being adopted for the demolition of structures

UNIT – I INTRODUCTION 9

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

UNIT – II DURABILITY OF STRUCTURES 9

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT - III MAINTENANCE AND REPAIR STRATEGIES 9

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNIT - IV MATERIALS FOR REPAIR 9

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

UNIT - V TECHNIQUES FOR REPAIR AND REPAIR OF STRUCTURES 9

Non-destructive Testing Techniques, Corrosion protection techniques , Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies

TOTAL : 45 HRS

TEXT BOOK

S.No	Title of Book	Author of Book	Publisher	Year of Publishing
1	Repair of concrete structures	R.T. Allen and S.C. Edwards	Blakie and Sons, UK.	2011

REFERENCES:

S.No	Title of Book	Author of Book	Publisher	Year of Publishing
1	Rehabilitation of concrete structures	Dr. B. Vidivelli	Standard Publsihers, Chennai	2011

WEBSITES:

- http://www.icivilengineer.com
- http://www.engineeringcivil.com/
- http://www.aboutcivil.com/
- http://www.engineersdaily.com
- http://www.asce.org/
- http://www.cif.org/
- http://icevirtuallibrary.com/
- http://www.ice.org.uk/
- http://www.engineering-software.com/ce/

19BECE0E04 COMPUTER-AIDED CIVIL ENGINEERING DRAWING 3 0 0 3 100

COURSE OBJECTIVES

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact

COURSE OUTCOME

The students will be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

UNIT 1:*INTRODUCTION*; Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards. 9

UNIT 2: *SYMBOLS AND SIGN CONVENTIONS*: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

9

UNIT 3: *MASONRY BONDS:* English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

9

UNIT 4: *BUILDING DRAWING*: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

9

UNIT 5: *PICTORIAL VIEW*: Principles of isometrics and perspective drawing. Perspective view of building.

9

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows.
2. Single storey RCC building
3. Multistorey RCC building

Text/Reference Books:

1. Subhash C Sharma & Gurucharan Singh (2005), " Civil Engineering Drawing" , Standard Publishers
2. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), " AUTOCAD for Engineers and Designers" , Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), " Building Drawing and Detailing", Spades publishing KDR building, Calicut

19BEMEOE01 COMPUTER AIDED DESIGN 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

1. To provide an overview of how computers are being used in mechanical component design
2. To study about the various computer graphics concepts
3. To get basic knowledge on geometric modeling
4. to study about the basics of parametric design and object representation
5. To get basic knowledge in product design and development.

COURSE OUTCOMES:

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

1. Give the overview of the cad systems and its importance
2. Explain the ideas and principles behind the computer graphics
3. Explain the process involved in graphic transformations
4. Understand the operations involved in the geometric modeling.
5. Describe the concepts of parametric design
6. Understand the basics of the product design and development.

UNIT I OVERVIEW OF CAD SYSTEMS

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

UNIT III GEOMETRIC MODELING

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, Boolean operations. Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry(CSG) and Analytical Solid Modeling(ASM)

UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations.

UNIT V PRODUCT DESIGN AND DEVELOPMENT

Automated 2D drafting - basics, mechanical assembly - bill of materials generation. Mass property calculations.

SUGGESTED READINGS

1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers,1st edition, John Wiley & Sons, New York, 2000
2. Radhakrishnan P and Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd, 2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice,2nd edition, McGraw Hill Inc., New York, 2009
4. Barry Hawhes, The CAD/CAM Process,1st edition, Pitman Publishing, London, 2007(digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics,1st edition, McGraw Hill Inc., New York, 2001
6. Sadhu Singh, Computer-Aided Design and Manufacturing,1st edition, Khanna Publishers, New Delhi, 1998

19BEMEOE02 INDUSTRIAL SAFETY AND ENVIRONMENT 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

1. To provide in-depth knowledge on various techniques of non-destructive testing

COURSE OUTCOME

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

1. Understand the need and awareness of the safety concepts
2. Understand the various safety techniques involved in industrial sector
3. Record and investigate the accident zone and prepare reports related to it.
4. Conduct basic safety inspections using strategies that they have developed
5. Identify and demonstrate working of safety monitoring
6. Train about the education and training based on safety

UNIT I CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV SAFETY PERFORMANCE MONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago, 2010(digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill Company, New York, 1941.
3. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay, 1997.
4. John R Ridley, Safety at Work,3rd edition, Elsevier,2014
5. Roland P. Blake ,Industrial Safety, 2ndedition,Prentice Hall, Inc., New Jersey, 1973
6. L M Deshmukh, Industrial safety management,1stedition, TATA McGraw Hill, 2005

19BEMEOE03 TRANSPORT PHENOMENA 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

1. To provide the basics of transport phenomena and its applications.
2. To provide the knowledge over the properties of the systems and unit systems used.
3. To understand the basics and mathematics involved in momentum transport.
4. To provide the basics and applications of energy transport.
5. To give basics and principles involved in the mass transport phenomena.

COURSE OUTCOMES

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

6. Understand the basic concepts of transport phenomena
7. Understand the essentiality of properties of a system and unit systems used.
8. Understand the basic concepts involved in momentum transport.
9. Apply the mathematics involved in fluid flow problems.
10. Explain the various energy transport phenomena.
11. Understand the basics of mass transport phenomena.

UNIT I INTRODUCTION AND BASIC CONCEPTS

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

UNIT II PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETERS

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

UNIT III MOMENTUM TRANSPORT

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed

UNIT IV ENERGY TRANSPORT

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside pipes, Heat transfer outside various geometrics in forced convection, General

discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heat transfer

UNIT V MASS TRANSPORT

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion- Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping

SUGGESTED READINGS

1. Geankoplis, C. J, Transport Processes and Separation Processes Principles, 4thedition, Prentice Hall, 2013
2. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, 1st edition, John Wiley & Sons, 2007.
3. Edwin N. Lightfoot, Transport phenomena and living systems: biomedical aspects of momentum and mass transport, 1st edition, Wiley, 1973, 2007 (digital)

19BEMEOE04 INTRODUCTION TO BIOMECHANICS 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

1. Biomechanics provides key information on the most effective and safest movement patterns, equipment, and relevant exercises to improve human movement.

COURSE OUTCOMES

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

1. Understand the basics and importance of biomechanics.
2. Present the nine fundamentals of biomechanics and its need.
3. Explain the nine principles used for application of biomechanics.
4. Describe the human anatomy
5. Explain the need for biomechanics in muscle actions
6. Understand the basics of the mechanics involved in musculoskeletal system.

UNIT I INTRODUCTION

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

UNIT II KEY MECHANICAL CONCEPTS

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

UNIT III HUMAN ANATOMY AND SOME BASIC TERMINOLOGY

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - Anthropometric Data

UNIT IV ANATOMICAL DESCRIPTION

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

UNIT V MECHANICS OF THE MUSCULOSKELETAL SYSTEM

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

SUGGESTED READINGS

1. Duane Knudson, Fundamentals of Biomechanics, 1st edition,Springer Science+ Business Media, LLC, 2013
2. C. Ross Ethier Craig A. Simmons, Introductory Biomechanics,1st edition, Cambridge University Press, 2008

COURSE OUTCOME

After completion of the course, students are able to

- Plan to optimize energy using systems and procedures to meet energy demand
- Describe the movement of substances in the entire globe
- Examine the relationship between energy systems and society
- Use optimization techniques for conservation of energy in chemical industries
- Evaluate the production rate and analyze the cost from economic balance for energy consumption.

PLANNING FOR ENERGY NEEDS

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix of energy sources.

(9)

ENERGY AND ENVIRONMENT

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology.

(9)

ENERGY AND SOCIETY

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

(9)

MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimization techniques.

(9)

ECONOMIC BALANCE IN ENERGY CONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs

(9)

TOTAL : 45

SUGGESTED READINGS

- Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc, 1976.
- Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork, 1975
- Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc., 1976.
- Gramlay G. M., Energy, Macmillan Publishing Co., New York, 1975.
- Rused C. K., Elements of Energy Conservation, McGraw-Hill Book Co., 1985

19BTCEOE02 FERTILIZER TECHNOLOGY 3 0 0 3 100

COURSE OUTCOME

- After completion of the course, students are able to
- Illustrate chemical, organic fertilizers and nutrients
- Develop the flow chart for manufacture of nitrogenous fertilizers
- Analyze the various processes and develop the flow chart for the manufacture of phosphatic fertilizers.
- Develop the flow chart for the manufacture of potassic fertilizer and analyze the unit operations involved in the
- process.
- Illustrate the quality and pollution standards permissible in fertilizer industry.

INTRODUCTION

Chemical Fertilizers and Organic Manures - Types of chemical Fertilizers.Secondary nutrients, micro nutrients.

(9)

NITROGEN FERTILIZERS

Nitrogenous Fertilizers - Methods of production of Ammonia and Urea. Nitric acid, Ammonium sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride - Their methods of production, characteristics, storage and handling specifications.

(9)

PHOSPHATIC FERTILIZERS

Raw materials, phosphate rock, Sulphur pyrites -Process for the production of Sulphuric and Phosphoric acids. Ground phosphate rock, bone meal. Single Super Phosphate, Triple Super phosphate -Methods of production, characteristics and specifications.

(9)

POTASSIC FERTILIZERS

Potassium chloride, Potassium sulphate, Potassium schoenite - Methods of production, specification, characteristics. Complex Fertilizers, NPK Fertilizers, Mono ammonium phosphate, Diammonium phosphate, Nitro phosphate Methods of production.

(9)

FERTILIZERS IMPACTS AND STANDARDS

Fluid fertilizers.Controlled Release of fertilizers. Solid, Liquid and Gaseous pollution from ammonia urea and NPK fertilizer industries and standards laid down for them. Fertilizer production in India. (9)

TOTAL : 45

SUGGESTED READINGS

- GopalaRao M., Marshall Sittig, Dryden's Outlines of Chemical Technology, Third Edition, WEP East-West Press, New Delhi, 2010.
- George T. Austin., Shreve's Chemical Process Industries, Fifth Edition, McGraw Hill Professional, 2012
- Vincent Sauchelli., The Chemistry and Technology of Fertilizers, Reinhold Pub. Corp., 1960
- Editorial Committee - FAI Seminar on Fertilizer in India in the Seventies (Proceedings), The Fertilizer Association of India,New Delhi, 1973.
- Editorial Committee - Seminar on Recent Advances in Fertilizer Technology, The Fertilizer Association of India, New Delhi,1972.
- Sauchelli V., Manual on Fertilizer Manufacture, Industry Publication Inc, New Jersy, 1963.
- CHEMTECH - II - (Chapter on Fertilizers by Chari, K.S.), Chemical Engineering Education Development Centre, I.I.T.,Madras, 1977.
- Menon M.G., Fertilizer Industry - Introductory Survey, Higginbothams, Madras, 1973

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.

INTRODUCTION TO WASTE WATER ENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

(7)

UNIT OPERATIONS AND UNIT PROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization (11)

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)

WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries.

(9)

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)

TOTAL : 45

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

COURSE OUTCOME

- After successful completion of the course, student will be able to
- Outline the salient features of solid waste management and handling.
- Deduce the source reduction, recycling and reuse techniques of solid waste.
- Analyze the collection systems and method of transfer of solid waste.
- Describe the processing techniques for solid and hazardous waste.
- Select the suitable methods for disposal of solid and hazardous waste.
- Interpret the legislation for management, handling and disposal of solid and hazardous waste.

CHARACTERISTICS AND SOURCE REDUCTION OF SOLID WASTE

Definition, sources, and types of solid waste - Composition, physical, chemical and biological properties of solid wastes - Percapita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange - Recyclingand reuses - Salient features of Indian legislations on management and handling of municipal solid wastes.

(9)

COLLECTION AND TRANSPORT OF SOLID WASTE

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services:municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary containersystem (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport - Transfer stationlocation- Means and methods of transfer. (9)

PROCESSING AND DISPOSAL OF SOLID WASTE

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversiontechnologies- disposal in Landfills: site selection methods and operations, leachate and gas generations and movement andcontrol of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes.

(9)

HAZARDOUS WASTE CHARACTERIZATION AND MANAGEMENT

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardouswastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design ofhazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management – AtomicEnergy Regulatory Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation -Nuclear power plants in India.

(9)

NUCLEAR WASTE AND e-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear wastevitrification, ion exchange, synroc – long term management - above ground disposal, geological disposal, ocean dumping, transmutation, space disposal - reuse ofwaste - nuclear

safety and waste regulation - case study on nuclear disaster - source of e-waste - material composition ofe-waste - recycling and recovery - integrated approaches to e-waste recycling - socio economic factors - treatment option -disposal option - e-waste legislation.

(9)

TOTAL : 45

TEXT BOOKS

- Tchobanoglous, G. et al., "Integrated Solid Waste Management", McGraw-Hill Publication., New York, 1993.
- Ronald E. Hester, Roy M. Harrison "Electronic Waste Management", Royal Society of Chemistry, 2009.
- Peavy, SH, Rowe, RD and Tchobanoglous, G, "Environmental Engineering", McGraw-Hill Inter Edition, 1985.
- Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publication, 2002

19BEBMEOE01 ROBOTICS IN MEDICINE 3 0 0 3 100

OBJECTIVES:

- Understand the basics of Robotics, Kinematics.
- Understand the basics of Inverse Kinematics.
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore various applications of Robots in Medicine.

UNIT I INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopaedics, Neurosurgery

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Robert Schilling	Fundamentals of Robotics-Analysis and control‖	Prentice Hall	2003
2	J.J.Craig	Introduction to Robotics‖,	Pearson Education	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Staugaard, Andrew C	Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖	Prentice Hall Of India	1987
2	Grover, Wiess, Nagel, Oderey	Industrial Robotics: Technology, Programming and Applications‖	McGraw Hill	1986.
3	Wolfram Stadler	Analytical Robotics and Mechatronics‖	McGraw Hill,	1995
4	Saeed B. Niku,	Introduction to Robotics: Analysis, Systems, Applications‖	Prentice Hall	2001
5	K. S. Fu, R. C. Gonzales and C. S. G. Lee	Robotics‖	McGraw Hill	2008

19BEBMEOE02 VIRTUAL REALITY AND AUGMENTED REALITY 3 0 0 3 100

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality

UNIT I INTRODUCTION

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback..

UNIT II VR DEVELOPMENT PROCESS

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNIT V APPLICATIONS

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications- games, movies, simulations, therapy.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	C. Burdea & Philippe Coiffet	Virtual Reality Technology‖	Second Edition, Gregory,	2008
2	Jason Jerald	. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool	New York, NY, US	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of
1	Dieter Schmalstieg & Tobias Hollerer	Augmented Reality: Principles and Practice (Usability)	Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United	2016
2	Steve Aukstakalnis,	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)	Addison-Wesley Professional 1 edition,	2016
3	Robert Scoble & Shel Israel	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything	, Patrick Brewster Press	2016
4	Tony Parisi,	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile	O'Reilly Media; 1 edition	2015
5	Tony Parisi	Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for	O'Reilly Media; 1 edition	2014
6	Jos Dirksen	Learning Three.js: The JavaScript 3D Library for WebGL	Packt Publishing - ebooks Account; 2nd Revised ed.	2015

19BEBMEOE03 ARTIFICIAL ORGANS AND IMPLANTS 3 0 0 3 100

OBJECTIVES:

- To have an overview of artificial organs & transplants
- To describe the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To study about various blood interfacing implants

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kopff W.J	Artificial Organs	John Wiley and sons, New York, 1st edition	1976
2	Park J.B.,	Biomaterials Science and Engineering‖	Plenum Press	1984

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino	Biomedical Engineering handbook Volume II	CRC Press / IEEE Press	2000
2	R S Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003
3	Joon B Park	Biomaterials – An Introduction	Plenum press, New York	1992
4	Yannas, I. V	Tissue and Organ Regeneration in Adults‖	New York, NY: Springer	2001
5	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino	Clinical Engineering‖	CRC Press, 1st edition	2010
6	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw- Hill	2003

19BTBTOE01 **BIOREACTOR DESIGN** **3H-3C**

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

Course Objectives:

- To impart basic knowledge in bioprocess Engineering
- To design the bioreactors for various operations.
- To understand the principle and working of heat transfer equipments.
- To extend the knowledge in principle of heat transfer inside a bioreactor
- To construct the equipments used in mass transfer operations.
- To learn the equipments used in separation process.

Course Outcomes:

- Summarize the basic concepts in bioprocess Engineering.
- Design the bioreactors for various operations.
- Develop the heat transfer equipments for Bioprocess Engineering.
- Construct the equipments used in mass transfer operations.
- Categorize the equipments used in separation process.

UNIT I –INRODUCTION TO BIOPROCESS ENGINEERING

Introduction – Biotechnology and Bioprocess Engineering- Biologists and Engineers Differ in their approach to research-How Biologists and Engineers work Together- Bioprocesses: Regulatory constraints.

UNIT II - REACTOR DESIGN

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNIT III - HEAT TRANSFER EQUIPMENTS

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

UNIT IV - MASS TRANSFER EQUIPMENTS

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNIT V - SEPARATION EQUIPMENTS

Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotary drum drier and Swenson –walker crystallizer.

SUGGESTED READINGS:

1. James Edwin Bailey, David F. Ollis (2015) Biochemical Engineering Fundamentals, Second Edition. McGraw-Hill Education (India) private limited.
2. Don W. Green, Robert H.Perry (2008). Chemical Engineer Hand book. The McGraw-Hill Companies, Inc.
3. Pauline. M. Doran (2015). Bioprocess Engineering Principles Second Edition . Academic Press.

19BTBTOE02 FOOD PROCESSING AND PRESERVATION 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- To learn the scope and importance of food processing.
- To impart basic knowledge in different food processing methods carried out in the food tech companies.
- To extend the brief knowledge in food conservation operations.
- To study the methods of food preservation by cooling.
- To familiarize the students on the concepts of preservation methods for fruits.
- To create deeper understanding on preservation methods for vegetables.

Course Outcomes

- Describe the scope and importance of food processing.
- Outline the various processing methods for foods.
- Extend the knowledge in food conservation operations.
- Describe the methods of food preservation by cooling.
- Summarize the preservation methods for fruits.
- Demonstrate the preservation methods for vegetables.

UNIT I - SCOPE AND IMPORTANCE OF FOOD PROCESSING

Properties of food - Physical, thermal, mechanical, sensory. Raw material Preparation - Cleaning, sorting, grading, peeling.

UNIT II - PROCESSING METHODS

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning-additives- fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing-Concepts and equipment used.

UNIT III - FOOD CONVERSION OPERATIONS

Size reduction – Fibrous foods, dry foods and liquid theory and foods – equipments - membrane separation- filtration- equipment and application.

UNIT IV - FOOD PRESERVATION BY COOLING

Refrigeration, Freezing-Theory, freezing time calculation, methods freezing of freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control water activity.

UNIT V - PRESERVATION METHODS FOR FRUITS AND VEGETABLES

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

SUGGESTED READINGS:

1. R. Paul Singh, Dennis R.Heldman (2014).Introduction to food engineering. Academic press.
2. P.Fellows.(2017). Food processing technology principles and practice, Fourth Edition. Wood head publishing Ltd.
3. Mircea Enachescu Dauthy. (1995). Food and vegetable processing.FAO agricultural services bulletin.
4. M.A. Rao, Syed S.H.Rizvi, Ashim K. Datta. (2014). Engineering properties of foods. CRC press.
5. B. Sivasankar. (2002). Food processing and preservation.PHI learning Pvt.Ltd.

19BTBTOE03 **BASIC BIOINFORMATICS** **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

- To understand the available tools and databases for performing research in bioinformatics.
- To expose students to sequence alignment tool in bioinformatics.
- To construct the phylogenetic trees for evolution.
- To get familiar with the 3D structure of protein and classification.
- To acquire basic knowledge in protein secondary structure prediction.
- To extend the brief knowledge in Micro array data analysis.

Course Outcomes

- Summarize the basic concepts and importance of Bioinformatics in various sectors.
- Demonstrate the sequence alignment tool in bioinformatics.
- Construct the phylogenetic trees for evolution.
- Analyze the three dimensional protein structure and classification using various tools.
- Illustrate the protein secondary structure prediction by comparative modeling.
- Extend the knowledge in micro array technology and applications of bioinformatics in various sectors.

UNIT I - OVERVIEW OF BIOINFORMATICS

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

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

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

UNIT IV - STRUCTURAL BIOINFORMATICS

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

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharma informatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

SUGGESTED READINGS:

1. Dan E krane Michael L Rayme. (2004). Fundamental concepts of Bioinformatics. Pearson Education.
2. Andreas D Baxevanis B.F. Franchis Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins. Wiley-Interscience.
3. David W. Mount. (2004). Sequence and Genome Analysis. Cold Spring Harbor Laboratory.
4. Jonathan Pevsner.(2015). Bioinformatics and functional genomics. wiley-Liss.
5. Michael J Koernberg. (2016).Microarray Data Analysis: Methods and applications. Humana Press

19BTBTOE04 FUNDAMENTALS OF NANOBIOTECHNOLOGY 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

- To impart the skills in the field of nano biotechnology and its applications.
- To acquire knowledge in the nano particles and its significance in various fields.
- To extend the knowledge in types and application of nano particles in sensors.
- To define the concepts of biomaterials through molecular self assembly.
- To equip students with clinical applications of nano devices.
- To describe deeper understanding of the socio-economic issues in nanobiotechnology.

Course Outcomes

- Develop skills in the field of nano biotechnology and its applications.
- Summarize the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Outline the clinical applications of nano devices.
- Describe the socio-economic issues in nanobiotechnology.

UNIT I - INTRODUCTION

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

UNIT II - NANO PARTICLES

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNIT III – MEDICAL NANOTECHNOLOGY

Nanomedicine, Nanobiosensor and Nanofludics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems.

Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNIT IV - NANOBIOTECHNOLOGY

Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine.Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nano carbontubules.Nanosurgical devices.

UNIT V - ETHICAL ISSUES IN NANOTECHNOLOGY

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

SUGGESTED READINGS:

1. Niemeyer, C.M. and Mirkin, C.A (2005). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
2. Goodsell, D.S. (2004). Bionanotechnology. John Wiley and Sons, Inc.
3. Shoseyov, O.and Levy, I (2008).Nanobiotechnology: Bioinspired Devices and Materials of the Future. Humana Press.
4. Bhushan, B.(2017). Springer Handbook of Nanotechnology. Springer-Verlag Berlin Heidelberg.
5. FreitasJr R.A (2006) Nanomedicine. Landes Biosciences.
6. Kohler, M. and Fritzsche, W. (2008). Nanotechnology – An Introduction to Nanostructuring Techniques. Wiley-VCH.

19BTFTOE01 PROCESSING OF FOOD MATERIALS 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:

- 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:

1. Discuss the various processing technologies involved in cereal, pulses and oilseed technology
2. Demonstrate the major operations applied in fruits and vegetable processing
3. Illustrate the techniques involved in the processing of dairy products
4. Infer the production of different types of milk
5. List the overall processing of meat, poultry and fish processing
6. Outline the processing of spices and plantation 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. (2010). Fruit and Vegetable Preservation: Principles and Practices. 3rd Edition. International Book Distributing Co. Lucknow.
2. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V., and Ramaswamy, H.S. (2003). Handbook of Post-harvest Technology. 1st Edition. Marcel Dekker Press. USA..
3. De,S. (2016). Outlines of Dairy Technology. 23rd impression. Oxford University Press. New Delhi.

19BTFTOE02 **Nutrition and Dietetics** **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

- Explain the basic concepts of food and nutrition
- Define the overall classification, function, and source of carbohydrates, lipids and proteins
- Discuss the overall aspects of vitamins
- Outline the role of health and nutritional importance of micro and macro minerals
- Summarize the recent trends in nutrition

Course outcomes

1. Discuss the basics in the area of nutritional assessment in health and disease
2. Categorize the recommended dietary allowances for different age groups
3. Express the classifications, functions and sources of carbohydrates, lipids and proteins
4. List the various attributes of fat and water soluble vitamins
5. Report the role, bioavailability, sources and deficiency diseases of macro and micro minerals
6. List the diets and concepts of foods suggested for nutrional, chronic and acute disorders

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. 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. Wardlaw, G M. (2013). Perspectives in Nutrition. 9th Edition. WCB McGraw-Hill Publishers. Boston.
2. Joshi,A.S. (2016). Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd. New Delhi. 4th Edition. 2016.
3. Srilakshmi, B. (2017). Nutrition Science. 6th Edition. New Age International Pvt. Ltd Publishers..
4. Watson,R.B. (2003). Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell.
5. Roday, S. (2018). Food Science and Nutrition. 3rd Edition. Oxford Higher Education/Oxford University Press.

19BTFTOE03 **Ready to Eat Foods** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- 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 (COs)

1. Review the overall aspects of snack food industry
2. Understand the Steps involved in the production of ready to eat foods from potato and maize flour
3. Discuss the various unit operations involved in the production of potato and tortilla chips
4. Illustrate the overall aspects of popcorn production
5. List the production, processing and manufacturing of fruit based snacks
6. Understand the technique of sensory analysis and packaging methods of snack foods

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 READING

1. Lusas, E. W and Rooney, L. W. (2001). Snack Foods Processing. 1st Edition. CRC Press.
2. Panda, H. (2013). The Complete Technology Book on Snack Foods. 2nd Edition. National Institute of Industrial Research. Delhi.
3. Saldivar, S.O.S. (2008). Industrial Manufacture of Snack Foods. Kennedys Books Ltd.

19BTFTOE04 **Agricultural Waste and Byproducts Utilization** **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

- Categorize the types of agricultural wastes
- Outline the production and utilization of biomass
- Explain the various parameters considered to be important in the designing of biogas units
- Review the various methods employed in the production of alcohol from the byproducts of agricultural wastes
- Summarize the overall aspects involved in the production of paperboards and particleboards from agricultural wastes

Course Outcomes

1. List and group the types of agricultural wastes
2. Discuss the technique and methods involved in conversion of agricultural waste into value added products.
3. Discuss the techniques and production involved in the utilization of biomass
4. Understand 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 particle boards 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. Sahay, K.M., and Singh,K.K. (2013). Unit Operations of Agricultural Processing. 2nd Edition. Vikas Publishing House Pvt Ltd, Noida, Uttar Pradesh.
2. Beggs, C. (2009). Energy Management and Conservation. 2nd Edition. Elsevier Publication..
3. Chaturvedi, P. (2009). Energy Management: Challenges for the Next Millennium. 1st Edition Concept Publishing Co.
4. Fardo, S.W., Patrick, D.R., Richardson, R.E., and Fardo, B.W. (2014). Energy Conservation Guidebook. 3rd Edition . The Fairmont Press.
5. Wulfinghoff, D.R. (2000). Energy Efficiency Manual. Energy Institute Press.