B.Tech. (Food Technology)

2018 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2018

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2018-2019 for Regular admission (Academic year 2019-2020 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

- Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

(or)

- Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

(or)

1.2.2 The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

i. Aeronautical Engineering
ii. Agricultural Engineering
iii. Automobile Engineering
iv. Civil Engineering
v. Computer Science and Engineering
vi. Electronics and Communication Engineering
vii. Electrical and Electronics Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

B. Tech. Programmes

i. Biotechnology
ii. Fashion Technology
iii. Food Technology
iv. Information Technology
v. Textile Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

(i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects

(ii) **Basic Engineering** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

(iv) **Professional Courses** include Discipline Core Courses, Professional Electives, and Open Electives.

(v) **Employability Enhancement Courses (EEC)** includes Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits based on the following

Contact period per week	Credits
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

3.4 Every student shall be required to opt for **Nine** electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VII as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, Credits will be indicated in the Grade Sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the Electives (other than open elective) of the Semester VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that one **regular elective** (in the **VIII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However one credit courses completed during I to III semesters shall be maintained in the Grade sheet as “Additional credits earned” (not considered for the computation of SGPA/CGPA).

3.8 A Student may be permitted to credit only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

3.9 **Industrial Training / Internship**

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
1 Month	2
2 Months	3

3.10 **Socially Relevant Projects**

A Student may be permitted to carry out a socially relevant project during semester II to semester VI in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the Semester for the valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum** in the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the

semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.5 Reappearance Registration

6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.

6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/

International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.7 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY 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 Faculty member of the Department who shall function as Faculty Advisor

for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2.

10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in Continuous Assessment and End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the

results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	**Minimum Credits**	
	Regular Admission	**Lateral Entry**
B.E. Programmes		
Aeronautical Engineering	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

11.5 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

Range of Total Marks (as specified in Clause 16) / Specific Reason	**Grade Points**	**Letter Grade**
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	I
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

'RA' ---Reappearance registration is required for that particular course

'I' --- Continuous evaluation is required for that particular course in the subsequent examinations.

'SA' --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA), and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

12.6 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.7 For the non credit courses grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

12.9 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

12.10 **Eligibility for the Award of Degree**

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
ii. Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years reckoned from the commencement of the first semester to which the candidate was admitted.
iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.
iv. No disciplinary action is pending against the student.
v. The award of Degree must have been approved by the Syndicate of the University.

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 **First Class with Distinction**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.
- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing end semester examination due to lack of attendance in any of the courses.

13.2 **First Class**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 7.00**

13.3 **Second Class**: All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second Class.**

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN working days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s).

14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

14.6 Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of-study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance

requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to rejoin the programme after the break / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean Academics in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	(Laboratory Assessment & Report)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**

III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (20)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (10)	
	Test – Cycle I (25)	
	Test – Cycle II (25)	
	Total Marks	**100**

IV	**PROJECT WORK I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Literature Survey (5)	
	Identification of topic and Justification (5)	
	Work plan (10)	
	Review II	
	Approach & Results (15)	
	Conclusion (15)	

	End Semester Examination	**50**
	Report[#] (20)	
	Presentation (20)	
	Viva voce (10)	
	Total Marks	**100**

V	**PROJECT WORK II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Progress (10)	
	Review II	
	Approach & Results (10)	
	Review III	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	**50**
	Viva voce (20)	
	Total Marks	**100**

VI	**LANGUAGE ELECTIVE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test 1	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Test 2	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Oral Exam	**50**
	Total Marks	**100**

VII	**ONE-CREDIT COURSE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**50**
	Quiz/ Assignment	**50**
	Total Marks	**100**

[#] *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**
IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	Total Marks	**100**

Optional Test: *A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Acquire theoretical and practical knowledge of food engineering and technology to become a qualified food process engineer.

II. Apply the skills of food technology in research, industry and entrepreneurship to ensure food safety and nutrition security.

III. Improve the standard of living and economy of the nation through convenience and novel food products with professional ethics.

PROGRAMME OUTCOMES (POs)

a. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

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

k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

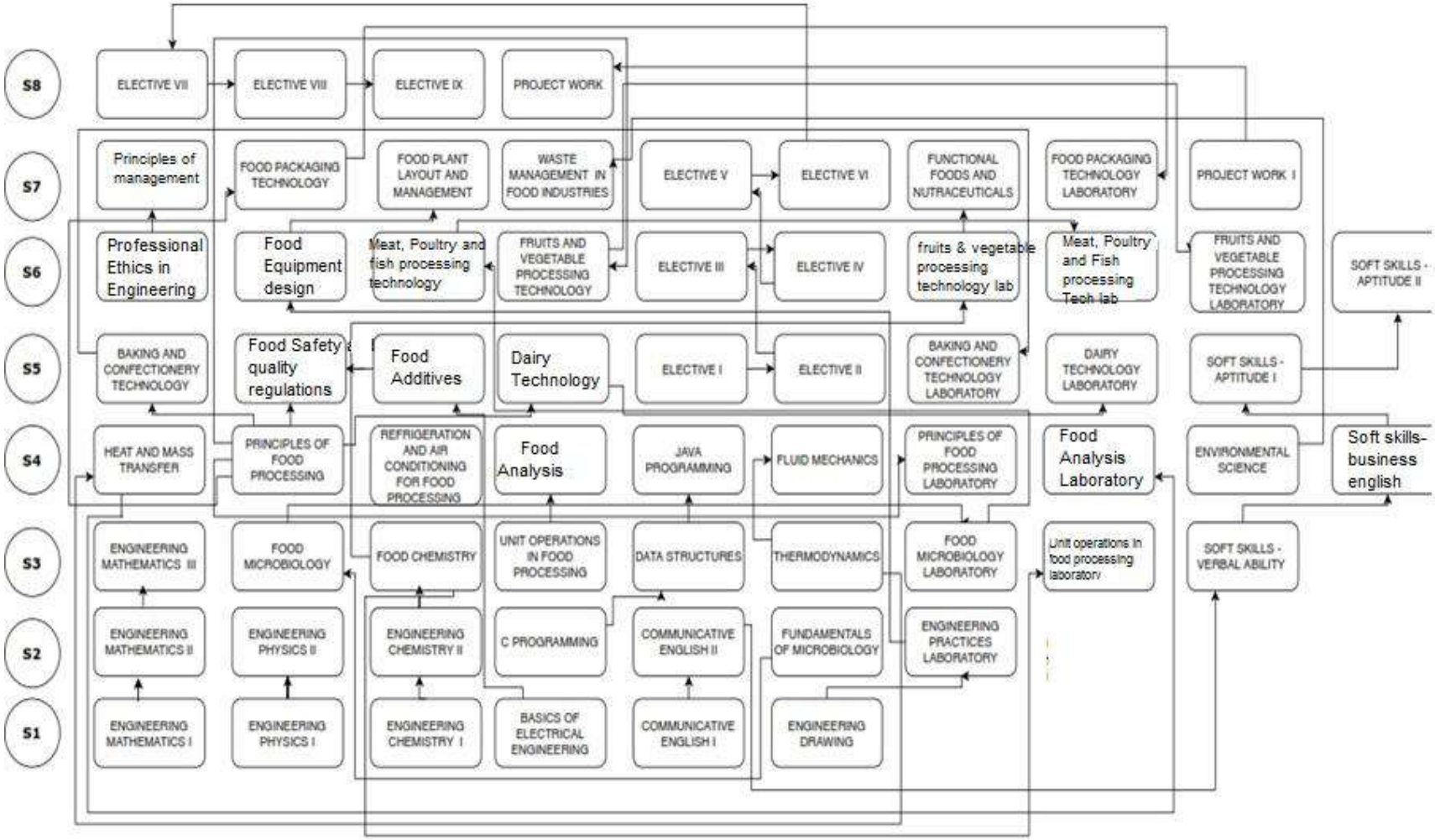
l. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independentandlife-longlearninginthebroadestcontextoftechnologicalchange.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- Execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge.
- Practical and research training will pave way for introducing novel technologies in food processing sectors for global sustenance.

MAPPING WITH PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO I	X	X	X	X							X	
PEO II		X		X	X		X	X				X
PEO III						X	X	X	X	X		


S8
ELECTIVE VII
ELECTIVE VIII
ELECTIVE IX
PROJECT WORK
S7
Principles of management
FOOD PACKAGING TECHNOLOGY
FOOD PLANT LAYOUT AND MANAGEMENT
WASTE MANAGEMENT IN FOOD INDUSTRIES
ELECTIVE V
ELECTIVE VI
FUNCTIONAL FOODS AND NUTRACEUTICALS
FOOD PACKAGING TECHNOLOGY LABORATORY
PROJECT WORK I
S6
Professional Ethics in Engineering
Food Equipment design
Meat, Poultry and fish processing technology
FRUITS AND VEGETABLE PROCESSING TECHNOLOGY
ELECTIVE III
ELECTIVE IV
fruits & vegetable processing technology lab
Meat, Poultry and Fish processing Tech lab
FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY
SOFT SKILLS - APTITUDE II
S5
BAKING AND CONFECTIONERY TECHNOLOGY
Food Safety quality regulations
Food Additives
Dairy Technology
ELECTIVE I
ELECTIVE II
BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY
DAIRY TECHNOLOGY LABORATORY
SOFT SKILLS - APTITUDE I
S4
HEAT AND MASS TRANSFER
PRINCIPLES OF FOOD PROCESSING
REFRIGERATION AND AIR CONDITIONING FOR FOOD PROCESSING
Food Analysis
JAVA PROGRAMMING
FLUID MECHANICS
PRINCIPLES OF FOOD PROCESSING LABORATORY
Food Analysis Laboratory
ENVIRONMENTAL SCIENCE
Soft skills- business english
S3
ENGINEERING MATHEMATICS III
FOOD MICROBIOLOGY
FOOD CHEMISTRY
UNIT OPERATIONS IN FOOD PROCESSING
DATA STRUCTURES
THERMODYNAMICS
FOOD MICROBIOLOGY LABORATORY
Unit operations in food processing laboratory
SOFT SKILLS - VERBAL ABILITY
S2
ENGINEERING MATHEMATICS II
ENGINEERING PHYSICS II
ENGINEERING CHEMISTRY II
C PROGRAMMING
COMMUNICATIVE ENGLISH II
FUNDAMENTALS OF MICROBIOLOGY
ENGINEERING PRACTICES LABORATORY
S1
ENGINEERING MATHEMATICS I
ENGINEERING PHYSICS I
ENGINEERING CHEMISTRY I
BASICS OF ELECTRICAL ENGINEERING
COMMUNICATIVE ENGLISH I
ENGINEERING DRAWING

DEPARTMENT OF FOOD TECHNOLOGY
Minimum Credits to be Earned: 170

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18FD101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18FD102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18FD103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18FD104	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18FD106	ENGINEERING DRAWING	1	0	4	3	5	50	50	100	ES
Total		**11**	**1**	**12**	**18**	**24**	**350**	**250**	**600**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18FD201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18FD202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18FD203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18FD204	COMPUTER PROGRAMMING	1	0	4	3	5	50	50	100	ES
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18FD206	FUNDAMENTALS OF MICROBIOLOGY	3	0	0	3	3	50	50	100	ES
18FD207	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	50	50	100	ES
Total		**12**	**1**	**14**	**20**	**27**	**400**	**300**	**700**	**-**

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18FD301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18FD302	FOOD MICROBIOLOGY	3	0	0	3	3	50	50	100	PC
18FD303	FOOD CHEMISTRY	3	0	2	4	5	50	50	100	BS
18FD304	UNIT OPERATIONS IN FOOD PROCESSING	3	0	0	3	3	50	50	100	PC
18FD305	DATA STRUCTURES	2	0	2	3	4	50	50	100	ES
18FD306	THERMODYNAMICS	2	1	0	3	3	50	50	100	PC
18FD307	FOOD MICROBIOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18FD308	UNIT OPERATIONS IN FOOD PROCESSING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	2	0	0	-	2	100	0	100	EEC
Total		**18**	**2**	**10**	**23**	**30**	**600**	**300**	**900**	**-**
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18FD401	HEAT AND MASS TRANSFER	3	0	2	4	5	50	50	100	ES
18FD402	PRINCIPLES OF FOOD PROCESSING AND PRESERVATION	3	0	0	3	3	50	50	100	PC
18FD403	REFRIGERATION AND COLD CHAIN MANAGEMENT	3	0	0	3	3	50	50	100	PC
18FD404	FOOD ANALYSIS	3	0	0	3	3	50	50	100	PC
18FD405	JAVA PROGRAMMING	2	0	2	3	4	50	50	100	ES
18FD406	FLUID MECHANICS	3	1	0	4	4	50	50	100	PC
18FD407	PRINCIPLES OF FOOD PROCESSING AND PRESERVATION LABORATORY	0	0	2	1	2	100	0	100	PC
18FD408	FOOD ANALYSIS LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE*	2	0	0	-	2	100	0	100	HS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**19**	**1**	**12**	**23**	**32**	**700**	**300**	**1000**	**-**

* MANDATORY NON-CREDIT COURSE (COMMON TO ALL BRANCHES)

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18FD501	BAKING AND CONFECTIONERY TECHNOLOGY	3	0	0	3	3	50	50	100	PC
18FD502	FOOD SAFETY AND QUALITY REGULATIONS	3	0	0	3	3	50	50	100	PC
18FD503	FOOD ADDITIVES	3	0	0	3	3	50	50	100	PC
18FD504	DAIRY TECHNOLOGY	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18FD507	BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18FD508	DAIRY TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**0**	**10**	**22**	**28**	**600**	**300**	**900**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGIN EERING	2	0	0	2	2	50	50	100	HSS
18FD602	FOOD EQUIPMENT DESIGN	3	1	0	4	4	50	50	100	PC
18FD603	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY	3	0	0	3	3	50	50	100	PC
18FD604	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18FD607	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18FD608	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**1**	**10**	**22**	**28**	**600**	**300**	**900**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18FD702	FOOD PACKAGING TECHNOLOGY	3	0	0	3	3	50	50	100	PC
18FD703	FOOD PROCESSING PLANT DESIGN AND LAYOUT	3	1	0	4	4	50	50	100	PC
18FD704	WASTE MANAGEMENT IN FOOD INDUSTRIES	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18FD707	WASTE MANAGEMENT IN FOOD INDUSTRIES LABORATORY	0	0	2	1	2	100	0	100	PC
18FD708	FOOD PACKAGING TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18FD709	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**1**	**12**	**24**	**30**	**550**	**350**	**900**	**-**
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18FD804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**18**	**27**	**200**	**200**	**400**	**-**

ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
LANGUAGE ELECTIVES										
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
DISCIPLINE ELECTIVES										
18FD001	INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY	3	0	0	3	3	50	50	100	PE
18FD002	FAT AND OIL TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD003	CROP PROCESS ENGINEERING	3	0	0	3	3	50	50	100	PE
18FD004	MILLING TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD005	DOWNSTREAM PROCESSING	3	0	0	3	3	50	50	100	PE
18FD006	EXTRUSION TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD007	APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING	3	0	0	3	3	50	50	100	PE
18FD008	RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS	3	0	0	3	3	50	50	100	PE
18FD009	FOOD COLORS AND FLAVOR TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD010	BEVERAGE PROCESSING	3	0	0	3	3	50	50	100	PE
18FD011	SUGAR TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD012	CEREAL, PULSES AND OILSEED TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD013	READY TO EAT FOODS	3	0	0	3	3	50	50	100	PE
18FD014	FOOD PRODUCT DESIGN AND DEVELOPMENT	3	0	0	3	3	50	50	100	PE
18FD015	FOOD BIOTECHNOLOGY	3	0	0	3	3	50	50	100	PE
18FD016	FOOD ALLERGY AND TOXICOLOGY	3	0	0	3	3	50	50	100	PE
18FD017	MUSHROOM PROCESSING TECHNOLOGY	3	0	0	3	3	50	50	100	PE

18FD018	PLANTATION AND SPICE PROCESSING	3	0	0	3	3	50	50	100	PE
18FD019	PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	3	0	0	3	3	50	50	100	PE
18FD020	ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGISTS	3	0	0	3	3	50	50	100	PE
18FD021	ENTERPRISE RESOURCE PLANNING	3	0	0	3	3	50	50	100	PE
18FD022	SUPPLY CHAIN AND RETAIL MANAGEMENT	3	0	0	3	3	50	50	100	PE
18FD023	TOTAL QUALITY MANAGEMENT	3	0	0	3	3	50	50	100	PE
18FD024	SENSORY EVALUATION OF FOODS	3	0	0	3	3	50	50	100	PE
18FD025	EMERGING TECHNOLOGIES IN FOOD PROCESSING	3	0	0	3	3	50	50	100	PE
18FD026	STORAGE ENGINEERING	3	0	0	3	3	50	50	100	PE
18FD027	CHEMICAL REACTION ENGINEEERING	3	0	0	3	3	50	50	100	PE
18FD028	BIOCHEMISTRY	3	0	0	3	3	50	50	100	PE
18FD029	FOOD INFORMATICS	3	0	0	3	3	50	50	100	PE
18FD030	FOOD ADULTERATION	3	0	0	3	3	50	50	100	PE
18FD031	FOOD SENSORS	3	0	0	3	3	50	50	100	PE
PHYSICS ELECTIVES										
18GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P4	BIOPHOTONICS	3	0	0	3	3	50	50	100	BS
18GE0P5	PHYSICS OF SOFT MATTER	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
ONE CREDIT COURSES										
18FD0XA	HALAL COMPLIANCE IN FOOD AUDIT	0	0	0	1	1	100	0	100	EEC
18FD0XB	FOOD FERMENTATION TECHNOLOGY	0	0	0	1	1	100	0	100	EEC
18FD0XC	FABRICATION OF FOOD PROCESSING EQUIPMENT	0	0	0	1	1	100	0	100	EEC

18FD0XD	FOOD SAFETY AND QUALITY MANAGEMENT SYSTEMS	0	0	0	1	1	100	0	100	EEC
18FD0XE	HACCP CERTIFICATION	0	0	0	1	1	100	0	100	EEC
18FD0XF	FSSAI-FOOD SAFETY TRAINING AND CERTIFICATION (FoSTaC)	0	0	0	1	1	100	0	100	EEC
18FD0XG	ISO-17025 FOR ACCREDITED LABORATORY	0	0	0	1	1	100	0	100	EEC
SPECIAL COURSES										
18FDV01	ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGIST	3	0	0	0	3	100	0	100	EEC
18FDV02	SKILLED TECHNOLOGY UPGRADATION PROGRAMME	3	0	0	0	3	100	0	100	EEC
18FDV03	PLANT PHYSIOLOGY, METABOLISM AND BIOECONOMY	3	0	0	0	3	100	0	100	EEC
OPEN ELECTIVES										
18FD0YA	TRADITIONAL FOODS	3	0	0	3	3	50	50	100	PE
18FD0YB	FOOD LAWS AND REGULATIONS	3	0	0	3	3	50	50	100	PE
18FD0YC	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	50	50	100	PE
ADDITIONAL ONE CREDIT COURSE										
18GE0XA	ETYMOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	1	0	0	1	1	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	1	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	1	0	0	1	1	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	1	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	1	0	0	1	1	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	1	0	0	1	1	100	0	100	EEC
18GE0XI	BLOG WRITING	1	0	0	1	1	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	1	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	1	0	0	1	1	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	1	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	1	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	1	0	0	1	1	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	8	-	-	-	-	-	28	16.47	15%	20%
2	ES	6	8	3	7	-	-	-	-	24	14.12	15%	20%
3	HSS	2	2	-	-	-	2	2	-	8	4.71	5%	10%
4	PC	-	-	12	16	16	14	13	-	71	41.76	30%	40%
5	PE	-	-	-	-	6	6	6	9	27	15.88	10%	15%
6	EEC	-	-	-	-	-	-	3	9	12	7.06	10%	15%
Total		18	20	23	23	22	22	24	18	170	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18FD101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	3	1												
3	1													
4	2		3											
5		3												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, LHopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas, Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

18FD102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1												
4	2	1												
5	2	1												

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight - Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum – Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission-rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem -determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection - image formation:concave mirrors - convex mirrors - thin lenses - compound microscope -human eye. Conditions of interference - Youngs double slit experiment -intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution -diffraction grating - applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph.Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), BharathiBhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012
6. D.S. Mathur, Elements of Properties of Matter, S.Chand& Co. Publishers, New Delhi, 2010.

18FD103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Explain the periodic trends in modern periodic table and structural parameters of chemical compounds based on periodic properties
- Summarize the fundamentals of chemical equilibrium and buffer action
- Explain the basic concepts of colligative properties and abnormalities in colligative properties
- Outline the concept of organic reactions mechanism with suitable examples

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the periodic trends in modern periodic table and structural parameters of chemical compounds based on periodic properties
2. Identify the bonding nature and structure of chemical compounds
3. Identify the chemical reactions in solutions and apply it for different solution phase reactions
4. Summarize the colligative properties of solution and analyze the molecular mass of solute
5. Outline the three dimensional orientation of organic molecules and explain the suitable organic reaction mechanisms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2													
5	2	1												

UNIT I **6 Hours**

PERIODIC CLASSIFICATION OF ELEMENTS

Brief history of periodic classification - modern periodic law and the present form of periodic table - periodic trends in properties of elements: Atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy and electronegativity.

UNIT II **6 Hours**

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Valence electrons - ionic bond - covalent bond - bond parameters. Lewis structure. Polar character of covalent bond and covalent character of ionic bond. Valence bond theory - resonance - geometry of covalent molecules - VSEPR theory - concept of hybridization involving s, p and d orbitals - shapes of some simple molecules. Hydrogen bond.

UNIT III **6 Hours**

CHEMICAL EQUILIBRIUM

Equilibrium in physical and chemical processes - law of mass action - equilibrium constant - factors affecting equilibrium - Le Chatelier s principle. Ionic equilibrium: Ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polyhydroxy acids, acid strength. Concept of pH - hydrolysis of salts - buffer solutions - Henderson equation - solubility product - common ion effect.

UNIT IV **6 Hours**

COLLIGATIVE PROPERTIES

Types of solutions - expression of concentration of solutions of solids in liquids - solubility of gases in liquids - solid solutions. Colligative properties of relative lowering of vapour pressure - Raoult`s law - elevation of boiling point - depression of freezing point - osmotic pressure - determination of molecular mass using colligative properties - abnormalities in colligative properties - Vant Hoff factor.

UNIT V **6 Hours**

STRUCTURE AND REACTIVITY OF ORGANIC COMPOUNDS

IUPAC nomenclature of organic compounds - electronic displacements in a covalent bond: Inductive effect, electromeric effect, resonance and hyper conjugation - homolytic and heterolytic fission of a covalent bond: Free radicals, carbocations, carbanions - electrophiles and nucleophiles - types of organic reactions.

FURTHER READING

Identification of adulteration by simple chemical test. Application of chemistry in food packing. Chemistry of artificial food additives.

1 **3 Hours**

EXPERIMENT 1

Detection of nitrogen, sulphur, chlorine, bromine and iodine in the given samples: Lassaignes Test

2 **3 Hours**

EXPERIMENT 2

Determination of percentage purity of baking soda

3 **3 Hours**

EXPERIMENT 3

Estimation of calcium in milk by complexometric method

4 **3 Hours**

EXPERIMENT 4

Determination of strength of a given hydrochloric acid solution by titrating it against standard sodium carbonate solution

5 **3 Hours**

EXPERIMENT 5

Determination of pH and titratable acidity of fruit juice solutions using pH meter

6 **4 Hours**

EXPERIMENT 6

Determination of dissolved oxygen in water by Winklers method

7 **3 Hours**

EXPERIMENT 7

Determination of molecular weight of given sample by depression of freezing point method and identify the given sample by comparing the experimental molecular weight with theoretical value

8 **4 Hours**

EXPERIMENT 8

Preparation of simple organic compounds: acetanilide and 2-naphthol aniline dye

9 **4 Hours**

MANDATORY GUIDELINES

Lab safety rules and guidelines for students
Preparation of N/10 oxalic acid and M/10 sodium carbonate solution

Total: 60 Hours

Reference(s)

1. J. D. Lee, Concise Inorganic Chemistry, 5th Edition, John Wiley & Sons, 2008.
2. P.S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International, 2005.
3. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
4. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. B S Bahl, Arun Bahl, Advanced Organic Chemistry, S.Chand, 5th Edition, 2012.

18FD104 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- Understand the concepts of electrical measuring units, sensors and transducers.
- Understand the selection of electric drives for food processing industry.
- Organize the electric heating methods and earthing techniques of electrical equipments.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Recognize the measuring devices and characteristics.
2. Explain different types of Sensors, transducers and actuators.
3. Classify the Electric Drives for various applications.
4. Differentiate the Heating techniques used in food processing.
5. Attribute the different types of earthing and electrical Safety.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1										
2	1	2		1										
3	1	1												
4	1	2												
5	1	2		1										

UNIT I **5 Hours**

MEASUREMENT AND PROPERTIES

AC, DC Supply, Current, Voltage, Power, frequency, Resistance, Inductance and Capacitance, electromagnetism, Transformer: step up, step down and high frequency transformer.

UNIT II **6 Hours**

SENSORS TRANSDUCERS AND ACTUATORS

Principles of transducers, strain guage, Thermistor, bridge type and crystal type, di-electric sensors - LVDT-Non Drive: solenoid and linear type.

UNIT III **8 Hours**

ELECTRICAL MACHINES AND DRIVES

Torque speed characteristics of single phase and three phase Induction motors, Universal motor, PM DC motor and Servo motor - Selection of motors for drives based on torque speed characteristics, rating and supply system of drives.

UNIT IV **5 Hours**

HEATING EQUIPMENT

High frequency power conversion (AC-AC and DC-AC), Resistance heating -Induction heating - Dielectric heating

UNIT V **6 Hours**

SAFETY AND ACESSARIES

Wires, Cables, Earthing: Necessity- Types of Earthing, Measurement of Earth Resistance- Types of fuses, MCB, ELCB, Types of switches, Plugs and Sockets.

1 **6 Hours**

EXPERIMENT 1

Measurement of power, voltage, current, frequency using digital meters.

2 **6 Hours**

EXPERIMENT 2

Measurement of temperature using thermistors and LVDT.

3 **6 Hours**

EXPERIMENT 3

Fabrication the prototype model of induction heater.

4 **6 Hours**

EXPERIMENT 4

Fuse replacement and earthing of equipment.

5 **6 Hours**

EXPERIMENT 5

Study the speed control of stepper motors and servo motors.

Total: 60 Hours

Reference(s)

1. Vedam Subramanyan,Electric Drives: Concepts and Applications, Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. A.L.Anwari,Basic of Electrical Engineering,Dhanpat Rai,2016.
3. Open Shaw Taylor,Utilization of Electrical Energy, University Press,2017.
4. Alan.S.Moris, Reza Langari,Measurement and Instrumentation, Elsevier,2011.
5. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2									2					
3														
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18FD106 ENGINEERING DRAWING 1 0 4 3

Course Objectives

- Provide knowledge on projection of points and lines.
- Impart skill in drawing projection of simple solids.
- Familiarize creation of orthographic views from isometric projections of simple solids and vice versa.
- Build the proficiency to create two dimensional sketches using software.
- Provide the skill to build three dimensional models and its orthographic views using software.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the projection of points and lines in different quadrants.
2. Construct orthographic projections of simple solids.
3. Create the orthographic and isometric projections of simple solids.
4. Sketch the two dimensional views of engineering components using software.
5. Construct three dimensional models of engineering components and its orthographic views using software.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **10 Hours**

PROJECTION OF POINTS

Practices on lettering, numbering and dimension of drawings. Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - parallel, perpendicular and inclined to anyone plane.

UNIT II **10 Hours**

PROJECTION OF SOLIDS

Orthographic projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

UNIT III **10 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTION

Conversion of isometric to orthographic projection and vice versa. Perspective projection of simple solids.

UNIT IV **10 Hours**

CREATION OF 2D SKETCHES USING SOFTWARE

Sketch Entities - line, circle, arc, rectangle, slots, polygon, text, snap, and grid. Sketch Tools-fillet, chamfer, offset, convert entities, trim, extend, mirror, move, copy, rotate, scale, stretch, sketch pattern. Geometrical constraints, Dimensioning - smart, horizontal, vertical, ordinate.

UNIT V **10 Hours**

PART MODELING AND DRAFTING USING SOFTWARE

Part Modeling - extrude, cut, revolve, creation of planes, fillet, chamfer, shell, rib, pattern, mirror, loft, draft and swept. Drafting - Converting 3D models to orthographic views with dimensions.

1 **3 Hours**

EXPERIMENT 1

Lettering and Numbering

2 **4 Hours**

EXPERIMENT 2

Projection of Points

3 **4 Hours**

EXPERIMENT 3

Projection of Lines

4 **5 Hours**

EXPERIMENT 4

Projection of Simple solids

5 **4 Hours**

EXPERIMENT 5

Isometric and Orthographic Projections

6 **2 Hours**

EXPERIMENT 6

Basic Commands in Autocad

7 **3 Hours**

EXPERIMENT 7

Isometric and Orthographic Projections in Autocad

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18FD201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas, Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18FD202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- infer the surface and electrical properties of food materials
- impart the knowledge in thermal and electromagnetic properties of food materials
- understand the importance of nanotechnology in food processing and packing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. exemplify the surface properties and measurement techniques of surface tension and interfacial tension
2. explain the relationship between rheological properties and fluid behavior of solid and liquid food materials
3. apply the knowledge of thermal conductivity and thermodymanics in calculating heat requirement for food preparation process
4. Outline the response of food materials to electromagnetic radiation in the range of optical frequencies and assess the quality of food materials based on dielectric properties
5. Assess the role of nanoparticles in food processing and efficiency of four types of food packing techniques using nanotechnology

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1							2					
4	2	1							2					
5	2													

UNIT I **6 Hours**

SURFACE PROPERTIES

Cohesive and adhesive forces - surface tension - temperature effects - capillary action - surface activity - interfacial tension - emulsions - detergency - foaming - wettability and solubility- colloidal systems in foods - applications.

UNIT II **6 Hours**

RHEOLOGICAL PROPERTIES

Classification of rheology - viscosity: measurement of viscosity in fluid food, shear stress and shear rate - Newtonian fluids and dynamic viscosity - Non-Newtonian behaviour: Time dependent fluids and time independent fluids - methods for measuring viscosity of fluid food -texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis.

6 Hours

UNIT III

THERMAL PROPERTIES

Thermal conductivity of food materials - Fouriers law of heat conduction - methods to measure thermal conductivity of food materials - conservation and conversion of energy in foods - energy value - specific heats of food - enthalpy and latent heat of food - thermal diffusivity in food materials.

UNIT IV **6 Hours**

ELECTROMAGNETIC PROPERTIES

Electromagnetic spectrum - interaction of radiation with matter - effects of incident radiation - dielectric properties of foods: basic principles of microwave heating, dipolar rotation - effect of moisture content - temperature - salt and sugar composition of food materials on dielectric properties - quality of food materials

UNIT V **6 Hours**

NANOSCIENCE IN FOOD TECHNOLOGY

Classification of nanoparticles - nanoparticles in food technology: nanodispersions - nanocapsules - nanoemulsions nanolaminates - nanosensors - food processing- types of food packing: improved packing- active packing- antimicrobial packing - smart packing

1 **4 Hours**

EXPERIMENT 1

Determination of critical velocity and coefficient of viscosity of the given liquid using Poiseuilles method by maintaining stream line flow in the capillary tube.

2 **4 Hours**

EXPERIMENT 2

Determine the velocity of ultrasonic waves in the given liquid.

3 **5 Hours**

EXPERIMENT 3

Determine the coefficient of thermal conductivity of a bad conductor by Lees disc method.

4 **4 Hours**

EXPERIMENT 4

Determine the capacitance of a capacitor connecting capacitors in series and in parallel

5 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given material

6 **5 Hours**

EXPERIMENT 6

Using the laws of reflection, refraction and transmission, determine the wavelength of the prominent lines of mercury spectrum through spectrometer

7 **4 Hours**

EXPERIMENT 7

Draw a hysteresis loop for a given ferromagnetic specimen and calculate the energy loss using the B_H curve

Total: 60 Hours

Reference(s)

1. Ludger O. Figura and Arthur A.Teixeira, Food Physics Physical Properties -Measurements and Applications, Springer-Verlag Berlin Heidelberg 2007.
2. Serpil Sahin and Servet Gulum Sumnu, Physics properties of food, Springer Science and Business Media, LLC, 2006.
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. https://www.researchgate.net/publication/51568480 The Applications of Nanotechnology in Food Industry

18FD203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Indicate the effect of water hardness and their softening processes
- Identify the need of colloidal chemistry in food processing
- Explain the terminologies of electrochemistry and acquire the basic knowledge of electrode potentials and electrochemical cells
- Summarize the fundamentals of corrosion, its types and protection methods
- Outline basic concepts of polymers, preparation and its processing methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Compare the internal and external treatment methods for the removal of hardness in water for domestic as well as industrial applications
2. Summarize the concept of colloidal chemistry and its application in food processing
3. Construct an electrochemical cell and measure its potential using selected reference electrode
4. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion protection method
5. Differentiate polymers based on its source, properties and applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2	1												
3	2	2												
4	2						1							
5	3	2												

UNIT I **6 Hours**

WATER TREATMENT TECHNOLOGY

Water quality parameters: Physical, chemical and biological impurities of water. Hardness of water - classification of hardness - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA method. Requirements of boiler feed water - disadvantages of using hard water in industrial boilers. Internal conditioning and external conditioning. Municipal water treatment. Water quality parameters for food industry.

UNIT II **6 Hours**

COLLOIDAL CHEMISTRY

Colloids- types of colloids - lyophilic and lyophobic colloids - preparation of colloidal solution - properties of colloids - Tyndall effect, Brownian effect, electrical properties. Stability of colloids - electrostatic stabilization and steric stabilization. Coagulation methods. Application of colloids in foods and medicines - emulsions, emulsifiers, gels, foams.

UNIT III **6 Hours**

ELECTROCHEMISTRY

Electrode potential: Single and standard electrode potential - half-cell reactions - Nernst equation - determination of single electrode potential. Cell - representation - types. Electrodes: Metal-metal ion electrode, metal-metal insoluble salt electrode and redox electrode - reference electrodes: Calomel electrode - silver-silver chloride electrode and glass electrode - measurement of pH using glass electrode- electrochemical series and its importance. Potentiometric titration (redox).

UNIT IV **6 Hours**

CORROSION SCIENCE

Chemical corrosion and electrochemical corrosion. Types of electrochemical corrosion: Galvanic corrosion and differential aeration corrosion. Galvanic series and its applications. Factors influencing corrosion rate: Nature of metal and environment. Corrosion control methods. Organic coating - paint, constituents and functions. Influence of Corrosion in food containers and control measures.

UNIT V **6 Hours**

POLYMER CHEMISTRY

Monomers - polymers - functionality - degree of polymerization - classification of polymers based on source and applications. Molecular weight determination - Ostwald viscometer method. Types of polymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting and thermoplastics, Biodegradable polymer and its application in food packing. Compounding of plastics - injection and extrusion moulding.

FURTHER READING

Application chemistry in food processing.

1 **4 Hours**

EXPERIMENT 1

Analysis the qualityof given sample of water with respect to hardness, TDS and pH.

2 **4 Hours**

EXPERIMENT 2

Estimation of chromium content in tannery effluent.

3 **4 Hours**

EXPERIMENT 3

Preparation of colloidal solution using emulsifier
(i) Oil in water emulsion
(ii) Water in oil emulsion

4 **4 Hours**

EXPERIMENT 4

Determination of the strength of Fe (II) in the given sample by potentiometric method.

5 **4 Hours**

EXPERIMENT 5

Conductometric titration of mixture of acids (HCl and CH3COOH).

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on mild steel by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Measurement of rate of corrosion on mild steel in aerated, neutral, acidic and alkaline medium by Tafel polarization method.

8 **2 Hours**

EXPERIMENT 8

Determination of molecular weight of a polymer by Ostwald viscometer.

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
4. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, 7th edition, 2012.

18FD204 COMPUTER PROGRAMMING 1 0 4 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Design applications using functions in C.
5. Apply the concepts of structures and files in writing C programs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			3									
2	1	2			3									
3	1	2			3									
4	1	2			3									
5	1	2			3									

UNIT I **3 Hours**

INTRODUCTORY CONCEPTS

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator Precedence and order of evaluation.

UNIT II **3 Hours**

CONTROL STATEMENTS

Decision Making and Branching- Decision Making and Looping -Jump Statements.

UNIT III **3 Hours**

ARRAYS AND STRINGS

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

UNIT IV **3 Hours**

FUNCTIONS

User Defined Functions- Elements of user defined functions - categories of function - call by value and call by reference - recursion

UNIT V **3 Hours**

STRUCTURES AND FILES

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

FOR FURTHER READING

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

1 **3 Hours**

EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

2 **3 Hours**

EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

3 **6 Hours**

EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

4 **3 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **3 Hours**

EXPERIMENT 5

Implementation of nested if else Conditional Statement.

6 **3 Hours**

EXPERIMENT 6

Implementation of Switch Case Statement.

7 **3 Hours**

EXPERIMENT 7

Implement a C program using for Looping Statement.

8 **3 Hours**

EXPERIMENT 8

Implement a C program using Do-While Looping Statement.

9 **3 Hours**

EXPERIMENT 9

Implement a C program using While Looping Statement.

10 **3 Hours**

EXPERIMENT 10

Implementation of Jumping Statements

11 **9 Hours**

EXPERIMENT 11

Implementation of One Dimensional Array and Two Dimensional Array.

12 **3 Hours**

EXPERIMENT 12

Implement a C program to perform String Manipulation Functions.

13 **9 Hours**

EXPERIMENT 13

Implement a C program using structures and files

14 **3 Hours**

EXPERIMENT 14

Implement a C program which includes four categories of functions and recursive functions.

15 **3 Hours**

EXPERIMENT 15

Implement a C program for Call by value and Call by Reference.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2017
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18FD206 FUNDAMENTALS OF MICROBIOLOGY 3 0 0 3

Course Objectives

- Understand the microbial classification and growth
- Apply the plating and staining techniques to identify the microbes
- Evaluate the role of microbes in food spoilage and food borne illness.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Assess the structure and nutritional requirements of microbes
2. Apply the growth characteristics and reproduction of microbes to predict their multiplication and destruction
3. Analyze the microbial structure by plating, staining and microscopic methods
4. Compare the microbial spoilage of different foods and their control measures
5. Evaluate the toxicity of microbes in food-borne illness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			2	1	2								
2	1			2	1	2								
3	2			2	2	2								-
4	2			2	1	1								
5	2			3	3	2								

UNIT I **9 Hours**

CLASSIFICATION AND STRUCTURE OF MICROBES

Evolution and scope of microbiology. Microbial classification, nomenclature, structural organization and multiplication of bacteria, viruses, algae and fungi. Taxonomic groups and general methods of classifying bacteria. Nutritional requirements and nutrient transport phenomenon: passive diffusion, facilitated diffusion, group translocation and active transport. Types of media used for growth and detection for microbes

UNIT II **9 Hours**

GROWTH AND MULTIPLICATION OF MICROBES

Microbial growth and reproduction,Binary fission, Generation time, Specific growth rate, growth curve, methods of measuring microbial growth; Nature of microbial growth, mixed population, Sequence of growth, diauxic growth, Symbiotic growth, synergistic growth antagonistic growth. Physical, chemical and biological factors influencing the growth and destruction of microorganisms including concepts of Z, F and D values; Bacterial Genetic recombination - transformation, transduction, conjugation

UNIT III **9 Hours**

PLATING, STAINING AND MICROSCOPY

Plating methods-Pour plate, Spread plate, Streak plate, slat, stab. Principles of staining techniques-simple staining, gram staining, acid fast, negative staining, capsular staining, flagellar staining, spore staining. Microscopy and microscopes: Types of microscope. Simple microscope, Compound microscope, Bright field microscope, Phase contrast microscope, Scanning electron microscope, Transmission electron microscope.

UNIT IV **9 Hours**

ROLE OF MICROBES IN SPOILAGE OF FOODS AND THEIR CONTROL

Causes of food spoilage, Factors affecting kinds, numbers and growth of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients , redox potential and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere, Chemical changes caused by microorganisms. Microbial flora associated with various food groups and their spoilage potential. Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, Benzoates, Sorbates / Propionates naturally occurring antimicrobials; Physical methods- Low and high temperatures, drying, radiation and high pressure

UNIT V **9 Hours**

MICROBIAL AGENTS OF FOOD BORNE ILLNESS

Food borne infections and food poisoning. Microbial toxins - types, Gram Negative and Gram positive food borne pathogens, Salmonella, Coliforms, E. coli, Shigella, Vibrio cholerae, Staphylococcus aureus, Clostridium Botulinum, Lysteria monocytogenes. Toxigenic algae and fungi. Food borne viruses - Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases. Helminths, nematodes and protozoa - Types of food involved, toxicity and symptoms

FURTHER READING

Recent trends in microscopy and staining methods, Prevention of water-borne and food-borne illness, Mutation in microbes. Microbiology of air and water. Hurdle technology

Total: 45 Hours

Reference(s)

1. Banwart, G, Basic food microbiology. Springer Science & Business Media, 2012.
2. Tauro, P., Kapoor, K. K., & Yadav, K. S. Microbiological methods. An Introduction to Microbiology,1986.

18FD207 ENGINEERING PRACTICES LABORATORY

0 0 4 2

Course Objectives

- To provide training for fabricating the components using carpentry, sheet metal, fitting and welding equipments/tools.
- To develop the skills for preparing the green sand mould using foundry tools and to make simple electrical & pipe line connections using suitable tools.
- To understand the procedure of dismantling and assembling of home appliances & petrol engine.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply simple components using carpentry, sheet metal, fitting & welding equipments/tools.
2. Analyse the basic pipe line connections for house hold applications
3. Evaluate the performance of basic household wiring connections
4. Implement a Boolean arithmetic operations
5. Analyse the efficacy of Multimeter, Shaping, Lathe and drilling equipments

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

1 **6 Hours**

EXPERIMENT 1

Forming of simple object using sheet metal tools -Model making (Trays, frame for solar drier).

2 **6 Hours**

EXPERIMENT 2

Welding-spot welding, Gas welding Practice, SS welding, arc welding of butt joints, lap joints, tee joints, making simple objects. Welding frame for solar drier

3 **6 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example - electrical switch box, Tool box, Letter box)

4 **6 Hours**

EXPERIMENT 4

Making basic pipe line connections using PVC pipe, valves, Tee joint , taps, coupling, unions, Reducers, Elbow, Pipes, Bend, Gate valve, Flanges (with threads) for making a pipe connections for house application. Symbols used for the identification in plumbing line sketches.

5 **6 Hours**

EXPERIMENT 5

Resistance color coding and usage of multimeter for V, I, R, C measurements and terminal identification of active devices.

6 **6 Hours**

EXPERIMENT 6

Study of electronic components and equipment - Basic household wiring using switches, fuse, indicator lamp etc.

7 **6 Hours**

EXPERIMENT 7

Implementation of boolean arithmetic operations and two way switch using logic gates.

8 **6 Hours**

EXPERIMENT 8

Bending and Flaring of pipes

9 **6 Hours**

EXPERIMENT 9

Shaping, Lathe and drilling

10 **6 Hours**

EXPERIMENT 10

Soldering simple electronic circuits and checking continuity.

Total: 60 Hours

18FD301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series
2. Formulate a function in frequency domain whenever the function is defined in time domain.
3. Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
4. Classify a partial differential equation and able to solve them.
5. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **10 Hours**

FOURIER ANALYSIS

Fourier series for periodic functions. Orthogonal functions. The Euler coefficients. Fourier transforms. Properties of Fourier transform. Applications of Fourier series and transform analysis.

UNIT II **5 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT III **11 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. . De Alemberts solution of the wave equation. Heat equation. Laplaces equation. Telegraph equations. Laplace transform method of solution.

UNIT IV **9 Hours**

MATHEMATICAL STATISTICS AND DATA ANALYSIS

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, T-test, DMRT, simple linear regression, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis. Data Sampling, Random Sampling, Reliability of Data, Testing of Hypothesis, RMSE, chi-square, Confidence Interval, Quality Control.

UNIT V **10 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
5. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995

18FD302 FOOD MICROBIOLOGY 3 0 0 3

Course Objectives

- Provide an idea about the general principles of food microbiology.
- Explain the interactions between microorganisms and food and factors influencing their growth and survival.
- Acquire knowledge about pathogens causing food borne infections and their detection methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Classify the microorganism and identify the microorganism associated with foods
2. Analyse the microorganism responsible for spoilage of foods and its assessments
3. Apply the preservation methods to control the spoilage and assess the microbial growth in foods
4. Analyze the importance of microorganism in food fermentation and fermented products
5. Assess the cause for food borne illness and Understand the quality control for safety of foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			3		2								
2	1			2		3								
3	2			2	2	3								
4	2			2	1	1								
5	1			2	2	3								

UNIT I **9 Hours**

MICROBES IN CEREALS, FRUITS AND VEGETABLES

Microbiology of cereal and cereal products, Microbiology of fruits and vegetables and canned foods, Microbiology of sugar and sugar products and salts and spices

UNIT II **9 Hours**

MICROBES IN MILK, MEAT, FISH AND POULTRY

Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods

UNIT III **9 Hours**

MICROBES IN FOOD FERMENTATIONS

Microbes of importance in food fermentations, Homo & hetero-fermentative bacteria,yeasts & fungi; Biochemistry of fermentations - pathways involved, Lactic acid bacteria fermentation and starter cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, Fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idly, soy products, fermented vegetables and meats.

UNIT IV **9 Hours**

CONTROL OF MICROBES IN FOODS

Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

UNIT V **9 Hours**

MICROBIAL EXAMINATION OF FOODS

Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulinum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

Total: 45 Hours

Reference(s)

1. Banwart, G.J., Basic Food Microbiology, 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. Food Microbiology. MJP Publishers, Chennai, 2007.
3. Jay, J.M. Modern Food Microbiology. 4th Edition. CBS Publishers, 2003
4. Adams, M.R. and M.O. Moss. Food Microbiology. New Age International, 2002
5. Khetarpaul, Neelam. Food Microbiology, Daya Publishing House, 2006.

18FD303 FOOD CHEMISTRY 3 0 2 4

Course Objectives

- Understand the properties and composition of food
- Assess the role of nutrients in food
- Evaluate the effect of processing on nutrients in food

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the metabolic process of food and recommended dietary allowances of nutrients
2. Apply the structural changes in carbohydrates during processing and predict their physiological effects in the body
3. Analyze the functional and nutritional properties of proteins
4. Evaluate the properties and physico-chemical changes of fats and oil during processing and their industrial importance
5. Justify the importance of vitamins and minerals and their physiological role in the human body

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2	2	3	2						2		
2		1	2	2	2	1						2		
3		1	2	2	2							2		
4		1	2	2	2	1						2		
5		1	2	2								2		

UNIT I **9 Hours**

INTRODUCTION TO FOOD COMPONENTS AND IMPORTANCE OF NUTRITION

Nutrients: Sources and functions; Food groups: classification and importance; Metabolism -Digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Energy Balance: Basal metabolism- BMR; Body surface area and factors affecting BMR. Water intake and losses; Diet: balanced diet, recommended dietary allowances; Malnutrition

UNIT II **9 Hours**

CARBOHYDRATES IN FOOD

Carbohydrates -Definition, classification, sources, structure, reducing and non-reducing sugars, properties of sugars-sweetness index, caramelization, Maillard reaction. Starch-sources, structure and composition, gelatinization and retrogradation. Modified starches: methods of starch modification; dietary fibers and carbohydrates digestibility

UNIT III **9 Hours**

PROTEINS IN FOOD

Proteins: Sources, Amino acids - classification, structure of protein, Nutritional Aspects: essential amino acids, biological value, Protein Efficiency Ratio (PER), Amino acid score, Protein digestibility; Functional properties of proteins in food and industrial importance. Processing induced functional and nutritional changes in protein.

UNIT IV **9 Hours**

FATS AND OILS IN FOOD

Fats -Sources, structure and classification of fatty acids,Nomenclature, Isomerism, essential fatty acids; Properties: Crystal formation, polymorphism, melting point, smoke point, Flash point, fire point and emulsification. Deep fat frying: physical, chemical and nutritional changes. Hydrolytic and Oxidative rancidity. Quality analysis: Iodine value, Peroxide value, Saponification value, Free fatty acid test. Fat Modification: Hydrogenation, Winterization and Inter-esterification.

UNIT V **9 Hours**

MICRONUTRIENTS, VITAMINS AND MINERALS

Vitamins and Minerals - Classification, Sources, Physiological role and Deficiency disorders, RDA, Losses of vitamins and minerals during processing, restoration and fortification.

FURTHER READING

Biological role of dietary fibers, plasticizing properties of fats, malnutrition, nutrient supplementation, food composition database, Fat replacers and Artificial sweeteners.

1 **3 Hours**

EXPERIMENT 1

Estimation of pH and titratable acidity

2 **3 Hours**

EXPERIMENT 2

Estimation of protein by colorimetric methods

3 **3 Hours**

EXPERIMENT 3

Estimation of protein by kjeldahl method

4 **3 Hours**

EXPERIMENT 4
Estimation of reducing sugars by titrimetric method

5 **3 Hours**

EXPERIMENT 5
Estimation of invert sugars by titrimetric method

6 **3 Hours**

EXPERIMENT 6
Estimation of starch by (a) titrimetric method (b) colorimetric method

7 **3 Hours**

EXPERIMENT 7
Estimation of fat by Soxhlet apparatus

8 **3 Hours**

EXPERIMENT 8
Estimation of Total Ash by muffle furnace

9 **3 Hours**

EXPERIMENT 9
Estimation of crude fiber

10 **3 Hours**

EXPERIMENT 10
Estimation of Vitamin C

Total: 75 Hours

Reference(s)

1. Cox, M.M. and Nelson, David L. Lehininger, Principles of Biochemistry. 5thEdition.H.Freeman, 2008
2. Murray, Robert K. et al.,Harper Illustrated Biochemistry, 27th Edition. McGraw-Hill, 2006.
3. Satyanarayanan, U. Biochemistry Books and Allied. 2005
4. Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 3rd Revised Edition, Springer-Verlag, 2004.
5. H.D.Belitz, W.Grosch,P.Schieberle,Food Chemistry,Springer,2009
6. Vaclavik, V. A. and Christian E. W. Essentials of Food Science. 2nd Edition, Kluwer-Academic, Springer, 2003.

18FD304 UNIT OPERATIONS IN FOOD PROCESSING

3 0 0 3

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the principle and operation of different types of evaporators and explain the drying of principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different kind of particles present in foods.
3. Differentiate the operation of different kind of mixing and size reduction equipment
4. Implement the leaching and extraction techniques to transform raw materials into value added products
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		1									1
2	1		2				2							1
3	2		1											1
4	2				1	2								2
5	2				2								1	

UNIT I **8 Hours**

DRYING AND EVAPORATION

Unit operations in food processing - Drying - principles, theory of drying, equilibrium moisture content, methods of moisture determination and source of heat. Evaporation - definition - single and multiple effect evaporation-types, application and performances of evaporators and boiling point elevation - steam economy, mass and heat balance.

UNIT II **11 Hours**

MECHANICAL AND MEMBRANE SEPARATION

Velocity of particles moving in a fluid- terminal velocity, drag coefficient. Sedimentation, Stokes' law, sedimentation equipment, flotation, sedimentation of particles in a gas, settling under combined forces. Centrifugal Separation, centrifuge equipment. Filtration, filter cake resistance, constant - rate filtration, constant - pressure filtration, filtration graph. Filtration equipment, plate and frame filter press, rotary filters, centrifugal filters, air filters. Air Separators and Sieving: Cyclones - optimum shape efficiency, impingement separators, classifiers, rates of throughput, standard sieve sizes, cumulative analysis, particle size analysis, industrial sieves. Membrane Separation: osmotic pressure, ultra filtration, reverse osmosis, rate of flow through membranes.

UNIT III **7 Hours**

MIXING AND SIZE REDUCTION

Mixing - theory of solid and liquid mixing- equipment - effect on foods. Size reduction - grinding and cutting - principles of comminuting - characteristics of comminuted products - particle size distribution in comminuted products - energy and power requirements in comminuting - crushing efficiency - Rittinger"s, Bond"s and Kick"s laws for crushing-size reduction equipment - crushers - jaw crusher, gyratory crusher-crushing rolls - grinders -hammer mills - rolling compression mills - attrition, rod, ball and tube mills - construction and operation.

UNIT IV **9 Hours**

EXTRACTION AND LEACHING

Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment. Leaching: Principles of continuous leaching, counter-current leaching, leaching equipment.

UNIT V **10 Hours**

CRYSTALLIZATION, DISTILLATION AND LEACHING

Crystallization - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers- Distillation: Distillation process - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch and fractional distillation - operation and process - advantages and limitations-distillation equipment -construction and operation - factors influencing the operation.

FURTHER READING

Other unit operations baking, frying, pasteurization, sterilization, blanching

Total: 45 Hours

Reference(s)

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd; 2nd Revised edition, Pergamon Press, 1983.
2. C.J.Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.
4. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2005
5. K. M. Sahay and K.K.Singh, Unit Operation of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
6. Albert Ibarz, Gustavo V. Barbosa-Canovas, Unit Operations in Food Engineering, Food Preservation Technology Series, CRC Press, London, 2003.

18FD305 DATA STRUCTURES 2 0 2 3

Course Objectives

- Understand the various techniques of sorting and searching
- Design and implement arrays, stacks, queues, and linked lists
- Understand the complex data structures such as trees and graphs

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Compute the time and space complexity of searching and sorting algorithms with asymptotic notations
2. Implement all the operations of linear data structures to store and retrieve the given data.
3. Create a hierarchical data structure to represent the given data using tree datastructure.
4. Design graph algorithms to compute the shortest path of the given graph and to identify the minimum spanning tree.
5. Implement heap and hash functions for dynamic extension of storage space.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	1									
2	1		2		2	1								
3	1		1		2	1								
4	1	1	2	1	1									
5	1	1	1		2	1								

UNIT I **5 Hours**

INTRODUCTION

Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices- Sorting Techniques-Selection, Bubble, Insertion, Merge, Heap, Quick, and Radix sort-Linear Search - Binary Search.

UNIT II **7 Hours**

LINEAR DATA STRUCTURES

Linked Lists - Linked stacks and queues - Operations on polynomials - Doubly linked lists - Circularly linked lists- Applications of Stack and Queue.

UNIT III **5 Hours**

NON LINEAR DATA STRUCTURES

Binary Trees - Binary search trees - Tree traversal - Expression manipulation

UNIT IV **7 Hours**

GRAPH ALGORITHMS

Graphs - Representation of graphs - BFS, DFS - Topological sort - Shortest path problems- Dijkstras Algorithm- Minimum Spanning Tree- Prims and Krushkals Algorithm

UNIT V **6 Hours**

DYNAMIC STORAGE MANAGEMENT

Dynamic storage management - Binary Heap - Heap sort - Hash functions - separate chaining, open addressing - rehashing - Extendible hashing.

FURTHER READING

AVL, Splay Trees, Tries, Backtracking.

1 **3 Hours**

EXPERIMENT 1

Implementation of searching algorithms
a) Linear Search
b) Binary Search

2 **3 Hours**

EXPERIMENT 2

Implementation of sorting algorithms
a) Insertion sort
b) Selection sort
c) Quick sort
d) Merge sort

3 **3 Hours**

EXPERIMENT 3

Design a Singly linked list and perform insertion, deletion and searching.
a) Array implementation of List ADT
b) Linked list implementation of List ADT

4 **4 Hours**

EXPERIMENT 4

Construct a stack ADT and perform push and pop operations.
a) Array implementation of Stack ADT
b) Linked list implementation of Stack ADT

5 **4 Hours**

EXPERIMENT 5

Construct a Queue ADT and perform enqueue and dequeue operations.
a) Array implementation of queue ADT
b) Linked list implementation of queue ADT

6 **3 Hours**

EXPERIMENT 6

Develop a program to create a Binary Search Tree and to traverse the tree

7 **3 Hours**

EXPERIMENT 7

Compute the shortest path from a single source node using Dijikstras Algorithm.

8 **3 Hours**

EXPERIMENT 8

Construct a graph and perform graph traversal

9 **4 Hours**

EXPERIMENT 9

Develop a program to construct a minimum spanning tree with the given graph using:
a) Prims Algorithm
b) Krushkals Algorithm

Total: 60 Hours

Reference(s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, MIT Press, 2014.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
4. Gilberg, Data Structures: A Pseudocode Approach with C, Second Edition, Cengage Learning, 2007.

18FD306 THERMODYNAMICS 2 1 0 3

Course Objectives

- Study the fundamentals of thermodynamics and First law.
- Provide knowledge on application of first law of thermodynamics.
- Impart knowledge on second law of thermodynamics and entropy.
- Study the thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
- Study the working principle of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

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, its phase change processes and understand the working of steam boilers.
5. Understand the working of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

REFRIGERATION SYSTEMS AND COMPONENTS

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

FOR FURTHER READING

Heat engine and heat pump, Air standard Otto cycle, Air standard Diesel cycle, Air-standard Brayton cycle

Total: 45 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2003.
2. P.K.Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
3. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi,2011.
4. R.S.Khurmi, Steam table with Psychometric chart,S.Chand Publications, New Delhi,2009.
5. J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2002.
6. C.P.Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003.

18FD307 FOOD MICROBIOLOGY LABORATORY 0 0 4 2

Course Objectives

- Expose various microbial aspects of Food Processing
- Impart knowledge on identification of microbes using different technique and its enumeration methods
- Recognize the role of microbes in Food spoilage and preservation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the sources of microorganism and its spoilage in food
2. Select the appropriate equipment for Microbiological works
3. Practice the different sterilization methods throughout the experiment
4. Inoculate, isolate and identify the microorganism from both liquid and solid samples
5. Understand the Principles of CCP(Critical Control Points) in Food safety

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				1									
2	2				2									
3	2		3		3	2	1							
4	1				2	3								
5					2	2	1							

1 **2 Hours**

EXPERIMENT 1

Introduction to equipments commonly used in microbiology laboratory and Guidelines for safety in food microbiology laboratory work

2 **2 Hours**

EXPERIMENT 2

Sterilization of glasswares used in microbiology laboratory

3 **4 Hours**

EXPERIMENT 3

Microscopy Working and care of Microscope

4 **4 Hours**

EXPERIMENT 4

Simple staining: monochrome staining and negative staining

5 **4 Hours**

EXPERIMENT 5

Differential staining: Grams staining

6 **4 Hours**

EXPERIMENT 6

Preparation of culture media and Broth, slants, stabs

7 **8 Hours**

EXPERIMENT 7

Microbiological quality of milk- Sampling, Serial Dilution and enumeration

8 **8 Hours**

EXPERIMENT 8

Isolation and enumeration of microorganisms using pour plate method

9 **12 Hours**

EXPERIMENT 9

Isolation and enumeration of microorganisms using spread plate method

10 **12 Hours**

EXPERIMENT 10

Isolation of microorganisms using streak plate method

Total: 60 Hours

Reference(s)

1. James G.Cappuccino,Natalie Sherman,Microbiology: A laboratory Manual,5th edition,Benjamin/Cummings Science,1998

18FD308 UNIT OPERATIONS IN FOOD PROCESSING LABORATORY

0 0 2 1

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Find the application of different types of evaporators and understand the drying principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different particles present in foods.
3. Select the mixing equipment for dry powders, low or high viscosity liquids and acquire knowledge on importance of size reduction and energy requirement.
4. Organize the transformation of raw materials to quality food products using different processing technologies.
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2												1	
2	2				1									
3			2											
4	1												1	
5	1				2									2

1 **2 Hours**

EXPERIMENT 1

Determination of economy and thermal efficiency of evaporator

2 **2 Hours**

EXPERIMENT 2

Solving problems on single effect evaporator

3 **2 Hours**

EXPERIMENT 3

Solving problems on multiple effect evaporators

4 **2 Hours**

EXPERIMENT 4

Determination of separation efficiency of centrifugal separator

5 **2 Hours**

EXPERIMENT 5

Determination of collection efficiency in cyclone separator

6 **2 Hours**

EXPERIMENT 6

Determination of efficiency of liquid solid separation by filtration

7 **2 Hours**

EXPERIMENT 7

Determination of particle size of granular foods by sieve analysis

8 **2 Hours**

EXPERIMENT 8

Performance evaluation of a sieve

9 **2 Hours**

EXPERIMENT 9

Determination of performance characteristics in size reduction using the burr mill

10 **2 Hours**

EXPERIMENT 10

Determination of energy requirement in size reduction using ball mill

11 **2 Hours**

EXPERIMENT 11

Determination of energy requirement in size reduction using hammer mill

12 **2 Hours**

EXPERIMENT 12

Performance evaluation of pin mill

13 **2 Hours**

EXPERIMENT 13

Performance evaluation of a hammer mill

14 **2 Hours**

EXPERIMENT 14

Performance evaluation of a steam distillation process

15 **2 Hours**

EXPERIMENT 15

Visit to extraction and sugar industry

Total: 30 Hours

Reference(s)

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd; 2nd Revised edition, Pergamon Press, 1983.
2. C.J.Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.
4. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2005
5. K. M. Sahay and K.K.Singh, Unit Operation of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work place communication

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2											2			
3									2					

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18FD401 HEAT AND MASS TRANSFER 3 0 2 4

Course Objectives

- Impart the knowledge of conduction heat transfer mechanisms
- Provide the knowledge on the principles of free and forced convection
- Impart the knowledge on black body radiation and grey body radiation
- Study the performance of various types of heat exchangers
- Learn about diffusion mass transfer

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand the Conduction mode of heat transfer in simple and composite systems
2. Determine the parameters associated with free and forced convection
3. Calculate the radiation heat transfer in black and grey bodies
4. Compare the performance of various types of heat exchangers
5. Understand the concept of diffusion mass transfer

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2	1	2												
3	1	2	1											
4	1	2	1											
5	1	2												

9 Hours

UNIT I

CONDUCTION

Introduction to unsteady state heat transfer by conduction and transient flow. Basic transfer processes - heat, mass and momentum - heat transfer process - conductors and insulators - Steady state heat - conduction - Fourier's law of heat conduction - thermal conductivity and thermal resistance - linear heat flow - heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and spheres - extended surfaces (fins).

9 Hours

UNIT II

CONVECTION

Newton law of cooling - film coefficient of heat transfer - convection - Forced convection- external flow, flow over plates, cylinders, bank of tubes, internal flow- Free convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer - overall heat transfer coefficient.

9 Hours

UNIT III

RADIATION

Radiation heat transfer - concept of black and grey body - monochromatic total emissive power - Kirchoff's law - Planck's law - Stefan-Boltzman's law - Black body radiation- Grey body radiation - Shape factor

9 Hours

UNIT IV

HEAT EXCHANGERS

Heat exchangers - Logarithmic Mean Temperature Difference (LMTD) - Classification - overall coefficient of heat transfer - tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger - applications of heat exchangers, NTU - Effectiveness - NTU methods.

9 Hours

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.

FOR FURTHER READING

Application of Heat and mass transfer in food processing operations. Heat exchangers for solid, liquid and semi-solid foods.

1 **2 Hours**

EXPERIMENT 1

Determination of thermal conductivity in a composite wall

2 **2 Hours**

EXPERIMENT 2

Determination of thermal conductivity by lagged pipe method

3 **4 Hours**

EXPERIMENT 3

Determination of heat transfer coefficient in a parallel flow heat exchangers

4 **2 Hours**

EXPERIMENT 4

Determination of heat transfer coefficient in a counter flow heat exchangers

5 **4 Hours**

EXPERIMENT 5

Determination of heat transfer coefficient in free convection

6 **4 Hours**

EXPERIMENT 6

Determination of emissivity of the given test surface

7 **2 Hours**

EXPERIMENT 7

Determination of Stefan-Boltzmanns constant in radiation heat transfer

8 **2 Hours**

EXPERIMENT 8

Determination of effectiveness of heat transfer in a coiled type heat exchanger

9 **4 Hours**

EXPERIMENT 9

Experiment on diffusion

10 **4 Hours**

EXPERIMENT 10

Mass transfer with or without chemical reaction

Total: 75 Hours

Reference(s)

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2010.
2. Yunus A.Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2007.
3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009.
4. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014.
5. Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007.
6. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2009.

18FD402 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

3 0 0 3

Course Objectives

- Understand the principles of food processing and their impact on the shelf life and quality of food materials and products
- Learn various methods of food processing viz., drying, milling, freezing, thermal treatments etc.
- Introduce novel food processing techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply different methods of high and low temperature processing techniques over raw foods and analyze the process time of that food properties of food
2. Understand and apply the suitable dryers to different food to increase the shelf life and analyse the working of extrusion process and their features
3. Analyze the shelf life of foods processed and preserved by natural and chemical agents
4. Understand the operations and features of different non-thermal processing techniques and applying to improve the shelf life of product
5. Apply the principle of advanced novel techniques in food processing industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2									1	
2	2	2		2										1
3	2	2												1
4	2	2											1	
5	2	2	2						2				1	

10 Hours

UNIT I

HIGH AND LOW TEMPERATURE PROCESSING OF FOODS

Methods of applying heat to food - Blanching, Pasteurization, Sterilization - thermo bacteriology, commercial sterility, calculation of process time - methods of sterilization - equipment. Methods of low temperature preservation - Chilling, Freezing, freeze drying and freeze concentration - theory and principles.

10 Hours

UNIT II

DRYING, DEHYDRATION AND EXTRUSION

Drying - types of dryers. Dehydration-Osmotic dehydration-theory and principles. Water activity - sorption behaviour of foods - water activity and food stability - Relationship between water activity and moisture - Equilibrium moisture content. Extrusion cooking - principles and types of extruders - single and double screw extruder- construction and working. Effect of different parameters - quality of the extruded products.

10 Hours

UNIT III

PROCESSING AND PRESERVATION OF FOODS BY CHEMICALS

Food preservation by sugar, salt, acid - Principles - mechanism- antimicrobial activity. Preservation by chemicals- type of chemical preservatives- sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc. Factors affecting antimicrobial activity of preservatives.

7 Hours

UNIT IV

NON THERMAL PROCESSING

Food Irradiation - High Pressure Processing- Pulsed electric field processing, pulsed light treatment and Ultrasound - Theory and Principles - effect on microorganisms- Application in Processing of foods.

8 Hours

UNIT V

NOVEL METHODS OF FOOD PROCESSING

UV treatment, Ozone treatment, dielectric heating- microwave, radio frequency, ohmic and infrared heating theory, equipment, applications and effect on foods. Hurdle technology and Nano-technology - principle - application in food processing.

FOR FURTHER READING

Electrical resistance heating of foods - Electrically Processed Foods. Effect of heat and ultrasound on microorganisms and enzymes. Oscillating magnetic fields in Food Preservation.

Total: 45 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press, 1st Edition, 2004

18FD403 REFRIGERATION AND COLD CHAIN MANAGEMENT

3 0 0 3

Course Objectives

- Learn the principles and the components involved in domestic and commercial refrigeration systems
- Impart knowledge on application of Refrigeration & Air conditioning systems in food industries
- Provide knowledge on handling and transport of food materials by ensuring the superior quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Select appropriate components of the refrigeration unit and analyze the effect of different refrigerants on environment
2. Differentiate various refrigeration cycles and its applicability
3. Apply knowledge of psychrometry for air conditioning & various food processing operations
4. Apply the knowledge of refrigeration and air conditioning in persevering foods using domestic and industrial refrigeration systems
5. Choose appropriate refrigerated transport facilities for ensuring the product quality

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		2			1							
2	3						1	1						
3	2		2	1			1						1	1
4	2	1	1	1		1		1					2	1
5	3	1	3			1			1				1	1

10 Hours

UNIT I

REFRIGERATION PRINCIPLES AND COMPONENTS

Refrigeration-principles - refrigeration effect-coefficient of performance-units of refrigeration - Refrigeration components-compressor-classification-principle and working- condensers-types-construction, principle and working. Evaporators-types-principle and working. Expansion device-types construction, principle and working. Refrigerants-properties-classification comparison and advantages-chloroform carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

9 Hours

UNIT II

VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

Simple vapour compression cycle- T-S diagram - p-h chart- vapour compression system-different types- vapour absorption cycle - simple and practical vapour absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator-Lithium bromide refrigeration-construction and principles

9 Hours

UNIT III

PSYCHROMETRY

Psychrometry-terms-psychrometric chart- sensible heating- sensible cooling process -by-pass factor-humidification- dehumidification-sensible heat factor- evaporative cooling-cooling and dehumidification- cooling and humidification process-heating and dehumidification - heating and humidification- adiabatic mixing of air streams

9 Hours

UNIT IV

AIR CONDITIONING SYSTEM

Air conditioning systems- equipment used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning system- application of refrigeration and air conditioning-domestic refrigerator and freezer-refrigerated trucks- ice manufacture- cold storage-freeze drying

8 Hours

UNIT V

COLD CHAIN MANAGEMENT

Cold chain, Refrigerated Transport-Refrigerated container trucks, Handling and Distribution, Traceability and barcode. Product Temperature and Moisture monitoring

FOR FURTHER READING

Eco friendly refrigerants, types of compressors and its selection, Industrial and domestic refrigerants

Total: 45 Hours

Reference(s)

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2002
2. R.S. Khurmi and J. K. Gupta, A text book of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002
3. Manohar Prasad, Refrigeration and Air conditioning, New Age International (P) Ltd, New Delhi, 1999
4. W. F. Stoecker, and J. W. Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1986
5. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th edition, 2001
6. S. C. Arora and S. Domkundwar, A course in Refrigeration and Air conditioning, DhanpatRai (P) Ltd., New Delhi, 1997

18FD404 FOOD ANALYSIS 3 0 0 3

Course Objectives

- Expose the principles of chemical and instrumental methods of food analysis
- Expose the methods of chemical and instrumental methods of food analysis
- Expose the techniques of chemical and instrumental methods of food analysis

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	1										2	
2		2						2				2	2	
3		2			1			2				2	2	
4			2		2			1				2	2	
5		2										2		2

10 Hours

UNIT I

INTRODUCTION

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude fiber and dietary fibre.

10 Hours

UNIT II

LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

10 Hours

UNIT III

SPECTROSCOPIC TECHNIQUES

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; IR Spectroscopy in online determination of components of food- FT-IR tintometer in color intensity determination; applic ation of Atomic Absorption Spectrophotometer and ICP-AES in analysis of mineral elements and fluorimeter in vitamin analysis.

10 Hours

UNIT IV

CHROMATOGRAPHIC TECHNIQUES

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; Column chromatography for purification analysis- Ion exchange and affinity chromatography; HPLC and GC in food analysis; Significance of MS detectors in HPLC and GC; FAME analysis in oils and fats

5 Hours

UNIT V

ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY

Basic principles; application of the electrophoresis in food analysis; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars; Estimation of simple sugars and disaccharides by polarimeter.

FOR FURTHER READING

Advanced Food analytical techniques, equipments and Instruments

Total: 45 Hours

Reference(s)

1. Pomeranz, Yeshajahu. Food Analysis: Theory and Practice 3rd Edition. Aspen Publishers / Springer, 2000
2. Nielsen, S. Suzanne. Food Analysis 3rd Edition. Springer, 2003
3. Otles, Semih. Methods of Analysis of Food Components and Additives, CRC Press, 2005
4. Nollet, Leo M.L. Hand Book of Food AnalysisII Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004

18FD405 JAVA PROGRAMMING 2 0 2 3

Course Objectives

- Design, write, debug and run java programs using JDK tools
- Develop applications to manipulate the data available in databases using database connectivity and Java library
- Develop applications to manipulate the data available in databases using Java and SQL

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Apply object oriented programming concepts to implement basic IT related problems using NetBeans tool
2. Develop applications using suitable data structures on collection classes and Java I/O classes and interfaces
3. Develop applications to manipulate the data available in databases using Java and SQL
4. Create event-driven GUI applications using event handling mechanisms and swings
5. Build programs that run on multi-core environments using multi-threaded programming concepts

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		1										
2	1	1		2										
3	1	2			1									
4	1	2									1			
5	1	1												

8 Hours

UNIT I

BASICS OF JAVA

Overview of Java - Data Types, Variables, and Operators - Control Structures - Arrays - Classes - Objects Methods - Nested Classes - Primitive type Wrappers - Inheritance - Method overriding - Abstract Classes - Interfaces - Packages and Exception Handling.

5 Hours

UNIT II

GENERIC PROGRAMMING AND I/O STREAMS

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure - Restrictions on Generics - Collection classes: Array List, HashMap, HashTable, Linked List, Vector, Garbage Collection - I/O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/O - Serialization.

7 Hours

UNIT III

JAVA LIBRARY

Enumerations - Autoboxing - Annotations- Assertion - Lambda Expressions - String Handling - Special String operations and Methods - String Buffer, String Builder - System - Math - Date and Time - Formatter - Database Connectivity - Basics of Networking.

5 Hours

UNIT IV

EVENT HANDLING

Applets - Event Handling Listener interfaces - Event Classes - Event Listeners - Adapter classes - AWT Controls

5 Hours

UNIT V

CONCURRENT PROGRAMMING

Multi-threaded programming - Life Cycle of a Thread - Creating Threads - Synchronization - Deadlock - Inter-thread Communication - Interrupting Threads - Concurrency Utilities

FURTHER PROCESSING

Note pad application- Standalone applications using java - Implementing algorithms using java - Reflection

1 **4 Hours**

EXPERIMENT 1

Programs using class and methods

2 **3 Hours**

EXPERIMENT 2

Inheritance implementation

3 **3 Hours**

EXPERIMENT 3

Inheritance via Interface and Abstract class

4 **4 Hours**

EXPERIMENT 4

Programs on Package implementations

5 **4 Hours**

EXPERIMENT 5

Applications using Generic collections

6 **4 Hours**

EXPERIMENT 6

File Handling using IO streams

7 **4 Hours**

EXPERIMENT 7

Desktop applications using Swing

8 **4 Hours**

EXPERIMENT 8

Multi-threaded Programming

Total: 60 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, 9th Edition, McGraw Hill Education, 2014.
2. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals,9th Edition, Prentice Hall, 2013.
3. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features,9th Edition, Prentice Hall, 2013.
4. Kathy Sierra, Bert Bates, OCA/OCP Java SE 7 Programmer I and II Study Guide, First edition, McGraw Hill Education, 2014.
5. Rajkumar Buyya, S Thamarai Selvi, Xingchen Chu, Object Oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited, 2009.
6. Bert Bates, Kathy Sierra, Head First Java, 2nd Edition, OReilly Media, 2005.

18FD406 FLUID MECHANICS 3 1 0 4

Course Objectives

- Understand the basic properties of fluids and pressure measurement devices.
- Make familiar with calculation of forces in fluid structure interaction.
- Familiar with all the basic working and calculation based on flow measurement devices.
- Derive the unit for any parameter using dimensional analysis.
- Understand the basic working principles of pumps and its application.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Understand the properties of fluids and calculations on pressure measurement devices
2. Demonstrate the calculation of forces in fluid structure interaction.
3. Implement the working and calculations on flow measurement devices.
4. Derive the units for any parameter using dimensional analysis.
5. Assess the working principles of pumps and its application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		1										
2	1	1		1										
3	1	2		2										
4	1	2		2										
5	1	1		1										

12 Hours

UNIT I

PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENT

Continuum - Fluid - Types of fluid - Laws of fluid mechanics - Properties of Fluids - densities - kinematic viscosity, dynamic viscosity, capillarity - Surface tension, vapour pressure, measurement of pressure, manometers, U-tube manometer, differential manometer, inverted U-tube manometer.

12 Hours

UNIT II

FLUID FLOW

Classification of Flow - velocity and acceleration of a fluid particle - Rotational - irrotational - circulation and vorticity - one dimensional, two dimensional, three dimensional flows, continuity equation in Cartesian co-ordinates. Flow pattern - stream line - equipotential line - stream tube - path line - steak line - flow net - velocity potential - stream function. Principles of conservation of mass - energy - momentum - Euler"s equation of motion.

12 Hours

UNIT III

FLOW MEASUREMENTS

Bernoulli"s equation - applications - Venturimeter -Orifice. Flow through pipes - Navier stokes equation. Reynold"s experiment - Darcy - Weisbach equation for friction head loss - Chezy"s formula - minor losses in pipes - hydraulic gradient line - energy gradient line.

12 Hours

UNIT IV

DIMENSIONAL ANALYSIS AND SIMILITUDE

Dimensional analysis - Principle of dimensional homogeneity - the Buckingham"s Pi theorem - non-dimensional action of the basic equations- concept of geometries, kinematic and dynamic similarity. Important non-dimensional numbers - Reynolds, Froude, Euler dimensional analysis for scale up studies. Similitude - relationship between dimensional analysis and similitude.

12 Hours

UNIT V

PUMPS

Fluid machines, Classification, Positive displacement, centrifugal pump, Gear pump, Diaphragm pumps, vacuum pump, metering pump, peristaltic pump, principles and application characteristics. Performance; selection and specification. Fans, blowers, aspirators and compressors. Selection, types and applications.

FOR FURTHER READING

Classification of models- characteristic curve for pumps

Total: 60 Hours

Reference(s)

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

18FD407 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION LABORATORY

0 0 2 1

Course Objectives

- Understand the basic principles involved in food process engineering
- Apply the concept of mass and energy balances during processing of food
- Perform calculations on unit operations involved in food Processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the important quality characteristics of both solid and liquid foods
2. Assess the moisture content and drying rate for both porous and non-porous food materials
3. Evaluate the efficiency of different types dryers for the food materials
4. Analyze the changes occur during thermal processing of foods
5. Assess the microbial quality of foods by applying novel processing methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2			2									2	
2	2			2									2	
3	2	2												2
4	2	1	2											2
5		1											2	

1 **2 Hours**

EXPERIMENT 1

Determination of textural characteristics of foods

2 **4 Hours**

EXPERIMENT 2

Determination of flow behavior of Newtonian and Non-Newtonian fluids

3 **4 Hours**

EXPERIMENT 3

Determination of Thermal Death Time

4 **2 Hours**

EXPERIMENT 4

Determination of Water activity of processed food products

5 **2 Hours**

EXPERIMENT 5

Determination of drying rate of fruits and vegetables in Tray dryer

6 **2 Hours**

EXPERIMENT 6

Determination of colour characteristics of curry leaves during Fluidized bed dryer

7 **4 Hours**

EXPERIMENT 7

Determination of textural characteristics by Extrusion cooking

8 **2 Hours**

EXPERIMENT 8

Retention of ascorbic acid during Microwave drying of leafy vegetable

9 **2 Hours**

EXPERIMENT 9

Dehydration and rehydration of vegetables in rotary dryer

10 **2 Hours**

EXPERIMENT 10

Determination of freezing point of food materials

11 **2 Hours**

EXPERIMENT 11

Effect of UV treatment on microbial quality of liquid foods

12 **2 Hours**

EXPERIMENT 12

Effect of ohmic heating on microbial quality of liquid foods

Total: 30 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press, 1st Edition, 2004

18FD408 FOOD ANALYSIS LABORATORY 0 0 4 2

Course Objectives

- Familiarize the students on estimation of food composition by different methods
- Understand physicochemical properties of food components
- Analyze the changes in composition of foods with respect to carbohydrates, lipids, protein and water on processing.

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the various experimental procedures for different food constituents
2. Explain the quality of food
3. Analyze the changes in food composition during processing and storage
4. Implement the process protocol for quality food production
5. Evaluate and generate food formulation with longer shelf life

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	1	3								2		2
2		1	1	1								2		2
3		2		2	2								2	
4		2		2								2	2	
5		2	1	2	2							2	2	

1 **4 Hours**

EXPERIMENT 1

Estimation of pH and Titratable acidity

2 **4 Hours**

EXPERIMENT 2

Determination of moisture content and water activity

3 **4 Hours**

EXPERIMENT 3

Estimation of total sugars by titrimetric method.

4 **4 Hours**

EXPERIMENT 4

Estimation of starch by (a) titrimetric method (b) calorimetric method.

5 **4 Hours**

EXPERIMENT 5

Estimation of total polyphenols.

6 **4 Hours**

EXPERIMENT 6

Determination of Free Fatty Acids

7 **4 Hours**

EXPERIMENT 7

Estimation of oil in oil seeds

8 **4 Hours**

EXPERIMENT 8

Estimation of protein by kjehdal method

9 **4 Hours**

EXPERIMENT 9

Estimation of crude fibre.

10 **4 Hours**

EXPERIMENT 10

Determination of antioxidant activity by DPPH Method

11 **4 Hours**

EXPERIMENT 11

Extraction and estimation of curcumin.

12 **4 Hours**

EXPERIMENT 12

Extraction and estimation of lycopene.

13 **4 Hours**

EXPERIMENT 13

Extraction and estimation of carotene.

14 **4 Hours**

EXPERIMENT 14

Determination of Reducing sugar by Nelson Somogyi method.

15 **4 Hours**

EXPERIMENT 15

Determination of adulterants in food

Total: 60 Hours

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights: Biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2										2				

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts –identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

18FD501 BAKING AND CONFECTIONERY TECHNOLOGY

3 0 0 3

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and cakes
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the principles of baking and analyze the role of ingredients in baking
2. Compare the processing method for the production of biscuits and cookies
3. Apply the production process for different types of confectionery products
4. Illustrate and analyze the processing parameters of baking machineries
5. Assess the standards and quality control for bakery and confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2									2			2
2			2							2				2
3			2	2									2	
4	2				2						2			2
5		2	2										2	

UNIT I **9 Hours**

BAKING PRINCIPLES AND BREAD

Introduction to wheat- Structure, types, quality evaluation. Dough rheology. Baking principles, Bread- role of ingredients and its chemistry, additives, varieties of bread. Methods of bread preparation- advantages and disadvantages, bread spoilage and remedies. Cake- types of cakes, role of ingredients, cake mixing methods, Preparation, faults and remedies.

UNIT II **9 Hours**

BISCUIT AND COOKIES

Biscuits and cookies - role of ingredients. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Classification and Production of biscuits and cookies. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **9 Hours**

CONFECTIONERY PRODUCTS

Introduction - Role of ingredients and additives used in confectionery. Cocoa products and its uses in confectionery. Stages of Sugar cookery. Types of confectionery products and manufacturing process - chocolate, caramels, toffees, fondants, fudges and flour confectionery.

UNIT IV **9 Hours**

BAKERY EQUIPMENTS

Equipments and machineries for a bakery unit - Light Equipments, Heavy/ Bulk handling Equipments - Dough mixers, Dividers, rounding, sheeting and laminating machines. Ovens and Slicers. Packaging equipment.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT

Packaging requirements and materials. FSSAI Standards and regulations for bakery and confectionery products. Quality control and Good Manufacturing Practices (GMP). Layout for Baking and Confectionery plant.

FOR FURTHER READINGS

Millet based biscuit and cookies, Eggless cake, different types of bakery oven, different types of dough kneaders.

Total: 45 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment,Academic Press, Elsevier, 2018
6. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009

18FD502 FOOD SAFETY AND QUALITY REGULATIONS

3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of foodborne illness - viz. physical, chemical and biological.- and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the sources of food spoilage and food toxicants.
2. Identify the food quality evaluation methods.
3. Execute the food inspection procedures to evaluate the food quality
4. Select the National and International Food laws and regulations.
5. Evaluate the quality control measures in food processing industry and marketing centers

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				3		2				2	1	2
2		3				3	1		2			1	1	2
3		3						1	1	1		1	2	1
4	3				2							1		
5	2	2	2			1			1			3		

UNIT I **9 Hours**

FOOD SAFETY

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms- microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality Attributes- Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials-Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation and Evaluation cards, Different methods of Quantitative descriptive analysis.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications. Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV 10 **Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labeling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe (GRAS), European Council (EU) , Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHE.

UNIT V 8 **Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

FOR FURTHER READING

Nutritional labeling, labeling regulations, FSSAI, Regulations for organized and unorganized food industries.

Total: 45 Hours

Reference(s)

1. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
2. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country Perspective, Macmillan, 2005.
3. P.A. Luning, F. Devlieghere and R. Verhe, Safety in the agri - food chain, Wageningen Academic Publishers, Netherland, 2006.
4. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel Dekker Inc., 2004.
5. J. Andres Vasconcellos,Quality Assurance for the Food Industry: A Practical Approach,1st Edition,2003.
6. V Ravishankar Rai, Jamuna A Bai,Food Safety and Protection 1st Edition,CRC Press,2017

18FD503 FOOD ADDITIVES 3 0 0 3

Course Objectives

- Expose the use of different chemical additives in foods during food processing
- Understand the different kind of additives and their role in food preservation
- Learn the safety use of additives and regulations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Course Outcomes (COs)

1. Understand the principles of chemical preservation of foods
2. Understand the role of different food additives in the processing of different foods
3. Analyse the specific functions of different food additives in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
4. Evaluate the different food additives in improving the physical and sensory characteristics of foods
5. To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	2													
3	2													1
4	2													1
5	1													1

UNIT I **9 Hours**

INTRODUCTION

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws

UNIT II **9 Hours**

ACIDITY REGULATORS AND PRESERVATIVES

Acidity Regulators definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations

UNIT III **9 Hours**

EMULSIFIERS, STABILIZERS AND THICKENERS

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

UNIT IV **9 Hours**

ANTIOXIDANTS AND ANTI-CAKING AGENTS

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

UNIT V **9 Hours**

COLOR AND ARTIFICIAL SWEETENERS

Color Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Artificial Sweeteners list, structure, taste profile, permitted list, usage levels and food applications.

Total: 45 Hours

Reference(s)

1. Mahindru, S. N. Food Additives- Characteristics Detection and EstimationTATA McGraw Hill, 2000
2. Wilson, R. Ingredient Handbook SweetenersBlackwell, 2007
3. Emerton, V. Food ColorsBlackwell, 2008
4. Branen, A. L. Food Additives2nd Edition, CRC press, 2002
5. Peter A Williams and Glyn O PhilipsGums and stabilizers for the Food Industry RSC, 2006.

18FD504 DAIRY TECHNOLOGY 3 0 0 3

Course Objectives

- Analyse the physico-chemical and functional properties of milk constituents
- Understand the steps involved in the processing of milk and milk products
- Apply the technologies for the production of different dairy products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the composition of milk and physical and chemical properties of milk
2. Apply the principles of different thermal processing of milk
3. Apply the principles and process of Homogenization and cream separation in milk processing
4. Analyse the process flow for the preparation of different dairy products
5. Analyse the process and equipments used for the manufacturing of ice-cream and milk powder production

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2									2			2	1
2	2	2		1	3		2						1	3
3	2	1		2	1	1			2				2	2
4	1	2		2				1	1				2	1
5	2	2		3	1	1							2	3

UNIT I **9 Hours**

MILK PROPERTIES AND PRESERVATION

Milk- Composition and Nutritional value- physico chemical properties, Macro components - Micro components. Milk reception- Platform test - Cooling and storage of raw milk -principles and methods transfer of milk -transport and storage tanks - Standardization-cleaning and sanitization of Dairy equipment- CIP systems - Can washers - types - working principle and maintenance.

UNIT II **9 Hours**

PASTEURIZATION AND FILLING OF MILK

Pasteurization - principles and objectives - methods- batch / LTLT method - equipments - HTST method - process and equipments- plate heat exchanger - regeneration efficiency - milk flow diagram - UHT pasteurization- principles and methods - vacreation - form fill seal machines- aseptic filling.

UNIT III **9 Hours**

HOMOGENIZATION AND CREAM SEPARATION

Homogenization - theory - effect on milk properties - working principle of homogenizers - valves - pumps-homogenization efficiency - cream separation - principles - gravity and centrifugal separation - clarifiers and separators - centrifugal separator- parts -construction and working principle - separation efficiency - fat loss in skim milk - bactofugation.

UNIT IV **9 Hours**

BUTTER AND CHEESE PROCESSING

Butter - composition- method of manufacture- churning of cream - theory of churning - operation of butter churn- over run -batch and continuous methods of butter making- cheese - composition classification - cheddar and cottage cheese - equipments- cheese vats and press- construction details.

UNIT V **9 Hours**

ICE CREAM AND MILK POWDER PRODUCTION

Ice cream - ingredients - preparation of ice cream mix - overrun- freezing - calculation of freezing point and refrigeration requirements of mixes- ice cream freezers -batch and continuous freezers - drying of milk - drying equipments - drum drier and spray drier - components - construction and working principles.

FOR FURTHER READING

Introduction to traditional milk products. Types of milk (Standardized milk, toned milk and double toned milk, etc), waste management in dairy industry

Total: 45 Hours

Reference(s)

1. R.K. Robinson, Modern dairy technology Vol. I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
2. Gerrit Smit, Dairy processing Improving quality, Published by Woodhead Publishing Limited, CCR PRESS, 2000.
3. H.G. Kessler, Food engineering and dairy technology, Verlag A. Kessler, Freising, (F.R.Germany.) 1981.
4. A.W. Farrall, Engineering for dairy and food products, John Wiley and Sons, New York, 1963.
5. De Sukumar Outlines of Dairy Technology, Oxford University press, New Delhi, 2002.

18FD507 BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Understand the basic terms and principles involved in baking
- Impart training on baking and confectionery methods
- Assess the role of ingredients in bakery and confectionery products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the ingredients and demonstrate the equipments and tools used for baking
2. Evaluate the dough characteristics for the preparation of bakery products
3. Analyse different types of bakery and confectionery products and their quality parameters
4. Assess the preparation of sugar confectionary products
5. Apply baking skills and understand the scope of baking industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2	2								2
2	2				2	2								2
3	2	2												2
4		2											2	
5	2	2												1

1 **5 Hours**

EXPERIMENT 1

Estimation of gluten content in wheat and refined flour

2 **5 Hours**

EXPERIMENT 2

Quality analysis of wheat and maida flour

3 **3 Hours**

EXPERIMENT 3

Determination of protein quality in wheat and maida flour

4 **4 Hours**

EXPERIMENT 4

Experiment on the preparation of Cookies

5 **5 Hours**

EXPERIMENT 5

Experiment on the preparation of Muffins

6 **5 Hours**

EXPERIMENT 6

Determination of Dough characteristics using farinographic and extensographic

7 **5 Hours**

EXPERIMENT 7

Experiment on preparation of Bun and bread rolls

8 **4 Hours**

EXPERIMENT 8

Preparation and analysis of baking and quality parameters in plain and fancy cakes

9 **3 Hours**

EXPERIMENT 9

Identification of different stages of sugar boiled confectionery

10 **3 Hours**

EXPERIMENT 10

Experiment on preparation of Fudge

11 **2 Hours**

EXPERIMENT 11

Experiment on Preparation of Fondant

12 **3 Hours**

EXPERIMENT 12

Experiment on Preparation of Soft candy

13 **4 Hours**

EXPERIMENT 13

Experiment on preparation of Hard candy

14 **3 Hours**

EXPERIMENT 14

Preparation of fruit candies

15 **6 Hours**

EXPERIMENT 15

Visit to bakery / confectionery units

Total: 60 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment,Academic Press, Elsevier, 2018
6. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009

18FD508 DAIRY TECHNOLOGY LABORATORY 0 0 4 2

Course Objectives

- Understand physico-chemical and colloidal properties of milk
- Assess the quality of raw milk and their implications on safety standards of milk and milk products
- Apply the unit operations in milk processing: separation, standardization, homogenization, pasteurization methods, spray drying

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the presence of macro components in milk and detect the adulterants in milk
2. Find the pasteurization efficiency of milk using different methods of pasteurization.
3. Demonstrate the construction details and milk flow pattern of plate heat exchanger
4. Evaluate the efficiency of various equipment for the processing of milk
5. Determine the drying efficiency of different dryers for the production of milk powder

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2			2	3	1						2	3
2		2				1	1						1	2
3		2			3	1	2						3	2
4	2	2	1					2					2	1
5					2			2					2	1

1 **4 Hours**

EXPERIMENT 1

Estimation of specific gravity of milk

2 **4 Hours**

EXPERIMENT 2

Determination of fat content of milk by Gerber's method

3 **4 Hours**

EXPERIMENT 3

Standardization of milk by Pearson square method

4 **4 Hours**

EXPERIMENT 4

Study on (Low temperature low time) LTLT process vat

5 **4 Hours**

EXPERIMENT 5

Study on construction details and milk flow pattern in Plate heat exchanger.

6 **4 Hours**

EXPERIMENT 6

Construction of parts and working of cream separator

7 **4 Hours**

EXPERIMENT 7

Problem solving - Skimming efficiency of cream separator

8 **4 Hours**

EXPERIMENT 8

Construction and operation of butter churning and butter working accessories

9 **4 Hours**

EXPERIMENT 9

Construction and working of homogenizer for reduction of fat globules

10 **4 Hours**

EXPERIMENT 10

Construction and operation of Spray dryer for the production of milk powder

11 **4 Hours**

EXPERIMENT 11

Preparation of ice cream

12 **4 Hours**

EXPERIMENT 12

Problem solving- calculations for the preparation of Ice cream mix

13 **4 Hours**

EXPERIMENT 13

Detection of Adulteration of milk

14 **4 Hours**

EXPERIMENT 14

Quality analysis of raw milk

15 **4 Hours**

EXPERIMENT 15

Visit to Dairy processing industry

Total: 60 Hours

Reference(s)

1. R.K. Robinson, Modern dairy technology Vol. I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
2. Gerrit Smit, Dairy processing Improving quality, Published by Woodhead Publishing Limited, CCR PRESS, 2000.
3. H.G. Kessler, Food engineering and dairy technology, Verlag A. Kessler, Freising, (F.R.Germany.) 1981.
4. A.W. Farrall, Engineering for dairy and food products, John Wiley and Sons, New York, 1963
5. De Sukumar Outlines of Dairy Technology, Oxford University press, New Delhi, 2002..

18GE501 SOFT SKILLS - APTITUDE I 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1	1				
2										2	1			
3									1	1				
4									2		1			

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS002 PROFESSIONAL ETHICS IN ENGINEERING

2 0 0 2

Course Objectives

- Understand Human Values and ethical theory.
- Understand codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- Understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

Programme Outcomes (POs)

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained lifelong learning.
2. Adopt a good character and follow high professional ethical life.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2	1						
2						1		2						
3							1	1						
4						1	2	2						
5						2		1						

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligans theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse.

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

Sample code of ethics like IETE,ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P)limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

18FD602 FOOD EQUIPMENT DESIGN 3 1 0 4

Course Objectives

- Impart knowledge on basic principles of designing equipment for food processing
- Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc.
- Provide an idea about devising cold storage units, freezers etc.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze the process parameters of equipment and design pressure vessels, storage tanks and pulper.
2. Select the suitable products and materials for designing heat exchangers and evaporator.
3. Design and analyze the performance of dryers and extruders.
4. Estimate the cooling load of cold storage and design a cold storage for fruits and vegetables.
5. Analyze and determine the parameter for designing size reduction and conveying equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1		1			1				1	
2	3	2	2								1		1	
3	3	2	2	1							1			1
4	2	2	2			1	1				1		2	
5	2	3	2			1							1	

UNIT I **12 Hours**

DESIGN OF PRESSURE VESSELS, STORAGE TANKS AND PULPER

Introduction to design - principles and selection of food processing equipment - design of pressure vessels - design aspects of storage tanks, design of sterilizers and process vats - design of pulper - design considerations - materials of construction - installation and operation.

UNIT II **12 Hours**

DESIGN OF HEAT EXCHANGERS AND EVAPORATORS

Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators- entrainment separators-installation and maintenance.

UNIT III **12 Hours**

DESIGN OF DRYERS AND EXTRUDERS

Design of dryers - cabinet dryer, fluidized bed dryer, heat pump dryer, foam mat dryer - freeze dryer - Spray dryer - design considerations, installation, operation and maintenance - design considerations of food extruders - single and twin screw extruders - installation, operation and maintenance of food extruders.

UNIT IV **12 Hours**

DESIGN OF COLD STORAGE AND FREEZERS

Design of cold storage - estimation of cooling load - construction, operation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables - design of freezers - types of freezers - design considerations - construction and operation-design of frozen storage.

UNIT V **12 Hours**

DESIGN OF SIZE REDUCTION AND CONVEYING EQUIPMENTS

Design consideration of size reduction equipments- installation and maintenance-design consideration of material conveying equipments- belt conveyor- screw conveyor - bucket elevator- pneumatic conveyor.

FOR FURTHER READING

Factor of safety, Poisson's ratio, Food grade stainless steel, hygienic design of equipments, hygienic practices during maintenance operation

Total: 60 Hours

Reference(s)

1. P.S. Phirke, Processing and conveying equipment design, Jain Brothers, New Delhi, 2004.
2. M.V. Joshi and V.V. Mahajani, Process Equipment Design (3rd edition), New India Publishing Agency, New Delhi, 2004.
3. K.M. Sahay and K.K. Singh, Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
4. Jasim Ahmed and Mohammad Shafiur Rahman (Editors), Handbook of Food Process Design, John Wiley and Sons, Ltd., U.K., 2012.
5. Kennath. J. Valentas and R.Paul Singh (Editors), Handbook of Food Engineering Practice, CRC Press, London, 1997.
6. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A, 2003.

18FD603 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Impart the processing technologies and equipment used for meat, fish and Poultry
- Understand the preservation and value addition of meat, egg and poultry products
- Assess the quality assurance, sanitation and Packing techniques for meat,fish and Poultry products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze the scope, challenges, nutritive value and processing techniques of meat and its products
2. Assess the nutritive value, processing and quality parameters of Poultry, egg and its products
3. Apply the appropriate processing and preservation methods for fish and its products
4. Evaluate the quality and suitable packaging for meat, fish and poultry products
5. Apply the effective processing methods for waste/By-product utilization from meat and poultry industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				3	1							2	2
2	2				3	2							3	3
3	3				3	2							2	2
4	2				3	3							2	2
5	2				3	3							2	2

UNIT I **10 Hours**

MEAT PROCESSING

Meat processing industries- status and scope- Structure, composition and nutritive value of meat, Common and commercially important meats, pre -slaughter care-stunning methods-slaughtering method- evisceration and dressing of carcasses-refrigeration and transport, Meat tenderization and Meat quality evaluation. Rigor mortis - changes of meat, carcass chilling, ageing; storage of fresh meat. Processing and preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT II **10 Hours**

POULTRY AND EGG PROCESSING

Composition and nutritive value of poultry meat, Types of poultry, production, classification & grading. Slaughtering, bleeding, scalding, defeathering, evisceration, chilling, packaging; storage. Egg structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing. Egg quality assessment

UNIT III **9 Hours**

FISH AND FISH PROCESSING

Fish-composition and nutrition value, commercially important fish and shell fish, Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; ready-to-eat fish and other sea food products, spoilage factors, ship board operations, storage and transport.

UNIT IV 8 **Hours**

PACKAGING AND QUALITY STANDARDS

Modified atmosphere packaging, packaging of retail cuts, Indian regulation and quality standards, Kosher and Halal certification, HACCP, Good Manufacturing Practices, meat plant sanitation and safety.

UNIT V 8 **Hours**

EQUIPMENTS AND BY-PRODUCT UTILIZATION

Meat processing equipment - Meat grinder, Sausage stuffer, Hand crank meat tenderizer, meat mixer, meat mincer and meat slicer. Poultry processing equipment - Chicken feather plucking machine, cutter, Slaughter machine, Bone and meat cutter. Fish processing equipment - Fish slicing machine, Fish gutting machine, fish grader, fish de-scaling machine, Solid waste, Liquid waste, Chicken rendering unit-Dry rendering, wet rendering, Effluent Treatment Plant, By product utilization.

FOR FURTHER READING

Non destruction quality assessment of egg, meat and poultry carcasses, Differences between country and leghorn eggs, carcasses.

Total: 45 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.
2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Dayapubliching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.
6. V.P. Singh and NeelamSachan, Principles of meat technology, New India publishing agency, New Delhi, 2012

18FD604 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Implement specific post harvest handling technique for storage and transport of fruits and vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				2								1
2	2				2									2
3	2	1		2										1
4	2		2	1										1
5	2			2	2									2

UNIT I **9 Hours**

HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - precooling and storage - Storage under ambient condition, low temperature storage - chilling, frozen storage- chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT II **9 Hours**

PRESERVATION OF FRUITS AND VEGETABLES BY 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. Machinery involved in processing of fruits and vegetables products

UNIT III **9 Hours**

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 - Applications. Preparation of product. Changes during drying and dehydration. Problems related to storage of dried and dehydrated products.

UNIT IV **9 Hours**

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 V **9 Hours**

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.

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
2. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
4. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
5. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.
6. Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.

18FD607 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Understand the properties of meat and meat products
- Evaluate the quality parameters of egg
- Gain Knowledge on preservation methods associated with meat, poultry and fish

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Demonstrate analytical methods of physical properties
2. Identify pathogenic microorganisms responsible for meat spoilage
3. Assess the quality of Egg
4. Execute the food laws of the country and their compliance
5. Implement the procedures to prepare value added products from meat

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			3	1								
2		3		2										
3		2		1	1		1		1					
4						1			1	2		1		
5	1		2	1	2	1								

1 **8 Hours**

EXPERIMENT 1

Determination of meat colour

2 **4 Hours**

EXPERIMENT 2

Determination of water holding capacity in meat

3 **4 Hours**

EXPERIMENT 3

Detection of presence of glycogen in meat

4 **4 Hours**

EXPERIMENT 4

Microbial analysis of meat and meat products

5 **8 Hours**

EXPERIMENT 5

Quality Evaluation of Eggs: External Qualities

6 **8 Hours**

EXPERIMENT 6

Quality Evaluation of Eggs: Internal Qualities

7 **4 Hours**

EXPERIMENT 7

preservation of shelled eggs

8 **4 Hours**

EXPERIMENT 8

Curing of meat by different methods

9 **4 Hours**

EXPERIMENT 9

Dehydration of meat and meat products

10 **4 Hours**

EXPERIMENT 10

Canning technology of fish

11 **8 Hours**

EXPERIMENT 11

Preparation of chicken based products

Total: 60 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.
2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Dayapubliching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.

18FD608 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Learn postharvest changes that occur in fruits and vegetables
- Demonstrate methods to prevent or reduce deterioration and loss of nutritional quality of vegetables and fruits
- Impart knowledge on fruits and vegetables preservation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Produce ready to serve beverages
2. Produce value added products like jam, jelly, ketchup, puree
3. Produce preserves and candy from fruits
4. Implement dehydration methods to produce dehydrated fruits and vegetables
5. Demonstrate the production of fermented products like pickles, sauerkraut from fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				1		1		1						1
2	1		2											1
3				1	2									1
4					2	1								1
5	1					2								1

1 **4 Hours**

EXPERIMENT 1

Preparation of Ready To Serve (RTS) beverages

2 **4 Hours**

EXPERIMENT 2

Preparation of plain/ mixed fruit jam

3 **4 Hours**

EXPERIMENT 3

Preparation of fruit jelly and orange marmalade

4 **4 Hours**

EXPERIMENT 4

Preparation of fruit preserve and candy

5 **4 Hours**

EXPERIMENT 5

Preparation of tomato puree and ketchup

6 **4 Hours**

EXPERIMENT 6

Preparation of pickles

7 **4 Hours**

EXPERIMENT 7

Minimal processing of fruits and vegetables

8 **6 Hours**

EXPERIMENT 8

Osmotic dehydration of fruits

9 **6 Hours**

EXPERIMENT 9

Osmotic dehydration of vegetables

10 **8 Hours**

EXPERIMENT 10

Dehydration of vegetables

11 **4 Hours**

EXPERIMENT 11

Sauerkraut fermentation

12 **4 Hours**

EXPERIMENT 12

Effect of blanching on enzymatic activity

13 **4 Hours**

EXPERIMENT 13

Determination of pectin content

14 **0 Hours**

EXPERIMENT 14

Visit to fruit processing industry

15 **0 Hours**

EXPERIMENT 15

Visit to fruit processing industry

Total: 60 Hours

Reference(s)

1. S. Ranganna, Hand Book of Analysis and Quality Control for Fruit and Vegetable products, second Edition, Tata McGrew Hill Publishing Company Pvt Ltd, 2008
2. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1	1				
2										2	1			
3									1	1				
4									2		1			
5									1	1				

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **2 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **2 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **4 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **4 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **2 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS003 PRINCIPLES OF MANAGEMENT 2 0 0 2

Course Objectives

- Develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1	2	1			
2									2	1				
3										2	1			
4									1	1	2			
5									2	1	1			

UNIT I **6 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management -Science or Art - Manager Vs Entrepreneur- types of managers - Managerial roles and skills - Evolution of Management - Scientific, Human Relations, System and Contingency approaches - Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment -Current Trends and issues in Management.

UNIT II **6 Hours**

PLANNING

Nature and purpose of planning-Planning process-Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **6 Hours**

ORGANISING

Nature and purpose - Formal and informal organization - Organization chart - Organization Structure and Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design-Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **6 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication - Process of communication - Barrier in communication - Effective communication - Communication and IT.

UNIT V **6 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance - Direct and preventive control -Reporting.

Total: 30 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008

18FD702 FOOD PACKAGING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the properties of food packaging materials and their suitability in extending shelf life of food products
- Impart knowledge on rationale in selecting packaging material for processed food products
- Learn about laws and regulations of packaging materials and labeling of foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the functions of food packaging for socio economic needs
2. Select suitable packaging materials for the extension of shelf life of food products
3. Apply the new innovation in developing advanced packaging material
4. Choose the different filling systems for whole and ground food products
5. Analyze the testing and labeling regulatory requirements with respect to food packaging

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							1	
4	2	2	2		2	1								
5	1	2	1											

UNIT I **9 Hours**

FUNCTIONS OF FOOD PACKAGING MATERIALS

Introduction- Science and technology of food packaging- Socio economic needs - functions of food packaging- Food Packaging environments- functions and environments grids-Food packaging systems-Food package development.

UNIT II **9 Hours**

RIGID AND SEMI RIGID FOOD PACKAGING MATERIALS

Glass as food packaging materials- advantages and disadvantages- closures used for glass containers- metal containers-tinplate - three piece can manufacture - double seaming - protective coatings- aluminium as food packaging materials- two piece can manufacturing process- kegs-drums-trays- wood as packaging material- solid fibre board boxes. Aseptic packaging- multilayer packaging materials- retort packaging materials.

UNIT III **9 Hours**

FLEXIBLE FOOD PACKAGING MATERIALS

Paper - different types - corrugated paper boards- definition - types - manufacturing method-paper board products - Polymer - basic concept of polymer- polymerization- plastics versus polymers- Advantages and disadvantages of plastics- polymer properties - molecular weight - chain entanglement- plastics - morphology-definition- different types of food packaging polymers- polymer processing methods- heat sealing - adhesives and labels-Nano composite food packaging materials- bio-degradable food packaging materials- bag in box system of food, Smart packaging, Intelligent packaging, Modified atmospheric packaging and control atmospheric storage.

UNIT IV **9 Hours**

FILLING SYSTEMS

Filling of liquid and wet products- to predetermined level and predetermined volume- filling of dry solids- by count- volume-weight - methods of wrapping and bagging- form -fill -seal methods- various forms of packaging - vacuum packaging- blister packaging-shrink packaging - stretch packaging.

UNIT V **9 Hours**

TESTING AND LABELING OF PACKAGING MATERIALS

Principles of measuring water vapour transmission rate and gas permeability rate through given flexible film, OUR from food and OTR from film .Testing of packaging materials using - UTM- Mullen Bursting strength tester- drop tester- Pouch burst tester- cob tester- gauge tester- torque tester- tear tester- gas analyzer-cushioning materials. Labeling, regulation and traceability. Global migration testing and design aspects.

FURTHER READING

Difference between packing and packaging, Manufacturing of nano packaging, Degradation of plastic materials, Alternate for plastic/glass material, Eco friendly packaging material.

Total: 45 Hours

Reference(s)

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Second Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2005
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.
4. Richard Coles and Mark J. Kirwan, Food and Beverage Packaging Technology, Second Edition, Wiley & Blackwell, 2011.
5. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
6. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, Food Packaging Science and Technology, CRC Press, 2008.

18FD703 FOOD PROCESSING PLANT DESIGN AND LAYOUT

3 1 0 4

Course Objectives

- Impart basic knowledge in selecting a location as well as plant layout with respect to material handling, space utilization, future expansion etc.
- Understand the importance of availability of raw material and facilities for production of goods
- Integrate man, materials and machinery for optimum production

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Design layout for various types of food processing industries.
2. Construct project profile analysis and prepare project report
3. Design water storage systems and prepare electrical layout
4. Apply different methods for production planning
5. Demonstrate the repair and maintenance of equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			2	2	1	2	1					
2	1	1			3	1		1	3		3			
3	3	3			3	3	1	1			3			
4	1	2			1	2	2	1			3			
5	1	3			2	2		1			1	1		

UNIT I **12 Hours**

PLANT LOCATION AND LAYOUTS

Introduction to food plant design - special features of food and agricultural process industry - plant location - location factors, site selection, location theory and models - layout - objectives, classical and practical layout - preparation of process chart and machinery layout - product layout and process layout - plant layout for size reduction machinery, evaporation plant, drying plant, bake ovens and frying plant, heat exchanger plant, refrigeration and air conditioning plant, boiler, packaging plant and ancillary equipments plant.

UNIT II **12 Hours**

PROJECT PROFILE ANALYSIS

Project profile, key aspects to consider in preparing a project profile and DPR (Detailed Project Report), Describing Project Operations, Categorizing Costs, Environmental Sustainability, completing and interpreting the profile, Project Profile Formats, Preparing model project report on fruit and vegetable processing unit.

UNIT III **12 Hours**

ELECTRICAL AND WATER SUPPLY

Estimation of services - peak and critical load - preparation of electrical layout - selection of fittings and accessories for electrical and water supply - provision of water supply - design of water storage system - selection of pipe, valves and safety devices - drainage - systems, pipeline, traps, safety devices - illumination and ventilation - materials, mounting, operation and maintenance - layout for effluent treatment plant - safe disposal of effluent.

UNIT IV **12 Hours**

PRODUCTION PLANNING AND CONTROL

Production planning and control - continuous and intermittent production - scheduling - routing and dispatching - activity chart and Gantt chart - net work planning methods - PERT and CPM - applications - method study - work study - methods - man-machine chart - time study - standard time of a job - inventory control - economic ordering quantity - inventory models.

UNIT V **12 Hours**

REPAIR AND MAINTENANCE OF EQUIPMENT

Repair and maintenance of equipment - preventive maintenance and breakdown maintenance - replacement of equipment - alternative methods and analysis - method of annual equivalence, present worth method and internal rate of returns.

FURTHER READING

PERT, CPM, Queuing theory, Break Even Point, DPR for fruit & Vegetable processing industry

Total: 60 Hours

Reference(s)

1. O.P.Kanna, Industrial Engineering and Management, DhanpatRai Publication (P) Ltd., New Delhi, 2003.
2. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014.
3. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A., 2003.
4. Antonio Lopez-Gomez and Gustavo V. Barbosa-Canovas, Food Plant Design, CRC, London, 2005.
5. C.S.Rao, Environmental Pollution Control Engineering, New age International (P) Ltd., New Delhi, 1999.

18FD704 WASTE MANAGEMENT IN FOOD INDUSTRIES

3 0 0 3

Course Objectives

- Understand the importance of treating waste product from food industry
- Learn different solid and liquid management techniques
- Impart knowledge on different treatment methods and recycling of waste product from food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyse the impacts of food wastage and its causes in environment
2. Assess and analyse the different food industry wastes leads to environmental pollution
3. Apply the physical, chemical and biological principles for liquid waste treatment
4. Analyse the solid waste management techniques
5. Evaluate the by-product/waste utilization from different food processing industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1						3	3	3				1		
2	1				2	3	3	1						
3	2			2	1	3	3	1		1	3			
4	2			3	2	3	3	2		2	3			
5	2			1	1	2					2			

UNIT I 8 **Hours**

INTRODUCTION TO WASTE MANAGEMENT

Definition-Food wastage- food loss- global scenario- Sources of waste and pollutants, Classification and characterization of wastes - causes and prevention of food waste- impact of food losses and waste- food waste hierarchy-need for minimization of food waste

UNIT II **9 Hours**

FOOD INDUSTRY WASTES AND ENVIRONMENTAL POLLUTION

Food Industries- Environmental Pollution due to Food Industry wastes - characteristics and impact on soil, water, air pollution - Processes for waste utilization from fruit and vegetable industries, meat, fish, dairy, oil processing industries.

UNIT III **10 Hours**

LIQUID WASTE MANAGEMENT IN FOOD INDUSTRIES

Principles of Physical treatment - Screening, Sedimentation, Filtration, back washing, membrane separation. Principles of Chemical treatment- COD, BOD, VLSS, MLSS and ETP. Coagulation, flocculation, Precipitation, flotation, Disinfection and fluoridation. Principles of biological treatment, aerobic process, activated sludge process, trickling filters, anaerobic digestion, UASB reactor.

UNIT IV 8 **Hours**

SOLID WASTE MANAGEMENT IN FOOD INDUSTRIES

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

UNIT V **10 Hours**

BY PRODUCT/WASTE UTILIZATION

Utilization of oil cake and defatted oil cake as cattle feed and industrial uses. Utilization of sugarcane tops, bagasse, molasses and press mud - animal feed from sugarcane tops and bagasse - Utilization of agro-industries - Utilization of furfural and activated carbon-Environmental Laws and Acts- Regulatory issues with food industry waste

FURTHER READING

Pollution control board, BOD, COD of water, Threshold level of solids present in water, Air pollution, mitigation measures for solid, liquid and air pollution. Case Studies and regulations on waste management.

Total: 45 Hours

Reference(s)

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. Wang, L. K., Lo, H. H., Hung, Y. T., & Yapijakis, C. Waste treatment in the food processing industry, CRC Press,2005
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Waldron, K. W, Handbook of waste management and co-product recovery in food processing, Elsevier,2009
5. Sylvan H Wittwer, Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995.
6. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (III ed), Himalaya Publishing House, New Delhi, 2010.

18FD707 WASTE MANAGEMENT IN FOOD INDUSTRIES LABORATORY

0 0 2 1

Course Objectives

Understand the importance of treating waste product from food industry.
Learn different solid and liquid management techniques
Impart knowledge on different treatment methods and recycling of waste product from food industry

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Practical and research training imparted to the graduates will pave way for introducing novel technologies in food processing sectors for global sustenance.
n. Focus and depth in the fields of food technology and safety will develop graduates competence with analytical skills and indigenous technologies to solve global problems in food technology.

Course Outcomes (COs)

1. Analyse the impacts of food wastage and its causes in environment
2. Assess and analyse the different food industry wastes leads to environmental pollution
3. Apply the physical, chemical and biological principles for liquid waste treatment
4. Analyse the solid waste management techniques
5. Evaluate the by-product/waste utilization from different food processing industries

Articulation Matrix

CO No		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2		1	1	2							2	2
2		1	2		2	2	2							2	2
3		2	3		2	1	3							2	2
4		2	3		3	2	3							2	2
5		2	2		3	1	2							3	3

1 **2 Hours**

EXPERIMENT 1

Preparation of Extruded product from Edible fruit and vegetable wastes

2 **4 Hours**

EXPERIMENT 2

Formulation of Biscuit from Banana peel waste

3 **4 Hours**

EXPERIMENT 3
Preparation of fruit jam from Musa acuminate peel

4 **4 Hours**

EXPERIMENT 4
Measuring tensile strength of flexible films using UTM.

5 **4 Hours**

EXPERIMENT 5
Preparation of whey from dairy waste

6 **2 Hours**

EXPERIMENT 6
Preparation of dry pickles from osmotic dehydrated fruit waste

7 **2 Hours**

EXPERIMENT 7
Measuring compressive strength of oil packaged in flexible pouches using Pouch burst tester.

8 **4 Hours**

EXPERIMENT 8
Efficient extraction of Micronutrient from industrial wastewater

9 **2 Hours**

EXPERIMENT 9
Hot Juice from edible fruit peel waste

10 **2 Hours**

EXPERIMENT 10
Microwave treatment of juicy tomato (Oil free chips)

Total: 30 Hours

Reference(s)

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. Wang, L. K., Lo, H. H., Hung, Y. T., & Yapijakis, C. Waste treatment in the food processing industry, CRC Press,2005
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Waldron, K. W, Handbook of waste management and co-product recovery in food processing, Elsevier,2009
5. Sylvan H Wittwer, Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995.
6. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (III ed), Himalaya Publishing House, New Delhi, 2010.

18FD708 FOOD PACKAGING TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Understand the properties and uses of various packaging materials
- Impart skills related to food packaging technology
- Familiarize different forms of packaging methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand and apply fundamental requirement for packed foods
2. Select a suitable packaging materials for perishable and non-perishable foods
3. Demonstrate a testing and properties of packaging materials for its regulatory requirements for raw and processed foods
4. Analyze the textural properties of packaging material and food packed inside the packaging materials
5. Evaluate the quality of packing materials using latest machineries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		1		1							2	1
2	1	2		2		2							1	
3	2	2		1		2								
4	2	3		2		3								
5	3	2		3		2							1	

1 **4 Hours**

EXPERIMENT 1

Measurement of thickness of packaging material

2 **4 Hours**

EXPERIMENT 2

Measuring GSM of various paper and flexible film based packaging materials.

3 **4 Hours**

EXPERIMENT 3

Measuring water absorption by different paper and paper boards using Cobb tester.

4 **4 Hours**

EXPERIMENT 4

Measuring tensile strength of flexible films using UTM.

5 **4 Hours**

EXPERIMENT 5

Measuring compressive strength of carton boxes using UTM.

6 **4 Hours**

EXPERIMENT 6

Measuring drop strength of packaged food material using drop tester

7 **4 Hours**

EXPERIMENT 7

Measuring compressive strength of oil packaged in flexible pouches using Pouch burst tester.

8 **4 Hours**

EXPERIMENT 8

Measuring bursting strength of different paper board based packaging materials.

9 **4 Hours**

EXPERIMENT 9

Preparation of biopolymer from food waste.

10 **4 Hours**

EXPERIMENT 10

Experiment on form fill seal machine - vertical type.

11 **4 Hours**

EXPERIMENT 11

Identification of different types of packaging and packaging material

12 **4 Hours**

EXPERIMENT 12

Performing different destructive tests for glass containers

13 **4 Hours**

EXPERIMENT 13

Demonstration of Retort processing

14 **4 Hours**

EXPERIMENT 14

Testing of chemical resistance of packaging materials

15 **4 Hours**

EXPERIMENT 15

Measuring internal tearing strength test in paper

Total: 60 Hours

18FD709 PROJECT WORK I **0 0 6 3**

Course Objectives

- To develop knowledge to formulate a real world problem and project"s goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 90 Hours

18FD804 PROJECT WORK II **0 0 18 9**

Course Objectives

- Develop knowledge to formulate a real world problem and project"s goals.
- Identify the various tasks of the project to determine standard procedures.
- Identify and learn new tools, algorithms and techniques.
- Understand the various procedures for validation of the product and analysis the cost effectiveness.
- Understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 270 Hours

18FD001 INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY

3 0 0 3

Course Objectives

- Provide fundamental knowledge on instruments and their applications in food processing
- Understand the function of instruments in food product development
- Identify different sensors and transducers used in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the different kinds of sensors and transducers and their specific application in food industry
2. Evaluate the operation of fluid flow and temperature measurement devices
3. Implement the process controllers in food processing operations
4. Examine the concepts of system representation, time and frequency responses
5. Execute the automation in food processing in food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2	2	3	1	1									1	
3	3	1	2	1										
4	2	1	2											
5	3	2	3	1	1	2							1	1

UNIT I **9 Hours**

SENSORS AND TRANSDUCERS

Introduction to measurement system - Resistive Transducers: Strain gauges - Resistance thermometers - Thermistors - Hotwire anemometer - Piezoresistive sensors - Humidity sensors - Inductive Transducers: LVDT - Induction potentiometer - Electromagnetic sensors - Capacitive Transducers: Variable air gap type - Variable permittivity type.

UNIT II **10 Hours**

FLOW AND TEMPERATURE MEASUREMENTS

Level measurement: Float gauges - level switches - bubbler tube. Capacitance type - Ultrasonic type - Flow Measurement: Fixed and variable type flow meter - turbine flow meter - Electromagnetic flow meter - Temperature Measurement: RTD - Thermistor - Thermocouple - Dry and wet bulb psychrometers - Viscosity measurements.

UNIT III **9 Hours**

PROCESS MODEL AND CONTROLLER

Introduction to open and closed loop system - Building blocks of mechanical and electrical systems - Single and Two tank system model - Controller Design: ON-OFF Control - P - Mode - I - Mode - D - Mode - P+I+D mode of controller - Digital Controller: Position and Velocity control.

UNIT IV 9 **Hours**

TIME AND FREQUENCY RESPONSE ANALYSIS

Time response - time domain specifications - Standard test inputs - Frequency response characteristics: Bode diagram - Nyquist plot and Stability analysis - Jury"s stability test.

UNIT V 8 **Hours**

INSTRUMENTATION AND SENSORS FOR THE FOOD INDUSTRY

Optical Inspection Systems: Computer Vision system, Colour sorter. Food component analysis using NIR and FTNIR. Principles of measurement - Calibrations application in food industry. Practical considerations for implementing online measurements. Radiation thermometers: Principles of measurements and applications. Introduction to automation in food processing. Biosensors - equipment - e nose, NIR.

FOR FURTHER READING

Different instrumentation devices and sensors used in dairy industry, beverage industry

Total: 45 Hours

Reference(s)

1. Erika Kress-Rogers and Christopher J. B. Brimelow, Instrumentation and sensors for the food industry, Wood head publishing, 2001.
2. D. Patranabis, Sensors and Transducers, Prentice Hall India Pvt. Ltd, 2007.
3. E. O. Doeblin, Measurement Systems: Applications and Design, Tata McGraw-Hill Book Co., 2008.
4. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 2011.
5. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006.

18FD002 FAT AND OIL TECHNOLOGY 3 0 0 3

Course Objectives

- Aims to develop the knowledge in the area of Fat and Oil processing and technology.
- Necessary for effective understanding specific aspects of food processing related to these foods
- Enables to appreciate the application of scientific principles in the processing of these materials

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Be able to understand and identify the specific processing technologies used for Fats and oils
2. Understand the application of scientific principles in the processing technologies specific to the materials.
3. Understand the quality of fats and oils.
4. Analyse the different processing methods of fats and oils
5. Understand the difference between fat replacers and fat substitutes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	1									1		
2		2		1								2	2	
3		1						1						2
4		1										2	1	
5												1	1	

UNIT I **10 Hours**

RAW MATERIALS AND PROPERTIES

Overview of fats and oil, sources of fats and oils- vegetables, animal fat; properties of fats and oils - nomenclature ad structure; chemical properties and reactions - hydrolysis and free fatty acids, esterification, inter-esterification, saponification and iodine value, oxidative stability, peroxide value, conjugated dienes, anisidine value; physical properties -colour, crystal structure f fat, thermal properties, density, SFI, optical and spectroscopical properties.

UNIT II **8 Hours**

FAT AND OIL PROCESSING

Recovery of fats and oils from plant and animal sources, refining, bleaching hydrogenation, fractionation, process and product of inter-esterification deodorization.

UNIT III **9 Hours**

QUALITY OF FATS AND OILS

Flavour quality of fats and oils - formation of flavours and off-flavours, hydrolytic rancidity, oxidative rancidity, flavour impact of oxidation compound, factors affecting flavour quality - intrinsic and extrinsic, methods to measure flavour quality - chemical, sensory analysis, oil quality improvement through processing

UNIT IV 8 **Hours**

OILS AND FATS APPLICATIONS

Utilization of fats and oils: shortening technology, margarine types and preparation technology, liquid oil technology, speciality fats and oils, by product utilization.

UNIT V **10 Hours**

NOVEL DEVELOPMENT IN FATS AND OIL TECHNOLOGY

Strategies for replacement of fats in food products-lipid based fat replacement - sucrose polyesters, propoxylated derivatives of glycerides, wax esters, esters of polycarboxylic acids, glyceryl fatty esters, partially digestible fat substitutes, protein based fat replacement, role of carbohydrate in replacement of fat, genically engineered and identity preserved oils.

Total: 45 Hours

Reference(s)

1. Introduction to oils and fats -"Richard D.O"Brien" and "Watter. E. .farr",:Peter. J.Wan". Seconf edition.

18FD003 CROP PROCESS ENGINEERING 3 0 0 3

Course Objectives

- Learn post-harvest handling and storage techniques of cereals and pulses
- Gain knowledge on processing and milling methods for cereals and pulses
- Understand technologies for value addition of by-products obtained during processing of cereals and pulses

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Demonstrate different engineering properties of grains and the method to determine moisture content
2. Select suitable equipment for threshing, cleaning, grading and drying of grains
3. Summarize the operations involved in rice and pulse processing
4. Apply the knowledge on the various storage methods to minimize the loss and extend the shelf life of the grains
5. Use different ways to utilize the waste into useful by products and value added products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			2		1								
2	1				2									1
3	2				1									1
4	2				1	1								1
5	2				1	1								1

UNIT I **9 Hours**

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 **9 Hours**

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, dehusker, groundnut decorticator and castor sheller, psychrometry - properties of air - water vapour mixture, grain drying - principles, types, heat sources, performance of dryers

UNIT III **9 Hours**

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 **9 Hours**

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 **9 Hours**

WASTE UTILIZATION

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

FOR FURTHER READING

Effect of moisture content on different milling operations, traditional and modern storage structures for grains, Storage of grains - status, opportunities and challenges in india, status of waste utilization in India.

Total: 45 Hours

Reference(s)

1. Chakraverty,A., Post Harvest Technology of cereals, pulses and oilseeds, Third Edition, Oxford & IBH publishing & Co. Pvt. Ltd., New Delhi, 2000
2. Sahay, K.M. and K.K. Singh. Unit operations in Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 1994
3. Henderson, S.M. and R.L.Perry, Agricultural process engineering, John Willey and Sons, New York, 1995.
4. Pande, P.H., Principles of agricultural processing, Kalyani Publishers, Ludhiana, 1994.
5. McCabe, W.L. and J.C.Smith, Unit operations in chemical engineering, McGraw Hill Kogakusha Ltd., Tokyo, 2001.
6. Mohsenin, N.N., Physical properties of plant and animal materials, Gordon and Breach publishers, New York, 1986

18FD004 MILLING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the importance, structure and properties of cereals and legumes
- Analyze the traditional and modern milling methods of cereals and legumes
- Evaluate the efficiency of major milling equipment used in modern mills of cereals and legumes

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Assess the structure, nutritional value and storage of cereals and legumes
2. Apply the milling techniques, parboiling methods and equipment used in rice milling
3. Analyze the milling efficiency in milled wheat and corn products
4. Compare the efficiency of dry and wet milling techniques in pulse milling
5. Evaluate the extraction and refining methods of oil from oilseeds

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2												2
2	2	2				2							2	
3		2		2	2								2	
4				2	2									2
5		2		2		1								1

UNIT I **7 Hours**

GRAIN PROPERTIES

Importance of cereals and legumes- Grain structure and Composition. Physicochemical properties of grains and nutritional value. Premilling operations of grains. Grading. Storage of grains in relation to maintaining grain quality and types of storage structures. Losses during storage and Prevention methods

UNIT II **10 Hours**

RICE MILLING

Rice - Structure and nutritional value, Traditional rice milling machineries. Modern Rice milling flow chart, operations and equipments used- Cleaning, Dehusking, Husk and paddy separation, Whitening, Polishing, Bran separation, Grading and Colour sorting. Parboiling- Physicochemical changes during Parboiling and effects on rice quality, Methods of Parboiling. Processed rice products - Rice flour, Puffed rice, Rice flakes, Instant Rice, Fermented Rice Products - Rice, Dosa and Dhokla. Byproducts utilization.

UNIT III **10 Hours**

WHEAT AND CORN MILLING

Wheat: Structure, Composition and nutritional value. Wheat milling operations - Cleaning, conditioning, grinding. Components of wheat mill- Sifters, Roller milling - Break rolls and reduction rolls, purifying. Equipments - Destoner, Entoleters. Parboiling of wheat. Efficiency of milling process. Corn: Structure, Composition and nutritional value. Dry and wet milling of corn -flow sheet, Products from corn milling - corn starch, corn syrup, corn flakes, corn meal, corn oil, corn gluten.

UNIT IV **9 Hours**

PULSE MILLING

Structure and Importance of Pulses. Unit operations of pulse milling. Dehulling losses and effect on nutritive value. Milling Methods of pulses. Problems of Pulse milling industry. Factors affecting Pulse milling outturn. Pulse milling Efficiency.

UNIT V **9 Hours**

OIL SEED MILLING

Oil seed processing- natural sources of oil, Seed composition and nutritive value of oil. Pretreatments before oil extraction- Cleaning, dehulling, Size reduction, flaking, Cooking. Extraction techniques - Ghanies, Screw press, Solvent Extraction. Refining of oil, hydrogenation, winterization. Deoiled seed flour.

FOR FURTHER READING

Millet processing, Infectation control of grains, Waste utilization of Cereals, Pulses and Oilseeds milling

Total: 45 Hours

Reference(s)

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

18FD005 DOWNSTREAM PROCESSING 3 0 0 3

Course Objectives

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Obtain depth knowledge and hands on experience on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the fundamentals of downstream processing for product recovery
2. Examine the requirements for successful operations of downstream processing
3. Analyze the components of downstream equipment and explain the purpose of each
4. Apply principles of various unit operations used in downstream processing and enhance problem solving techniques
5. Apply the knowledge of downstream processing in final product formulation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3			3					2		2		
2	3	2		2	2					2		2		
3	3	2		3	2					2		2		
4	3	3			3					2		2		
5	3	2	1		3					2		2		

UNIT I **9 Hours**

INTRODUCTION

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

UNIT II **9 Hours**

PHYSICAL METHODS OF SEPARATION

Unit operations for solid-liquid separation - filtration and centrifugation

UNIT III **9 Hours**

ISOLATION OF PRODUCTS

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV **9 Hours**

PRODUCT PURIFICATION

Chromatography principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques

UNIT V **9 Hours**

FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, drying and lyophilization in final product formulation

Total: 45 Hours

Reference(s)

1. Belter, P.A., E.L. Cussler and Wei-Houhu -Bioseparations - Downstream Processing for Biotechnology, John Wiley, 2011.
2. Sivasankar, B. - Bioseparations: Principles and Techniques. PHI, 2005
3. Asenjo, Juan A. - Separation Processes in Biotechnology-. CRC / Taylor & Francis, 1990

18FD006 EXTRUSION TECHNOLOGY 3 0 0 3

Course Objectives

- Impart knowledge to the students about extrusion technology and its principles
- Understand the classification of extruders according to process and construction
- Develop novel extruded products for commercialization

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Explain and predict the current and future trends of extruders in food industry
2. Assess the pre-conditioning process followed by extrusion
3. Differentiate single and twin screw extruder based on its processing
4. Analyze the characteristics of extruded products
5. Apply the extrusion technologies in development of snack foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2		3									
2	3	3	2											
3	3	3	2		2									
4	3	2	2		3									
5		2	2			2						1		

UNIT I 8 **Hours**

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 8 **Hours**

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 **10 Hours**

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 **10 Hours**

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 9 **Hours**

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.

FOR FURTHER READING

Extrusion Blow moulding Extrusion cooking - recent developments, methods, equipment, and design criteria of extruders, Extrusion - Retort pouch packaging.

Total: 45 Hours

Reference(s)

1. Richardson P., Thermal Technologies in Food Processing, Wood head Publishers, Cambridge, CRC Press, 2001.
2. Guy R. Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge, 2001
3. Fast R.B. and Caldwell E.F. Breakfast Cereals and How they are made. American Association of Cereal Chemists, St. Paul, Minnesota, 2000.
4. Jean Marie Bouvier Osvaldo H. Campanella. Extrusion Processing Technology: Food and Non Food Biomaterials,John Wiley & Sons, Ltd.,April 2014.
5. Harper J.M. Extrusion of Foods. Vol. 1&2, CRC Press, Inc; Boca Raton, Florida. 1991.

18FD007 APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING

3 0 0 3

Course Objectives

- Understand the concept of Nanotechnology and nano material synthesis
- Impart knowledge on synthesis and characterization techniques involved in Nanotechnology
- Learn the principle and application of cryogenics in food processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Acquire knowledge about current trends and future aspects in the field of Nanotechnology
2. Identify the synthesis methods for the production of nano materials
3. Apply the function of Nanotechnology in Food processing and assess its socio economic issue
4. Differentiate the types of cryogenics based on its applications
5. Apply and analyze the necessitate of cryogenics in food industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		1		1							2	2
2	1	2		2		2								
3	2	3		2		1							2	2
4	2	2		3		1							1	1
5	3	2		3		2							3	3

UNIT I **9 Hours**

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 - Nanomaterial 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 **9 Hours**

NANOMATERIALS AND SYNTHESIS METHOD

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 **9 Hours**

APPLICATIONS 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 IV **9 Hours**

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 V **9 Hours**

APPLICATIONS 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.

FOR FURTHER READING

Nanotechnology and Food Allergy, Nano-Ethics, Physics of Bionanotechnology, Nanoparticles in Food Diagnostics

Total: 45 Hours

Reference(s)

1. Kenneth David & Paul Thompson. What Can Nanotechnology Learn From Biotechnology, ISBN, 2008
2. Qasim chaudhry, Laurence castle and Richard Watkins.. Text book on Nanotechnologies in food, RSC Nano science and Nano technology, published by the Royal society of chemistry, ISBN 978-0-85404-169-5, 2010
3. RE hester and R.M Harrison.. Nanotechnology, Consequences for Human Health and the Environment, ISBN: 978-0-85404-216-6, 2007
4. Peter JM Bartos, John J Hughes, Pavel Trtik.. Nanotechnology in construction, ISBN: 978-0-85404-623-2, 2004
5. Randall F. Barron, Cryogenics Systems, Second Edition Oxford Univesity Press New York, Clarendon Press, Oxford, 1985.
6. Timmerhaus, Flynn, Cryogenics Process Engineering , Plenum Press, New York

18FD008 RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS

3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Explain and apply the concept of Radiation chemistry on food preservation
2. Analyze the effect of dosage of radiation on plant and animal foods
3. Exemplify and analyze the effect of microwave in food processing
4. Analyze the effect of Infra-red radiation in food processing
5. Justify and assess the effect of radio frequency on foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		2							1	1
2	2	1	2	1		2								2
3	2	3	1	2		3								
4	3	2	2	1		2							3	3
5	3	2	3	2		2							2	2

UNIT I **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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

FOR FURTHER READING

Black body radiation, Absorption of radiation, Radiation heat transfer, Laws in radiation, ionizing radiation.

Total: 45 Hours

Reference(s)

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

18FD009 FOOD COLORS AND FLAVOR TECHNOLOGY

3 0 0 3

Course Objectives

- To analyse different food colors and application in food formulations
- To understand different food flavors and its applications
- To know the quality control techniques and regulations involved in colors and flavors

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the synthetic and natural colors and its regulations
2. Evaluate the properties and the importance of colors in food industry
3. Classify the food flavours and its stability
4. Determine the recent developments of application of flavor in food industry
5. Analyze the methods of estimation of colors and flavors in foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2		1										
2	1	2	2	3	2	2	1							
3		2		2	2		1							
4		2	3	2	1	1								
5		3	2	2	2									

UNIT I **9 Hours**

FOOD COLOURS 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 **7 Hours**

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 **12 Hours**

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 **9 Hours**

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 **8 Hours**

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.

FOR FURTHER READING

Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid, ethanol in food flavours. Spices and herbs as food flavorings.

Total: 45 Hours

Reference(s)

1. Mathew Attokaran.Natural Food Flavors and Colorants, Second Edition,John Wiley & Sons Ltd,Jan,2017.
2. Fenaroli, G, Handbook of flavour ingredients, CRC Press. Bota Rica, New York, 2005
3. Yamanishi, T, Recent advances in flavour researches, Dekker, New York, 2005
4. Andrew J. Taylor and Robert S. T. Linforth, Food Flavour Technology, Blackwell Publishing Ltd, 2010.
5. Suvendu Bhattacharya, Conventional and Advanced Food Processing Technologies, Wiley Publishers, 2015
6. Heath, HB, Flavour chemistry and technology, CBS Publ., New Delhi, 2005.

18FD010 BEVERAGE PROCESSING 3 0 0 3

Course Objectives

- Understand the classification of beverages
- Impart knowledge and skills of beverage processing techniques
- Understand the quality aspects of beverages

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Organize the formulation of beverages using selected ingredients
2. Apply Unit operations involved in the carbonated beverage manufacturing
3. Explain the various production techniques in non-carbonated beverages
4. Evaluate the quality parameters of fermented beverages
5. Implement the food laws and regulations of beverages

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				2		2								2
2			3	2	2									
3				2		3							1	
4	1			2	3									
5				3	2	3								

UNIT I **10 Hours**

INGREDIENTS IN BEVERAGES

Beverage: Introduction, Global and Indian scenario. Classification of beverages. Ingredients- water, quality evaluation, raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, Micro and nano-emulsions of flavors, coloursÃ¢?? natural and artificial, preservatives, clouding agents emulsifiers and stabilizers.

UNIT II **9 Hours**

CARBONATED BEVERAGES

Preparation of Syrup making, blending, Carbonation of soft drinks, filling, packaging, containers, closures. Powdered dry mix; Energy drinks and sports drinks; Fruit based carbonated beverages, carbonated water. Equipments used in the manufacture of carbonated beverages.

UNIT III 9 **Hours**

NON-CARBONATED BEVERAGES AND BOTTLED WATER

Beverages based on tea, coffee, cocoa, spices, herbs, dairy based beverages, Fruit based non carbonated beverage - RTS beverages, Squash, Nectar, Cordial and Fruit concentrate. Flash pasteurization, Canning and Aseptic Packaging of beverages. Bottled water, mineral water, spring water, flavored water.

UNIT IV **9 Hours**

FERMENTED BEVERAGES

Alcoholic beverages- Classification. Fermented alcoholic beverage - Beer - ale type beer, lager type beer, the role of yeast in beer, technology of brewing process. Wine, Cider, Perry and Sake. Distilled spirits - Whisky, Brandy, Vodka, Rum, Tequila and gin. Equipment used for brewing and distillation

UNIT V 8 **Hours**

SANITATION AND QUALITY CONTROL

Quality control in beverage industry- System quality control Product quality control and microbial quality control. CIP. Sanitation and hygiene in beverage industry. Standards and regulations of beverages.

FOR FURTHER READING

Traditional natural beverages. Raw materials, quality and technology for producing Wine, Beer, Whiskey, Brandy, and Rum. Tea and Coffee processing

Total: 45 Hours

Reference(s)

1. L.Jagan Mohan Rao and K.Ramalakshmi, Recent trend in Soft beverages, Woodhead Publishing India Pvt Ltd.,New Delhi 2011
2. Woodroof, Jasper Guy, and G. Frank Phillips. Beverages: carbonated and noncarbonated. AVI Pub. Co., 1981
3. Mitchell, Alan J. Formulation and Production Carbonated Soft Drinks. Springer Science & Business Media, 1990
4. Richard Coles and Mark Kirwan Food and Beverage Packaging Technology Second Edition Blackwell Publishing Ltd., 2011.
5. Hui, Yiu H., et al., eds. Handbook of food and beverage fermentation technology. Vol. 134. CRC Press, 2004.
6. Boulton, Christopher, and David Quain. Brewing yeast and fermentation. John Wiley & Sons, 2008.

18FD011 SUGAR TECHNOLOGY 3 0 0 3

Course Objectives

- Understand important unit operations involved in sugarcane processing
- Know the production of sugar from sugarcane, beet and palm
- Explore the large scale processing of sugar from sugarcane

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

Course Outcomes (COs)

1. Identify the suitable machineries for pre-processing and transportation of sugarcane
2. Select appropriate crushers for cane juice extraction and determine its efficiency
3. Assess the cane juice clarification using different clarifying agents
4. Explain and apply the filtration and evaporation in sugarcane processing
5. Attribute crystallization for the large scale production of sugar

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1		2									1	
2	2	1		1	1	1								
3	1	2		2	2	2								
4	2	2		2	2	2								
5	2	2		1										

UNIT I **9 Hours**

PRE PROCESSING OPERATIONS

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

UNIT II **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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.

FOR FURTHER READING

Physical & chemical properties of sugars, Manufacture of sugar-free, sugarless carbonated beverages, Sugars and sweetening agents, Sugar alcohols.

Total: 45 Hours

Reference(s)

1. Meade and Chen, Hand of book of cane sugar, 11th Ed , Wiley Interscience, New York, 2001
2. John H. Payne, Unit operation in cane sugar production, Sugar series book 4, Elsevier Pub. Co., New York, 1982.
3. Baikow, V.E. 1967. Manufacturing and refining of raw cane sugar. Elsevier Publishing Company, New York
4. McCabe, W.L. and J.e. Smith 1976. Unit operations in chemical engineering. McGraw Hill Kogakusha Ltd., Tokyo.
5. R B L Mathur, Hand Book of Cane Sugar Technology, 2 nd Ed, Oxford & IBH, 1978

18FD012 CEREAL, PULSES AND OILSEED TECHNOLOGY

3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2		2								
2	1	2		2		1								
3	2	2		1		2								
4	2	3		2		2								2
5	2	2		2		3								

UNIT I **9 Hours**

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats

Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

FOR FURTHER READING

Major growing areas of cereals and pulses in India, National and global scenario of millet processing and
products, Novel extruded millet and cereal products.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

18FD013 READY TO EAT FOODS 3 0 0 3

Course Objectives

- Know the current status of snack food Industry
- Impart knowledge on various unit operations and manufacturing process in different Snack Foods Industries like Potato Processing, Tortilla Processing and Popcorn processing
- Study the difference between small and industrial level processing of snack foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Outline the current production and marketing status of Snack foods
2. Show the manufacturing steps involved in the production of potato chips and value added products from potato
3. Construct the flowchart for the processing steps and equipment's involved in the Tortilla chips processing
4. Carryout the selection and preparation of popcorn by industrial manufacturing process
5. Analyse the methods of sensory evaluation and packaging technologies in Snack Food Industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2			2								1
2	2		1	1		1								1
3		1	2	1		1							1	
4	1		2	2		1								
5	3	2	1	2		2								1

UNIT I **9 Hours**

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 **9 Hours**

POTATO CHIPS PROCESSING

Potato Production- Market value of Potato- History of Fabricated potato snacks- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Future of Fabricated Potato snacks- Other value added products from Potato

UNIT III **9 Hours**

TORTILLA CHIP PROCESSING

Introduction- Raw Materials- Processing steps-Corn cooking and soaking-Washing and Draining-Grinding Equipment-Reconstitution of Dry Masa Flour- Masa feeding- Pumping- Preheating-Sheeting/Cutting- Baking Conditioning/Equilibration-Frying

UNIT IV **9 Hours**

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 V **9 Hours**

SENSORY EVALUATION AND PACKAGING 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

FOR FURTHER READING

Ready to eat expanded products - breakfast cereals, Value added products from different pulses and millets, Baby foods - traditional batch processing, extrusion system for baby foods, papad process.

Total: 45 Hours

Reference(s)

1. Lusas, E. W., & Rooney, L. W. (Eds.) Snack foods processing. CRC Press, 2001
2. Panda, H, The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi, 2013
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd. 2008

18FD014 DESIGN AND FORMULATION OF FOODS 3 0 0 3

Course Objectives

- Understand and evaluate the nutritional value of foods to formulate the balanced diet.
- Develop skills to assess and apply nutrition standards and guidelines for achieving optimum human nutrition and health
- Create the knowledge to design functional and special foods for the nutritional and health benefits

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the concept and analyse the nutritive value and health benefit of foods.
2. Apply the principles of menu planning process and to formulate the menus for different age groups
3. Analyse the nutritional requirements for balanced diet from infancy to adolescence and able to formulate therapeutic diets for diseases like diabetic and cardio vascular problems.
4. Evaluate the energy content and energy requirements using different standards and regulations.
5. Create the functional and special foods for the health benefit

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			1		2							1	1
2	3	1	2	1		2								
3	3		3	1		2							3	3
4	3		2	2		2							2	2
5	3		2	2		2							1	2

UNIT I **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

FUNCTIONAL AND SPECIAL FOODS

Concepts for functional foods design, prebiotics & probiotics- nutraceuticals- designer foods- Space foods-Army foods-Athlete foods-Packaged food supply in Flights

FURTHER READING

Organic vs Inorganic Nutrients: Differences & Importance; Nature, type and scope of nutraceutical and functional foods; Techniques of assessment of nutritional status; Methods of measuring body composition: direct and indirect; Techniques to measure energy expenditure and energy intake. Techniques to assess physical fitness.

Total: 45 Hours

Reference(s)

1. Antia, F. P. Gopalan, C., Sastri, B. R., & Balasubramanian, S. C. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research. 1976
2. Antia, F. P. Clinical dietetics and nutrition with special reference to tropical foods. Clinical dietetics and nutrition with special reference to tropical foods.1966
3. Srilakshmi, B. Dietetics. New Age International. 2007

18FD015 FOOD BIOTECHNOLOGY 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Apply the principles of biotechnology in Food processing industries to improve the quality of foods
2. Execute the production of commercially important metabolites
3. Apply the principle of downstream processing and explain various stages involved in downstream processing
4. Evaluate the diagnostic techniques for food borne pathogens and toxins 5.
5. Assess the safety aspects and social issues related to applications and implications of genetically modified foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		1	1	2								
2	1	3		2	2	2								
3	1	2		1	2	1								
4	1	3		3	2	2								
5	1	2		2	1	2								

UNIT I **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

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 **9 Hours**

GM FOODS - SOCIAL AND ETHICAL ISSUES

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

FOR FURTHER READING

Role of biotechnology in enzymology and product development, fermentation process, fruit juice extraction, genetic improvement of food grade microorganisms, Nutritional significance of food products developed by biotechnological techniques, Nutrigenomics.

Total: 45 Hours

Reference(s)

1. Bielecki S., Ed., Polak J., J. and Bielecki, Tramper S., Food Biotechnology, Elsevier Science Publishing Company, New Delhi, 2000
2. Joshi, V.K. and Pandey, A., Biotechnology - Food Fermentation, Volume. I & II, Education Publishing, New Delhi, 1999.
3. Gutierre, Gustavo F., Food Science and Food Biotechnology, CRC Press, New York, 2003
4. Crueger, W. and Crueger A., Biotechnology: A Textbook of Industrial Microbiology, Science Tech. Madison, USA, 1987
5. Knorr, D., Food Biotechnology, Marcel Dekker, New York. 1999.
6. Rita Singh, Food Biotechnology, Global vision publication house, Delhi, 2004.

18FD016 FOOD ALLERGY AND TOXICOLOGY 3 0 0 3

Course Objectives

- Understand the various kinds of food allergens and basis of allergic reactions
- Familiarize with various natural toxins in food
- Determine different toxicants found in foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Find the hazards and the toxicity associated with food and their implications for health
2. Analyse the chemistry of food allergens and disorders associated with food
3. Assess the risk and exposure of toxins in food sampling
4. Determine the toxicants in foods by the qualitative and quantitative analysis
5. Critique the formation of toxins during post harvest processing or else during storage

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1						2							
2	2						1	1						
3	1						2	1						
4							2	1						
5	1						1							

UNIT I **9 Hours**

INTRODUCTION

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources

UNIT II **9 Hours**

FOOD ALLERGY AND SENSITIVITY

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

UNIT III **9 Hours**

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 **9 Hours**

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 **9 Hours**

TOXICANTS FORMED DURING FOOD PROCESSING

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour 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

FOR FURTHER READING

Toxicants and allergens in foods derived from plants, animals, marine, algae and mushroom, Derived food toxicants- processing and packaging Different types of hazards, Toxicants generated during food processing.

Total: 45 Hours

Reference(s)

1. Helferich, William and Carl K.Winter, Food Toxicology, CRC Press, 2001
2. Alluwalia and Vikas, Food Hygiene and Toxicology, Paragon International Publishers, 2007.
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes, Introduction to Food Toxicology, 2nd Edition, Academic Press, 2009
4. Maleki, Soheila J. A.Wesley Burks, and Ricki M.Helm, Food Allergy, ASM Press, 2006.
5. Cliver, Dean O. and Hans P.Riemann, Food Borne Diseases, 2nd Edition, Academic Press/Elsevier, 2002.
6. Riemann, Hans P. and Dean O. Cliver, Food Borne Infections and Intoxications, 3rd Edition, Academic Press/Elsevier, 2006.

18FD017 MUSHROOM PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Understand the basic concepts and techniques of mushroom cultivation
- Plan the construction of houses for mushroom cultivation
- Apply suitable post-harvest processing technology and represent the advances in mycology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Exemplify the Classification, Morphology and Nutrient profile of Mushrooms
2. Implement the mushroom cultivation techniques
3. Plan and execute the construction of mushroom houses
4. Carryout mushroom production and post-harvest management
5. Check the recent advances in mushroom cultivation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				1									
2	1			2										1
3	1			1		2	2							1
4	1	1			2	2								1
5	1				1									

UNIT I **9 Hours**

INTRODUCTION

History and classification of Indian Mushrooms- Edible and Poisonous Mushroom- Mushroom Classification-Based on occurrence, Morphology- Edibility and poisonous properties, nuclear behaviour and ultra-structural changes during the development of the mushroom fungi. Morphological and Microscopical identification of mushrooms-Nutrient Profile of Mushroom- Protein, amino acids, calorific values, carbohydrates, fats, vitamins & minerals

UNIT II **9 Hours**

TECHNIQUES OF MUSHROOM CULTIVATION

Structure and construction of Mushroom House- Layout of traditional and green house method. Methods of Mushroom cultivation: Bed Method, Polythene Bag Method- Breeding conditions of mushroom strains: temperate conditions, Isolation of spawn, growth media- Principles of composting, machinery required for compost making, materials for compost preparation. Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC)

UNIT III **9 Hours**

CONSTRCTION OF MUSHROOM HOUSES

Structure and construction of Mushroom House- Layout of traditional and green house method-Methods of Mushroom cultivation: Bed Method-Polythene Bag Method-Principles of composting, machinery required for compost making-Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC)

UNIT IV **9 Hours**

PROCESSING TECHNOLOGY

Cultivation of Oyster-Paddy and Button mushroom-Preparation of Pure Culture and spawn cultivation methods and harvesting- Post harvest technology: Storage-Freezing- dry Freezing- drying- canning-quality assurance and entrepreneurship

UNIT V **9 Hours**

ADVANCED MYCOLOGY

Genetic development process in Mushroom cultivation- Genetically edited mushrooms- Selection, Anastomosis, Hybridization, Mutagenesis, Protoplast fusion- Genetic engineering- Genetically modified mushrooms: White mushrooms, Advantages and disadvantages-Medicinal and nutritional value- Health benefits- Microbicidal effects

FOR FURTHER READING

Diseases and problems of mushroom cultivation, Value added products from mushroom, mushroom marketing, entrepreneurship development in mushroom cultivation.

Total: 45 Hours

Reference(s)

1. Mushroom Production and Processing Technology, PathakYadav Gour Published by Agrobios India, 2010.
2. Mushroom Cultivation, Tripathi, D.POxford & IBH Publishing Co. PVT.LTD, New Delhi,(2005)
3. Gupta,P. K. Elements of Biotechnology.2nd Edition (3rd Reprint) 2015.
4. Kannaiyan, S. Ramasamy, K. A hand book of edible mushroom, Today & Tomorrows Printers &Publishers, New Delhi 1980
5. Pathak, V. N. and Yadav, N., Mushroom Production and Processing Technology, Agrobios, Jodhpur, 1998.

18FD018 PLANTATION AND SPICE PROCESSING 3 0 0 3

Course Objectives

- Understand Coffee and Tea Processing Techniques and its quality grading
- Analyze the methods of processing for Cashew, Coconut, Vanilla and Cocoa
- Evaluate the Processing and Extraction Techniques of Major and Minor spices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

Course Outcomes (COs)

1. Assess the unit operations and processing steps involved in the manufacture of tea and coffee
2. Apply the processing techniques of cashew and coconut to develop value added products
3. Analyze the chemistry and manufacturing techniques of Vanilla and cocoa products
4. Compare the processing methods and extraction techniques of major spices
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2									1	
2	1	2		2										
3	2	1		2										
4	3	2	1	2									1	
5	3	2	1	2									1	

UNIT I **9 Hours**

COFFEE AND TEA PROCESSING

Coffee- Occurrence - chemical constituents - harvesting - fermentation of coffee beans fermentation- drying- roasting- Process flow sheet for the manufacture of coffee powder- Instant coffee, technology- Chicory chemistry- Quality grading of coffee- Tea - occurrence- chemical 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 II **9 Hours**

CASHEW AND COCONUT PROCESSING

Cashew-Importance - harvesting- products - uses of cashew & CSNL- cashew nut processing - methods of roasting - shelling - grading- packaging- infestation- Hygiene and safety. Coconut- harvesting - Processing technology of Virgin Coconut oil- Desiccated Coconut, Milk Cream, Nata-de-Coco, Packed Tender Coconut Water- Vinegar and Activated Carbon.

UNIT III **9 Hours**

VANILLA AND COCOA PROCESSING

Vanilla- Occurrence -chemistry of vanilla -stage of harvesting - different curing techniques -quality control and grading of cured beans -vanillin extraction methods - super critical fluid extraction of vanillin- Cocoa - Occurrence - Chemistry of the cocoa bean - changes taking place during fermentation of cocoa bean - Processing of cocoa bean - cocoa powder - cocoa liquor manufacture- Chocolate - Types - Chemistry and technology of chocolate manufacture - Quality control of chocolates.

UNIT IV **9 Hours**

MAJOR SPICE PROCESSING

Importance for spices - production and export status - stages and methods of harvest of important spices- equipment used for threshing, shelling, decortications of spices-Processing of cardamom-stage of harvest-processing of pepper-harvesting- packaging-processing of white pepper - wet and dry pulping and retting methods - drying; Processing of turmeric - Processing of chilli - harvesting and drying - packaging and grinding - low temperature grinding - advantages - refrigerant used - construction and working

UNIT V **9 Hours**

MINOR SPICE PROCESSING

Minor Spices - processing of Cumin, Coriander, Cinnamon, fenugreek, Garlic and Clove- Oleoresins and essential oils- Method of manufacture - Chemistry of the volatiles- Enzymatic synthesis of flavor identicals - Quality control - Processing of ginger -harvesting, washing, drying, and packaging - quality aspects - processing of clove, nutmeg and other minor spices- Packaging and storage of spices - quality analysis- AGMARK and ASTA standards.

FURTHER READING

Value addition of spices, turmeric, areca nut, oil palm processing, chemistry of different spice flavours, adulteration in spices.

Total: 45 Hours

Reference(s)

1. Chakraverty, A, Arun S. Mujumdar, G.S.Vijayaraghavan, and Hosahalli. S. Ramaswamy.Handbook of Post Harvet Technology: Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker. Inc. New York.2003
2. Board, N. I. I. R.Hand Book on herbs cultivation & processing. Asia Pacific Business Press, 2004
3. Kader, A. A. Postharvest Technology of Horticultural Crops, third Edition, Division of Agriculture and National Resources, California University. 2011
4. Minifie Bernard W, Chocolate, Cocoa and Confectionery Technology, Third Edition, Aspen Publication, 2014.

18FD019 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

3 0 0 3

Course Objectives

- Introduce process economics and industrial management principles to Food engineers
- Teach principles of cost estimation, feasibility analysis, management, organization and quality control
- Introduce some of the fundamental tools and concepts of economic balance and quality control

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate the organizational structure and concepts of management
2. Analyze the cost economics
3. Justify the investment, profit and alternate policies
4. Evaluate the annual report and performance analysis
5. Implement the economic and operations management quality control

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				1	2								
2	2	2	2	2	2	1								
3	1	1	1	2	1	2								
4	2	2	1	2	2	2								
5	1	1	1	1	1	2								

UNIT I 9 **Hours**

PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION

Planning- organization- staffing- coordination- directing- controlling- communicating- organization as a process and a structure- types of organizations Method study- work measurement techniques- basic procedure- motion study- motion economy- principlesof time study- elements of production control- forecasting- planning- routing; - cheduling- dispatching- costs and costs control, inventory and inventory control

UNIT II 9 **Hours**

ENGINEERING ECONOMICS FOR PROCESS ENGINEERS

Time Value of money- capital costs and depreciation- estimation of capital cost- manufacturing costs and working capital- invested capital and profitability

UNIT III 9 **Hours**

PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

Estimation of project profitability- sensitivity analysis- investment alternatives- replacement policy- forecasting sales- inflation and its impact

UNIT IV 9 **Hours**

ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

Principles of accounting- balance sheet- income statement- financial ratios- analysis of performance and growth

UNIT V 9 **Hours**

ECONOMIC BALANCE AND QUALITY CONTROL

Essentials of economic balance -Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control

FURTHER READING

Business management, production analysis and pricing, estimation, costing, accounting and investment decision.

Total: 45 Hours

Reference(s)

1. Peters, M. S. and Timmerhaus, C. D. Plant Design and Economics for Chemical Engineers 5th Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K. Introduction to process Economics, 2nd Edn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V. Production and Costing, Khanna Publishers,New Delhi, 2009.
4. Allen, L.A.,Management and Organization, McGraw Hill.
5. Perry, R. H. and Green, D.,Chemical EngineerÃƒÂ¢??s Handbook, 7th Edn., McGraw Hill

18FD020 ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGISTS

3 0 0 3

Course Objectives

- Develop the Entrepreneurial skills for Food Technologists
- Acquire basic knowledge in Trade license and registration marks, Sources of finance, Selection of land and factory sheds
- Impart knowledge on Preparation of project report, Market feasibility reports , Techno-economic feasibility report

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Describe the meaning and role of an entrepreneur and the functions
2. Check the policies and regulations for entrepreneurship
3. Generate the business plan and evaluate the feasibility
4. Generate and launch small business plan
5. Apply the guidelines of developed business plan to manage small business

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1			3									
2	1	1			3									
3	1	2	1	2	2									
4	1	1	1	1	2									
5	1	1		1	1									

UNIT I **9 Hours**

ENTREPRENEURAL COMPETENCE

Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality Characteristics- Knowledge- Skills- Attitude Requirement

UNIT II **9 Hours**

ENTREPRENEURAL ENVIRONMENT

Business Environment- Role of Family and Society- Entrepreneurship Development Training and Other Support Organizational Services- Central and State Government Industrial Policies and Regulations- International Business

UNIT III **9 Hours**

BUSINESS PLAN PREPARATION

Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product- Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the Project- Feasibility Report Preparation and Evaluation Criteria

UNIT IV **9 Hours**

LAUNCHING OF SMALL BUSINESS

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

UNIT V **9 Hours**

MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business

FURTHER READING

Entrepreneurial development, food business management, SWOT Analysis, preparation of project report, market assessment.

Total: 45 Hours

Reference(s)

1. Hisrich, "Entrepreneurship", Tata McGraw Hill, New Delhi, 2005.
2. Saravanavel, P.,'Entrepreneurial Development', Ess Pee kayPublishing House, Chennai, 2005
3. Khanka, S S.,"Entrepreneurial Development", S.Chand and Co Limited, New Delhi, 2001.
4. Jain, P C.,"Handbook for New Entrepreneurs", Second Edition, Oxford University Press, New Delhi, 2002.

18FD021 ENTERPRISE RESOURCE PLANNING 3 0 0 3

Course Objectives

- Understand the fundamental concepts of ERP systems, their architecture, and working of different modules in ERP.
- Develop and design the modules used in ERP systems, and can customize the existing modules of ERP systems
- Create an awareness with regard to application of ERP in Enterprises and Open Source ERP

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate the basic issues in Enterprise Systems
2. Conclude with a suitable solution for small, medium and large enterprise vendors
3. Assess an organization's readiness for enterprise system implementation with a professional approach
4. Implement ERP and assess its success and failure factors
5. Apply the concepts of BPR, SCM and CRM based on its emerging requirements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				2								
2	1	2	1	2	1	2								
3	1	2		1	1	2								
4	1	2	1	1	2	2								
5	1	1	1	1	1	1								

UNIT I **9 Hours**

INTRODUCTION

Overview of enterprise systems - Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems

UNIT II **9 Hours**

ERP SOLUTIONS AND FUNCTIONAL MODULES

Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR,and best business practices - Business process Management, Functional modules

UNIT III **9 Hours**

ERP IMPLEMENTATION

Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training - Data Migration. People Organization in implementation- Consultants, Vendors and Employees

UNIT IV **9 Hours**

POST IMPLEMENTATION

Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation

UNIT V **9 Hours**

EMERGING TRENDS ON ERP

Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing

FURTHER READING

Implementation and maintaining ERP in milk industry, Software used for ERP (SAP etc.), Practical difficulties in implementing ERP.

Total: 45 Hours

Reference(s)

1. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System,Wiley India, 2012
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
3. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
4. MahadeoJaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
5. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.

18FD022 SUPPLY CHAIN AND RETAIL MANAGEMENT

3 0 0 3

Course Objectives

- Familiarize the basics of business, management, the legal environment, and issues relating to governance and ethics
- Enrich knowledge on key areas related to management of retail services
- Acquire skills necessary to successfully carve a career in retail management

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze and understand the manufacturing and partnership strategies in food sector
2. Assess the opportunities and challenges in marketing of food products
3. Demonstrate the food safety standards involved in retail sector
4. Demonstrate the various operations involved in supply chain
5. Apply logistics and purchasing in globalization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				2	1								1
2	1					1								
3		1				1							1	
4		1			1									
5	1				1									1

UNIT I **9 Hours**

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 supply Chain Partnerships - Contracts, Strategic Alliances

UNIT II **10 Hours**

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 8 **Hours**

RETAIL MANAGEMENT

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

UNIT IV **10 Hours**

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, Trace-ability, Identity, Preservation issues in the Food System - Retail supply chain management, Changes in Retail, Food Delivery

UNIT V 8 **Hours**

GLOBALIZATION

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

FURTHER READING

Ways to improve supply chain management by retailers, how to lower Retail Supply Chain Costs, working of RFID in supply chain management, Impact of FDA on retail sales.

Total: 45 Hours

Reference(s)

1. Sunil Chopra, Peter Meindl . Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall, 2nd ed. 2004
2. Kohls, R.L., and J.N. Uhl. Marketing of Agricultural Products, 8th ed. New York:Macmillan 1998.
3. Kotabe, M, and K. Helsen, Global Marketing. 2nd ed. New York: Wiley, 2001
4. Rhodes, V.J., and J.L, Dauve.. The Agricultural Marketing System. 5th ed. Scottsdale, Ariz. Hathaway, 1998
5. Kenneth Lysons, Brian Farrington Purchasing and Supply Chain Management, Prentice Hall,

18FD023 TOTAL QUALITY MANAGEMENT 3 0 0 3

Course Objectives

- Understand the basic concepts of total quality management and appreciate its importance in today's business environment
- Enable them to acquire required diagnostic skills and use various quality tools
- Familiarize the students about the Quality Management System

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply TQM concepts for improving the quality of products and services
2. Implement the basic principles of TQM in manufacturing and service based organization
3. Apply the tools and techniques of quality management to manufacturing and service processes
4. Predict the improvement necessary for the better performance
5. Implement Quality Management System.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1		1		2							1	1
2		2		2		2							2	2
3	1	1	2		1	1								
4	2		1	2		2							2	2
5		1		2		1							1	1

UNIT I **9 Hours**

INTRODUCTION

Introduction - Definition of quality - Quality control tools - Quality control chart - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Quality Gurus - Barriers to TQM - Cost of Quality

UNIT II **9 Hours**

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 **9 Hours**

TQM TOOLS

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 **9 Hours**

TQM TOOLS

Quality circles - Quality Function Deployment (QFD) -Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures - BPR

UNIT V **9 Hours**

QUALITY SYSTEMS

Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 -ISO 14000- ISO 22000 - Concepts, Requirements and Benefits -Quality Council - Leadership, Employee involvement -Motivation, Empowerment, Team and Teamwork, Recognition and Reward

FURTHER READING

Application of TQM in food industry-A case study (Beverage industry, Dairy industry etc.), TQM in food industry- Benefits, Current situation and potential in India.

Total: 45 Hours

Reference(s)

1. Evans, James R. and William M. Lindsay, "The Management and Control of Quality".6th Edition South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM - Text with Cases", 3rd Edition. Butterworth - Heinemann, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", PHI, 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management - Text and Cases". PHI, 2006.
5. Besterfiled, Dale H. et al., "Total Quality Management", 4th Edition, Pearson Education. Asia, 2006.

18FD024 SENSORY EVALUATION OF FOODS 3 0 0 3

Course Objectives

- Understand the influence of taste, odour and colour perception on sensory quality
- Apply the principles of sensory evaluation methodologies.
- Evaluate the sensory quality of foods using instruments

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. To assess the perception of senses by human sensory organs
2. To apply the sensory principles and practices to establish sensory panel and facilities
3. To choose the appropriate sensory evaluation tests related to the quality of foods
4. To analyze the sensory quality of foods using instruments
5. To evaluate the sensory evaluation by applying basic statistical concepts.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				1	1				1		3		
2	1				3			2	3	3	2			
3	1	2	1	3	3				2	3	3			
4	2	1	3	1	3			1						
5	3	2		3	1	3		1			1			

UNIT I **9 Hours**

HUMAN SENSES - ANATOMY, PHYSIOLOGY AND PERCEPTION

Aim of sensory evaluation and Applications. Sensory properties and human senses. Importance of Taste, odour, Colour and Texture. Structure and physiology of taste organs - tongue, papillae, taste buds, salivary glands. Mechanism of taste perception- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami. olfactory organs and receptors - physiology of odour perception and colour perception Texture classification and texture perception.

UNIT II **9 Hours**

SENSORY PANELS AND TESTING FACILITIES

Establishing sensory panels - Types of panels (Trained panel, discriminative and communicative panel). Selection, training and performance monitoring. Factors influencing sensory verdicts. Response Errors - Types and Steps to reduce the errors. Designing Sensory Testing Facilities. Sampling, preparation and presentation of samples. Panel Measurement scales.

UNIT III **9 Hours**

METHODS OF SENSORY EVALUATION

Methodology for sensory evaluation: Consumer oriented tests and Product Oriented tests. Consumer oriented tests- Preference test, Acceptance test, Hedonic test. Product Oriented tests - Threshold tests; Discriminative test - paired comparison, Duo-trio, triangle; Ranking, Sensitivity Test, Descriptive test - flavor profiling, texture profiling, ratio scaling, quantitative descriptive analysis.

UNIT IV **9 Hours**

INSTRUMENTATION IN SENSORY EVALUATION

Need for Instrumentation in sensory evaluation. Colour Measurement - spectrophotometry, colorimetry, Munsell colour system, CIE colour system, Hunter colour system, Electronic eye (IRIS). Texture measurement - Basic rheological instruments, Texture analyzer. Taste measurement- E-tongue. Odour measurement- E nose, GC - olfactory.

UNIT V **9 Hours**

STATISTICAL ANALYSIS OF SENSORY EVALUATION

Conducting a sensory study. Basic statistical concepts for sensory evaluation: Hypothesis testing and sensory inference, variation of T Test, Nonparametric and binomial based Statistical methods, Chi-square test, analysis of variation, Correlation regression.

FURTHER READING

Recent trends in Sensory analysis of food products. Instrumentation advancements in sensory science.

Total: 45 Hours

Reference(s)

1. Lyon, D.H., Francombe, M.A., Hasdell, T.A., Lawson, K. (eds), Guidelines for Sensory Analysis in Food Product Development and Quality Control. Chapman and Hall, London, 1992.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation. Academic Press, New York, 1965.
3. Martens, M.; Dalen, G.A.; Russwurm, H. (eds): Flavour Science and Technology. John Wiley and Sons, Chichester, 1987.
4. Moskowitz, H.R. (eds), Food Texture: Instrumental and Sensory Measurement. Marcel Dekker Inc. New York, 1987
5. Rao E. S.. Food Quality Evaluation, Variety Books. 2013.
6. B. M. Watts, G. L. Ylimaki, L. E. Jeffery, L. G. Elias, Basic Sensory Methods For Food Evaluation, 1989

18FD025 EMERGING TECHNOLOGIES IN FOOD PROCESSING

3 0 0 3

Course Objectives

- Understand and apply the different emerging technologies in processing of foods
- Familiarize about the equipment used for the processing of foods by novel technologies
- Compare the application of alternate thermal and non-thermal processing techniques on foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the effect of high pressure processing on microbial inactivation of foods
2. Apply the principle of pulsed electric field and analyse the impact of pulsed electric field processing for both solid and liquid foods
3. Apply and assess the irradiation dosage requirement for foods
4. Apply non thermal technologies for inactivation of microorganisms and improve the food quality
5. Apply advanced thermal treatments for food processing and preservation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3							1	1
2	1		2	2		3								
3	1	3				3							2	2
4	2	1				3							1	1
5	2		1			3							2	2

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles - Mechanism and applications of high pressure processing to food systems - High pressure processing of salads, meats and sea foods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II 9 **Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology - Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

UNIT III 9 **Hours**

FOOD IRRADIATION

Introduction - Fundamentals of food Irradiation - Type and sources of radiation, dosimetry, mode of action of ionizing radiation - Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations.

UNIT IV **10 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High intensity pulsed light technology:- principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ultrasound Processing: Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultra sound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms.

UNIT V **8 Hours**

ALTERNATIVE THERMAL PROCESSING TECHNIQUES

Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave-vacuum drying, microwave freeze-drying - applications.

FURTHER READING

Ohmic heating, UV: Equipment- processing- effect of UV on microorganisms and enzyme- application of UV in food processing. Safety and standards regulations of novel processing on food.

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1 Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004.
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.
4. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M. Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food,2000
5. Amit K. Jaiswal, Food Processing Technologies: Impact on Product Attributes. CRC Press, 2017

18FD026 STORAGE ENGINEERING 3 0 0 3

Course Objectives

- Analyse the parameters influencing the design of cold storage, refrigerated storage and controlled atmospheric storage system
- Understand specific aspects of storage
- Evaluate the effect of storage conditions on product quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Design cold storage and estimate cooling load
2. Evaluate the quality of frozen foods
3. Design the controlled atmosphere storage structures
4. Understand the effect of gas composition on shelf life of food products
5. Analyse the parameters for hypobaric storage

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2	1								1
2	2					1							2	
3	2					1								2
4		2			2								2	
5	2				2									2

UNIT I **9 Hours**

COLD STORAGE

Cold storage- Moist air and applied psychrometry, Estimation of cooling load, Air conditioning systems, Evaporators, Compressors, Condensers, Expansion devices, Cooling towers, Different types of refrigerants, Transmission and distribution system of cool air, Thermal and vapor insulation materials, Design of small capacity cold storage, Instrumentation and climate management in cold storage

UNIT II **9 Hours**

FROZEN STORAGE

Quality loses in frozen foods- Physical changes, Chemical changes in food components, Nutritional aspects of freezing, Microbiology of frozen products, Glass transitions temperature and stability of frozen foods, Temperature requirements during frozen storage, Shelf-life of frozen foods- shelf-life testing, Modelling loss of quality in frozen foods, Time-Temperature integrators, Packaging of frozen foods, Different types of freezers.

UNIT III **9 Hours**

CONTROLLED ATMOSPHERIC STORAGE

Biochemical considerations of CAS, Gas exchange mechanisms, Mass balance principles, Gas generators, Equipments for producing and regulating controlled atmosphere, Design of controlled atmosphere storage chambers

UNIT IV **9 Hours**

MODIFIED ATMOSPHERIC STORAGE

Overview of Modified atmospheric storage, Gases and Vapor applied to modified atmosphere processing operations, MAP modelling- Kinetics of food deteriorative reactions, Shelf-life testing, Enzyme kinetics applied to MAP, MAP design with oxygen modelling

UNIT V **9 Hours**

HYPOBARIC STORAGE

History of Hypobaric storage, Experimental errors in hypobaric storage research, Gas and vapor mass transfer at low pressure, Requirements for installation- measurement devices (Relative humidity, Pressure, Air-change rate, Oxygen, Carbon dioxide, Ethyl alcohol, Acetaldehyde, hypobaric acid vapor), Flow control, Humidity control, Effects on food, Effects on microbes.

FURTHER READING

scientific principles in the storage technologies specific to the materials

Total: 45 Hours

Reference(s)

1. Stanley.P.Berg "Hypobaric storage in food industry- Advances in technology and theory"- First edition, Academic Press, 2014
2. Judith.A.Evans, "Frozen food science and Technology"blackwell publishing, 2008
3. Chandra Gopala Rao Engineering for storage of fruits and vegetables- BSP Books Pvt Ltd, 2015

18FD027 CHEMICAL REACTION ENGINEERING 3 0 0 3

Course Objectives

- Provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- Provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Build basic knowledge of classification of reactions.
2. Understanding the fundamentals of ideal reactors
3. Understanding the fundamentals of non ideal reactors
4. Acquire knowledge about gas-solid, gas-liquid reactions
5. Acquire knowledge about fixed bed and fluid bed reactors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1										
2	2	2	1	1										
3	2	2	1	2										
4	2	2	1	1										
5	2	2		2										

UNIT I **9 Hours**

SCOPE OF CHEMICAL KINETICS

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II **9 Hours**

IDEAL REACTORS

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III **9 Hours**

NON IDEAL REACTORS

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV **9 Hours**

GAS-SOLID, GAS-LIQUID REACTIONS

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V **9 Hours**

FIXED BED AND FLUID BED REACTORS

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

Total: 45 Hours

Reference(s)

1. Zeki Berk, Food Process Engineering and Technology,Academic Press is an imprint of Elsevier,2009.
2. Dawande, S.D., Principles of Reaction Engineering, Ist Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., Coulson Richardson - Chemical Engineering, Vol.III, IIIrd Edition, Butterworth- Heinemann- Elsevier, 2006.
4. Levenspiel O. Chemical Reaction Engineering. IIIrd Edition. John Wiley.2006.
5. Fogler H.S. Elements of Chemical Reaction Engineering. Prentice Hall India.2002

18FD028 BIOCHEMISTRY 3 0 0 3

Course Objectives

- To enable students learn the fundamentals of Biochemical Processes
- To enable students learn the fundamentals of structure and properties of important biomolecules
- To acquire knowledge about metabolism concepts, intermediary metabolism and regulation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. To ensure students have a strong foundation in the basic principles of organic chemistry
2. Upon completion of course, the students will be able to acquire knowledge about structure and properties of important biomolecules
3. Upon completion of course, the students will be able to acquire knowledge about metabolic concepts of proteins and its pathways
4. To ensure students have a strong foundation in the metabolism and pathways of glucose and fatty acids
5. Upon completion of course, the students will be able to analyse Case study on overproduction of primary and secondary metabolites

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	2								3	3
2		2	2		2			1			1		3	3
3	2	2	2		1	2	2	2	1			1	2	2
4	1	2			2			2					2	-
5		2	2	3			2		1		1		2	2

UNIT I 8 **Hours**

INTRODUCTION TO BIOMOLECULES

Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules,chemical nature of water, pH and biological buffers.

UNIT II **10 Hours**

STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES

Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. roteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

Lipids: Fatty acids, glycerol, triacylglycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of Lipid-metabolism-Tay- Saach"s disease, Niemann-Pick"s disease and Gaucher"s disease. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration Amino Acids, Peptides, and Proteins.Classification based on side-chain properties. Structures, hierarchy of organization primary, secondary, tertiary and quaternary structures,glycoproteins, lipoproteins. Determination of primary structure.

UNIT III 9 **Hours**

METABOLISM CONCEPTS

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites.Interconnection of pathways and metabolic regulation.

UNIT IV 9 **Hours**

INTERMEDIARY METABOLISM AND REGULATION

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination anddecarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential ofcompounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose andfatty acids.

UNIT V 9 **Hours**

CASE STUDIES

Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine ,lysine, methionine, isoleucine, propionic acid and ethanol.

Total: 45 Hours

Reference(s)

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox Satyanarayana, U. and U. Chakerapani, Biochemistry 3rd Rev. Edition, Books & Allied Ltd., 2006.
2. Rastogi, S.C. Biochemistry 2nd Edition, Tata McGraw-Hill, 2003.
3. Berg, Jeremy M. et al. Biochemsitry, 6th Edition, W.H. Freeman & Co., 2006.
4. Murray, R.K., etal Harpers Illustrated Biochemistry, 27th Edition, McGraw-Hill, 2006.
5. Voet, D. and Voet, J.G., Biochemistry, 3rd Edition, John Wiley & Sons Inc.,2004.

18FD029 FOOD INFORMATICS 3 0 0 3

Course Objectives

- Understand the theory and background of commonly available computational tools, so that they are able to judge the validity of the results provided by these tools.
- Apply computational based solutions for biological perspective.
- Develop bioinformatics tools with programming skills.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic concepts in biological sequencing and computational tools.
2. Analyze the technical details of required for information retrieval from different databases.
3. Analyze systematics, taxonomy and phylogeny with the nomenclatures and annotation issues in food informatics.
4. Understand the concepts of sequence alignment and scoring matrices using computational tools and algorithms.
5. Create advanced high-throughput databases for food processing and analysis.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			2		1							1	1
2	3	2	1	2		3							2	2
3	3	1	2	2		1								
4	3	1	2	2		3							3	3
5	3	2	2	2		2							1	2

UNIT I **9 Hours**

NATURE AND SCOPE OF INFORMATICS

Nature and scope of Bioinformatics in Food, evolution of Bio-molecules- DNA, RNA, Protein and amino acids, Introduction to DNA and Protein sequencing, Food Genome Project.

UNIT II **9 Hours**

INTRODUCTION TO BIOLOGICAL DATABASES

Databases and programs - Information retrieval from databases for nucleic acids and proteins, Types of databases - Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, Gene Bank, DDBJ; Secondary nucleotide sequence databases.

UNIT III **9 Hours**

SEQUENCE ANALYSIS

Basic concepts of sequence similarity - Identity and homology, Definitions of homologues, orthologues, paralogues and xenologues, Scoring matrices: basic concept of a scoring matrix - matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles.

UNIT IV **9 Hours**

ALGORITHMS AND ALIGNMENT TOOLS

Pairwise sequence alignments - basic concepts of sequence alignment, local and global alignments, Dot plot, Scoring matrices, Multiple Sequence Alignment - CLUSTALW, Genetic Algorithm, Profiles, Blocks, HMM, RNA secondary structure.

UNIT V **9 Hours**

BIOINFORMATICS APPROACHES IN FOOD INDUSTRY

Databases and tools for detection of allergen and pathogens, In-silico Approaches - Food Processing, bioactive peptides, microbial informatics, Computer aided drug design.

Total: 45 Hours

Reference(s)

1. Lesk, A. K., Introduction to Bioinformatics 4th Edition, Oxford University Press, 2013.
2. Durbin, R., Eddy, S., Krogh, A., and Mitchison, G., Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids Cambridge, UK: Cambridge University Press, 1998.
3. Mount, D.W., Bioinformatics Sequence and Genome Analysis 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
4. Andreas D. Baxevanis, B. F. Francis Ouellette: Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Volume 39, John Wiley, 1998.

18FD030 FOOD ADULTERATION 3 0 0 3

Course Objectives

- To educate about common food adulterants and their detection
- To impart knowledge in the legislatory aspects of adulteration.
- To educate about standards and composition of foods and role of consumer.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the Food Adulteration and its causes to the society
2. Understand the various International laws of food safety and their implementation to prevent adulteration
3. Apply the concept of Food adulteration with various food products
4. Understand the main difference between Food adulteration and food additives and their significance in food preservation
5. Analyze the importance of consumer awareness for the successful implementation of adulteration free food

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1	2	2						
2						1	2	2	2					
3		2		3					2			2		
4	1								2				2	2

5						1	2	2	2			3		

UNIT I 9 **Hours**

INTRODUCTION TO FOOD ADULTERATION

Food adulteration: Introduction of Food adulteration, definition. New adulterants in Foods. Historical Food legislation in India; Central food laboratory, Municipal laboratories, Export inspection council laboratory, Central grain analysis laboratory, standards of weights and measures act, solvent extracted oil deoiled meal and edible flour order,export and quality control and inspection act and other acts and orders.

UNIT II 9 **Hours**

FOOD SAFETY LAWS

Food Safety and Standards Act 2006.vertical standards Vs horizontal standards. Food safety officer; powers, procedures, role of food analyst most important international laws; Codex alimentarius, FDA, USDA, FAO and WHO. Other International regulatory bodies like EFSA. European food safety authority. Food standards of Australia and Newzealand , Soudi Arabia food regulations.

UNIT III 9 **Hours**

ROLE OF LAWS IN DIFFERENT FOOD PRODUCTS

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies, private testing laboratories, Quality control laboratories of consumer co-operatives,.Standardization of Foods; Definition, Standards of Quality, for cereals, starchy foods,spices and condiments, sweetening agents, meat and meat products, vinegar, sugar and confectionary, beverages-alcoholic and non alcoholic , carbonated water etc., Milk and milk products , oils and fats , Canned foods, fruits and vegetables products.

UNIT IV 9 **Hours**

FOOD ADDITIVES

Food additives classification, nature and characteristics and use of additives in food such as antioxidants, chelating agents, coloring agents, curing agents, emulsions,flavors and flavor enhancers, flour improvers, humectants and anti caking agents,nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners. Raising agents types and their role in food processing., artificial colors Artificial flavors

UNIT V 9 **Hours**

FOOD ADULTERATION AND CONSUMER EDUCATION

Consumer education , consumers problems rights and responsibilities, copra 1986, tips for wise purchasing, redressal measures how to give complaints and proforma of complaints

Total: 45 Hours

Reference(s)

1. A first course in Food Analysis A.Y. Sathe, New Age International (P) Ltd., 1999.
2. Food Safety, case studies Ramesh. V. Bhat, NIN, 1992.

18FD031 FOOD SENSORS 3 0 0 3

Course Objectives

- Understand the principle, mechanism of different types of biosensors for identifying nutrient deficiencies.
- Develop skills to assess food quality with basic knowledge about biosensors.
- Create the knowledge to design biosensors for early detection of deficient quality in foods.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the concepts principles and terminologies with respect to biosensors.
2. Apply the concept of field effect transistors to detect enzymes and biomolecules in food.
3. Understand the principles of optical, calorimetric and magnetic biosensors.
4. Apply the principles of tranceducers and able to fabricate biosensors with bio-recognizing elements.
5. Assess and develop Biosensors for application in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			1		2							1	1
2	3		2	2		2							2	2
3	3	1	2	1		2								
4	3		3	1		2							3	3
5	3		2	2		2							1	2

UNIT I **9 Hours**

BASICS OF BIOSENSOR

Introduction to Sensors - Chemical sensors- Biosensors -working principles- Classification - Sensitivity - Selectivity - Reproducibility - Portability - Stability -Detection Limit - Response time.

UNIT II **9 Hours**

ELECTROCHEMICAL BIOSENSOR

Principles - Electrochemistry -Conductometry - Voltammetry- Impedance biosensors - Semiconductor -Ion Selective Field Effect Transistor (ISFET) and Enzyme Field Effect Transistor (ENFET) - Glucose biosensor - Nanostructure materials used for Electrochemical biosensors.

UNIT III **9 Hours**

OPTICAL AND COLORIMETRIC BIOSENSORS

Principles - Absorbance - Fluorescence - Raman Spectrum - Colorimetric sensors - Surface Plasmon Resonance (SPR) - Magnetic biosensors - Nanomaterials used in optical and magnetic biosensors.

UNIT IV **9 Hours**

TRANSDUCERS AND BIO-RECOGNITION ELEMENTS

Introduction to Transducers - Bio recognizing Elements - Enzymes - Antibodies - Receptors - Nucleic acids Ã¢?? Biosensor- Fabrication - Immobilization of biomolecules - Methods of Immobilization - Covalent and non-covalent - self-assembly method and physical adsorption.

UNIT V **9 Hours**

APPLICATIONS OF BIOSENSORS IN FOOD

Enzyme-based biosensors in food quality control to measure amino acids, amides, amines, carbohydrates, heterocyclic compounds, carboxylic acids, gases, inorganic ions, cofactors, alcohols and phenols, Trending Biosensors - E-nose and E- Tongue, Assessment and analysis of produce such as wine, beer, milk and yoghurt.

Total: 45 Hours

Reference(s)

1. Floninel- Gabriel Banica, Chemical Sensor and Biosensor Fundamental and Applications Handbook 2015.
2. Ajit Sadana and Neeti Sadana (2011) Handbook of Biosensors and Biosensor Kinetics ISBN: 978-0-444-53262-6, Elsevier.
3. Jeong-Yeol Yoon (2016) Introduction to Biosensors: From Electric Circuits to Immunosensors. Springer Int. Publishers. ISBN 978-3-319-27411-9.
4. Vinod Kumar Khanna 2011 Nanosensors: Physical, Chemical, and Biological CRC Press, 2011 ISBN 9781439827123.

18FD0XA HALAL COMPLIANCE IN FOOD AUDIT 0 0 0 1

Course Objectives

- Understand the basic terminologies, principles of Halal Auditing and the regulatory compliance in food industry and catering units

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Indicate the Halal standards
2. Apply for the Halal certification process and audit

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						
2								2						

Halal Regulations requirements and Halal Food Production standards

Introduction- A Benchmarking on International Halal Food Standards- Food Production, International Legislation, and Halal Requirements – Processed Meat- Halal Food Production, International Legislation, and Halal Requirements – Food Additives, Enzymes, Processing aids, Flavourings- Food Production, International Legislation and Halal Requirements – Beverages, Soy Sauce and Vinegar- Food Production, International Legislation, and Halal Requirements] – GMOs- Food Production, International Legislation and Halal Requirements – Dairy-Halal Animal Slaughtering- Halal Products Characteristics including Testing Techniques- Halal Products Conformity Assessment and International Certification Schemes-Auditing of the Halal products, service and process Inspection and Market surveillances requirements

Total: 20 Hours

Reference(s)

1. Riaz, M N. Chaudry, M M. Handbook of Halal Food Production. 2019 CRC PRESS.

18FD0XB FOOD SAFETY AND QUALITY MANAGEMENTS **0 0 0 1**

Course Objectives

- To evaluate the regulatory compliance in industrial and catering units and gain knowledge on food quality practicalities and its control measures

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Indicate the Quality standards
- Apply for the ISO audits and evaluate the retailers standard

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						
2						1		2						

Management Systems, Auditing and Accreditation - ISO 9001 : 2000 - ISO 22000: 2005- Laboratory Quality Management System - Requirements Specific to Food Testing Laboratories – Physical and Chemical Parameters - Requirements Specific to Food Testing Laboratories – Biological Parameters - General Topics: Related to Food Testing Laboratories- Retailer Standards- BRC Food and BRC IOP Standards : An Overview - International Food Standard -SQF :1000 SQF: 2000 - Global Gap and India Gap.

Total: 20 Hours

References

1. Fundamentals in Management of Food Safety in the Industrial Setting: Challenges and Outlook of the 21st Century

18FD0XC HACCP CERTIFICATION 0 0 0 1

Course Objectives

- To analyse implementation of HACCP in the organisation and evaluate other professionals on adopting HACCP

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Indicate and apply the types of hazards in HACCP plan, analyse the pre-requisite programs and evaluate the critical limit

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						

Types of Hazards – Microbiological, Chemical, Physical, allergens- Principles of HACCP- Development of HACCP Plan- Describe the food and its distribution- Describe its intended use and consumers- Develop a flow diagram explaining the process- Common Pre-requisite Programs- Benefits of HACCP – Types of records-Challenges of HACCP implementation- Activities

Total: 15 Hours

References:

1. https://www.igmpiindia.org/industry-certificate-haccp.html

18FD0XD FSSAI FOOD SAFETY TRAINING AND CERTIFICATION **0 0 0 1**

Course Objectives

- Creating an improved environment of self-compliance to FSS Act, rules and regulations by the responsible Food Business.

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Evaluate the Food Safety Management System Plan (FSMS) incorporating HACCP

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2		2						

Introduction to food quality – FSSAI- Location, layout and facilities – cleaning and sanitation:maintenance of establishment-pest control- personal hygiene- food operation and controls – activities and tasks

Total: 20 Hours

References:

1. https://efaidnbmnnnibpcajpcglclefindmkaj/https://eatrightindia.gov.in/creativecatalogue/upload/books/PDF/520.pdf

18FD0XE ISO-17025 FOR ACCREDITED LABORATORY **0 0 0 1**

Course Objectives

- Understand the complete knowledge and information about ISO 17025
- Analyse implementation of ISO 17025 in the organisation
- Evaluate other professionals on adopting ISO 17025

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Implement ISO 17025 and evaluate the risk and opportunities in an organization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2						

Introduction to ISO 17025 and initiation of a LMS- Plan the implementation of ISO 17025 - Analysis : structural requirement, and resource requirements- Calibration – Structure of documentation of a management system- risk analysis and management

Total: 15 Hours

References:

1. https://www.unido.org/sites/default/files/2010-08/Complying_with_ISO-IEC_17025_Update_May_2010_0.pdf

18FD0XF FOOD FERMENTATION TECHNOLOGY 0 0 0 1

Course Objectives

- Understand the fermentation process and industrial cultures
- Impart knowledge on primary and secondary metabolites
- Gain the knowledge on food fermentation

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the culture for microbial fermentation
2. Select the microbial culture for industrial fermentation process
3. Analyse the microbiological quality control in food fermentation process
4. Understand the role of microbes in fermented foods
5. Select the appropriate fermenters for fermentation process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					1		1							1
2						2	2							1
3			1				1							2
4			1				2	-						2
5			1			2	-							1

Total: 15 Hours

Introduction to Fermentation Technology: History, types of fermentation, examples of fermentation industry. Microbial Growth Kinetics: Growth, substrate utilization and product formation - Fermentation Media: Formulation, carbon, nitrogen, oxygen, minerals sources, etc.- Sterilization: Sterilization of air and medium; sterilization of fermentor, thermal death kinetics of microorganisms- Bioreactor Design: Material and energy balances in bioprocess: open and closed systems, steady-state

and non-steady state systems, reacting and non-reacting systems, stoichiometry - Bioreactor Operation Systems: stirred tank reactor (batch, semi-batch, continuous), bubble column, airlift and packed bed - Physical Processes in Fermentation System: fluid flow and mixing, mass and heat transfer.

Reference(s)

1. Stanbury, P.E. and Whitaker, A., Principles of Fermentation Technology (1984), Pergamon Press.
2. Pirt, S.J., Principles of Microbial and Cell Cultivation. Blackwell Scientific Publication, London.
3. Biely, J.E. and Ollis, D.F. BioChemical Engineering Fundamentals (1986), Mcgraw

18FD0XG FABRICATION OF FOOD PROCESSING EQUIPMENT 1 0 0 1

Course Objectives

- To identify materials for fabrication of food processing equipment
- To understand the design details, fabrication, installation, operation and maintenance of equipment
- To impart knowledge on food plant design and layout

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course outcomes (COs)

1. Select the materials used in food processing equipment
2. Assess the design details and requirements of food processing equipment
3. Explain the equipment fabrication and compare with the design
4. Demonstrate the installation, operation and maintenance of food processing equipment
5. Generate the plan for food plant design and considerations, project management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					1		1							1
2						2	2							1
3			1				1							2
4			1				2	-						2
5			1			2	-							1

FUNDAMENTALS OF FOOD PROCESSING EQUIPMENT DESIGN

Introduction to food processing equipment – food processing unit operations -selection of materials - differences in design and fabrication of food processing and non-food processing equipment. Equipment design considerations – case study. Food processing equipment fabrication – design details and considerations – case study. Food process equipment installation, commissioning, operation and maintenance. Food Process plant design – location – decision – plant layout factors – layout design procedure – project management

Total: 15 Hours

18FD0YA TRADITIONAL FOODS 3 0 0 3

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2		1												
3	2	1	1											
4								2						
5								2						

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulabjamun; formulation and preparation of namkeen, papads, vada, potato chips, banana chips, samosa etc. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing; milk based puddings/ desserts

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Tempe, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing procedures to reduce loses of nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

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

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

FOR FURTHER READING

Specific social contexts, religious festivals, breakfast, meal and snack foods of different regions of India, typical fast foods / junk foods, Street foods.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

18FD0YB FOOD LAWS AND REGULATIONS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2	1						
3		1												
4	1	2												
5	1	2												

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labeling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

FOR FURTHER READING

Food quality, Nutritional labeling, labeling regulations, Food composition analysis, Food adulteration and detection techniques, Hygienic practices, Novel food packaging, Food advertisement methods.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

18FD0YC POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1			1							
2	1	1												
3	1	2												
4	1		1											
5	2	1	1											

UNIT I **6 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage,

controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **15 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Definition and need for value addition, Requirements of a food processing unit. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup. Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipments. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **6 Hours**

PRESERVATION BY CONCENTRATION AND FERMENTATION

Preservation by Concentration- Methods, changes during concentration. Preservation by fermentation - sauerkraut and pickles. Utilization of fruit and vegetable waste.

UNIT V **9 Hours**

PRESERVATION BY CANNING

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

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.

6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	1	1												
4	1	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor.

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells – efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1	1	1												
2	1	2												
3	2	1												
4	1	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein"s prediction - Einstein"s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

18GE0C1 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio

and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Compare different methods of storing hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1												
4	2	2												
5	3	3												

UNIT I **8 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-

cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **9 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **9 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) - ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene - butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age
2. International (P) Ltd., New Delhi, 2015
3. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
4. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
5. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
6. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
7. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.

2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2	1					
2								2	2					
3								2	3					

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016

4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993

18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2							
2						2	2							

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles - Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film.

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2	2					
2								2	2					
3								2	2					

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hour

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3												

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts

2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							1		2					
2				-		2			2					
3				-		2			2					

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing;Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact procedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2								
2						2								
3						2								

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING 1 0 0 1

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										1				
3						2								
4							2							
5							2							

UNIT I **7 Hours**

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							2		2					
3							2		2					
4							2		2					
5							2		2					

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 201

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)
Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure - roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							1		2					
3							1		2					

UNIT I **12 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION

National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets. DRILL AND WEAPON TRAINING Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.NATIONAL INTEGRATION AND SOCIAL AWARENESS National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP : Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2			2					
2						2			2					
3						2			2					

4						2			2					

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation –MVP Positioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business Plan Mentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Business stripped bare, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2	2						
2							2	2						
3							2	2						
4							2	2						

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation - Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? - Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company''s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly - Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2		1					
2						1	2		1					
3						2	2		3					

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

18GE0XP FM RADIO BROADCASTING TECHNOLOGY

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording.
2. Examine the available options for telephony interfaces for radio.
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2											
2	2	2	2											
3	2	2	2											

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio- Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable- propagation and coverage of RF signals-FM transmitter setup- Radio audience -measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.

3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.mediacollege.com

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What""s your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois.| Grammaire Les verbes s appeler,etre, avoir, les articles definis, indefinis | Communication - Saluer, s informer sur quelquun, demander de se presenter | Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites | Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu | Communication - Chercher un logement, d ecrire son voisin, s informer sur un logement | Lexique - L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche | Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie | Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT - OUVRIR - LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film | Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite | Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										2				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.