KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI   ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI - 2020

**(CHOICE BASED CREDIT SYSTEM AND
OUTCOME BASED EDUCATION)**

(For the students admitted during 2020 - 2021 and onwards)

BACHELOR OF TECHNOLOGY DEGREE
IN
FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

Assuring the Best

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KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)
INSTITUTE VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

INSTITUTE MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the nation and beyond through research and development
- Continuously improve our services

DEPARTMENT OF FOOD TECHNOLOGY

VISION

To be a centre of excellence for development and dissemination of knowledge in the field of Food Technology for the nation and beyond.

MISSION

Department of Food Technology is committed to::

MS1: Develop vibrant, competent and ethical food engineers who can promote technical advancements in the field of Food Technology

MS2: Foster the research activities of faculty and students to explore the state-of- the-art techniques to meet the industrial and societal needs.

MS3: Endeavour for constant upgradation of technical expertise to support continuous learning.

MS4: Develop vibrant, competent and ethical food engineers who can promote technical advancements in the field of Food Technology

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Food Technology will be able to

PEO1: Apply principles of basic sciences, and engineering to succeed in their professional career.

PEO2: Analyze, design and develop food processes/products that are technically feasible, economically viable and socially relevant.

PEO3: Exhibit professional, ethical codes of conduct and an aptitude for continuous learning for catering to the ever changing needs of the society.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	3
MS2	3	3	2
MS3	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Food Technology will be able to :

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **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.

PO3 **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.

PO4 **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.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **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.

PO7 **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.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **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.

PO11 **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.

PO12 **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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of Food Technology will:	
PSO1	Explore the ideas and methodologies in developing innovative food processing techniques and food products
PSO2	Adapt multidisciplinary approach to solve food industry problems and ensure food quality and safety

MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	2	2	2	1	1	1	1	1	2	3	3
PEO2	3	3	3	3	3	3	2	2	1	1	2	3	3	3
PEO3	1	1	1	1	1	3	3	3	2	2	1	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(Autonomous)

REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

BACHELOR OF ENGINEERING (BE) / BACHELOR OF TECHNOLOGY (BTech) DEGREE PROGRAMMES

These regulations are applicable to all candidates admitted into BE/BTech Degree programmes from the academic year 2020 – 2021 onwards.

1. **DEFINITIONS AND NOMENCLATURE**

   In these Regulations, unless otherwise specified:

   i.   "University" means ANNA UNIVERSITY, Chennai.

   ii.   "College" means KONGU ENGINEERING COLLEGE.

   iii.   "Programme" means Bachelor of Engineering (BE) / Bachelor of Technology (BTech) Degree programme

   iv.   "Branch" means specialization or discipline of BE/BTech Degree programme, like Civil Engineering, Information Technology, etc.

   v.   "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Mathematics, Physics etc.

   vi.   "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

   vii.   "Grade" means the letter grade assigned to each course based on the marks range specified.

   viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

   ix.   "Principal" means Chairman, Academic Council of the College.

   x.   "Controller of Examinations" means authorized person who is responsible for all examination related activities of the College.

   xi.   "Head of the Department" means Head of the Department concerned of the College.

2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

Programme	Branch
BE	Civil Engineering
	Mechanical Engineering
	Electronics and Communication Engineering
	Computer Science and Engineering
	Electrical and Electronics Engineering
	Electronics and Instrumentation Engineering
	Mechatronics Engineering
	Automobile Engineering
	Computer Science and Design
BTech	Chemical Engineering
	Information Technology
	Food Technology
	Artificial Intelligence and Data Science
	Artificial Intelligence and Machine Learning

3. ADMISSION REQUIREMENTS

3.1 First Semester Admission

The candidates seeking admission to the first semester of the eight semester BE / BTech Degree Programme:

Should have passed the Higher Secondary Examination (10 + 2) in the academic stream with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III subjects of the study conducted by the Government of Tamil Nadu or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto.

(OR)

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

They should also satisfy other eligibility conditions as prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

3.2   Lateral Entry Admission

The candidates who hold a Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE / BTech in relevant branches of study.

<div align="center">(OR)</div>

The candidates who hold a BSc degree (10+2+3 stream) with mathematics as one of the subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

They should satisfy other eligibility conditions prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

4.   STRUCTURE OF PROGRAMMES

4.1   Categorisation of Courses

The BE / BTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training, project work, internship, etc. that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i.   Humanities and Social Sciences (HS) including Management Courses

ii.   Basic Science (BS) Courses

iii.   Engineering Science (ES) Courses

iv.   Professional Core (PC) Courses

v.   Professional Elective (PE) Courses

vi.   Open Elective (OE) Courses

vii.   Employability Enhancement Courses (EC) like Project work, Professional Skills, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship in Industry or elsewhere

viii.   Audit Courses (AC)

ix.   Mandatory Courses (MC) like Student Induction Program and Environmental Science.

x.   Honours Degree Courses (HC)

4.2   Credit Assignment and Honours Degree

4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits
1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training / Internship Periods	1

The minimum number of credits to complete the BE/BTech programme is 169.

4.2.2. Honours Degree

If a candidate earns 18 to 20 additional credits in an emerging area, then he/she can be awarded with Honours degree mentioning that emerging area as his/her specialization. The respective board of studies shall recommend the specializations for honours degree and appropriate additional courses to be studied by the candidate which shall get approval from Academic Council of the institution. A candidate shall have not less than 8.0 CGPA and no history of arrears during the entire programme to opt for the honours degree.

Various specializations for various branches recommended by the respective boards of studies are given below:

S. No.	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	Civil Engineering
2.	Robotics	Mechanical Engineering
3.	Electric Vehicles	Mechanical Engineering
4.	Artificial Intelligence and Machine Learning	Mechatronics Engineering
5.	Electric Vehicles	Automobile Engineering
6.	Artificial Intelligence and Machine Learning	Electronics and Communication Engineering
7.	Electric Vehicles	Electrical and Electronics Engineering
8.	Control Systems and Sensors Technology	Electronics and Instrumentation Engineering
9.	Cyber Security	Computer Science and Engineering
10.	Data Science	Computer Science and Engineering
11.	Cyber Security	Information Technology
12.	Data Science	Information Technology
13.	Waste Technology	Chemical Engineering
14.	Food Processing and Management	Food Technology

The courses specified under Honours degree in the emerging area may include theory, theory cum practical, practical, project work, etc. under the particular specialization. A candidate can choose and study these specified courses from fourth semester onwards and he/she shall successfully complete the courses within the stipulated time vide clause 5. Total number of credits earned in each semester may vary from candidate to candidate based on the courses chosen. The registration, assessment & evaluation pattern and classification of grades of these courses shall be the same as that of the courses in the regular curriculum of the programme of the candidate vide clause 6, clause 7 and clause 15 respectively. A candidate can earn Honours degree in only one specialization during the entire duration of the programme.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, internship, professional skills training, comprehensive test & viva, internship and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/ Entrepreneurships/Start Ups

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fifth semester and phase II in sixth semester including vacation periods and each phase can carry two credits.

<p align="center">(or)</p>

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in sixth semester. He/She shall attend Professional Skills Training Phase I in fifth semester and can earn two credits.

<p align="center">(or)</p>

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during BE/BTech programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training I or Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Comprehensive Test & Viva

The overall knowledge of the candidate in various courses he/she studied shall be evaluated by (i) conducting comprehensive tests with multiple choice questions generally with pattern similar to GATE and/or (ii) viva-voce examination conducted by a panel of experts assigned by the Head of the department. The members can examine the knowledge of the candidate by asking questions from various domains and the marks will be assigned based on their answers. This course shall carry two credits.

4.3.3 Internships

The curriculum enables a candidate to go for full time projects through internship during a part of seventh semester and/or entire final semester and can earn credits

vide clause 7.6 and clause 7.11.

A candidate is permitted to go for full time projects through internship in seventh semester with the following condition: The candidate shall complete a part of the seventh semester courses with a total credit of about 50% of the total credits of seventh semester including Project Work I Phase II in the first two months from the commencement of the seventh semester under fast track mode. The balance credits required to complete the seventh semester shall be earned by the candidate through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

A candidate is permitted to go for full time projects through internship during eighth semester. Such candidate shall earn the minimum number of credits required to complete eighth semester other than project through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

4.4 Value Added Courses / Online Courses / Self Study Courses

The candidates may optionally undergo Value Added Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 Value Added Courses: Value Added courses each with One / Two credits shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through value added courses during the entire duration of the programme.

4.4.2 Online Courses: Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.

4.4.3 Self Study Courses: The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty following due approval procedure. Self study course is limited to one per semester.

4.4.4 The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance.

4.4.5 A candidate can earn a maximum of 30 credits through all value added courses, online courses and self study courses.

4.5 Flexibility to Add or Drop Courses

4.5.1 A candidate 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 the candidate wishes, then the candidate is permitted to earn more

than the total number of credits prescribed in the curriculum of the candidate's programme.

4.5.2 From the first to eighth semesters the candidates have the option of registering for additional elective/Honours courses or dropping of already registered additional elective/Honours courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates. Total number of credits of such courses during the entire programme of study cannot exceed eight.

4.6 Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

4.7 The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

4.8 The medium of instruction, examinations and project report shall be English.

5. DURATION OF THE PROGRAMME

5.1 A candidate is normally expected to complete the BE / BTech Degree programme in 8 consecutive semesters/4 Years (6 semesters/3 Years for lateral entry candidate), but in any case not more than 14 semesters/7 Years (12 semesters/6 Years for lateral entry candidate).

5.2 Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

6. COURSE REGISTRATION FOR THE EXAMINATION

6.1 Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

6.2 The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8), earn continuous assessment marks. This will be

considered as an attempt for the purpose of classification.

6.3 If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

6.4 A candidate shall register for the chosen courses as well as arrear courses (if any vide clause 6.2 and 6.3) from the list of courses specified under Honours degree.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Project Work, Professional Skills Training / Industrial Training, Internship and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory / Practical	50	50
2.	Theory cum Practical	The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.	
3.	Professional Skills Training / / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work 1 / Industrial Training / Mandatory Course	100	---
4.	Project Work 2 Phase I / Project Work 2 Phase II / Internships	50	50
5.	Value Added Course	The distribution of marks shall be decided based on the credit weightage	---
6.	All other Courses		

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and entrepreneurships/start ups shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1 The assessment pattern for awarding continuous assessment marks shall be as follows:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	30	Average of best two
	Test - II	30	
	Test - III	30	
2.	Tutorial	15	Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal)
3.	Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	50	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

7.3.2 A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

7.3.3 The end semester examination for theory courses shall be for a duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters every year.

7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's records shall be maintained.

7.5.1 The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.

7.6 **Project Work II Phase I / Project Work II Phase II**

7.6.1 Project work shall be assigned to a single candidate or to a group of candidates not exceeding 4 candidates in a group. The project work is mandatory for all the candidates.

7.6.2 The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

7.6.3 The continuous assessment and end semester examination marks for Project Work II (both Phase I and Phase II) and the Viva-Voce Examination shall be distributed as below:

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max. 30 Marks)		Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Rv. Com	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Ext. Exr.	Guide	Exr.1	Exr.2
0	0	10	10	15	15	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 The project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and guide of the project work.

7.6.7 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

7.6.8 A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

7.7 Project Work I Phase I / Industrial Training

The evaluation method shall be same as that of the Project Work II as per clause 7.6 excluding 7.6.3, 7.6.5, 7.6.6 and 7.6.7. The marks distribution is given below:

Continuous Assessment (Max. 100 Marks)								
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max.. 30 Marks)		Review III (Max. 50 Marks)		
						Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)	
Review Committee	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Review Committee	Guide	Review Committee
0	0	10	10	15	15	20	10	20

If a candidate fails to secure 50 % of the continuous assessment marks in this course, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted.

7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 4th semester vacation and during 5th semester. Phase II training shall be conducted for minimum of 80 hours in 5th semester vacation and during 6th semester. The evaluation procedure shall be approved by the Principal.

7.9 Comprehensive Test/Viva

A candidate can earn 2 credits by successfully completing this course. The evaluation procedures shall be approved by the Principal.

7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and two credits in sixth semester respectively and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups is to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

7.11   Projects through Internships

Each candidate shall submit a brief report about the internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work II as per clause 7.6.

7.12   Value Added Course

Minimum of two assessments shall be conducted during the value added course duration by the offering department concerned.

7.13   Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

7.14   Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

7.15   Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.
The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.
A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SF (Satisfactory). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

7.16 Mandatory Course

A candidate shall attend and complete the induction training program of duration three weeks at the beginning of the first semester. It is mandatory for all candidates who have joined in various branches of all BE/BTech programmes. The induction training program includes the courses recommended by AICTE. Apart from this induction program, a candidate shall undergo the courses listed by AICTE as mandatory courses during their programme. No credits shall be given for such courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Since these courses have no grade points assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

7.17 Yoga and Values for Holistic Development (YVHD) and Universal Human Values (UHV)

Courses such as YVHD and UHV shall be offered to all candidates of all BE/BTech programmes. These courses shall carry a maximum of 100 marks each and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits for UHV and 1 credit for YVHD by successfully completing these courses. Two continuous assessment tests will be conducted and the average marks will be taken for the calculation of grades.

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

8.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

8.1.1 Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

8.1.2 A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurships/ start ups activities, but has secured not

less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

8.1.3 In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

8.1.4 A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

8.1.5 Candidate's progress is satisfactory.

8.1.6 Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

8.2. The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

8.3 The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

9.1 A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

9.2 When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

9.3 A candidate 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 letter grades / marks.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

10.1 A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

10.2 The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

10.3 The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

10.4 If a candidate 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 examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

10.5 The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

11.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

11.3 The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through 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.

11.4 The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

11.5 If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

12. PASSING REQUIREMENTS

12.1 A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

12.2 A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

12.3 For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

The candidates who have failed in the courses Professional Skill Training I/II and Comprehensive Test/Viva shall be permitted to take up supplementary examinations.

15. AWARD OF LETTER GRADES

Range of % of Total Marks	Letter Grade	Grade Point
91 to 100	O (Outstanding)	10
81 to 90	A+ (Excellent)	9
71 to 80	A (Very Good)	8
61 to 70	B+ (Good)	7
50 to 60	B (Average)	6
Less than 50	RA (Reappear)	0
Satisfactory	SF	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$GPA = \frac{\sum[(course\ credits) \times (grade\ points)]\ for\ all\ courses\ in\ the\ specific\ semester}{\sum(course\ credits)\ for\ all\ courses\ in\ the\ specific\ semester}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$CGPA = \frac{\sum[(course\ credits) \times (grade\ points)]\ for\ all\ courses\ in\ all\ the\ semesters\ so\ far}{\sum(course\ credits)\ for\ all\ courses\ in\ all\ the\ semesters\ so\ far}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the BE / BTech Degree provided

the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.

ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2020 (vide clause 11.3)

iv. No disciplinary action pending against him / her.

17. CLASSIFICATION OF THE DEGREE AWARDED

17.1 First Class with Distinction:

17.1.1 A candidate who qualifies for the award of the degree (vide clause 16) and 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 candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.

- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.

- Should have secured a CGPA of not less than 8.50

(OR)

17.1.2 A candidate who joins from other institutions on transfer and who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and 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 candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.

- Submission of equivalent course list approved by the respective Board of studies.

- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.

- Should have secured a CGPA of not less than 9.00

17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and 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 candidates) within ten consecutive semesters (eight consecutive semesters for lateral entry candidates) excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 7.00

17.3 Second Class:

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

17.4 A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

17.5 Honours Degree:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have earned the BE/BTech degree with Honours (vide clause 16 and clause 4.2.2):

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.00

18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the Kongu Engineering College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

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B.TECH. DEGREE IN FOOD TECHNOLOGY
CURRICULUM UNDER REGULATIONS 2020
(For the candidates admitted from academic year 2020-2021 onwards)

CURRICULUM BREAKDOWN STRUCTURE										
Summary of Credit Distribution										
Category	**Semester**								**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
HS	4	3		**3**			3		13	**7.7**
BS	11	11	4	4					30	**17.7**
ES	4	4	8	4					20	**11.8**
PC	3	3	13	9	13	12	**3**		56	**33.1**
PE					**3**		12	3	18	**10.7**
OE				4	4	**3**		3	14	**8.3**
EC					2	6	3	**7**	18	**10.7**
MC	**Nil**		**Nil**						Nil	**-**
Semesterwise Total	22	21	25	24	22	21	21	13	169	**100.00**

Category	Abbreviation
Lecture hours per week	**L**
Tutorial hours per week	**T**
Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week	**P**
Credits	**C**

CATEGORISATION OF COURSES						
HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)						
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20EGT11	English Language Skills	3	0	0	3	I
2.	20VEC11	Yoga and Values for Holistic Development	1	0	1	1	I
3.	20EGT21	Advanced Communication Skills	3	0	0	3	II
4.	20EGL31	English for Workplace Communication Laboratory	0	0	2	1	IV
5.	20GET31	Universal Human Values	2	0	0	2	IV
6.	20GET71	Engineering Economics & Management	3	0	0	3	VII
Total Credits to be earned						**13**	

BASIC SCIENCE (BS)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20MAC11	Matrices and Diffrential Equations	3	1*	2*	4	I
2.	20PHT11	Applied Physics	3	0	0	3	I
3.	20CYT11	Applied Chemistry	3	0	0	3	I
4.	20PHL11	Physical Sciences Laboratory I	0	0	2	1	I
5.	20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	II
6.	20PHT26	Physics for Food Technology	3	0	0	3	II
7.	20CYT25	Chemistry for Food Technology	3	0	0	3	II
8.	20PHL30	Physical Sciences Laboratory II	0	0	2	1	II
9.	20MAT31	Probability and Partial Differential Equations	3	1	0	4	III
10.	20MAT41	Statistics and Numerical Methods	3	1	0	4	IV
Total Credits to be earned						**30**	

ENGINEERING SCIENCE (ES)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20MEC11	Engineering Drawing	2	0	2	3	I
2.	20MEL11	Engineering Practices Laboratory	0	0	2	1	I
3.	20FTT21	Basics of Mechanical Engineering	3	0	0	3	II
4.	20FTL21	Basics of Mechanical Engineering Laboratory	0	0	2	1	II
5.	20CSC31	Programming in C	3	0	2*	4	III
6.	20FTT31	Process Fluid Mechanics	3	1	0	4	III
7.	20FTT41	Heat Transfer Operations	3	1	0	4	IV
Total Credits to be earned						**20**	

PROFESSIONAL CORE (PC)

S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
1.	20FTT11	Fundamentals of Biochemistry	3	0	0	3	I	CA
2.	20FTT22	Engineering Properties of Food Materials	3	0	0	3	II	FE
3.	20FTT32	Food Process Calculations	3	1	0	4	III	PE

			L	T	P	C	Sem	Domain/Stream
4.	20FTT33	Food Chemistry	3	0	0	3	III	CA
5.	20FTT34	Refrigeration and Cold Chain Management	3	1	0	4	III	FE
6.	20FTL31	Fluid Flow Laboratory	0	0	2	1	III	PE
7.	20FTL32	Food Chemistry Laboratory	0	0	2	1	III	CA
8.	20FTT42	Mass Transfer in Food Processing Operations	3	1	0	4	IV	PE
9.	20FTT43	Food Microbiology	3	0	0	3	IV	FE
10.	20FTL41	Heat and Mass Transfer Laboratory	0	0	2	1	IV	PE
11.	20FTL42	Food Microbiology Laboratory	0	0	2	1	IV	FE
12	20FTT51	Food Process Engineering I	3	1	0	4	V	FE
13.	20FTT52	Food Process Engineering - II	3	0	0	3	V	FE
14.	20FTT53	Fruit and Vegetable Processing Technology	3	0	0	3	V	FE
15.	20FTL51	Food Process Engineering Laboratory	0	0	2	1	V	FE
16.	20FTL52	Fruits , Vegetables and Packaging Technology Laboratory	0	0	2	1	V	FE
17.	20FTL53	Food Process Equipment Design and Drawing Laboratory	0	0	2	1	V	FE
18.	20FTT61	Dairy Technology	3	0	0	3	VI	FE
19.	20FTT62	Baking and Confectionery Technology	3	0	0	3	VI	FE
20.	20FTT63	Food Quality and Safety	3	0	0	3	VI	CA
21.	20FTL61	Dairy Technology Laboratory	0	0	2	1	VI	FE
22.	20FTL62	Baking and Confectionery Technology Laboratory	0	0	2	1	VI	FE
23.	20FTL63	Food Analysis Laboratory	0	0	2	1	VI	CA
24.	20FTT71	Food Packaging Technology	3	0	0	3	VII	FE
Total Credits to be earned						56		

PROFESSIONAL ELECTIVE (PE)								
S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
		Elective – I						
1.	20FTE01	Food Science and Nutrition	3	0	0	3	V	CA
2.	20FTE02	Technology of Snack and Extruded Foods	3	0	0	3	V	FE
3.	20FTE03	Nanotechnology in Food Processing	3	0	0	3	V	PE
4.	20FTE04	Fermentation Technology	3	0	0	3	V	CA

5.	20FTE05	Food Storage and Infestation Control	3	0	0	3	V	FE
		Elective – II						
6.	20FTE06	Modern Separation Process	3	0	0	3	VII	PE
7.	20FTE07	Bioprocess Engineering	3	0	0	3	VII	PE
8.	20FTE08	Emerging Technologies in Food Processing	3	0	0	3	VII	PE
9.	20FTE09	Plantation and Spices Products Technology	3	0	0	3	VII	FE
10.	20FTE10	Enzymes in Food Processing	3	0	0	3	VII	FE
11	20GEE01	Fundamentals of Research	3	0	0	3	VII	GE
		Elective – III						
12.	20FTE11	Dairy Products Technology	3	0	0	3	VII	FE
13.	20FTE12	Technology of Fats and Oils	3	0	0	3	VII	CA
14.	20FTE13	Technology of Cereals, Pulses and Oil Seeds	3	0	0	3	VII	FE
15.	20FTE14	Meat, Fish and Poultry Processing	3	0	0	3	VII	FE
16.	20FTE15	Waste Management and By-Product Utilization in Food Industries	3	0	0	3	VII	FE
		Elective – IV						
17.	20FTE16	Energy Management in Process Industries	3	0	0	3	VII	PE
18.	20FTE17	Process Instrumentation and control	3	0	0	3	VII	PE
19.	20FTE18	Fundamentals of Computation Fluid Dynamics	3	0	0	3	VII	PE
20.	20FTE19	Reaction Engineering	3	0	0	3	VII	PE
21.	20FTE20	Modeling, Simulation and Soft tools for Food Technologists	3	0	0	3	VII	FE
		Elective –V						
22.	20FTE21	Production of Field and Horticulture Crops	3	0	0	3	VII	FE
23.	20FTE22	Cane Sugar Technology	3	0	0	3	VII	FE
24.	20FTE23	Beverage Technology	3	0	0	3	VII	FE
25.	20FTE24	Traditional Foods	3	0	0	3	VII	FE
26.	20FTE25	Agri Business Management and Retail marketing	3	0	0	3	VII	FE
		Elective – VI						
27.	20FTE26	Food Additives and Nutraceuticals	3	0	0	3	VIII	CA
28.	20FTE27	Food Allergens and Toxicology	3	0	0	3	VIII	CA
29.	20FTE28	Food Process Plant Layout and Safety	3	0	0	3	VIII	PE

30.	20FTE29	Industrial Waste Water Treatment	3	0	0	3	VIII	PE
31.	20FTE30	Analytical Instruments in Food Industries	3	0	0	3	VIII	FE
Total Credits to be earned						**18**		

* Domain/Stream Abbreviations: PE – PROCESS ENGINEERING, CA – CHEMISTRY AND ANALYIS, FE-– FOOD ENGINEERING

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20GEL51/ 20GEI51	Professional Skills Training - I /Industrial Training - I	0	0	0	2	V
2.	20GEL61/ 20GEI61	Professional Skills Training - II /Industrial Training - II	0	0	0	2	VI
3	20GEP61	Comprehensive Test / Viva	---	---	---	2	VI
4	20FTP61	Project Work 1	0	0	4	2	VI
5	20FTP71	Project Work 2 Phase - I	0	0	6	3	VII
6	20FTP81	Project Work 2 Phase - II	---	---	14	7	VIII
Total Credits to be earned						**18**	

MANDATORY COURSES(MC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20MNT11	Induction Training Program	---	---	---	0	I
2.	20MNT31	Environmental Science	2	0	0	0	III
Total Credits to be earned						**0**	

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20FTO01	Baking Technology	3	0	2	4	IV
2.	20FTO02	Food Processing Technology	3	1	0	4	IV
3.	20FTO03	Processing of milk and milk products	3	0	2	4	V
4.	20FTO04	Processing of Fruits and Vegetables	3	0	2	4	V
5.	20FTO05	Principles of Food safety	3	0	0	3	VI
6.	20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	VI
7.	20FTO07	Food Ingredients	3	0	0	3	VIII
8.	20FTO08	Food and Nutrition	3	0	0	3	VIII

KEC R2020: SCHEDULING OF COURSES – B.Tech (Food Technology)   Total Credits: 169

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	20EGT11 English Language Skills (3-0-0-3)	20MAC11 Matrices and Diffrential Equations (3-1*-2*-4)	20PHT11 Applied Physics (3-0-0-3)	20CYT11 Applied Chemistry (3-0-0-3)	20MEC11 Engineering Drawing (2-0-2-3)	20FTT11 Fundamentals of Biochemistry (3-0-0-3)	20VEC11 Yoga andValues for Holistic Development (1-0-1-1)	20MNT11 Induction Training Program	20PHL11 Physical Sciences Laboratory I (0-0-2-1)	20MEL11 Engineering Practices Laboratory (0-0-2-1)	22
II	20EGT21 Advanced Communication Skills (3-0-0-3)	20MAC21 Multivariable Calculus and complex Analysis (3-1*-2*-4)	20PHT26 Physics for Food Technology (3-0-0-3)	20CYT25 Chemistry for Food Technology (3-0-0-3)	20FTT21 Basics of Mechanical Engineering (3-0-0-3)	20FTT22 Engineering Properties of Food Materials (3-0-0-3)	20PHL30 Physical Sciences Laboratory II (0-0-2-1)	20FTL21 Basics of Mechanical Engineering Laboratory (0-0-2-1)			21
III	20MAT31 Probability and Partial Differential Equations (3-1-0-4)	20CSC31 Programming in C (3-0-2-4)	20FTT31 Process Fluid Mechanics (3-1-0-4)	20FTT32 Food Process Calculations (3-1-0-4)	20FTT33 Food Chemistry (3-0-0-3)	20FTT34 Refrigeration and Cold Chain Management (3-1-0-4)	20FTL31 Fluid Flow Laboratory (0-0-2-1)	20FTL32 Food Chemistry Laboratory (0-0-2-1)	20MNT31 Environmental Science (2-0-0-0)		25
IV	20MAT41 Statistics and Numerical Methods (3-1-0-4)	20FTT41 Heat Transfer Operations (3-1-0-4)	20FTT42 Mass Transfer in Food Processing Operations (3-1-0-4)	20FTT43 Food Microbiology (3-0-0-3)	Open Elective-I (3-1/0-0/2-4)	20FTL41 Heat and Mass Transfer Laboratory (0-0-2-1)	20FTL42 Food Microbiology Laboratory (0-0-2-1)	20EGL31 English for Workplace Communication Laboratory (0-0-2-1)	20GET31 Universal Human Values (2-0-0-2)		24
V	20FTT51 Food Process Engineering I (3-1-0-4)	20FTT52 Food Process Engineering – II (3-0-0-3)	20FTT53 Fruit and Vegetable Processing Technology (3-0-0-3)	Professional Elective I (3-0-2-3)	Open Elective-II (3-1/0-0/2-4)	20FTL51 Food Process Engineering Laboratory (0-0-2-1)	20FTL52 Fruits and Vegetables Processing Technology Laboratory (0-0-2-1)	20FTL53 Food Process Equipment Design and Drawing Laboratory (0-0-2-1)	20GEL51/ 20GEI51 Professional Skills Training - I / Industrial Training I (0-0-0-2)		22
VI	20FTT61 Dairy Technology (3-0-0-3)	20FTT62 Baking and Confectionery Technology (3-0-0-3)	20FTT63 Food Quality and safety (3-0-0-3)	Open Elective-III (3-0-0-3)	20FTL61 Dairy Technology Laboratory (0-0-2-1)	20FTL62 Baking and Confectionery Technology Laboratory (0-0-2-1)	20FTL63 Food Analysis Laboratory (0-0-2-1)	20FTP61 Project Work I (0-0-4-2)	20GEL61/ 20GEI61 Professional Skills Training II / Industrial Training II (0-0-0-2)	20GEP61 Comprehensive Test / Viva (0-0-0-2)	21
VII	20GET71 Engineering Economics & Management (3-0-0-3)	20FTT71 Food Packaging Technology (3-0-0-3)	Professional Elective II (3-0-0-3)	Professional Elective III (3-0-0-3)	Professional Elective IV (3-0-0-3)	Professional Elective V (3-0-0-3)	20FTP71 Project Work 2 Phase - I (0-0-6-3)				21
VIII	Open Elective IV (3-0-0-3)	Professional Elective VI (3-0-0-3)	20FTP81 Project Work 2 Phase II (0-0-14-7)								13

MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	20EGT11	English Language Skills						✓			✓	✓	✓	✓		
1	20MAC11	Matrices and Differential Equations	✓	✓	✓	✓	✓									
1	20PHT11	Applied Physics	✓	✓	✓											
1	20CYT11	Applied Chemistry	✓	✓	✓	✓										
1	20MEC11	Engineering Drawing	✓	✓	✓	✓						✓	✓	✓	✓	✓
1	20FTT11	Fundamentals of Biochemistry	✓	✓	✓	✓		✓						✓	✓	✓
1	20VEC11	Yoga and Values for Holistic Development						✓		✓	✓			✓		
1	20PHL11	Physical Sciences Laboratory- I				✓										
1	20MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓		
2	20EGT21	Advanced Communication Skills						✓			✓	✓	✓	✓		
2	20MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	20PHT26	Physics for Food Technology	✓	✓	✓											
2	20CYT25	Chemistry for food Technology	✓	✓	✓	✓			✓							
2	20FTT21	Basics of Mechanical Engineering	✓	✓	✓			✓	✓					✓		✓
2	20FTT22	Engineering Properties of Food Materials	✓	✓	✓	✓	✓							✓	✓	✓
2	20PHL30	Physical Sciences Laboratory- II			✓											
2	20FTL21	Basics of Mechanical Engineering Laboratory	✓			✓					✓			✓		✓
3	20MAT31	Probability and Partial Differential Equations	✓	✓	✓											
3	20CSC31	Programming in C	✓	✓	✓	✓	✓				✓	✓		✓		
3	20FTT31	Process Fluid Mechanics	✓	✓	✓	✓	✓							✓	✓	✓
3	20FTT32	Food Process Calculations	✓	✓	✓	✓	✓							✓	✓	✓
3	20FTT33	Food Chemistry	✓	✓	✓	✓	✓							✓	✓	✓

	Code	Course	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3	20FTT34	Refrigeration and Cold Chain Management	✓	✓	✓	✓	✓								✓	✓	✓
3	20FTL31	Fluid Flow Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓	✓
3	20FTL32	Food Chemistry Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓	✓
3	20MNT31	Environmental Science	✓	✓	✓				✓						✓	✓	✓
4	20MAT41	Statistics and Numerical Methods	✓	✓	✓	✓											
4	20FTT41	Heat Transfer Operations	✓	✓	✓	✓	✓								✓	✓	✓
4	20FTT42	Mass Transfer in Food Processing Operations	✓	✓	✓	✓	✓								✓	✓	✓
4	20FTT43	Food Microbiology	✓	✓	✓		✓									✓	✓
4	20FTL41	Heat and Mass Transfer Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓	✓
4	20FTL42	Food Microbiology Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓	✓
4	20EGL31	English for Workplace Communication Laboratory										✓	✓		✓		
4	20GET31	Universal Human Values						✓	✓	✓	✓	✓					
5	20FTT51	Food Process Engineering - I	✓	✓	✓	✓									✓	✓	✓
5	20FTT52	Food Process Engineering - II	✓	✓	✓	✓	✓								✓	✓	✓
5	20FTT53	Fruit and Vegetable Processing Technology	✓	✓	✓	✓										✓	✓
5	20FTL51	Food Process Engineering Laboratory	✓	✓	✓	✓									✓	✓	✓
5	20FTL52	Fruits and Vegetables Processing Technology Laboratory	✓	✓	✓	✓	✓								✓	✓	✓
5	20FTL53	Food Process Equipment Design and Drawing Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓	✓
5	20GEL51	Professional Skills Training- I	✓	✓				✓	✓			✓	✓	✓	✓		
6	20FTT61	Dairy Technology	✓	✓	✓		✓	✓		✓					✓	✓	✓
6	20FTT62	Baking and Confectionery Technology	✓	✓	✓	✓		✓							✓	✓	✓
6	20FTT63	Food Quality and Safety	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
6	20FTL61	Dairy Technology Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20FTL62	Baking and Confectionery Technology Laboratory	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓
6	20FTL63	Food Analysis Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓
6	20FTP61	Project work - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	20GEL61	Professional Skills Training- II	✓	✓				✓	✓		✓	✓	✓	✓		
7	20GET71	Engineering Economics & Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20FTT71	Food Packaging Technology	✓	✓	✓	✓	✓			✓					✓	✓
7	20FTP61	Project work 1 Phase - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	20FTP81	Project Work 2 Phase - II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Professional Elective																
5	20FTE01	Food Science and Nutrition	✓	✓	✓	✓		✓						✓	✓	✓
5	20FTE02	Technology of Snack and Extruded Foods	✓	✓	✓	✓								✓	✓	✓
5	20FTE03	Nanotechnology in Food Processing	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
5	20FTE04	Fermentation Technology	✓	✓	✓	✓	✓							✓	✓	✓
5	20FTE05	Food Storage and Infestation Control	✓	✓	✓	✓	✓	✓						✓	✓	✓
7	20FTE06	Modern Separation Process	✓	✓	✓		✓	✓	✓					✓	✓	✓
7	20FTE07	Bioprocess Engineering	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE08	Emerging Technologies in Food Processing	✓	✓	✓		✓	✓						✓	✓	✓
7	20FTE09	Plantation and Spices Products Technology	✓	✓	✓		✓	✓	✓	✓				✓	✓	✓
7	20FTE10	Enzymes in Food Processing	✓	✓	✓	✓								✓	✓	✓
7	20GEE01	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20FTE11	Dairy Products Technology	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE12	Technology of Fats and Oils	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓

Sem	Code	Course	1	2	3	4	5	6	7	8	9	10	11	13	14	15
7	20FTE13	Technology of Cereals, Pulses and Oil Seeds	✓	✓	✓	✓	✓			✓				✓	✓	✓
7	20FTE14	Meat, Fish and Poultry Processing	✓	✓	✓		✓							✓	✓	✓
7	20FTE15	Waste Management and By-Product Utilization in Food Industries	✓	✓	✓	✓	✓		✓					✓	✓	✓
7	20FTE16	Energy Management in Process Industries	✓	✓	✓	✓	✓		✓					✓	✓	✓
7	20FTE17	Process Instrumentation and control	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE18	Fundamentals of Computation Fluid Dynamics	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE19	Reaction Engineering	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE20	Modeling, Simulation and Soft tools for Food Technologists	✓	✓	✓	✓	✓							✓	✓	✓
7	20FTE21	Production of Field and Horticulture Crops	✓	✓	✓	✓								✓	✓	✓
7	20FTE22	Cane Sugar Technology	✓	✓	✓		✓		✓					✓	✓	✓
7	20FTE23	Beverage Technology	✓	✓	✓		✓	✓		✓				✓	✓	✓
7	20FTE24	Traditional Foods	✓	✓	✓		✓	✓		✓				✓	✓	✓
7	20FTE25	Agri Business Management and Retail marketing	✓	✓	✓							✓	✓	✓		✓
8	20FTE26	Food Additives and Nutraceuticals	✓	✓	✓		✓								✓	✓
8	20FTE27	Food Allergens and Toxicology	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
8	20FTE28	Food Process Plant Layout and Safety	✓	✓	✓	✓		✓	✓					✓	✓	✓
8	20FTE29	Industrial Waste Water Treatment	✓	✓	✓	✓		✓	✓					✓	✓	✓
8	20FTE30	Analytical Instruments in Food Industries	✓	✓		✓	✓							✓	✓	✓
Open Elective																
4	20FTO01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
4	20FTO02	Food Processing Technology	✓	✓	✓	✓								✓	✓	✓
5	20FTO03	Processing of milk and milk products	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓

5	20FTO04	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓
6	20FTO05	Principles of Food safety	✓	✓	✓		✓	✓	✓	✓				✓	✓	✓
6	20FTO06	Fundamentals of Food Packaging and Storage	✓	✓	✓		✓	✓		✓				✓	✓	✓
8	20FTO07	Food Ingredients	✓	✓	✓			✓						✓	✓	✓
8	20FTO08	Food and Nutrition	✓	✓	✓	✓		✓						✓	✓	✓

B.TECH. DEGREE IN FOOD TECHNOLOGY
CURRICULUM UNDER REGULATIONS 2020
(For the candidates admitted from academic year 2020-21 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	50	50	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	50	50	100	BS
20CYT11	Applied Chemistry	3	0	0	3	50	50	100	BS
20FTT11	Fundamentals of Biochemistry	3	0	0	3	50	50	100	PC
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
20PHL11	Physical Sciences Laboratory I	0	0	2	1	50	50	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
20MNT11	Student Induction Program#	-	-	-	0	100	0	100	MC
Total Credits to be earned					**22**				

Induction Training Program (including, Indian Constitution and Essence of Indian Knowledge Tradition, etc.) to be conducted at the beginning of the semester for 3 weeks. L – Lecture, T – Tutorial, P – Practical, C – Credits, CA – Continuous Assessment, ESE – End Semester Examination, CBS – Curriculum Breakdown Structure. *Alternate week

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
	Theory/Theory with Practical								
20EGT21	Advanced Communication Skills	3	0	0	3	50	50	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT26	Physics for Food Technology	3	0	0	3	50	50	100	BS
20CYT25	Chemistry for Food Technology	3	0	0	3	50	50	100	BS
20FTT21	Basics of Mechanical Engineering	3	0	0	3	50	50	100	ES
20FTT22	Engineering Properties of Food Materials	3	0	0	3	50	50	100	PC
	Practical								
20FTL21	Basics of Mechanical Engineering Laboratory	0	0	2	1	50	50	100	ES
20PHL30	Physical Sciences Laboratory II	0	0	2	1	50	50	100	BS
				Total	**21**				

B.TECH. FOOD TECHNOLOGY CURRICULUM – R2020

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT31	Probability and Partial Differential Equations	3	1	0	4	50	50	100	BS
20CSC31	Programming in C	3	0	2	4	50	50	100	ES
20FTT31	Process Fluid Mechanics	3	1	0	4	50	50	100	ES
20FTT32	Food Process Calculations	3	1	0	4	50	50	100	PC
20FTT33	Food Chemistry	3	0	0	3	50	50	100	PC
20FTT34	Refrigeration and Cold Chain Management	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20FTL31	Fluid Flow Laboratory	0	0	2	1	50	50	100	PC
20FTL32	Food Chemistry Laboratory	0	0	2	1	50	50	100	PC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Total Credits to be earned					**25**				

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT41	Statistics and Numerical Methods	3	1	0	4	50	50	100	BS
20FTT41	Heat Transfer Operations	3	1	0	4	50	50	100	ES
20FTT42	Mass Transfer in Food Processing Operations	3	1	0	4	50	50	100	PC
20FTT43	Food Microbiology	3	0	0	3	50	50	100	PC
	Open Elective I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	50	50	100	HS
20FTL41	Heat and Mass Transfer Laboratory	0	0	2	1	50	50	100	PC
20FTL42	Food Microbiology Laboratory	0	0	2	1	50	50	100	PC
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**24**				

B.TECH. FOOD TECHNOLOGY CURRICULUM – R2020

SEMESTER – V

Course Code	Course Title	L	T	P	Credit	CA	ESE	Total	Category
		Hours / Week				**Maximum Marks**			
Theory/Theory with Practical									
20FTT51	Food Process Engineering I	3	1	0	4	50	50	100	PC
20FTT52	Food Process Engineering -II	3	0	0	3	50	50	100	PC
20FTT53	Fruit and Vegetable Processing Technology	3	0	0	3	50	50	100	PC
	Professional Elective I	3	0	2	3	50	50	100	PE
	Open Elective II	3	1/0	2/0	4	50	50	100	OE
Practical / Employability Enhancement									
20FTL51	Food Process Engineering Laboratory	0	0	2	1	50	50	100	PC
20FTL52	Fruits and Vegetables Processing Technology Laboratory	0	0	2	1	50	50	100	PC
20FTL53	Food Process Equipment Design and Drawing Laboratory	0	0	2	1	50	50	100	PC
20GEL51/ 20GEI51	Professional Skills Training - I /Industrial Training - I $	--	--	--	2	100	0	100	EC
Total Credits to be earned					**22**				

$ Professional Skills Training / Industrial Training for a total period of about 80 hr during the period of 4th sem end summer holidays and 5th sem.

SEMESTER – VI

Course Code	Course Title	L	T	P	Credit	CA	ESE	Total	Category
		Hours / Week				**Maximum Marks**			
Theory/Theory with Practical									
20FTT61	Dairy Technology	3	0	0	3	50	50	100	PC
20FTT62	Baking and Confectionery Technology	3	0	0	3	50	50	100	PC
20FTT63	Food Quality and Safety	3	0	0	3	50	50	100	PC
	Open Elective III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20FTL61	Dairy Technology Laboratory	0	0	2	1	50	50	100	PC
20FTL62	Baking and Confectionery Technology Laboratory	0	0	2	1	50	50	100	PC
20FTL63	Food Analysis Laboratory	0	0	2	1	50	50	100	PC
20FTP61	Project Work I #	0	0	4	2	100	0	100	EC
20GEL61/ 20GEI61	Professional Skills Training - II /Industrial Training - II $	---	---	---	2	100	0	100	EC
20GEP61	Comprehensive Test / Viva	---	---	---	2	100	0	100	EC
Total Credits to be earned					**21**				

$ Professional Skills Training / Industrial Training for a total period of about 80 hr during 5th sem end summer holidays and 6th sem.

B.TECH. FOOD TECHNOLOGY CURRICULUM – R2020

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20GET71	Engineering Economics & Management	3	0	0	3	50	50	100	HS
20FTT71	Food Packaging Technology	3	0	0	3	50	50	100	PC
	Professional Elective II	3	0	0	3	50	50	100	PE
	Professional Elective III	3	0	0	3	50	50	100	PE
	Professional Elective IV	3	0	0	3	50	50	100	PE
	Professional Elective V	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20FTP71	Project Work 2 Phase - I	0	0	6	3	100	0	100	EC
Total Credits to be earned					**21**				

Engineering Economics & Management, Food Packaging Technology and Professional Elective II can be completed in the first half of the semester under fast-track Scheme.

Professional Elective III, Professional Elective IV and Professional Elective V can be handled in the second half of the semester or these courses can also be completed in earlier semesters under add/drop scheme. Intern students can earn equivalent credits through NPTEL/MOOC portals also.

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	Professional Elective VI	3	0	0	3	50	50	100	PE
	Open Elective IV	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20FTP81	Project Work 2 Phase -II $	---	---	14	7	50	50	100	EC
Total Credits to be earned					**13**				

$ Mandatory for all students

One or both of the courses of Open Elective IV and Professional Elective VI can also be completed in earlier semesters under add/drop scheme. Intern students can earn equivalent credits through NPTEL/MOOC portals also.

LIST OF PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20FTE01	Food Science and Nutrition	3	0	0	3	5
2.	20FTE02	Technology of Snack and Extruded Foods	3	0	0	3	5
3.	20FTE03	Nanotechnology in Food Processing	3	0	0	3	5
4.	20FTE04	Fermentation Technology	3	0	0	3	5
5.	20FTE05	Food Storage and Infestation Control	3	0	0	3	5
6.	20FTE06	Modern Separation Process	3	0	0	3	7
7.	20FTE07	Bioprocess Engineering	3	0	0	3	7
8.	20FTE08	Emerging Technologies in Food Processing	3	0	0	3	7
9.	20FTE09	Plantation and Spices Products Technology	3	0	0	3	7
10.	20FTE10	Enzymes in Food Processing	3	0	0	3	7
11.	20GEE01	Fundamentals of Research	3	0	0	3	7
12.	20FTE11	Dairy Products Technology	3	0	0	3	7
13.	20FTE12	Technology of Fats and Oils	3	0	0	3	7
14.	20FTE13	Technology of Cereals, Pulses and Oil Seeds	3	0	0	3	7
15.	20FTE14	Meat, Fish and Poultry Processing	3	0	0	3	7
16.	20FTE15	Waste Management and By-Product Utilization in Food Industries	3	0	0	3	7
17.	20FTE16	Energy Management in Process Industries	3	0	0	3	7
18.	20FTE17	Process Instrumentation and control	3	0	0	3	7
19.	20FTE18	Fundamentals of Computation Fluid Dynamics	3	0	0	3	7
20.	20FTE19	Reaction Engineering	3	0	0	3	7
21.	20FTE20	Modeling, Simulation and Soft tools for Food Technologists	3	0	0	3	7
22.	20FTE21	Production of Field and Horticulture Crops	3	0	0	3	7
23.	20FTE22	Cane Sugar Technology	3	0	0	3	7
24.	20FTE23	Beverage Technology	3	0	0	3	7
25.	20FTE24	Traditional Foods	3	0	0	3	7
26.	20FTE25	Agri Business Management and Retail marketing	3	0	0	3	7
27.	20FTE26	Food Additives and Nutraceuticals	3	0	0	3	8
28.	20FTE27	Food Allergens and Toxicology	3	0	0	3	8
29.	20FTE28	Food Process Plant Layout and Safety	3	0	0	3	8
30.	20FTE29	Industrial Waste Water Treatment	3	0	0	3	8
31.	20FTE30	Analytical Instruments in Food Industries	3	0	0	3	8

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS
(Common to all departments except offering department)

Course Code	Course Name	L	T	P	C	Sem
20FTO01	Baking Technology	3	0	2	4	4
20FTO02	Food Processing Technology	3	1	0	4	4
20FTO03	Processing of milk and milk products	3	0	2	4	5
20FTO04	Processing of Fruits and Vegetables	3	0	2	4	5
20FTO05	Principles of Food safety	3	0	0	3	6
20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	6
20FTO07	Food Ingredients	3	0	0	3	8
20FTO08	Food and Nutrition	3	0	0	3	8

20EGT11   ENGLISH LANGUAGE SKILLS

(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at A2/B1 Level in the Common European Framework (CEFR).

Unit - I	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – I	9

Listening - Talking about past experiences - listening to descriptions - Speaking - Exchanging personal information - Talking about cities and transportation - Reading - Life and achievements of a famous personality - Global transport systems - Writing - Childhood experiences - Process Description – Grammar & Vocabulary – Past tense – Expressions of quantity – Indirect questions.

Unit - II	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – II	9

Listening - Information about hotels and accommodation - Recipes and food items - Speaking - Life style changes and making comparisons - Talking about food - Reading - Habit formation and changing habits - International cuisine - Writing - Personal email - emails about food and recipes – Grammar & Vocabulary – Evaluations and Comparisons with adjectives – Simple past and present perfect tenses.

Unit - III	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – III	9

Listening - Information about travel - descriptions / conversations about family life - Speaking - Vacations and Holidays - Requests, complaints and offering explanations - Reading - Tourist places and travel experiences - Group behaviour and politeness - Writing - Personal letter about travelling - Writing guidelines and checklists – Grammar & Vocabulary – Future tense – Modals – Two-part verbs.

Unit - IV	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IV	9

Listening - Descriptions about festivals - Presentations on technology - Speaking - About technology - festivals, special events and traditions - Reading - Sports, hobbies and past time - About different cultures - Writing - Product Description - Writing web content – Grammar & Vocabulary – Infinitives and Gerunds for uses and purposes – Imperatives for giving suggestions – Relative clauses of time.

Unit - V	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – V	9

Listening - Talking about changes - Job preferences - Speaking - Comparing different periods or phases in life – Changes that happen - Skills and abilities, Personality Development - Employability Skills – Reading - Reading about life experiences - Emotions and feelings – Job preferences – Jobs and Personality – Writing - Writing about one's past, present and future – Researching job options – Choosing the right job – Grammar & Vocabulary – Time contrasts – Conditional sentences with "if clauses" – Gerunds – short responses.

Total: 45

TEXT BOOK:

1.	Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 2", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1.	Sanjay Kumar and Pushp Lata, "Communication Skills", 2nd Edition, Oxford University Press, New Delhi, 2015.
.2	Pamela Hartmann and Brenda Wegmann, "New Interactions English Language Learning and Assessment Platform (Level Intro - Level IV)", McGraw Hill India, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	use language effectively and accurately acquiring vocabulary from real-life context	Applying (K3)
CO2	listen/view and comprehend different spoken discourses / excerpts in different accents	Applying (K3)
CO3	read different genres of texts adopting various reading strategies	Analyzing (K4)
CO4	write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic	Creating (K6)
CO5	speak clearly, confidently, comprehensibly and communicate with others using appropriate communicative strategies	Creating (K6)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3	2	2		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		1		
CO5									2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		16	30	37		17	100
CAT2		17	30	37		16	100
CAT3		13	33	37		17	100
ESE		7	21	37		35	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20MAC11 - MATRICES AND DIFFERENTIAL EQUATIONS
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	1*	2*	4

Preamble	To provide the skills to the students for solving different real time problems by applying matrices and differential equations.

Unit - I	**Matrices:**	9

Introduction – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley - Hamilton theorem (Statement and applications only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation.

Unit - II	**Ordinary Differential Equations:**	9

Introduction – Solutions of First order differential equations: Exact differential equations – Leibnitz's Linear Equation – Bernoulli's equation – Clairaut's equation.

Unit - III	**Ordinary Differential Equations of Higher Order:**	9

Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax / sinax – x^n – $e^{ax}x^n$, $e^{ax}sinbx$ and $e^{ax}cosbx$ – $x^n sinax$ and $x^n cosax$ – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.

Unit - IV	**Applications of Ordinary Differential Equations:**	9

Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given).

Unit - V	**Laplace Transform** & **Inverse Laplace Transform:**	9

Laplace Transform: Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Transform of unit step function – Transform of periodic functions. Inverse Laplace transform: Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Solution of linear ODE of second order with constant coefficients.

List of Exercises / Experiments:

1.	Introduction to MATLAB
2.	Computation of eigen values and eigen vectors
3.	Plotting and visualizing single variable functions
4.	Solving first and second order ordinary differential equations
5.	Solution of Simultaneous first order ODEs
6.	Solving second order ODE by variation of parameters
7.	Determining Laplace and inverse Laplace transform of basic functions
8.	Solution of Second order ODE by employing Laplace transforms

*Alternate week

Lecture: 45, Tutorial and Practical:15, Total:60

TEXT BOOK:

1.	Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2014, S.Chand and Co., New Delhi.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	solve engineering problems which needs matrix computations.	Applying (K3)
CO2	identify the appropriate method for solving first order ordinary differential equations.	Applying (K3)
CO3	solve higher order linear differential equations with constant and variable coefficients.	Applying (K3)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.	Applying (K3)
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations	Applying (K3)
CO6	know the basics of MATLAB and computing eigen values and eigen vectors of real matrix by MATLAB.	Understanding (K2), Manipulation (S2)
CO7	solve ordinary differential equations with constant and variable coefficients and simultaneous first order ordinary differential equations using MATLAB.	Applying (K3), Manipulation (S2)
CO8	compute Laplace and inverse Laplace Transform of basic functions and solve Second Order ODE by using Laplace Transform with MATLAB.	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1										
CO2	3	3	2	1										
CO3	3	3	2	1										
CO4	3	3	2											
CO5	3	3	2	1										
CO6					3									
CO7					3									
CO8					3									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20PHT11 - APPLIED PHYSICS
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	This course aims to impart the essential concepts of propagation of elastic waves, acoustics, ultrasonics, laser and fiber optics, quantum physics, crystal structure and crystal defects. It also describes the physical phenomena related to the aforementioned concepts and their applications in engineering and provides motivation towards innovations

Unit - I	Propagation of Elastic Waves:	9

Oscillatory Motion: Introduction to simple harmonic motion - Damping velocity - Damping coefficient - Differential equation of simple harmonic motion - Velocity and acceleration - Restoring force - Vibration of a spring and mass system - Frequency response - Phase response - Resonance - Wave motion: Definition of a plane progressive wave - Attenuation of waves - Differential equation of a plane progressive wave - Phase velocity - Phase and phase difference - Solution of the differential equation of a plane progressive wave.

Unit - II	Acoustics and Ultrasonics:	9

Acoustics: Introduction - Reverberation and reverberation time - Growth and decay of sound - Sabine's formula for reverberation time – Determination of sound absorption coefficient – Design of an auditorium: Factors affecting acoustics of buildings and the remedies. Ultrasonics: Introduction – Properties of ultrasonic waves – Generation of ultrasonic waves: Magnetostrictive generator and Piezoelectric generator - Determination of velocity of ultrasonics in a liquid: Acoustic grating – Industrial application: Non-destructive testing - Other applications of ultrasonic waves (qualitative).

Unit - III	Laser and Fiber Optics:	9

Laser and Applications: Introduction – Interaction of light with matter - Three quantum process: Stimulated absorption, spontaneous emission and stimulated emission - Population inversion - Einstein's coefficients and their relations - Pumping methods - Nd:YAG laser - CO_2 laser - Holography. Fiber Optics and Applications: Introduction - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optics communication system (qualitative) - Fiber optic sensors: Temperature and displacement sensors.

Unit - IV	Quantum Physics:	9

Introduction - Blackbody radiation - Planck's quantum hypothesis - Compton scattering (qualitative) - de Broglie's hypothesis - Properties of matter waves - Application of Heisenberg uncertainty principle - Schrodinger's time independent and time dependent wave equations - Physical significance of wave function - The free particle - Potential energy step - Infinite potential well (one - dimensional).

Unit - V	Crystal Physics:	9

Introduction - Classification of solids - Space lattice - Crystal structure - Unit cell - Bravais lattice - Single and polycrystalline materials - Lattice planes - Miller indices - Indices of crystal direction - Interplanar spacing in cubic system - Hexagonal close packed crystal structure and c/a ratio - Symmetry -Symmetry elements in cubic crystal - Crystal imperfections: line, surface and volume imperfections - Features of crystal imperfections (qualitative).

Total: 45

TEXT BOOK:

1. Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics",11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019.

REFERENCES:

1. Purnima Khare and Swarup A.,"Engineering Physics: Fundamentals and Modern Applications", 1st Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2009.
2. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
3. Tamilarasan K. and Prabu K., "Engineering Physics – I", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves.	Applying (K3)
CO2	apply the concepts of growth and decay of sound energy in a hall to compute Sabine's formula to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic wave, working of acoustic grating & non-destructive testing using ultrasonic waves.	Applying (K3)
CO3	apply the concepts of stimulated emission to explain the working and the applications of laser in engineering and technology, and to apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture to comprehend the loss in optical fiber, fiber optic communication system and working of fiber optic sensors.	Applying (K3)
CO4	use the concepts of quantum mechanics to describe the behavior of electrons in a metal by solving Schrodinger's wave equation for particle motion in infinite potential well.	Applying (K3)
CO5	utilize the concepts of the seven crystal systems to obtain interplanar spacing in cubic lattice and c/a ratio of HCP crystal structure, and to comprehend symmetry elements, reciprocal lattice and the types of crystal imperfections and their impacts.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	35	45				100
CAT3	25	35	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20CYT11 - APPLIED CHEMISTRY
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	Applied Chemistry course explores the basic principles and advancements of chemistry in the field of engineering and technology. It aims to impart the fundamentals of chemistry towards innovations in science and technology and also for societal applications.

Unit - I	Water Technology:	9

Introduction - sources of water - impurities in water - types of water - hardness of water- expression of hardness (simple problems) - units of hardness –estimation of hardness of water by EDTA method – determination of alkalinity - disadvantages of using hard water in Industries - boiler troubles - scale and sludge, boiler corrosion, caustic embrittlement, priming and foaming - softening of water: i) Internal treatment process - carbonate and calgon conditioning ii) External treatment method -demineralization process iii) Treatment of water for municipal water supply (Removal of suspended particles and disinfection methods, Break-point of chlorination).

Unit - II	Electrochemistry:	9

Introduction – electrochemical cells - applications of electrochemical series - reference electrode - standard calomel electrode - ion selective electrode - glass electrode - concentration cells - electrode and electrolyte concentration cells (simple problems) - applications- potentiometric titrations - acid-base, redox, precipitation titrations - advantages- conductometric titrations - strong acid vs strong base, weak acid vs strong base, mixture of weak and strong acid vs strong base- advantages of conductometric titrations.

Unit - III	Corrosion and its Control:	9

Introduction – causes and effects of corrosion - types of corrosion - chemical corrosion – Pilling Bed-worth rule - electrochemical corrosion –types **-** galvanic corrosion, concentration cell corrosion – other types of corrosion -stress, intergranular and microbiological corrosion- galvanic series - factors influencing rate of corrosion – corrosion control methods - design and material selection, anodic protection, corrosion inhibitors, protective coatings - i) metallic coatings : hot dipping (tinning and galvanizing) ii) non-metallic coating : anodizing iii) organic coating : paints – constituents and their functions.

Unit - IV	Fuels and Combustion:	9

Introduction – classification of fuels - characteristics of a good fuel - combustion - calorific values – gross and net calorific values - Dulong's formula (simple problems) - Flue gas analysis by Orsat's method - ignition temperature - spontaneous ignition temperature - explosive range - solid fuels - coal and its varieties – proximate and ultimate analysis – significance – metallurgical coke - Otto-Hoffman byproduct method - liquid fuel - refining of petroleum – manufacture of synthetic petrol - hydrogenation of coal - Bergius process - knocking - octane number – cetane number - gaseous fuel - water gas.

Unit - V	Polymers:	9

Introduction – terminology - classification - polymerization - types of polymerization (definition only)- polymerisation techniques- bulk, solution, suspension and emulsion polymerisation - plastics- difference between thermoplastics and thermosetting plastics - compounding of plastics- plastic moulding methods - compression, injection, extrusion and blow moulding methods - industrial polymers: preparation, properties and applications of PVC, PAN, polyurethane, polyesters –biodegradable polymers-classification and applications.

Total: 45

TEXT BOOK:

1.	Wiley Editorial Board, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2.	Payal B. Joshi, Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
3.	Palanna O., "Engineering Chemistry", McGraw Hill Education, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the suitable water softening methods to avoid boiler troubles.	Applying (K3)
CO2	apply the principle of electrochemistry for various applications.	Applying (K3)
CO3	make use of corrosion control methods to solve corrosion related problems.	Applying (K3)
CO4	illustrate the quality of fuels from its characteristics.	Understanding (K2)
CO5	explain the types of polymers, plastics and fabrication methods.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT11 - FUNDAMENTALS OF BIOCHEMISTRY

Programme & Branch	BTech – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	PC	3	0	0	3

Preamble	To impart knowledge about the structure and properties of biomolecules, actions of enzymes and metabolism	
Unit - I	Carbohydrates:	9

Classification; Simple Sugars: mono and disaccharides, Hygroscopicity and solubility, optical rotation, muta rotation; Sweetness: structure-activity relationship and sweetness index; Dextrose Equivalent; Sugar alcohols; Oligosaccharides: structure and occurrence. Polysaccharides: Starch-amylose and amylopectin- properties. Cellulose. Pectins, gums and seaweeds – structure & properties. Dietary fibres - Food sources, functional role.

Unit - II	Lipids:	9

Structure, classification and composition of fats. Food lipids and health. Physical properties of fats and oils: crystal formation, polymorphism, melting point, plasticity. Shortening power of fats, smoke point. Chemical properties of fats – Hydrolysis, saponification, halogenation. Hydrolytic rancidity and oxidative rancidity. Chemical constants.

Unit - III	Proteins:	9

Amino acids - Definition, structure and classification. Protein - classification and structural conformation, Food sources and biological role. Properties of proteins in food systems: solubility, hydration, foam formation & stabilization, gel formation, emulsifying effect. Denaturation.

Unit - IV	Enzymes:	9

Introduction, Nature, classification and nomenclature of enzymes. Mechanism of enzyme action; active site; Specificity. Enzyme kinetics – Michelis - Menten equation, Factors affecting enzyme action, Immobilization methods.

Unit - V	Nucleic Acids and Energy Metabolism:	9

Nucleic Acids: Composition and structure of DNA and RNA. Energy Metabolism: Glycolysis; TCA cycle; substrate level phosphorylation. Cellular respiration - electron transport chain. Fatty acid metabolism – beta oxidation and fatty acid synthesis.

Total: 45

TEXT BOOK:

1.	Satyanarayana U. and Chakrapani U., "Biochemistry", 5th Edition, Elsevier, New Delhi, 2017.

REFERENCES:

1.	Belitz H. D., Grosch W., and Schieberle P., "Food Chemistry", 3rd Edition, Springer Verley, Berlin, 2008.
2.	Jain J.L., Sunjay Jain and Nitin Jain, "Fundamentals of Biochemistry", 7th Edition, S. Chand & Co., New Delhi, 2016.
3.	Rastogi S.C., "Biochemistry", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 interpret the structure and properties of carbohydrates	Understanding (K2)
CO2 outline the structure and properties of lipids	Understanding (K2)
CO3 relate the structural and functional role of proteins	Understanding (K2)
CO4 classify the enzymes and interpret the enzyme action and their immobilization	Understanding (K2)
CO5 infer the structure of nucleic acids and illustrate the basics of energy metabolism	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2		1						1	3	2
CO2	3	2	2	2		1						1	3	2
CO3	3	2	2	2		1						1	3	2
CO4	3	2	2	2								1	3	2
CO5	3	1	1	1								1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	70					100
CAT3	30	70					100
ESE	20	80					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20MEC11 – ENGINEERING DRAWING
(Common to Civil, Mechanical, Mechatronics, Automobile Engineering, Chemical & Food Technology Branches)

Programme & Branch	BE(Civil, Mech, MTS, Auto) &BTech(Chem, FT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	2	0	2	3

Preamble	To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.

Unit - I	General Principles of Orthographic Projection:	9

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning - Projections of Points, Lines and Planes - General principles of orthographic projection - First angle projection - Layout of views - Projection of points located in all quadrant and straight lines located in the first quadrant - Determination of true lengths and true inclinations and location of traces - Projection of polygonal surface and circular lamina inclined to both reference planes.

Unit - II	Projections of Solid:	9

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

Unit - III	Sectioning of Solids:	9

Sectioning of solids - prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other - Obtaining true shape of section.

Unit - IV	Development of Surfaces:	9

Development of lateral surfaces of simple solids like prisms, pyramids, cylinders and cones – development of simple truncated solids involving prisms, pyramids, cylinders and cones.

Unit - V	Isometric Projection and Introduction to AutoCAD:	9

Principles of isometric projection - Isometric scale - Isometric projections of simple and truncated solids like prisms, pyramids, cylinders and cones - Conversion of isometric projection into orthographic projection - Introduction to AutoCAD.

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International Pvt. Ltd., New Delhi, 2018.

REFERENCES:

1. Basant Agrawal, Agrawal C.M., "Engineering Drawing", 2nd Edition, McGraw Hill Education, 2019.
2. Gopalakrishnana K.R. "Engineering Drawing", Volume. I & II, Subhas Publications, Bengaluru, 2014.
3. Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes.	Understanding (K2)
CO2	draw the projections of 3D primitive objects like prisms, pyramids, cylinders and cones.	Applying (K3)
CO3	construct the various sectional views of solids like prisms, pyramids, cylinders and cones.	Applying (K3)
CO4	develop the lateral surfaces of simple and truncated solids.	Applying (K3)
CO5	sketch the isometric projections of simple and truncated solids and convert isometric drawing in to orthographic projection.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2								3	2	2	2	3
CO2	3	2	1	1						3	2	3	2	3
CO3	3	2	1	1						3	2	3	2	3
CO4	3	2	1	1						3	2	3	2	3
CO5	3	2	1	1						3	2	3	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20MEL11 – ENGINEERING PRACTICES LABORATORY

(Common to Civil, Mechanical, Mechatronics, Automobile Engineering, Chemical & Food Technology Branches)

Programme & Branch	BE (Civil, Mech, MTS, Auto) & BTech (Chem, FT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	0	0	2	1

Preamble	This course is designed to provide a hands-on experience in basic of mechanical and electrical engineering practices.

List of Exercises / Experiments:

	PART A – MECHANICAL ENGINEERING
1.	To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions.
2.	To carryout drilling, tapping and assembly on the given MS plates.
3.	To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank.
4.	To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc.
5.	Welding practice through arc welding / simulator
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
1.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
2.	Wiring circuit for fluorescent lamp and Stair case wiring
3.	Measurement of Earth resistance
4.	Soldering of Simple Circuits and trouble shooting
5.	Implementation of half wave and full wave Rectifier using diodes

Total: 30

REFERENCES /MANUAL / SOFTWARE:

1.	Engineering Practices Laboratory Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	plan the sequence of operations for effective completion of the planned models/ innovative articles	Creating (K6), Precision (S3)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3), Precision (S3)
CO3	select fuses and Circuit breakers	Understanding (K2), Manipulation (S2)
CO4	perform house wiring and realize the importance of earthing	Applying (K3), Manipulation (S2)
CO5	trouble shoot the electrical and electronic circuits	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3	3	2	1			3	3		3		
CO2	2		3	3	2				3	3		3		
CO3	3		3	3	1				2	2		3		
CO4	3		3	3	1				2	3		3		
CO5	3		3	3	1				2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20PHL11 – PHYSICAL SCIENCES LABORATORY I
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	BS	0	0	2	1

Preamble	This course aims to impart hands on training in the determination of the physical parameters such as Young's modulus, rigidity modulus, frequency of vibration, velocity of ultrasonic waves, compressibility of water, wavelength of laser, acceptance angle and the numerical aperture of an optical fiber, and to develop the skills in handling different basic instruments and also aims to impart the basic concepts of volumetric, conductometric and pH meter experiments and thereby, to improve the analytical capability.

List of Exercises / Experiments:

1.	Determination of the Young's modulus of the material of a given beam using uniform bending method.
2.	Determination of the rigidity modulus of the material of a given wire using torsional pendulum.
3.	Determination of frequency of electrically vibrating rod by forming standing waves using Melde's apparatus.
4.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer.
5.	Determination of (i) the wavelength of a semiconductor laser and (ii) the acceptance angle and the numerical aperture of a given optical fiber.
6.	Estimation of total, temporary and permanent hardness of water by EDTA method.
7.	Estimation of Ca^{2+} and Mg^{2+} hardness separately by EDTA method.
8.	Estimation of alkalinity of the given water sample.
9.	Conductometric titration -Mixture of acids.
10.	Estimation of hydrochloric acid using pH meter.

Total: 30

REFERENCES:

1.	Tamilarasan K. and Prabu K.,"Physics Laboratory Manual', 1st Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Rajaganapathy Publishers, Erode, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	determine the Young's modulus of a material using the concepts of elasticity and bending moment of a beam and to determine the rigidity modulus of a wire using the concepts of twisting couple and to compute the frequency of electrically vibrating rod using the concept of standing waves formed in fixed vibrating string.	Applying (K3), Precision (S3)
CO2	determine the wavelength of a semiconductor laser beam using the concept of diffraction of light, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concepts of total internal reflection and divergence of light in air and estimate the amount of hardness for the given water sample by EDTA method, and the amount of alkalinity for the given water sample.	Applying (K3), Precision (S3)
CO3	demonstrate the conductivity meter and pH meter to estimate the amount of the given solution.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				3										
CO2				3										
CO3				3										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20VEC11 – YOGA AND VALUES FOR HOLISTIC DEVELOPMENT

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	1	0	1	1

Preamble	Providing Value Education to improve the Students' character - understanding yogic life and physical health - maintaining youthfulness - Measure and method in five aspects of life

Unit - I	Physical Health:	2

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment. **Simplified Physical Exercises:** Need and Objectives of Simplified Physical Exercise - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits. **Yogasanas:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana. **Pranayama:** Naddi suddi - Clearance Practice - Benefits.

Unit - II	Life Force:	2

Reasons for Diseases: Body Function - Reason for Diseases and Prevention - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). **Philosophy of Kaya kalpa:** Enriching Bio-Magnetism - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind. **Maintaining youthfulness:** Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life - Controlling undue Passion. **Kayakalpa practice:** Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

Unit - III	Mental Health:	2

Mental Frequencies: Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. **Shanti meditation:** Shanthi Meditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing:** Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection.

Unit - IV	Values:	2

Human Values: Self control - Self confidence - Honesty Contentment - Humility – Modesty - Tolerance - Adjustment - Sacrifice – Forgiveness - Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity. **Social Values:** Non violence – Service. Patriotism – Equality. Respect for parents and elders - care and protection - Respect for teacher. Punctuality - Time Management.

Unit - V	Morality (Virtues):	2

Importance of Introspection: I - Mine (Ego, Possessiveness). Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance. Maneuvering of Six Temperaments: Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness). Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability - Creativity (Improved Memory Power).

Lecture:10, Practical:10, Total:20

TEXT BOOK:

1.	Thathuvagnani Vethathiri Maharishi, "Yoga for Youth Empowerment", Vethathiri Publications, 2019.

REFERENCES:

1.	Thathuvagnani Vethathiri Maharishi, "Yoga for Modern Age", Vethathiri Publications, 2019.
2.	Thathuvagnani Vethathiri Maharishi, "Simplified Physical Exercises", Vethathiri Publications, 2019.
3.	Neelam Sharma, "Holistic Education and Yoga", Shipra Publications, 2017.
4.	Dr. Joseph Murphy, "The Power of Your Subconscious Mind", Pushpak Publication, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the importance of physical health and practice simplified physical yoga exercise.	Applying (K3)
CO2	understand the importance of Kayakalpa exercise to enrich Bio-Magnetism and practice it.	Applying (K3)
CO3	understand the significance of meditation and do meditation to get sound mind.	Applying (K3)
CO4	understand the human and social values to provide service to society.	Applying (K3)
CO5	understand the evil temperaments and five essential qualities acquired through meditation	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		2	1			1		
CO2						3		2				1		
CO3						3		3				1		
CO4						3		2	1			1		
CO5						3		3				1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	NA						
CAT2	NA						
CAT3			100				100
ESE	NA						

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20EGT21 - ADVANCED COMMUNICATION SKILLS
(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	20EGT11 – English Language Skills	2	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1Level in the Common European Framework (CEFR).

Unit - I	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase –VI	9

Listening – Job and career related descriptions and conversations – requests of different kinds and the responses – **Speaking -** Career choices and professional skills – making requests and responding to requests – **Reading** – Using texts about jobs and careers – about different societies and cultural differences – **Writing** – Resumes, CVs and job oriented advertisements – business and career related emails – **Grammar &Vocabulary** – Gerunds and elements of comparison – requests and indirect requests.

Unit - II	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VII	9

Listening – Expository and narrative descriptions – information about different cultures, nations and societies. **Speaking** – Narrating and describing – talking about other countries and other cultures – **Reading** – Using texts about media and information technology – living abroad and experiencing different cultures – **Writing** – Blog writing – brochures and tourist pamphlets – **Grammar & Vocabulary** – The past tense forms - noun phrases and relative clauses.

Unit - III	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VIII	9

Listening – Consumerism – product description – complaints and redressal – environmental issues – ecology – saving the planet – **Speaking** – Talking about problems, issues, complaints – solutions and redressal – talking about environmental issues – **Reading** – Using texts on segregating wastes – recycling and reusing – texts on environmental issues – **Writing** – Online reviews, articles and writing web content – **Grammar & Vocabulary** – Phrases and sentences used for describing problems – passives – prepositions and infinitives.

Unit - IV	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IX	9

Listening – Education, learning and the choice of courses – various services needed in daily life – self-improvement for success in life – **Speaking** - Discussions about educational and career oriented issues – talking about everyday services – giving advice and self improvement – **Reading** – Reading about learning strategies and learning styles – using texts about personality development – **Writing** – Writing about hobbies – pastime and individual skills – writing short articles on everyday life and personality development – **Grammar & Vocabulary** – Using of "would" and certain gerund forms – use of modals, verbs, gerunds, negative questions and infinitives.

Unit - V	Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – X	9

Listening – Historical narratives – biographies and learning about the future – important life events, milestones and happenings of the past – **Speaking** – Talking about the past, present and the future – talking about important events in life – **Reading** – Texts about new technologies and future science – using texts about social organization, culture and social practices – **Writing** – Biographical sketches – historical events – famous personalities, stages of life and getting along with people – **Grammar & Vocabulary** – Future tense forms – time clauses and certain "if clauses".

Total: 45

TEXT BOOK:

1.	Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1.	Sanjay Kumar and Pushp Lata, "Communication Skills: A Workbook based on AICTE Syllabus", Oxford University Press, 2018.
2.	Board of Editors, "Skills Annexe: Functional English for Success", Orient BlackSwan, Hyderabad, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different spoken excerpts critically and infer Unspoken and implied meanings.	Applying (K3)
CO3	read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation.	Analyzing (K4)
CO4	write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.	Creating (K6)
CO5	speak effectively, to express opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies.	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			1	3	1	1		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		2		
CO5									2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		13	30	33	-	17	100
CAT2		13	33	37	-	17	100
CAT3		20	30	33	-	17	100
ESE		6	40	36	-	18	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	1*	2*	4

Preamble	To impart the knowledge of partial derivatives, evaluation of real and complex integrals, vector calculus and analytic functions to the students for solving the problems related to various engineering disciplines.	
Unit - I	**Functions of Several Variables:**	**9**

Functions of two or more variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method

Unit - II	**Multiple Integrals:**	**9**

Double integration in cartesian coordinates – Change of order of integration – Application: Area between two curves – Triple integration in cartesian coordinates –Volume as triple integrals

Unit - III	**Vector Calculus:**	**9**

Directional derivative – Gradient of a scalar point function – Divergence of a vector point function – Curl of a vector – Solenoidal and Irrotational vectors – Green's, Stoke's and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.

Unit - IV	**Analytic Functions:**	**9**

Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy–Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation.

Unit - V	**Complex Integration:**	**9**

Introduction – Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor's and Laurent series – Singularities – Classification – Cauchy's residue theorem (without proof) – Applications: Evaluation of definite integrals involving sine and cosine functions over the circular contour.

List of Exercises / Experiments:

1.	Finding ordinary and partial derivatives
2.	Computing extremes of a single variable function
3.	Evaluating double and triple integrals
4.	Finding the area between two curves
5.	Computing gradient, divergence and curl of point functions
6.	Applying Milne-Thomson method for constructing analytic function
7.	Determination of Mobius transformation for the given set of points
8.	Finding poles and residues of an analytic function

*Alternate week

Lecture: 45, Tutorial and Practical:15, Total:60

TEXT BOOK:

1.	Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2.	Dass H K, "Higher Engineering Mathematics", 3rd Revised Edition, S.Chand and Co., New Delhi, 2014.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	compute extremal values which arise in function of several variables.	Applying (K3)
CO2	solve Problems involving Double and Triple integrals.	Understanding (K2)
CO3	apply the concept of vectors in engineering problems.	Applying (K3)
CO4	identify, construct and apply analytic functions in electrostatics and fluid flow problems.	Applying (K3)
CO5	evaluate complex integrals which are extensively applied in engineering.	Applying (K3)
CO6	compute maxima and minima of a single variable function, gradient, curl and divergence of a vector function using MATLAB.	Understanding (K2), Manipulation (S2)
CO7	evaluate Double, Triple integrals and determine area between two curves using MATLAB	Applying (K3), Manipulation (S2)
CO8	construct analytic function, find bilinear transformation and compute poles and residues using MATLAB.	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3												
CO2	3	3	2											
CO3	3	3												
CO4	3	3												
CO5	3	3	2											
CO6					3									
CO7					3									
CO8					3									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20PHT26 - PHYSICS FOR FOOD TECHNOLOGY

Programme & Branch	BTech – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	0	3

Preamble	This course aims to impart the knowledge on the physics of conductors, dielectrics, magnetic materials and nano materials. It also describes the phenomena related microwaves, the select crystal growth and characterization techniques and the applications of aforementioned materials in Food Technology and provides motivation towards innovations.

Unit - I	Conducting and Dielectric Materials:	9

Conducting Materials: Introduction - Classical free electron theory – Electrical and thermal conductivities based on classical free electron theory of metals - Merits and demerits of classical free electron theory - Quantum free electron theory of metals - Fermi distribution function - Effect of temperature on Fermi function - Dielectric materials: Introduction - Dielectric constant –Types of polarization (qualitative) – Frequency and temperature dependence of polarization – Concepts of dielectric loss and dielectric breakdown – Uses of dielectric materials in ohmic heating.

Unit - II	Magnetic Materials and Microwaves:	9

Introduction - Domain theory of ferromagnetism – Hysteresis of ferromagnetic materials based on domains - Classification of soft and hard magnetic materials based on domains – Ferrites: Properties and structures - Applications: Metal detector and magnetic inductive flow meter. Microwaves: Introduction - Conversion of microwaves into heat - Penetration depth and applications.

Unit - III	Nanomaterials:	9

Introduction - Low dimensional structures: quantum dot, quantum wire and quantum well –Properties of nanomaterials - Synthesis techniques: Ball milling, physical vapour deposition, chemical vapour deposition and sol-gel methods – Properties and applications of nanomaterials – Carbon nanotubes: structures, properties and synthesis by laser ablation method – Industrial applications of nanotechnology in food processing and packaging.

Unit - IV	Crystal Growth:	9

Introduction – Nucleation: Classical theory of nucleation – Critical radius and critical free energy – homogeneous and heterogeneous nucleation – Free energy formation of critical nucleus – Crystal growth techniques – Melt growth methods: Bridgman and Czochralski methods – Solution growth method: High temperature solution growth and low temperature solution growth methods - Examples in food processing.

Unit - V	Materials Characterization:	9

Importance of food materials characterization - X-ray diffraction - Scanning electron microscope: principle, construction and working - Transmission electron microscope: principle, construction and working – Spectroscopy: IR and UV-visible spectroscopy, Raman spectroscopy (qualitative) - Thermal analysis: Thermo gravimetric analysis, Differential scanning calorimetry.

Total:45

TEXT BOOK:

1.	Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics", 11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019, for Units I, II, III, IV.
2.	Sam Zhang, Lin Li and Ashok Kumar, "Materials Characterization Techniques", 1st Edition, CRC Press, Boca Raton, 2008, for Unit V.

REFERENCES:

1.	Ludger O. Figura and Teixeira A., "Food Physics: Physical Properties – Measurements and Applications", 1st Edition, Springer, Germany, 2007.
2.	Raghavan V., "Materials Science and Engineering", 6th Edition, PHI Learning Pvt. Ltd., Delhi, 2015.
3.	Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concepts of classical and quantum free electron theory to compute electrical and thermal conductivity of metals and to comprehend the effect of temperature on Fermi function, and to describe the phenomena related to dielectric polarization, dielectric loss and dielectric breakdown and the applications of dielectrics.	Applying (K3)
CO2	apply the concepts of domain theory of ferromagnetism to explain hysteresis and to comprehend the working of metal detector, magnetic inductive flow meter and to explain the uses of microwaves in food processing.	Applying (K3)
CO3	utilize appropriate techniques to prepare nano-materials and carbon nano-tubes, and to comprehend their features and applications.	Applying (K3)
CO4	utilize appropriate theory and models of select crystal growth techniques to grow crystals.	Applying (K3)
CO5	apply the concepts of Raman effect, X-ray diffraction, matter waves and thermograph to describe the principle and working of select material characterization techniques.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	30	30	40				100
CAT3	25	35	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20CYT25 - CHEMISTRY FOR FOOD TECHNOLOGY

Programme & Branch	BTech - Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	0	3

Preamble	Chemistry for Food Technology aims to realize the students to have a sound knowledge of chemistry and stimulate them to know about Fertilizer, Pesticide, materials for sustainable food processing.

Unit - I	**Fertilizers :**	9

Introduction- plant nutrients -nutrient function – micronutrients -fertilizer type - need for fertilizers - classification of fertilizers - straight and mixed fertilizers - sources of fertilizers - natural organic fertilizers - natural inorganic fertilizers - artificial fertilizers – synthesis and importance of i) Nitrogenous fertilizers - ammonium nitrate - urea - action of urea as fertilizer ii) Phosphate fertilizers - phosphate rock - normal superphosphate - triple superphosphate - phosphate fixation – iii) Potassium fertilizers iv) NPK fertilizers - mixed fertilizers.

Unit - II	**Insecticides and Pesticides :**	9

Introduction - classification – i) Inorganic insecticides - ii) Natural or plant insecticides – iii)Organic insecticides - Dinitrophenols - DDT - BHC or benzene hexachloride - Aldrin and dieldrin - endrin - synthesis of organochlorines - Tetraethyl pyrophosphate (TEPP) - Malathion - Parathion - attractants and repellents - Fumigants - Fungicides - Herbicides - synthetic insecticides - pesticides pollution - persistent pesticides - biodegradation of pesticides - mode of poisoning of pesticides - degradation and mobility of pesticides.

Unit - III	**Chemistry of Materials :**	9

Abrasives – properties of abrasives – types: i) natural abrasives - diamond, corundum, emery, garnets and quartz ii) synthetic abrasives - silicon carbide, boron carbide – industrial applications of abrasives. Adhesives – requisites of a good adhesive– classification of adhesives - process of bonding- advantages and disadvantages of adhesive bonding - industrial applications of adhesives. Insulator – characteristics of insulating materials – electrical insulator – thermal insulator – applications. Lubricant – mechanism of lubrication – classification – properties – viscosity index, flash and fire point, cloud and pour point, oiliness, aniline point – selection of lubricants.

Unit - IV	**Food and Energy Resources:**	9

Forest resources: Importance – causes and consequences of deforestation, case studies - Food resources: malnutrition, under nutrition, world food problems, changes caused by modern agriculture, water logging, salinity, case studies– applications of biotechnology in agriculture – food science – medicines. Energy resources: Growing energy needs, renewable and non-renewable energy sources, solar energy, hydropower, use of alternate energy sources. Case studies – role of an individual in conserving food and energy resources.

Unit - V	**Sustainable Food Processing :**	9

Sustainability: green engineering technologies in the food processing industries – drivers for sustainable food Processing: legislative, economic, consumer, corporate performance – environmental impacts of food processing: energy, solid waste, water and wastewater - environmental impact assessment methods in food processing – carbon foot print, ecological foot print, life cycle assessment.

Total: 45

TEXT BOOK:

1.	Sharma B.K.,"Industrial Chemistry including Chemical Engineering", Goel Publishing House, Meerut, 2011 for Units I, II, III.
2.	Palanisamy P.N., Manikandan P., Geetha A. & Manjula Rani K., "Environmental Science", Revised Edition, Pearson Education, New Delhi, 2019 for Units IV, V.

REFERENCES:

1.	Wiley Editorial Board, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd., New Delhi, Reprint 2019, for Units III, IV.
2.	Das,P.C., "Manures and Fertilizers", Kalyani Publishers, Ludhiana, 2008 for Units I , II.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	organize the manufacture and properties of different types of fertilizers and its applications.	Applying (K3)
CO2	make use of the knowledge of pesticide and insecticide to know their effects on soil, water and air.	Applying (K3)
CO3	iilustrate the chemistry of materials for better understanding the industrial needs.	Understanding (K2)
CO4	Illustrate the various food and energy resources and role of individual for its conservation.	Understanding (K2)
CO5	apply the green engineering principle for sustainable food processing.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1	-	-	-	-	3							
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT21 - BASICS OF MECHANICAL ENGINEERING

Programme & Branch	BTech – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	0	0	3

Preamble	To impart knowledge on basic concepts of steam power and boiler, IC Engine and manufacturing technology.	
Unit - I	Boilers:	9

Types and classification of boilers – Fire tube and water tube boilers - Cochran Boiler, Lancashire boiler, Locomotive Boiler, Babcock and Wilcox boiler. Fluidized Bed Boiler. Boiler mountings and Accessories. Performance and energy efficiency of boilers. Simple calculation of Boiler efficiency. Importance of boiler water treatment and blow down.

Unit - II	Steam Properties:	9

Properties of steam, usage of steam table and h-s chart. Determination of dryness fraction of steam. Calorimeters – Tank or barrel type, throttling, separating, separating and throttling. Steam distribution systems. Application of steam in food process industries.

Unit - III	I.C Engines:	9

Classifications of Internal Combustion engines and their working principles –Lubrication – Types, Cooling systems – Types. Air Fuel Ratio, Delay Period or Ignition Lag, Variable effecting Delay Period, Diesel Knocks, Methods of Controlling Diesel Knock, I.C Engine Combustion Chambers, Cold Starting of I.C. Engine and Cold Starting Aids.

Unit - IV	Mechanical Components And Their Applications:	9

Basic principles and applications of power transmission systems such as belt, rope, chain and gear drives – Function and principles of coupling, clutch, brake, flywheel and governor.

Unit - V	Manufacturing Technology:	9

Principle and applications of Metal forming process – Foundry, Forging. Principle and applications of Metal Joining process – Welding, Soldering and Brazing, Basics of CAD/CAM/CIM.

Total:45

TEXT BOOK:

1.	R.K.Rajput, "Thermal Engineering", 10th Edition, Laxmi Publications, New Delhi, 2018, for Units I,II,III.
2.	Navaneethakrishnan P., Selvakumar P., Rajeshkumar G. and Sangeetha R.K., "Basic Civil and Mechanical Engineering", 1st Edition, McGraw Hill Education, New Delhi, 2016 for Unit IV, V.

REFERENCES:

1.	Pravin Kumar, "Basic Mechanical Engineering", 1st Edition, Pearson Publishers", New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify the boilers and explain their types	Understanding (K2)
CO2	interpret the properties of steam and infer the quality of steam using calorimeters	Understanding (K2)
CO3	Outline the basic concept of IC engine and their combustion chambers	Understanding (K2)
CO4	explain the basic principles of various mechanical components	Understanding (K2)
CO5	summarize the manufacturing technology of various metals processing	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2			2	1					2		3
CO2	3	3	2			2	1					2		3
CO3	3	3	2			2	1					2		3
CO4	3	3	2			2	1					2		3
CO5	3	3	2			2	1					2		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50					100
CAT2	50	50					100
CAT3	50	50					100
ESE	50	50					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT22 - ENGINEERING PROPERTIES OF FOOD MATERIALS

Programme &Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	PC	3	0	0	3

Preamble	To impart knowledge on physical, thermal, optical, electromagnetic, rheological and textural properties of food materials and its measurement methods

Unit - I	Physical Properties:	9

Importance of engineering properties, Physical properties of food materials- size, shape, volume, density, porosity and surface area – definitions and measurements, Frictional properties –coefficient of friction, angle of repose – types and its determination, rolling resistance and angle of internal friction – definition, Aerodynamic properties – Drag co efficient, Terminal Velocity and its application.

Unit - II	Thermal Properties:	9

Definition of specific heat, enthalpy, thermal conductivity, thermal diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity – steady state and unsteady state methods, thermal diffusivity – Dickerson's method, Calorific value of food, Bomb calorimeter, Boiling point elevation and freezing point depression - definition, Applications of thermal properties.

Unit - III	Optical Properties:	9

Refractive index of food items, Abbes refractometer, Optical activity, Polarimeter, Gloss and glossimeter, color, translucency – Definitions and applications. Electromagnetic Properties: Electrical properties- electrical conductivity and its measurement, dielectric properties - measurement methods, effect on moisture, temperature and composition, microwave heating and other applications.

Unit - IV	Rheological Properties:	9

Classification of rheology, Stress Strain behavior of Newtonian and Non- Newtonian fluids- Bingham and Non Bingham. Stress-strain relationships in solids, liquids and visco elastic behavior- stress relaxation test, creep test and dynamic test, stress-strain diagrams, Rheological models – Kelvin and Maxwell model. Viscosity – Types and its definitions, measurement methods - Capillary, Orifice, Falling and Rotational viscometers..

Unit - V	Textural Properties:	9

Types of food textures, Texture measuring instruments- Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA, Properties of food powders. Color: Interaction of object with light, Measurement methods -Spectrophotometer and Colorimeter, Color order systems- Munsel color system, CIE color system, Hunter lab color space, Lovibond system.

Total:45

TEXT BOOK:

1.	Serpil Sahin and Servet Gulum Sumnu,"Physical Properties of Foods", 1st Edition, Springer, New York, 2006.

REFERENCES:

1.	Rao M.A. and Rizvi S.S.H., "Engineering Properties of Foods", 4thEdition, CRC Press, New York, 2014.
2.	Sahay K.M. and Singh K.K., "Unit Operations of Agricultural Processing", 2nd Edition, Vikas Publishing, New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the various physical properties in food process design	Applying (K3)
CO2	outline the thermal properties of foods and its measurement methods	Understanding (K2)
CO3	make use of optical and electromagnetic properties of food materials in food processes	Applying (K3)
CO4	explain various rheological behavior of solid, liquid and viscoelastic food materials	Understanding (K2)
CO5	choose suitable textural and color measurement techniques for food materials	Applying (K3)

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Mapping of COs with POs and PSOs

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COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1							1	3	1
CO2	3	3	2	1	1							1	3	1
CO3	3	3	2	1	1							1	3	1
CO4	3	3	2	1	1							1	3	1
CO5	3	3	2	1	1							1	3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

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ASSESSMENT PATTERN - THEORY

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Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	0	0	0	50
CAT2	20	40	40	0	0	0	50
CAT3	20	40	40	0	0	0	50
ESE	20	40	40	0	0	0	100

* **±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20FTL21 - BASICS OF MECHANICAL ENGINEERING LABORATORY

Programme & Branch	BTech – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	0	0	2	1

Preamble	To provide practical exposure on various manufacturing processes in Mechanical Engineering.

LIST OF EXPERIMENTS:

1.	To prepare different weld joints like T/L/Lap weld joints by using horizontal and vertical position of Arc welding operations
2.	To prepare different weld joints by using Gas welding operations.
3.	To prepare the Gas cutting and spot welding operations.
4.	To prepare a sand mold using Foundry tools
5.	Perform facing, plain turning and step turning operations in centre lathe
6.	Perform knurling and taper turning operations in centre lathe
7.	Perform external thread cutting operations in centre lathe
8.	Perform eccentric turning and bush turning operations in centre lathe
9.	Drill and tap on the flat metal plate by using drilling and taping tools
10.	Perform various milling operations by using milling machine

REFERENCES / MANUALS /SOFTWARES:

1.	Laboratory Manual
2.	Pravin Kumar, "Basic Mechanical Engineeringǁ, Pearson Publishers", New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 perform the welding joint using the given welding process	Applying (K3), Manipulation (S2)
CO2 prepare mould for given component	Applying (K3), Precision (S3)
CO3 produce different profiles on metal parts by machining operations using lathe, milling, shaping and drilling machines	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2					2			1		3
CO2	2			2					2			1		3
CO3	2			2					2			1		3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

20PHL30 - PHYSICAL SCIENCES LABORATORY II

Prog. & Branch	BTech - Food Technology	Sem.	Category	L	T	P	Credit
Pre requisite	Nil	2	BS	0	0	2	1

Preamble	This course aims to impart hands on training in the determination of physical parameters such as specific resistance, thermal conductivity, the wavelength of Hg spectrum, the thickness of a nano-crystalline thin film and particle size, and to develop the skills in handling different basic instruments. This course also aims to impart the knowledge of water quality parameters and thereby, to improve the analytical capability.

List of Exercises / Experiments:

1.	Determination of the specific resistance of a conductor using Carey Foster's bridge.
2.	Determination of the thermal conductivity of a dielectric material using Lee's disc arrangement.
3.	Determination of the wavelength of Hg spectrum using spectrometer grating.
4.	Determination of the thickness of a nano-crystalline thin film using air-wedge arrangement.
5.	Determination of the particle size of given powder using a Laser.
6.	Estimation of chloride ion in the given water sample using Argentometric method.
7.	Determination of Dissolved Oxygen in the given wastewater sample.
8.	Determination of COD in the given wastewater sample.
9.	Kinetics of reactions – Acid catalyzed hydrolysis of an ester.
10.	Determination of physical characterization of wastewater (pH, color, turbidity and dissolved solids).

Total: 30

REFERENCES:

1.	Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 1st Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Kalaikathir Publishers, Coimbatore, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	determine the specific resistance of metals using the concept of electrical conductivity and to determine the thermal conductivity of dielectric materials using the concept of heat conduction through the materials.	Applying (K3), Precision (S3)
CO2	determine the wavelength of Hg spectrum and the particle size of powder using the concept of diffraction of light, and to determine the thickness of nano-crystalline thin film using the concept of interference of light. Determine the amount of chloride and DO in the given water sample and the rate constant of hydrolysis of an ester.	Applying (K3), Precision (S3)
CO3	determine the pH, colour, turbidity, dissolved solids and COD in the given wastewater.	Applying (K3), Precision (S3)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3											
CO2			3											
CO3			3											

Mapping of COs with POs and PSOs

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20MAT31 - PROBABILITY AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to Civil, Mechanical, Mechatronics, Automobile, Chemical & Food Technology branches)

Programme & Branch	BE & Civil, Mechanical, Mechatronics, Automobile Engineering & BTech Chemical, Food Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	BS	3	1	0	4

Preamble	To provide the skills for solving the real time engineering problems involving partial differential equations and impart knowledge in applying probability concepts in their respective fields and express functions in terms of Fourier series.

Unit - I	Random Variables:	9+3

Introduction to Probability – Definition of random variable – Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating functions.

Unit - II	Standard Probability Distributions:	9+3

Discrete Distributions: Binomial distribution – Poisson distribution – Geometric distribution – Continuous Distributions: Uniform distribution – Exponential distribution – Normal distribution.

Unit - III	Fourier Series:	9+3

Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.

Unit - IV	Partial Differential Equations:	9+3

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients.

Unit - V	Applications of Partial Differential Equations:	9+3

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Ravish R. Singh, Mukul Bhatt, "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons Limited, 2019.
2.	Veerarajan T., "Transforms and Partial Differential Equations", 3rd Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
3.	Jay L. Devore., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the concept of random variables.	Applying (K3)
CO2	implement the exact distribution for solving engineering problems.	Applying (K3)
CO3	express the given function or data in terms of Fourier series.	Applying (K3)
CO4	formulate and solve higher order partial differential equations	Applying (K3)
CO5	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1											
CO2	3	3	2											
CO3	3	2												
CO4	3	3	1											
CO5	3	3	2											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	10	80	-	-	-	100
CAT2	10	10	80	-	-	-	100
CAT3	10	10	80	-	-	-	100
ESE	10	20	70	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20CSC31 - PROGRAMMING IN C
(Common to all BE/BTech Engineering & Technology branches except CSE, IT)

Programme & Branch	All BE/BTech Engineering & Technology branches except CSE, IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	ES	3	0	2	4

Preamble	The course is designed for use by freshmen students taking their first course in programming. It deals with the techniques needed to practice computational thinking, the art of using computers to solve problems and the ways the computers can be used to solve problems. This course also focuses on developing programming skills using C language.

Unit - I	Introduction to Computer and Problem Solving:	9

Overview of computers : Types, Generations, Characteristics, Basic computer Organization – Problem solving techniques: Algorithms - Flowcharts – Pseudo codes – Structuring the logic: Sequential, selection and repetitive structure

Unit - II	Introduction to C and Control Statements:	9

The structure of a C program – Compiling and executing C program – C Tokens – Character set in C – Keywords – identifiers- Basic data Types – Variables – constants – Input/Output statements – operators - decision making and looping statements

Unit - III	Arrays and Functions:	9

Declaring, initializing and accessing arrays – operations on arrays – Two dimensional arrays and their operations. Functions : Introduction- Using functions, function declaration and definition – function call – return statement – passing parameters to functions: basic data types and arrays – storage classes – recursive functions

Unit - IV	Strings and Pointers:	9

Strings :Introduction – operations on strings : finding length, concatenation, comparing and copying – string and character manipulation functions, Arrays of strings. Pointers : declaring pointer variables – pointer expression and arithmetic, passing arguments to function using pointers -pointers and 1D arrays –arrays vs pointers , pointers and strings,

Unit - V	User-defined Data Types and File Handling:	9

User-defined data types: Structure: Introduction – nested structures– arrays of structure – structure and functions -unions – enumerated data type. File Handling : Introduction - opening and closing files – reading and writing data to files -Manipulating file position indicator : fseek(), ftell() and rewind()

List of Exercises:

1.	Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, Selection and repetition structures
2.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators
3.	Programs using decision making and repetitive statements
4.	Programs for demonstrating one-dimensional and two-dimensional numeric array
5.	Programs to demonstrate modular programming concepts using functions and strings (Using built-in and user-defined functions)
6.	Programs to illustrate the use of structures and pointers
7.	Programs to implement file operations

Lecture:45, Practical : 30, Total:75

TEXT BOOK:

1.	Reema Thareja, "Programming in C ", 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
2.	Sumitabha Das, "Computer Fundamentals and C Programming", 1st Edition, McGraw Hill, 2018.
3.	Balagurusamy E., "Programming in ANSI C", 7th Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	outline the basics of computers and apply problem solving techniques to express the solution for the given problem	Applying (K3)
CO2:	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3)
CO3:	develop simple C programs using the concepts of arrays and modular programming	Applying (K3)
CO4:	apply the concepts of pointers and develop C programs using strings and pointers	Applying (K3)
CO5:	make use of user defined data types and file concept to solve given problems	Applying (K3)
CO6:	demonstrate the execution of flowcharts for the given problem using Raptor	Applying (K3), Precision (S3)
CO7:	demonstrate the application of sequential, selective and repetitive control structures	Applying (K3), Precision (S3)
CO8:	develop solutions to the given problem using derived /user defined data types and functions and also using file concepts	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs														
COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1						1	1		1		
CO2	3	2	2						1	1		1		
CO3	3	2	2						1	1		1		
CO4	3	2	2						1	1		1		
CO5	3	2	2						1	1		1		
CO6	3	2	2	2	1				1	1		1		
CO7	3	2	2	2	1				1	1		1		
CO8	3	2	2	2	1				1	1		1		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	50				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	20	30	50				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT31 - PROCESS FLUID MECHANICS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	ES	3	1	0	4

Preamble	This course provides an introduction to the properties and behaviour of fluids. It introduces dimensional analysis and equations of Fluid flow and enables the students to apply in mixing, pumping and metering.

Unit - I	Fluid Statics and Flow phenomena:	9+3

Nature of fluids **-** Physical properties of fluids. Fluid statics -Hydrostatic equilibrium. Application of fluid statics: manometers - continuous gravity decanter- storage Tank. Types of fluids: Compressible and incompressible fluids, Newtonian and Non–Newtonian fluids. Flow of Fluids : Concept of flow rates, velocity and type of flows

Unit - II	Equations of Fluid Flow:	9+3

Continuity equation **-** Reynolds number **-** Fluid flow regimes**.** Bernoulli equation-Correction of Bernoulli equation for fluid friction-Application of Bernoulli equation for pump work. Shear stress and skin friction in pipes - Laminar and turbulent flow of fluids through closed conduits - Velocity profiles and friction factor for smooth and rough pipes- Friction loss due to sudden enlargement and contraction- Friction loss in fittings, valves and coils.

Unit - III	Flow Past Immersed Bodies:	9+3

Pressure drop for flow of liquids through porous media. Motion of particles through fluids: Equation for one dimensional motion of spherical particle through fluid, terminal velocity, Hindered settling. Agitation of Liquids and Basics of dimensional analysis: Agitation Vessels **-** Types of impellers - Flow pattern in agitated vessel - Estimation of Power consumption in agitated vessels. Dimensional analysis -Rayleigh's method and Bukingham's π method.

Unit - IV	Transportation of Fluids:	9+3

Classification of Pumps. Positive displacement pumps: operation, capacity and characteristics. Centrifugal pump: Performance, losses and characteristics. Calculation of power and discharge. Working principle and applications of Gear pumps, Lobe pumps, Screw pumps, diaphragm pumps, progressive cavity pumps, vacuum pumps, metering pumps and peristaltic pumps. Fans, blowers and compressors – Selection, types and applications. Pipelines for the transportation – sanitary aspects and material of construction

Unit - V	Metering of Fluids:	9+3

Variable head meters: Orifice meter, Venturimeter, Pitot tube. Variable areameters: Rotameter. Working Principle and applications of Doppler Ultrasonic flow meters, Transit time flow meters, Magnetic flow meters, Tubine flow meters, Thermal flow meters, Positive displacement flow meters, Coriolisflowmeter and Surface Acoustic Wave flow meters. Notches and Weirs. Valves – Types, selection and applications.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	McCabe W.L., Smith J.C. and Harriot P., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, New York, 2005.

REFERENCES:

1.	Romeo T. Toledo, "Fundamentals of Food Process Engineering", 4th Edition, Springer, New York, 2018.
2.	Paul Singh R., Dennis R. Heldman, "Introduction to Food Engineering", 5th Edition, Academic Publisher, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify fluids, apply hydrostatic equilibrium	Applying (K3)
CO2	derive and apply basic equations of fluid flow	Applying (K3)
CO3	analyze fluid flow through porous media and select suitable mixing equipment	Analyzing (K4)
CO4	select and examine the performance of pumps	Analyzing (K4)
CO5	explain the working principle and choose flow measuring devices and valves	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1							1	2	1
CO2	3	2	2	1	1							1	2	1
CO3	3	3	2	2	1							1	3	2
CO4	3	3	2	2	1							1	3	2
CO5	3	2	1	1	1							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	50				100
CAT2	20	20	50	10			100
CAT3	20	30	40	10			100
ESE	20	25	45	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT32 - FOOD PROCESS CALCULATIONS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	PC	3	1	0	4

Preamble	The course helps the student to understand fundamental and the stoichiometric calculations, material and energy balance associated with unit operations.

Unit - I	Units and Dimensions, Fundamental Calculations:	9+3

Basic and derived units, unit conversions, use of model units in calculations, methods of expression, compositions of mixture and solutions, ideal and real gas laws – gas constant - calculations of pressure, volume and temperature using ideal and van der Waals equation, use of partial pressure and pure component volume in gas mixture calculations.

Unit - II	Material Balance Calculation:	9+3

Stoichiometric principles, material balance without chemical reaction - application of material balance to unit operations: distillation, evaporation, crystallization, drying, blending of food ingredients and extraction.

Unit - III	Recycle Operations and Humidity and Saturation:	9+3

Bypass and Recycle Operations: Bypass operation, recycle operations - block diagram, purging operations, purge ratio, recycle ratio and purge stream. Humidity and Saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, wet and dry bulb temperature, dew point - Humidity chart usage.

Unit - IV	Energy Balance Calculation:	9+3

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, enthalpy changes in food. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction.

Unit - V	Combustion and Process Flow Sheet Calculation:	9+3

Combustion: Combustion of solids, liquid and gas, determination of NHV and GHV. Determination of composition by Orsat analysis - Calculation of excess air, theoretical oxygen requirement. Process Flow Sheet Calculation: Material and Energy Balance for selected food Process.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall of India, New Delhi, 2013.

REFERENCES:

1.	Stavros Yanniotis, "Solving Problems in Food Engineering", 3rd Edition Springer, New York, 2008.
2.	Romeo T. Toledo, Rakesh K. Singh, Fanbin Kong, "Fundamentals of Food Process Engineering", 4th Edition, Springer Publishers, New York, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of different systems of units and dimensions, estimate compositions of mixtures and solutions	Applying (K3)
CO2	outline the stoichiometry principles and apply material balance for different unit operations	Applying (K3)
CO3	apply material balance for bypass, recycle operations and perform humidification calculations	Applying (K3)
CO4	make use of energy balance for system without chemical reactions	Applying (K3)
CO5	make use of material and energy balance in various process and determine the GHV, NHV and composition of fuels	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1							1	1	1
CO2	3	3	2	2	1							1	3	3
CO3	3	3	2	2	1							1	3	3
CO4	3	3	2	2	1							1	2	1
CO5	3	3	2	2	1							1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	60				100
CAT2	20	20	60				100
CAT3	0	20	50	30			100
ESE	10	20	40	30			100

 * ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT33 - FOOD CHEMISTRY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	PC	3	0	0	3

Preamble	This course deals about the importance of micronutrients, food additives, modification of biomolecules and chemistry of muscle tissue.

Unit - I	**Minerals and Vitamins:**	9

Minerals: Major minerals - Calcium, Potassium, Sodium, Phosphorus. Minor minerals - Iron, Zinc, Iodine, Copper, Selenium. Functional role and deficiency. Vitamins: Definition, water soluble and fat soluble vitamins, sources, functions and deficiency symptoms.

Unit - II	**Changes during Cooking:**	9

Cooking: objectives - methods – moist heat, dry heat and combination. Loss of nutrients and prevention - biochemical changes in carbohydrates - Gelatinization and retrogradation of starch - proteins and lipids. Parboiling of rice. Enzymatic browning reaction, non enzymatic browning reactions - caramelization, Maillard reaction

Unit - III	**Modification of Biomolecules:**	9

Modified starches, resistant starch. Starch hydrolysates – Maltodextrin, cyclodextrin and dextrin. Modification of proteins – chemical and enzymatic methods. Modification of fats - Hydrogenation - cis and trans isomers, interesterification, winterization. Biochemical changes during processing of foods – malting and baking.

Unit - IV	**Food Additives, Food colours and Flavours**	9

Food additives: classification and purpose - Role of thickeners, stabilizers, sweeteners, emulsifiers, leaveners, colours, flavoring agents, flour improvers, anticaking agents, sequestrants, humectants, preservatives - examples. Food colours and Flavours: Natural and synthetic colourants - chlorophyll, carotenoids, betalains, anthocyanins and other phenols. Flavours – sensory perception of flavors, Molecular Mechanisms of Flavour Perception, specific and synthetic flavours, Taste and Other Saporous Substances, Vegetable, Fruit, and Spice Flavours, Flavours from Lactic Acid–Ethanol Fermentations, Flavour Volatiles from Fats and Oils.

Unit - V	**Chemistry of edible muscle Tissues:**	9

Structure of muscle-conversion of muscle to meat – natural and induced postmortem biochemical changes affecting meat quality. Chemistry of processed meats – curing, hydration and water retention, formation of gel matrix, fat immobilization and stabilization

Total:45

TEXT BOOK:

1.	Srinivasan Damodaran, Kirk L. Parkin (Eds), Fennema's, "Food Chemistry", 5th Edition, CRC Press, Florida, 2017.

REFERENCES:

1.	Belitz H.D., Grosch W. and Schieberle P., "Food Chemistry", 3rd Edition, Springer-Verley, Berlin, 2009.
2.	John M. deMan, John Finley, W. Jeffrey Hurst, Chang Lee, "Principles of Food Chemistry", 4th Edition, Springer International Publishing, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the nutritional importance of vitamins and minerals	Understanding (K2)
CO2	recognize the changes in food components during cooking, processing and storage	Understanding (K2)
CO3	modify the carbohydrates, proteins and fats based on its role in processing	Analyzing (K4)
CO4	identify the role of food additive, colours and flavors in food processing	Applying (K3)
CO5	infer the biochemical changes in meat during processing	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									1	2	1
CO2	3	2	1	1	1							2	2	2
CO3	3	3	2	1	1							2	3	2
CO4	3	3	2	1	1							2	3	3
CO5	3	3	1	1								1	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	40	20	20			100
CAT3	10	50	40				100
ESE	10	50	20	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT34 - REFRIGERATION AND COLD CHAIN MANAGEMENT

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	3	1	0	4

Preamble	The course imparts the basic concepts of thermodynamics, refrigeration systems, low temperature storage systems and theoretical knowledge on cold chain management.

Unit - I	Introduction to Thermodynamics:	9+3

Fundamental concepts of thermodynamics- systems, properties, process, functions, heat and work. Zeroth and First Law of Thermodynamics. Statement of first law for flow and non - flow process. Internal energy, enthalpy, heat capacities (C_V and C_P).Second Law of thermodynamics: Kelvin-Plank, Clausius statements, Carnot cycle, Entropy changes during processes.

Unit - II	Refrigeration Components:	9+3

Introduction to refrigeration, unit of refrigeration capacity , Refrigerants - classification and thermodynamic properties, Ozone depletion potential, Reversed Carnot cycle, Limitations of reversed Carnot systems. Evaporator- dry and flooded type, liquid cooling evaporator. Condenser- water cooled, air cooled and evaporative condenser. Compressor - Reciprocating type compressors. Expansion valve - thermostatic expansion valve.

Unit - III	Refrigeration Systems:	9+3

Refrigeration cycle – simple vapour compression and absorption system. p-h and T-s diagrams, determination of COP. Energy ratios and Power consumption of a refrigerating machine. Standard rating cycle and effect of operating conditions. Air refrigeration system – reversed Brayton cycle.

Unit - IV	Low Temperature Storage Systems:	9+3

Pre-cooling systems, Cold storage- construction, insulation and operation. Design of cold storage unit. Calculation of refrigeration load in cold store. Prefabricated systems, walk-in-coolers. Frozen storage, Freezer types, Cryogenics – Linde and Claude system for liquefaction of air.

Unit - V	Cold Chain:	9+3

Introduction, Components of cold chain. Refrigerated distribution and transport systems, Cold chain in retail, Information systems-Time temperature management – Application of RFID. Role of refrigeration in candy manufacture, beverage processing, bakery products, meat products, poultry products, fish products, fruit /vegetables and dairy products.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Rajput R.K, "Refrigeration And Air-conditioning", 3rd Edition, S.K. Kataria and Sons, Delhi, 2012.

REFERENCES:

1.	Dellino C.V.J., "Cold and Chilled Storage Technology", 2nd Edition, Springer, US, 2011.
2.	Narayanan K.V., "A Text Book of Chemical Engineering Thermodynamics", 2nd Edition, Pentice Hall of India, New Delhi, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the concepts of thermodynamics	Understanding(K2)
CO2	summarize the components of refrigeration system	Understanding(K2)
CO3	classify various refrigeration system and assess its power consumption	Analyzing(K4)
CO4	select the appropriate low temperature storage systems	Evaluating(K5)
CO5	apply the concept of cold chain for storage and distribution of various food products	Applying(K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1	1	1
CO2	3	3	2	1								1	1	1
CO3	3	3	3	2								1	1	2
CO4	3	3	3	2	1							2	2	2
CO5	3	3	3	2	2							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	30	20	30			100
CAT3	20	20	30	30			100
ESE	20	30	30	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTL31 - FLUID FLOW LABORATORY

Programme & Branch	B.TECH. – Food Technology		Sem.	Category	L	T	P	Credit
Prerequisites	Nil		3	PC	0	0	2	1
Preamble	To impart practical knowledge required for handling Newtonian Fluids.							

List of Exercises / Experiments:

1.	Determination of discharge coefficient of Venturimeter
2.	Determination of discharge coefficient of Orificemeter
3.	Verifying relationship between friction factor and Reynolds number for flow through square ducts
4.	Verifying Darcy's equation for flow through circular pipes
5.	Determination of critical Reynolds number for flow through helical coils
6.	Determination of discharge coefficient of V- notch
7.	Verifying relationship between friction factor and Reynolds number for flow through annular pipes
8.	Determination of loss coefficient of valves and pipe fittings
9.	Estimation of performance characteristics of centrifugal pump
10.	Estimation of performance characteristics of reciprocating pump
11	Virtual Lab : 1. Demonstration and estimation of discharge coefficient of Venturimeter 2.Demonstration and determination of energy loss in pipe

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	McCabe W.L., Smith J.C., and Harriot P., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, New York, 2005.
3.	Perry Robert, "Perry's Chemical Engineers Hand book", 8th Edition, McGraw Hill, New York, 2007.
4.	Gavhane K.A., "Unit Operations – I", 27th Edition, Nirali Prakashan Publications, Pune, 2018.
5.	Amirtha virtual lab tool :https://vlab.amrita.edu/

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	estimate the discharge coefficient for variable area and head flow meters	Evaluating (K5), Precision (S3)
CO2	measure the flow of fluids through closed conduits, valves and pipe fittings	Evaluating (K5), Precision (S3)
CO3	select and evaluate the performance of pumps	Evaluating K5, Precision S3

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2				3	2		1	3	2
CO2	3	3	3	3	2				3	2		1	3	2
CO3	3	3	3	3	1				3	2		1	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTL32 - FOOD CHEMISTRY LABORATORY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	0	0	2	1
Preamble	To deal about analysis and estimation of biomolecules.						

List of Exercises / Experiments :

1.	Qualitative tests for monosaccharide, disaccharides, polysaccharides
2.	Estimation of starch by anthrone method
3.	Extraction and analysis of oil (iodine number, saponification number, acid number)
4.	Estimation of protein by Lowry's method
5.	Determination of dextrose equivalent in modified starches
6.	Extraction and estimation of carotenoids and lycopene in fruits/vegetables
7.	Estimation of polyphenols in fruits/vegetables
8.	Estimation of flavanoids in fruits/vegetables
9.	Estimation of Vitamin C in fruits/vegetables
10.	Estimation of Iron in food samples
11.	Virtual Laboratory Experiments: a. Isoelectric precipitation of protein from milk

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Ranganna S., "Handbook of Analysis and Quality Control for Fruit and Vegetable Products", 2nd Edition, Tata McGraw Hill, New Delhi, 2008.
3.	Sadasivam S. and Manickam A., "Biochemical Methods", 3rd Edition, New Age International, New Delhi, 2018.
4.	http://vlab.amrita.edu/?sub=3&brch=63&sim=158&cnt=1

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 analyze and estimate macro and micronutrients in food products	Evaluating(K5), Precision (S3)
CO2 extract oil and analyze its properties	Evaluating (K5), Precision (S3)
CO3 extract and estimate phytochemicals in food products	Evaluating (K5), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2				3	2		1	2	3
CO2	3	3	3	3	2				3	2		1	2	3
CO3	3	3	3	3	2				3	2		1	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20MNT31 - ENVIRONMENTAL SCIENCE

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3 / 4	MC	2	0	0	0

Preamble	This course provides an approach to understand the various natural resources, ecosystem, bio-diversity, pollution control & monitoring methods for sustainable life and also to provide knowledge and to create awareness for engineering students on biological sciences.

Unit - I	Environmental Studies and Natural Resources:	5

Introduction to Environmental Science – uses, over-exploitation and conservation of forest, water, mineral, food, energy and land resources–case studies

Unit - II	Ecosystem and Biodiversity:	5

Ecosystems: concept and components of an ecosystem -structural and functional features – Functional attributes (Food chain and Food web only). Biodiversity: Introduction – Classification – Bio geographical classification of India- Value of biodiversity – Threats and Conservation of biodiversity - case studies.

Unit - III	Environmental Pollution:	5

Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Role of an individual in prevention of pollution - case studies.

Unit - IV	Environmental Monitoring:	5

Sustainability -three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development - Introduction to EIA - objectives of EIA - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act.

Unit - V	Introduction to Biological Science:	5

Functions of Carbohydrates, lipids, proteins and nucleic acids - Cells and its organelles - plasma membrane, mitochondria and nucleus- Heredity and DNA - organization of DNA in cells - Genes and chromosomes- Cell division -Types of cell division- mitosis & meiosis - Cell cycle and molecules that control cell cycle.

Total: 25

TEXT BOOK:

1.	Anubha Kaushik, and Kaushik C.P., "Environmental Science and Engineering", 6th Multicolour Edition, New Age International Pvt. Ltd., New Delhi, 2018.
2.	Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell J., "Molecular Cell Biology", 4th Edition, Freeman Press, 2000.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., "Environmental Science", Pearson Education, New Delhi, Revised Edition 2019.
2.	Satyanarayan, U.,& Chakrapani, U., "Textbook of Biochemistry",1999 Ed. June 2017

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the various natural resources and role of individual for its conservation	Understanding (K2)
CO2	elaborate the features of ecosystem and biodiversity to find the need for conservation.	Understanding (K2)
CO3	manipulate the sources, effects and control methods of various environmental pollution.	Applying (K3)
CO4	make use of the knowledge of EIA and environmental legislation laws towards sustainability.	Applying (K3)
CO5	explain the functions of carbohydrates, lipids, proteins, nucleic acids, Cells and its organelles	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1					3							
CO2	2	1					3							
CO3	3	2	1				3							
CO4	3	2	1				3							
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	40	35				100
CAT2	25	40	35				100
CAT3	NA						100
ESE	NA						100

*±3% may be varied (CAT 1,2 – 50 marks)

20MAT41 - STATISTICS AND NUMERICAL METHODS
(Common to all Engineering and Technology Branches except ECE, CSE and IT)

Programme & Branch	All BE/BTech branches except ECE, CSE and IT branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	BS	3	1	0	4

Preamble	To impart knowledge in testing of samples, ANOVA and interpolation. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations and solve linear and ordinary differential equations.
Unit - I	**Testing of Hypothesis:** 9+3
Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single proportion and difference of two sample proportions – Z-test for single mean and difference of means – Small sample tests: Student's t-test for testing significance of single mean and difference of means – F-test for comparison of variances – Chi-square test: Test of goodness of fit – Test of independence of attributes.	
Unit - II	**Design of Experiments:** 9+3
Introduction – Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.	
Unit - III	**Solution to Algebraic and Transcendental Equations:** 9+3
Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.	
Unit - IV	**Interpolation, Numerical Differentiation and Integration::** 9+3
Interpolation: Interpolation with equal intervals: Newton's forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. Numerical Differentiation and Integration: Differentiation using Newton's forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule.	
Unit - V	**Numerical Solution of First order Ordinary Differential Equations:** 9+3
Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.	

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan T, Ramachandran T., "Statistics and Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1.	Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.
2.	Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
3.	Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", 7th Edition, McGraw-Hill Education, 2014.
4.	Ravish R. Singh, Mukul Bhatt, "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	apply statistical tests for solving engineering problems involving small and large sample tests.	Applying (K3)
CO2	handle experimental data with the knowledge of ANOVA.	Applying (K3)
CO3	apply various numerical techniques to solve algebraic and transcendental equations	Applying (K3)
CO4	compute intermediate values of given data, numerical derivatives and integral values	Applying (K3)
CO5	obtain the solution of first ordinary differential equations by numerical methods.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3										
CO2	3	2	1	3										
CO3	3	3	2											
CO4	3	2												
CO5	3	3	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT41 - HEAT TRANSFER OPERATIONS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	ES	3	1	0	4

Preamble	The course enable the students to study the phenomena of modes of heat transfer, heat exchangers, evaporators and its application in food processing operations .

Unit - I	Heat transfer Operations and conductions:	9+3

Introduction to Heat transfer Operations: Introduction, Modes of Heat Transfer, role in food processing operations.
Conduction: Fourier's law of heat conduction - One dimensional steady state heat conduction equation for flat plate, composite wall, hollow cylinder, composite cylinder, Thermal Conductivity - effect of temperature on thermal conductivity, Thermal Insulation.

Unit - II	Convection:	9+3

Natural and forced convection– Application of dimensional analysis for convection - Equations for forced and natural convection under laminar, transition and turbulent conditions. Individual and overall heat transfer coefficients and its relationship between them. Unsteady state heat transfer. Introduction to Fins.

Unit - III	Radiation:	9+3

Black body concept - Radiation Properties–Stefan Boltzmann's law, emissivity and absorptivity. Concept of grey body – radiation between non-black surfaces –parallel planes, radiation shields.

Unit - IV	Heat Exchangers:	9+3

Parallel and counter flow heat exchangers - LMTD - Heat exchangers effectiveness; number of transfer unit – use of correction factor charts - Fouling factor. Types of heat exchanger- working principles and applications: Single pass, multi pass heat exchangers, shell and tube heat exchanger, plate heat exchangers.

Unit - V	Evaporators:	9+3

Types of evaporators – working principle and applications: Single effect evaporators, multiple effect evaporators -Feed forward and feed backward operations, Open pan evaporator, horizontal tube evaporator, vertical tube evaporator, long tube evaporator, forced circulation evaporator.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Gavhane K.A., "Heat Transfer SI Units", 13th Edition, Nirali Prakashan Publications, Pune, 2012.

REFERENCES:

1.	Dutta Binay K., **"Heat Transfer Principles and Applications",** 1st Edition, Prentice Hall of India, New Delhi, 2015.
2.	Earle R.L., **"Unit Operations in Food Processing",** 2nd Edition, The New Zealand Institute of Food Science and Technology, 2008. https://www.nzifst.org.nz/resources/unitoperations/index.htm

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	outline the concept of heat conduction	Understanding(K2)
CO2	make use of equations for calculating convective heat transfer coefficients	Applying(K3)
CO3	apply the concepts of radiation to solve heat transfer problems	Applying(K3)
CO4	select a suitable heat exchanger and analyze the performance	Analyzing (K4)
CO5	choose evaporators and infer its performance	Applying(K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1							1	1	1
CO2	3	3	1	2	2							1	2	1
CO3	3	3	1	2	1							1	1	1
CO4	3	3	2	2	2							1	3	2
CO5	3	3	2	2	2							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	20	60				100
CAT3	0	20	50	30			100
ESE	10	20	40	30			100

 * ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT42 - MASS TRANSFER IN FOOD PROCESSING OPERATIONS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Process Calculations	4	PC	3	1	0	4

Preamble	This course provides an insight to the diffusion process and mechanisms of mass transfer. The students will apply the mass transfer concepts to humidification, crystallization, distillation, extraction and leaching.

Unit - I	Mass Transfer Operations and Diffusion:	9+3

Introduction to Mass Transfer Operations: Introduction, Classification and role of mass transfer operations in food processing. Diffusion: Ficks law of diffusion. Steady state molecular and eddy diffusion in gases and liquids. Measurement and prediction of diffusivity of gas and liquids, diffusion in solids. Introduction to unsteady state diffusion. Individual and over all mass transfer co-efficients.

Unit - II	Theories of Mass Transfer and Analogies, Humidification and Crystallization:	9+3

Theories of Mass Transfer and Analogies: Theories of mass transfer: Two Film, penetration- surface renewal. Analogy between heat, mass and momentum transfer: Reynolds, Chilton -Colburn, Taylor- Prandtl, Von-Karman Analogies. Humidification and Crystallization: Adiabatic saturation process and theory of wet bulb temperature - Measurement of humidity - Cooling towers and Spray Chambers. Principles of crystallization. Crystallizers - Types – Applications.

Unit - III	Distillation:	9+3

Vapour-Liquid Equilibria - Raoult's law and deviations from ideality. Methods of distillation: Simple distillation- Rayleigh equation - Flash vaporization- steam distillation- vacuum distillation. Tray and Packed Towers. Design of multistage tray towers for binary systems using McCabe-Thiele method

Unit - IV	Liquid-Liquid Extraction:	9+3

Equilibrium in ternary systems - Solvent selection criteria- equilibrium stage wise contact. Single stage extraction- Multi stage cross current and counter current operations. Extractors - working principle and applications: mixer settlers- packed towers - spray towers- perforated plate towers- rotating disc contactors - pulsed columns

Unit - V	Leaching:	9+3

Solid-liquid equilibrium - single stage leaching - multi stage cross current and countercurrent leaching operations. Leaching equipments – working principle and applications: Bollman extractor- Rotocel extractor- Hildebrand Extractor–Kennedy Extractor - Pachuca tank - Dorr agitator.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Anantharaman N., Meera Sheriffa Begam K.M., **"Mass Transfer Theory and Practice",** 1st Edition, PHI Publications, New Delhi, 2011

REFERENCES:

1.	Treybal R.E., **"Mass Transfer Operations"**, 3rd Edition, McGraw Hill, New York, 2012.
2.	Smith P.G., **"Introduction to Food Process Engineering"**, 2nd Edition, Springer, New York, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify, explain and model the diffusion in gas, liquid and solid	Understanding(K2)
CO2	explain and make use of the concepts of humidification and crystallization	Applying (K3)
CO3	summarize various distillation processes and determine equilibrium stages in distillation tower	Evaluating (K5)
CO4	select suitable solvent and extraction equipments	Applying (K3)
CO5	illustrate the principle and operation of leaching equipments and make use of leaching calculations	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1								1	1
CO2	3	3	2	2	1							1	2	2
CO3	3	3	3	3	3							1	3	2
CO4	3	3	3	3	2							1	3	2
CO5	3	3	3	3	2							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	50	10	0	0	100
CAT2	10	20	50	10	10	0	100
CAT3	20	30	40	10	0	0	100
ESE	15	25	45	10	5	0	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT43 - FOOD MICROBIOLOGY

ogramme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	PC	3	0	0	3

Preamble	To get in depth knowledge in microbiology basics, identification and incidence of microbes in food, spoilage, diseases and its control.

Unit - I	9

Introduction: Origin and Scope of Microbiology- History-Contribution by scientists. Three kingdom concept- Whitaker Five Kingdom concept-Classification of Microorganisms- Prokaryotes and Eukaryotes. Structure, reproduction and importance of bacteria, virus, fungi and algae in foods

Unit - II	9

Classification and Identification: Classification of microbes based on nutritional requirements. Staining techniques- Simple staining, Differential staining, Special Staining. Culture media- types of media. Pure culture techniques- Cultivation, maintenance and preservation of media. Growth curve.

Unit - III	9

Incidence of Microorganisms: Primary sources of microbes in food, Parameters influencing the growth of microorganisms in food-Intrinsic and Extrinsic. Microbial Load assessment: SPC, MPN, DMC, Dye Reduction test, ATP measurement. Immunological methods: PCR, Fluorescent Antibody, ELISA.

Unit - IV	9

Microbial spoilage and its control: Types of food spoilage, Microbial spoilage of different types of foods– fruits and vegetables, meat and meat products, bakery products, dairy products, fermented foods and canned foods. Control of microorganisms: Physical agents, Chemical agents and their mode of action. Role of antibiotics

Unit - V	9

Food Borne Diseases and Quality Control: Gastroenteritis, Listeriosis, Salmonellosis, Shigellosis, Vibriosis, Campylobacteriosis. Food toxins – Aflatoxin, Ochratoxin, Patulin, Botulin. Indicators of food product quality- Coliform bacteria- Indicators of food safety. Microbiological criteria for foods.

Total: 45

TEXT BOOK:

1.	James M. Jay, Martin J. Loessner, David A. Golden, "Modern Food Microbiology", 7th Edition, Springer, Boston, MA, USA,2005.
2.	Frazier W.C., Westhoff D.C. and Vanitha N.M., "Food Microbiology", 5th Edition, Tata McGraw Hill, New Delhi, 2014.

REFERENCES:

1.	Pelczar M.J., Chan E.C.S. and Krieg N.R., "Microbiology", 5th Edition, Tata McGraw Hill, New York, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	recall the historical developments in microbiology and to classify microorganisms	Remembering (K1)
CO2	outline the appropriate techniques to identify and cultivate microorganisms	Understanding(K2)
CO3	review the importance of microorganisms in foods and to assess microbial load	Understanding(K2)
CO4	identify microbial spoilage in different foods and recommend control measures	Applying (K3)
CO5	infer the food borne diseases and quality control of foods	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1										1	1
CO2	3	2	2		2								2	2
CO3	2	2	3										2	3
CO4	3	3	3		2								1	3
CO5	2	2	2										1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	25	15			100
CAT2	20	40	25	15			100
CAT3	25	40	20	15			100
ESE	20	40	30	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY
(Common to all BE/BTech Engineering and Technology branches)

Prog. & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	3 /4	HS	0	0	2	1

Preamble:	This course is designed to impart required levels of fluency in using the English Language at B1/B2 level in the CEFR through activities, hands-on training and application.	
Unit -I	**Listening:**	**6**

Techniques for effective listening and note taking; listening to audio scripts, podcasts and TED talks; listening to discourse samples of native speakers and imitating; improving pronunciation; introduction to the basics of phonetics and understanding different accents.

Unit -II	**Reading:**	**6**

Speed reading skills; reading to gain knowledge; reading newspaper articles to improve writing; academic journals to enrich vocabulary and word power; reading aloud with proper stress and intonation; reading to draw inferences.

Unit -III	**Soft Skills:**	**6**

Importance of soft skills at workplace - understanding soft skills through case studies - developing positive attitude; goal setting; time management; team work; telephone etiquette; developing professionalism, interpersonal skills and work ethics.

Unit -IV	**Writing:**	**6**

Introduction to pre-writing, style and mechanics of writing; mind mapping; creating content from an outline; paragraph and resume writing; nuances of academic writing; writing Statement of Purpose (SOP), editing, revising and proof reading for clarity and readability; structural and grammatical accuracy.

Unit -V	**Speaking:**	**6**

Verbal and non-verbal communication; fluency and spoken English; introducing oneself and others; making presentations on topics using prepared material; mock interviews; dynamics of Group Discussion.

List of Exercises / Experiments :

1.	Mock Interview
2.	Presentation
3.	Reading Aloud
4.	Group Discussion
5.	Soft Skills through Case Studies
6.	Listening Test

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Jeff Butterfield, "Soft Skills for Everyone", 1st Edition, Cengage Learning, New Delhi, 2011.
2.	Bob Dignen, Steve Flinders and Simon Sweeney, "Professional English for Work and Life, English 365, Student's Book 2", 1st Edition, Cambridge University Press, New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	acquire effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2:	acquire and demonstrate appropriate professional skills for the workplace	Applying (K3), Naturalization (S5)
CO3:	speak fluently and write meaningfully in English in the given context	Applying (K3), Articulation (S4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									2	3		2		
CO2									2	3		2		
CO3									3	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTL41 – HEAT AND MASS TRANSFER LABORATORY

Programme & Branch	B.TECH. – Food Technology		Sem.	Category	L	T	P	Credit
Prerequisites	Nil		4	PC	0	0	2	1
Preamble	To impart practical knowledge on heat and mass transfer that is required for process industries.							

List of Exercises / Experiments :

1.	Estimation of individual heat transfer coefficient under Natural/Forced convection heat transfer
2.	Determination of Stefan Boltzman constant for radiation heat transfer
3.	Estimation of individual and overall heat transfer coefficient for heat transfer in shell and tube heat exchanger
4.	Estimation of individual and overall heat transfer coefficient for heat transfer in agitated vessel
5.	Estimation of individual heat transfer coefficient for heat transfer through bare tube heat exchanger
6.	Verifying the Raleigh's equation for the given system using simple distillation setup
7.	Determination of vaporization efficiency (E_v) and thermal efficiency (E_t) of the given system using steam distillation setup
8.	Determination of the diffusivity of given liquid to air
9.	Studying the theoretical and actual recovery of solvent using leaching and Estimation of oil recovery using Expeller
10	Determine % recovery of the overhead and bottom products of methanol water system under total reflux conditions of Packed column Distillation
11	Virtual Lab: Demonstration of thermal Conductivity of a material

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	McCabe W.L., Smith J.C., and Harriot P. "Unit Operations of Chemical Engineering". 7th Edition, McGraw Hill, New York, 2005.
3.	Perry Robert. "Perry's Chemical Engineers Hand book". 8th Edition, McGraw Hill, New York, 2007.
4	Treybal. R.E. "Mass Transfer Operations".3rd Edition, McGraw-Hill, New York, 1981.
5.	Amirtha virtual lab tool :https://vlab.amrita.edu/

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	estimate heat transfer coefficient for heat exchangers	Evaluating K5, Precision S3
CO2	determine Stefan Boltzmann constant and diffusivity coefficient	Evaluating K5, Precision S3
CO3	evaluate the process/performance parameters for distillation, extraction, and leaching	Evaluating K5, Precision S3

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2				3	2		1	3	2
CO2	3	3	3	3	2				3	2		1	3	2
CO3	3	3	3	3	2				3	2		1	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTL42 - FOOD MICROBIOLOGY LABORATORY

Programme& Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	PC	0	0	2	1
Preamble	To identify and characterize microbes associated with foods and to enumerate it.						

List of Exercises / Experiments :

1.	Study experiments on microbiology lab equipment's and safety practices
2.	Identification of microorganisms by Simple staining technique
3.	Identification of microorganisms by Gram staining technique
4.	Preparation of different culture media and microbial isolation using serial dilution technique
5.	Cultivation and enumeration of microorganisms using different plating method(Pour/Spread/Streak)
6.	Enumeration of microorganisms in spoiled bakery and confectionery products
7.	Microbial examination of blanched / pasteurized / sterilized/refrigerated / frozen foods
8.	Assessing the load of coliform bacteria as an indicator microorganism using MPN method
9.	Biochemical characteristics of microorganisms using IMViC test
10.	Antibiotic sensitivity for microorganisms
11.	Virtual lab: simple staining, gram staining, serial dilution, plating techniques, IMViC test

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	James G. Cappuccino, Natalie Sherman, " Microbiology A Laboratory Manual", 10th Edition, Pearson Education, NewYork, 2014.
3.	McLandsborough L., "Food Microbiology Laboratory", 1st Edition, CRC Press, US, 2004.
4	http://www.amrita.edu/create

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the morphology of microorganisms by different staining technique	Applying (K3), Precision (S3)
CO2	isolate the microorganisms from different food stuffs	Applying (K3), Manipulation (S2)
CO3	characterize the microorganisms using different methods	Analyzing(K4), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1				3	2		1	1	3
CO2	3	3	2	2					3	2		1	1	3
CO3	3	3	2	2	2				3	2		2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20GET31 - UNIVERSAL HUMAN VALUES
(Common to All BE/BTech branches)

Programme & Branch	All BE/BTech Engineeirng & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3 / 4	HS	2	0	0	2

Preamble	To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly

Unit - I	Introduction:	6

Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding.

Unit - II	Harmony in the Self and Body:	6

Human Being and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body.

Unit - III	Harmony in the Family and Society:	6

Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour.

Unit - IV	Harmony in Nature and Existence:	6

Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence.

Unit - V	Implications of the above Holistic Understanding of Harmony on Professional Ethics:	6

Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics.

Total: 30

TEXT BOOK:

1. Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excell Books Pvt. Ltd., New Delhi, 2016.

REFERENCES:

1. Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2. Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	restate the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	Applying (K3)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self, the Co–existence of Self and Body	Applying (K3)
CO3	infer the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society	Applying (K3)
CO4	transform themselves to co-exist with nature by realising interconnectedness and four order of nature	Applying (K3)
CO5	distinguish between ethical and unethical practices, and extend ethical and moral practices for a better living	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3	3	3				
CO2						3	3	3	3	3				
CO3						3	3	3	3	3				
CO4						3	3	3	3	3				
CO5						3	3	3	3	3				

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
CAT3	NA						
ESE	NA						

* ±3% may be varied (CAT 1, 2 – 100 marks)

20FTT51 - FOOD PROCESS ENGINEERING – I

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PC	3	1	0	4

Preamble	The course provides knowledge on basic unit operations such as post harvest processing, size reduction, mechanical separation, mixing and extrusion in food processing.

Unit - I	Pre-Processing Operations:	9+3

Post-harvest losses in field crops – Cleaning - Peeling - Grading and Sorting - Principles, types and equipment's. Moisture content – free moisture, bound and unbound moisture. Equilibrium moisture content - determination methods, models - Hysteresis effect. Water activity.

Unit - II	Size Reduction:	9+3

Fibrous foods, Dry foods and Liquid foods – Calculation of Energy Used in Grinding. New Surface Formed by Grinding. Grinding and Cutting equipment's - Crushers, Hammer mills, Fixed head mills, Ball mills, Plate mills and Roller mills. Cutters - Slicers, Dicers, Shredder and Pulper. Size reduction in liquids

Unit - III	Mechanical Separation:	9+3

Sedimentation in liquids - Gravitational sedimentation – Floatation -Sedimentation of particles in gas. Centrifugal separation – Velocity of particles – Radius of neutral zone – Measurement- Equipment's. Filtration – Constant rate and Constant pressure filtration – Area calculation- Equipment's, Sieving effectiveness and Applications

Unit - IV	Mixing:	9+3

Characteristics of mixtures. Measurement of mixing - sample size, sample composition. Particle mixing and Liquid Mixing - mixing index. Mixing of different quantities. Rate of Mixing and Energy Input in Mixing. Mixing equipment's - Liquid Mixers, Powder and Particle Mixers, Dough and Paste Mixers.

Unit - V	Extrusion and Material Handling:	9+3

Theory - Rheological properties and Operating Characteristics. Single and Twin screw extruders - Ancillary Equipment's. Applications and Effects on Foods. Types of handling and conveying system for food products - Belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Fellows P.J., "Food Processing Technology: Principles and Practice", 3rd Edition, Woodhead Publishing Ltd, New Delhi, 2009.

REFERENCES:

1.	Earle R.L., "Unit Operations in Food Processing", 2nd Edition, Pergamon Press, U.K., 2004.
2.	Paul Singh R. and Dennis R. Heldman, "Introduction to Food Process Engineering", 5th Edition, Academic Press, USA, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify appropriate pre-processing operations and determine the moisture characteristics of food products	Applying (K3)
CO2	select suitable size reduction equipment for food materials	Applying (K3)
CO3	appraise the mechanical separation in food processing stages in distillation tower	Evaluating (K5)
CO4	determine the characteristics of the mixtures to select appropriate mixing equipment	Evaluating (K5)
CO5	examine the process of extrusion and select suitable material handling systems	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								1	2	1
CO2	3	3	2	2								1	2	1
CO3	3	3	2	3								1	2	1
CO4	3	3	2	3								1	2	1
CO5	3	3	2	2								1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	40				100
CAT2	8	16	24	36	16		100
CAT3	8	16	24	36	16		100
ESE	16	20	18	36	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT52 - FOOD PROCESS ENGINEERING - II

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Heat Transfer Operations	5	PC	3	0	0	3

Preamble	To impart knowledge of drying, heating and cooling as preservation techniques in food processing.	
Unit - I	**Drying:**	**9**

Theory and mechanism of drying - Drying characteristics of materials. Psychrometric chart –applications. Thin layer and deep bed drying. Methods of drying agricultural materials - batch and continuous drying. Drying equipment design and performance of various drying equipment.

Unit - II	**Types of Dryers:**	**9**

Tunnel Dryer, Belt Dryer, Drum Dryer, Spray Dryer, Fluidized Bed Dryer, Spouted bed dryer, Pneumatic Dryer, Rotary Dryer, Vacuum Drying, Freeze Drying. Dielectric drying, IR drying and Micro wave drying.

Unit - III	**Preservation by Heating:**	**9**

Methods of applying heat to food - Blanching, Pasteurization, Sterilization. Thermal death time relationships (D, Z and F values). Process calculations: General method, Ball's formula method. Sterilization – methods and equipments. UHT sterilization. Retort processing

Unit - IV	**Preservation by Cooling:**	**9**

Chilling - Equipments, Cold storage. Freezing - Thermodynamics of food freezing, Phase diagrams, Ice crystals formation, Properties of frozen foods. Freezing time calculations, Freezing equipments. Freeze concentration.

Unit - V	**Non thermal Preservation:**	**9**

High Pressure Processing – Principles & Equipments. Pulsed Electric Fields – Mechanism and treatment system. Ultrasound – Fundamentals, Preservation and processing tool. Irradiation – Fundamentals and Biological effects. Hurdle Technology. Ohmic Heating – Fundamentals and Generic configurations.

Lecture : 45

TEXT BOOK:

1. Fellows P.J., "Food processing Technology: Principles and Practice", 3rd Edition, Woodhead Publishing Ltd., New Delhi, 2009.

REFERENCES:

1. Sahay K.M. and Singh K.K., "Unit Operations of Agricultural Processing", 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
2. Da-Wen Sun, "Emerging Technologies for Food Processing", 2nd Edition, Elsevier Academic Press, London, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the drying mechanism of food materials	Understanding (K2)
CO2	classify and select suitable dryers for food materials	Analyzing (K4)
CO3	compare different thermal preservation techniques for food materials	Analyzing (K4)
CO4	examine low temperature processing as a preservation techniques	Analyzing (K4)
CO5	recommend suitable non thermal preservation techniques for food materials	Evaluating (K5)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									1	2	2
CO2	3	2	2									1	2	2
CO3	3	2	3									1	2	2
CO4	3	2	3									1	2	2
CO5	3	2	3									2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	40	20			100
CAT2	12	20	40	28			100
CAT3	8	16	24	36	16		100
ESE	20	20	20	30	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT53 - FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	0	0	3

Preamble	To help the students to learn about the physiology, pre-processing, postharvest storage and various products of fruits and vegetables

Unit - I	Physiology and Pre-processing of fruits and vegetables:	9

Scope of Fruits and Vegetables Processing Industry in India and World-present status – constraints-prospects Classification of fruits and vegetables. Composition and nutrition aspects. Pre harvest and post-harvest changes. Concept of maturity indices-Factors leading to deterioration of fruits and vegetables. Methods to reduce post-harvest losses. Pre-processing of fruits and vegetables: Precooling, Cleaning, washing, sorting, grading peeling, blanching.

Unit - II	Post-harvest storage methods and Preservation Techniques:	9

Ambient conditions. Application of refrigeration concept in post-harvest storage, Freezing methods-Air Blast Freezer, Immersion Freezer, Cryogenic Freezer. Hypobaric Storage, CAS. Irradiation, Waxing. Trends in Packaging fresh produce-MAP, Inert and Vacuum Packaging. Concentration-freeze drying –osmotic dehydration, brining, syruping, canning.

Unit - III	Processing Technology of fruits and fruit beverages:	9

Unit operations involved in Juice preparation-equipments-screw type juice extractor, pulper, pressing, Rack and cloth press, Hydraulic Press, Filters, clarification and concentration by membranes. Classification of fruit juices- Squash, cordial, nectar, RTS. IMF products -Jam, Jelly, marmalade, candied preserves.

Unit - IV	Processing Technology of vegetable products:	9

Preparation and processing parameters of vegetable wafers, soup powders, pulp, puree, pastes, sauces, ketchups, chutneys. Preparation of various types of pickles. Dehydrated vegetable and leafy products. Processing parameters of mushroom and baby corn. Crystallized fruit, glazed fruit, fruit toffee, fruit powders, fruit leather and tutti-frutti.

Unit - V	Hurdle Technology, Minimally Processed Fruits and Vegetables, Edible Coating:	9

Types of hurdle, aspects of hurdle technology, stress- effect on fresh produce , shelf stable products. Factors affecting the shelf life and the quality of the minimally processed fruits and vegetables, physiology and biochemistry of the fresh cut fruits and vegetables. Processing, quality parameters and biochemical changes in the final quality of the fresh produce.

Total:45

TEXT BOOK:

1.	Srivastava R.P & Sanjeev Kumar, "Fruit and Vegetable Preservation: Principles and Practices", 3rd Edition, CBS Publishers & Distributors, New Delhi, 2014.

REFERENCES:

1.	S. Rajarathnam and R.S. Ramteke. "Advances in Preservation and Processing Technologies of Fruits and Vegetables", 1st Edition, New India Publishing Agency, New Delhi, 2011.
2.	U.D. Chavan and J.V. Patil., "Industrial Processing of Fruits and Vegetables", 1st Edition, Astral International Pvt. Ltd., New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret physiological and biochemical changes in fruits and vegetables	Understanding (K2)
CO2	select suitable storage and preservation techniques for fruits and vegetables	Applying (K3)
CO3	apply different technology to process fruits into different fruit products	Applying (K3)
CO4	make use of techniques to process different vegetable products and other speciality products	Applying (K3)
CO5	interpret techniques involved in hurdle technology and minimal processing	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											3	1
CO2	3	2	1										3	1
CO3	3	2	1	1									3	1
CO4	3	2	1	1									3	1
CO5	2	1											3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	25	40	35				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTL51 - FOOD PROCESS ENGINEERING LABORATORY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Heat Transfer Operations	5	PC	0	0	2	1

List of Exercises / Experiments :

1.	Determination of size, roundness, sphericity and 1000 grain weight of food grains.
2.	Determination of bulk density, true density and porosity.
3.	Determination of angle of repose for grain sample.
4.	Determination of co efficient of friction for grain sample.
5.	Experiment on paddy dehusker to determine the shelling efficiency.
6.	Determination of conveying efficiency and power requirement of different conveyor.
7.	Determination of separation efficiency of inclined belt separator.
8.	Experiment on analysis of particle size distribution using hammer mill and ball mill.
9.	Experiment on sedimentation
10	Experiment on drying characteristics of food material using different dryers.
11	Experiment on different types of peeling
12.	Demonstration experiment on dry heating (Flaking,Puffing,Popping)

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Margarida Vieira and Peter Ho, "Experiments in Unit Operations and Processing of Foods", 1st Edition Springer Science & Business Media, New York, 2008.
3.	Rao M. A. and Rizvi S.S.H., Engineering Properties of Foods, 4th edition, CRC Press, New York, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 assess the performance of agro processing equipment	Evaluating(K5),Precision(S3)
CO2 determine the effectiveness of size reduction equipment	Evaluating(K5),Precision(S3)
CO3 interpret the drying characteristics of food materials using different dryers	Evaluating(K5),Precision(S3)

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1	2	2
CO2	3	3	2	1								1	2	2
CO3	3	3	2	1								1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

20FTL52 – FRUITS AND VEGETABLES PROCESSING TECHNOLOGY LABORATORY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	0	0	2	1

List of Exercises / Experiments :

1.	Study the effect of blanching treatment on the fruits and vegetables.
2.	Estimation of efficiency of screw press extractor and pulper.
3.	Development and analysis of squash and sauce
4.	Preparation of fruit bar and fruit toffee and study on its shelf life characteristics.
5.	Formulation of jams and comparison with commercial product.
6.	Formulation of jellies / marmalade and comparison with commercial product.
7.	Estimation of bursting strength of packaging materials
8.	Determination of tear resistance of packaging materials
9.	Determination of tensile strength of different packaging materials
10.	Estimation of water absorption capacity and water vapour permeability of different packaging materials

11.	Virtual Laboratory Experiments
	    a. Osmotic Drying of foods – Experimentation
	    b. Oxygen and carbon dioxide in modified atmospheric packed food

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	FSSAI Manual of Methods of Analysis of Foods Fruit and Vegetable Products, 2016
3.	Gordon L. Robertson, "Food Packaging and Shelf Life: A Practical Guide", CRC Press, USA, 2009.
4.	http://www.rpaulsingh.com/learning/virtual/virtual.html

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 assess the changes occurred during fruits and vegetables blanching and also estimate the efficiency juice extraction equipment.	Evaluating(K5)
CO2 prepare and characterize fruit/vegetable based products	Evaluating(K5)
CO3 evaluate mechanical and water barrier properties of packaging materials	Evaluating(K5)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1							2	3	2
CO2	3	3	3	2	3							2	3	2
CO3	3	2	2	2	2							2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTL53 - FOOD PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY

Programme& Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PC	0	0	2	1

List of Exercises / Experiments:

1.	Studies of symbols and materials used for design and drawing.
2.	Design and drawing of pipes and fittings.
3.	Design and drawing of storage vessel.
4.	Design and drawing of agitated vessel.
5.	Design and drawing of double pipe heat exchangers.
6.	Design and drawing of shell and tube heat exchangers.
7.	Design and drawing of plate heat exchanger.
8.	Design and drawing of single effect evaporator.
9.	Design and drawing of cyclone separators.
10.	Design and drawing of rotary drier/spray drier
11.	Demonstration experiment on design and drawing of a food plant layout

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Dawande S.D., "Process Equipment Design Volume 1 and 2", 5th Edition, Denett and Company, India, 2015.
3.	Joshi M.V. and Mahajan V.V., "Process Equipment Design", 4th Edition, MacMillan India, New Delhi, 2009.
4.	Perry R.H. and Green D.W., "Chemical Engineers Handbook", 8th Edition, McGraw-Hill, New York, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design the vessels and fittings required for food process operations	Applying (K3), Precision(S3)
CO2	design the heat exchangers and evaporators	Applying (K3), Precision(S3)
CO3	design the separating and drying equipment	Applying (K3), Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1				3	2		1	2	2
CO2	3	2	3	2	1				3	2		1	3	2
CO3	3	2	3	2	1				3	2		1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20GEL51 - PROFESSIONAL SKILLS TRAINING- I
(Common to all BE/ BTech / MSc / MCA /BSc Branches)

Programme & Branch	B.TECH- FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	EC	0	0	0	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – I**	**20**

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners- Telephone etiquette- Body Language.

Unit - II	**Quantitative Aptitude & Logical Reasoning - I**	**30**

Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement

Unit - III	**Written Communication & Verbal Aptitude**	**30**

Writing Skills: Writing strategies and formats – Importance of Résumés – Writing a Cover letter – Writing a fresher's CV / Résumés – Responding to Job Advertisements – Professional e-mail Writing – Responding to e-mails and business letters – Technical Report writing – Interpretation of Technical Data (Transcoding) – Writing One-page Essays. Verbal Aptitude – Synonyms – Antonyms – Homonyms – One word substitution – Idioms and Phrases – Paired words – Analogies – Spelling test – Cloze test – using suitable verb forms – using appropriate articles and prepositions; Spotting Errors – Sentence Correction and Formation – Grammar Based questions (Transformation : Active-Passive & Direct-Indirect); Rearranging Jumbled Sentences & Jumbled paragraphs, Identifying Facts, Inferences and Judgements statements.

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Bailey Stephen, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2	Raman, Meenakshi and Sharma, Sangeeta, "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT61 - DAIRY TECHNOLOGY

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry, Food Microbiology	6	PC	3	0	0	3

Preamble	To provide exposure to variety of technical operations in milk and milk product processing industry and helps students discover their own professional directions for future development in dairy sector.	
Unit - I	**Physical chemistry of milk:**	**9**
Milk - Definition, Types of market milk, Composition of milk, Factors affecting composition, Properties of milk: Colour, Flavour, Specific Gravity, Boiling point, Freezing point, Acidity and pH, Viscosity		
Unit - II	**Collection, reception and pre-processing of raw milk:**	**9**
Practices for collection of raw milk, Raw milk shelf life extension systems, Cooling and transportation of raw milk, Platform tests of raw milk, Reception of raw milk, Filtration and Clarification of raw milk, Bactofugation of raw milk, Cooling and storage of raw milk		
Unit - III	**Unit operations of milk processing:**	**9**
Milk Standardization, Cream Separation, Milk Homogenization, Milk Pasteurization: HTST and LTLT pasteurization, Milk Sterilization, UHT Processing of milk, Packaging systems of milk: pouch filling, bottle filling, aseptic filling systems, Good Hygiene Practices (GHP) during milk production operations.		
Unit - IV	**Quality assurance of dairy products:**	**9**
Adulterants in milk and their detection, Defects in market milks, Defects in fat-rich products, Defects in concentrated milks, Defects in frozen dairy products, Defects in coagulated products, Defects in fermented products. Legal standards for milk and milk products		
Unit - V	**Cleaning and sanitization of dairy equipment:**	**9**
Aspects of cleaning: Trade obligations, moral obligations, legal obligations, Cleaning agents and methods, CIP flow system, types of CIP system: Centralized CIP system and decentralized CIP system, CIP cycle of equipments: silo, tanker, pasteurizer, Sanitizing agents and methods, Assessment of effectiveness of cleaning and sanitization..		

Total:45

TEXT BOOK:

1.	Sukumar De, "Outlines of Dairy Technology", 1st Edition, Royal Oxford University Press, New Delhi, 2001.

REFERENCES:

1.	Hui,Y.H, "Dairy Science and Technology Handbook: Applications Science, Technology and Engineering", 3rd Edition, Wiley, New Delhi, 2014.
2.	Bylund, G, "Dairy Processing Handbook", 1st Edition, Tetra Pak Processing Systems AB, Bylund, G., "Dairy Processing Handbook" 1st Edition, Tetra Pak Processing Systems AB, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the physico-chemical properties of milk	Understanding (K2)
CO2	apply the acquired knowledge of raw milk collection, transportation and reception in practical scenarios	Applying (K3)
CO3	infer the technical aspects of unit processing operations of milk	Understanding (K2)
CO4	identify defects in milk and milk products	Applying (K3)
CO5	choose suitable cleaning operations in dairy industry	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2			1						1	1	1
CO2	3	2	2		1	2						2	2	3
CO3	3	2	3		2	2						2	3	3
CO4	3	2	3		1	3		1				2	2	3
CO5	3	2	2		2	3						2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

20FTT62 - BAKING AND CONFECTIONERY TECHNOLOGY

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry	6	PC	3	0	0	3

Preamble	To provide insight knowledge about the different raw materials, equipment and products of bakery and confectionery sectors.	
Unit - I	**Science Behind Baking:**	**9**
Classification of bakery products. Bakery Ingredients-Testing of raw materials and functions - flour, yeast, sugar, fat, egg, water, salt, coloring agents, flavoring agents, milk, milk powder, emulsifiers, leaveners, antioxidants and improvers.		
Unit - II	**Equipments in Bakery Industry and Rheology of dough:**	**9**
Handling of ingredients- dough mixers, dividers, rounder, sheeter, laminating equipments, fermentation enclosures and brew equipment, ovens and slicers. Farinograph, Amylograph, Alveograph, and Extensograph.		
Unit - III	**Bread Making Process and Cake making:**	**9**
Chemistry of Dough Development. Bread making methods- Straight dough/bulk fermentation, Sponge and dough, Activated dough development, Chorleywood bread process, No time process. Characteristics of good bread- Internal and external characters. Bread defects/faults and remedies. Spoilage of bread. Cake making ingredients and their function. Methods for different types of cakes manufacture.		
Unit - IV	**Biscuit making and Confectionery:**	**9**
Ingredients and their functions. Types of biscuit dough – Developed dough, short dough's, semi-sweet, enzyme modified dough and batters. Biscuit manufacturing process, Wafers, puff pastry, chemically leavened bakery products. Classification of confectionery Products – Ingredients-Basic Technical considerations in sugar based confectionery		
Unit - V	**Confectionery Products:**	**9**
Composition and manufacturing process- Sugar boiled products-Candy, Toffees, fudge, caramel, aerated confectionery. Bubble gums and chewing gums. Chocolate Processing –chocolate shells, candy bars. Fruit confections. Confectionery product quality parameters, faults and corrective measures. Spoilage of confectionery products.		

Total:45

TEXT BOOK:

1.	Yogambal Ashok kumar, "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.

REFERENCES:

1.	Weibiao Zhou and Y. H. Hui, "Bakery Products Science and Technology", 2nd Edition, Wiley Blackwell, US, 2014.
2.	Ferenc A. Mohos, "Confectionery and Chocolate Engineering: Principles and Applications", 1st Edition, Wiley Blackwell, UK, 2010.
3.	Samuel A. Matz, "Bakery Technology and Engineering", 3rd Edition, Springer, US, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	outline the role of ingredients in bakery industry	Understanding (K2)
CO2	select appropriate equipment for baking process and relate the rheological properties of dough	Applying (K3)
CO3	identify and apply processing techniques for bread and cake manufacturing process	Applying (K3)
CO4	illustrate the processing techniques for preparation of miscellaneous bakery products and summarize the role of confectionery ingredients	Understanding (K2)
CO5	apply the processing techniques to formulate different confectionery products	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		2						1	2	1
CO2	3	2	1	1		1						2	3	2
CO3	3	3	3	3		2						2	3	2
CO4	3	3	3	3		2						2	3	2
CO5	3	3	3	3		2						2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40				100
CAT2	30	40	30				100
CAT3	20	40	40				100
ESE	30	35	35				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT63 - FOOD QUALITY AND SAFETY

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	0	3

Preamble	To give insight on food quality, safety and its regulatory standards.	
Unit - I	**Food quality and safety:**	**9**

Quality and Safety concepts. Characterization of food hazards – physical, chemical and biological. Food spoilage and food borne infection –sources of food spoilage- microbial aspects in food safety-food toxicants and food poisoning –prevention. Cross contamination.

Unit - II	**Quality Assurance and Safety operations in Food industry:**	**9**

Objectives, importance and functions of quality control and quality assurance. Quality Control and Assurance procedures, HACCP, Good Manufacturing Practice, Good Laboratory Practices, Good Hygiene Practices.

Unit - III	**Sampling and Statistical Quality Control:**	**9**

Sampling- concept, methods and importance. Statistical Process and Quality Control – concept, importance and tools. Control charts: importance, types, design process, Control limits and errors, Process Capability.

Unit - IV	**Quality and Safety Standards:**	**9**

Quality Standards – mandatory and optional standards. Mechanism of developing and fixing food standards. Food Safety Systems – ISO 22000, FSSC 22000. National organizations: BIS, CCFS, AGMARK and APEDA. Standards of Weights and Measures. Organic food certification-POP, NPOP. International organizations: ISO, CAC, WTO, USFDA, EIC.

Unit - V	**Regulations for Food Business Operator:**	**9**

Food adulteration and food safety, Food laws – Food Safety and Standards Act (FSSAI), Prevention of Food Adulteration Act, Packaged Commodities Rules, Functions of Food Business Operator, QA Audit, IPR and Patents, Issues affecting consumers and industry – Genetically Modified Foods, Fortification, Pesticide Residues, Organic Foods, Food Additives.

Total:45

TEXT BOOK:

1.	Inteaz Alli, "Food Quality Assurance: Principles and Practices", 2nd Edition, Taylor and Francis, UK, 2014.

REFERENCES:

1.	Schmidt, R.H. and Rodrick, G.E, "Food Safety Handbook", 2nd Edition, John Wiley & Sons Inc, New Jersy, 2005.
2.	Andres Vasconcellos J, "Quality Assurance for the Food Industry: A Practical Approach", 2nd Edition, CRC Press, New York, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the concepts of quality and safety in food processing	Understanding (K2)
CO2	apply principles of quality assurance and safety in food industries	Applying (K3)
CO3	analyze and Categorize sampling and statistical quality control techniques	Applying (K3)
CO4	outline suitable food quality and Safety standards	Understanding (K2)
CO5	make use of various regulations for food business operator	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3			3	1	2				1	1	3
CO2	3	2	3	2		3	1	2				1	1	3
CO3	3	3	3	3	1	3						1	2	3
CO4	3	1	3			3	1	2				2	2	3
CO5	3	2	3			3	1	2				2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTL61 -DAIRY TECHNOLOGY LABORATORY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry, Food Microbiology	6	PC	0	0	2	1

List of Exercises / Experiments :

1.	Studies on titratable acidity and specific gravity of milk.
2.	Estimation of fat and solids-not-fat contents of milk and Analysis of thermal stability of milk.
3.	Detection of adulterants in milk.
4.	Studies on homogenization process of milk.
5.	Studies on standardization process of milk and Development of market milk.
6.	Development of flavoured and fortified milk.
7.	Development of coagulated milk product.
8.	Development of butter by power churn
9.	Development of spray dried milk powder
10.	Studies on Cream Separation from milk.
11.	Virtual lab : Heating milk in a tubular heat exchanger.

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual.
2.	Sukumar De, "Outlines of Dairy Technology", 1st Edition, Royal Oxford University Press, New Delhi, 2001.
3.	Hui,Y.H,, "Dairy Science and Technology Handbook: Applications Science, Technology and Engineering", 3rd Edition, Wiley, New Delhi, 2014.
4.	Bylund, G, "Dairy Processing Handbook" 1st Edition, Tetra Pak Processing Systems AB, 2003.
5.	http://www.rpaulsingh.com/learning/virtual/experiments/heatexchanger/index.html

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 analyze physico-chemical properties of milk	Analyzing (K4),
CO2 infer the technical aspects of raw milk processing	Applying (K3),
CO3 appraise the factors affecting various dairy processes	Evaluating (K5),

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	1		1	3	2		1	2	2
CO2	3	2	2	2	2	1		1	3	2		2	3	3
CO3	3	2	3	2	2	1		1	3	2		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTL62 - BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry	6	PC	0	0	2	1

List of Exercises / Experiments :

1.	Estimation of quality parameters of bakery ingredients.
2.	Estimation of wet and dry gluten content of wheat flour.
3.	Determination of dough rising capacity of yeast.
4.	Estimation of diastatic activity and maltose value of flour
5.	Estimation of water absorption power, alkaline water retention and sedimentation value of flour.
6.	Preparation and analysis of bread.
7.	Preparation and analysis of biscuits and cookies.
8.	Preparation and analysis of cake.
9.	Preparation of sugar boiled and cocoa based confectionery.
10.	Preparation of toffee and fudge.
11.	Virtual Lab: Demonstration on Yeast Fermentation.

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual
2.	Duncan Manley, "Biscuit, Cracker and Cookie Recipes for the Food Industry", 1st Edition, Woodhead Publishing, England, 2001.
3.	Yogambal Ashokkumar, "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
4.	http://www.bch.cuhk.edu.hk/vlab2/animation/fermentation/index.html

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze the quality of flour and other ingredients used for preparation of bakery products	Analyzing (K4), Precision (S3)
CO2	prepare the bakery product and evaluate its properties	Evaluating (K5), Manipulation (S2)
CO3	formulate confectionery products and perform sensory properties	Evaluating (K5), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2		1		1	3	2		2	1	3
CO2	3	2	2	2		1		1	3	2		2	3	2
CO3	3	2	2	2		1		1	3	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20FTL63 - FOOD ANALYSIS LABORATORY

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry	6	PC	0	0	2	1

List of Exercises / Experiments :

1.	Analysis of vegetable oils / Fats.
2.	Analysis of spices (Turmeric / Chilly).
3.	Analysis of Vinegar/ Tea/ Coffee.
4.	Analysis of Jam/Jelly/ Marmalade / Juices.
5.	Analysis of dehydrated vegetables and Fruits.
6.	Analysis of water.
7.	Analysis of salt/ sugar/ Jaggery.
8.	Detection of food Adulteration.
9.	Textural and Colour profile analysis of food material.
10.	Determination of energy value of foods.
11.	Virtual laboratory experiments a. Estimation of minerals by flame photometry – Demo. b. Determining water rehydration in pasta – Experimentation.

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual
2.	Ministry of Health and Family Welfare, "Manual of Methods for the Analysis of Foods", Government of India, New Delhi, 2016.
3.	Sadasivam, S., and Manickam, A, "Biochemical Methods", 3rd Edition, New Age International, Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze various food products	Analyzing (K4), Precision (S3)
CO2	detect adulteration in food samples	Evaluating (K5), Precision (S3)
CO3	determine the textural and color profile of food materials	Evaluating (K5), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	1			1	3	2		2	3	3
CO2	3	2	3	3	1			1	3	2		2	2	3
CO3	3	2	3	3					3	2		2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTP61 - PROJECT WORK I

Programme & Branch	B.TECH. – FOOD TECHNOLOGY				Sem.	Category	L	T	P	Credit
Prerequisites	Nil				6	EC	0	0	4	2

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COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 identify and define the problems that need to be solved	Applying (K3)
CO2 select appropriate literature and frame the objectives	Applying (K3)
CO3 develop/ design value added food products and equipments using research tools and methods	Creating (K6)
CO4 analyze the experimental data and derive the valid conclusion	Analyzing (K4)
CO5 elaborate the project in the form of oral presentation, report and technical paper publications	Creating (K6)

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	Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	2	3	2	3	3	3	3	3	3
CO2	3	2	2	2	3	2	2	2	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	2	3	3	2	2	2	3	3	3	3	2	2
CO5	3	2	2	2	2	2	2	2	3	3	3	3	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20GEL61 PROFESSIONAL SKILLS TRAINING - II
(Common to all BE/ BTech / MSc/ MCA /BSc Branches)

Programme & Branch	B.TECH- FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	EC	0	0	0	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – I**l	**20**

Group discussions: Advantages of group discussions-Structured GD- Team work: Value of team work in organizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Group development activities. Facing an interview: Foundation in core subject- industry orientation / knowledge about the company- professional personality-Communication skills-Activities before Interview, upon entering interview room, during the interview and at the end Mock interviews.

Unit - II	**Quantitative Aptitude & Logical Reasoning - II**	**30**

Problem solving level II: Money related problems-Mixtures-Symbol base problem-Clocks and calendars-Simple-linear-quadratic and polynomial equations-Special, equations-Inequalities-Sequence and series-Set theory-Permutations and combinations-Probability-Statistics-Data sufficiency- Geometry-Trigonometry-Heights and distances-Co-ordinate geometry-Mensuration. Logical reasoning: Conditionality and grouping-Sequencing and scheduling- Selections-Networks:-Codes; Cubes-Venn diagram in logical reasoning- Quant based reasoning-Flaw detection- Puzzles-Cryptarithms.

Unit - III	**Reading & Speaking Skills**	**30**

Reading: Reading comprehension– Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, 2015.
2	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5th edition, Pearson Education, India, 2013.
3	Rizvi, Ashraf M, "Effective Technical Communication," 2nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	Solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	Apply reading and speaking skills effectively for various academic and professional purposes	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	3	3	0	3	0	3	2		
CO2	3	2	0	0	0	3	3	0	3	0	3	2		
CO3	0	2	0	0	0	3	3	0	3	3	3	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20GET71 – ENGINEERING ECONOMICS AND MANAGEMENT
(Common to All BE/BTech Engineering And Technology Branches except Chemical Engineering)

Programme & Branch	B.Tech. & Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	HS	3	0	0	3

Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics,national income, marketing, operations management, accounting principles etc.	
Unit - I	**Micro Economics:**	**9**
Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.		
Unit - II	**Macro Economics, Business Ownership and Management concepts:**	**9**
National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Ownership types. Management concepts: Taylor and Fayol's Principles – Functions of Management - Managerial Skills -Levels of Management - Roles of manager.		
Unit - III	**Marketing Management:**	**9**
Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development – Intellectual Property rights (IPR), ProductLife Cycle - Pricing Strategies and Decisions.		
Unit - IV	**Operations Management:**	**9**
Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning andControl - Inventory - EOQ Determination.		
Unit - V	**Financial Management:**	**9**
Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break EvenAnalysis – Capital Budgeting: Significance –Traditional and discounted cash flow methods.		

Total:45

TEXT BOOK:

1.	Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1stEdition, McGraw Hill Education, Noida, 2013.

REFERENCES:

1.	Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 3rd Edition, McGraw-Hill, New Delhi, 2018.
2.	William J. Stevenson, "Operations Management", 14th Edition, McGraw-Hill Education, 2021.
3.	William G. Nickels, James M. McHugh, Susan M. McHugh, "Understanding Business", 12th Edition, McGraw-Hill Education, NewYork, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	identify market equilibrium and interpret national income calculations and inflation issues	Applying (K3)
CO2	choose a suitable business ownership for their enterprise and illustrate managerial functions	Applying (K3)
CO3	infer marketing management decisions	Understanding (K2)
CO4	apply appropriate operation management concept in business situations	Applying (K3)
CO5	interpret financial and accounting statements and evaluate new proposals	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2	1	2
CO2		1	2			2	2	2	2	2	3	2	1	2
CO3	1	2	1			2		2	2	2	3	2	2	2
CO4	1	2	1			2		2	2	2	3	2	1	2
CO5	2	2				2		2	2	2	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTT71 - FOOD PACKAGING TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PC	3	0	0	3

Preamble	To impart knowledge about basic and recent advancements in food packaging materials, methods and food labeling	
Unit - I	**Basics of Food Packaging:**	**9**
Definitions and basic functions of a food package. Food package design and development. Physical and physico-chemical processes affecting product quality, migration from packaging to foods, predicting the shelf life of foods. Package standards and regulation. Labeling, bar coding.		
Unit - II	**Paper and Paperboard Packaging:**	**9**
Paper and paperboard- manufacture, properties analysis and packaging aspects. Package types – pouches, sacks, cartons, boxes, tubes, tubs, labels, sealing tapes, cap liners and diaphragm etc.		
Unit - III	**Plastic Packaging:**	**9**
Types of plastics used in packaging – PE, PP, PET, PVC, EVOH, PVA. Secondary conversion techniques – film, extrusion and thermal lamination. Printing of plastic films and rigid plastic containers. Natural extracts in plastic food packaging. Food contact and barrier properties. Sealability and closure.		
Unit - IV	**Metal cans:**	**9**
Raw materials for can making –steel, aluminum. Can making processes - three piece welded cans, DWI, DRD cans – end making processes, coating, film laminates and inks, corrosion and sulphur staining. Flash 18 process, retorting equipment. Definition and composition. Glass container manufacture – melting, forming, surface treatments. Closure selection. Glass bottle design and specification.		
Unit - V	**Trends in Food Packaging:**	**9**
Active and intelligent packaging, modified atmosphere packaging - vacuum and inert gas packaging, biodegradable and edible packaging, aseptic packaging, self-heating and cooling cans. Recycling of non-biodegradable packaging materials		

Total:45

TEXT BOOK:

1.	Richard Coles and Mark J. Kirwan, "Food and Beverage Packaging Technology", 2nd Edition, Blackwell Publishing Asia Pvt Ltd, CRC press, USA, 2011.

REFERENCES:

1.	Han Jung H, "Innovations in Food Packaging", 2nd Edition, Academic Press, USA, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer basic concepts in food packaging	Understanding (K2)
CO2	make use of paper and paperboards for various food applications	Applying (K3)
CO3	identify suitable plastic for packaging based on their properties	Applying (K3)
CO4	choose appropriate metal and glass containers for food packaging	Applying (K3)
CO5	select and adapt recent trends in food packaging	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1			2				1	2	2
CO2	3	3	2	1								1	1	3
CO3	3	3	2	1				1				1	1	3
CO4	3	3	2	1								1	1	3
CO5	3	3	2	1	1			1				2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	70	10				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTP71 - PROJECT WORK 2 PHASE- I

Programme & Branch	B.TECH. – Food Technology		Sem.	Category	L	T	P	Credit
Prerequisites	Nil		7	EC	0	0	6	3

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify and define the problems that need to be solved	Applying (K3)
CO2	select appropriate literature and frame the objectives	Applying (K3)
CO3	develop/ design value added food products and equipments using research tools and methods	Creating (K6)
CO4	analyze the experimental data and derive the valid conclusion	Analyzing (K4)
CO5	elaborate the project in the form of oral presentation, report and technical paper publications	Creating (K6)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	2	3	2	3	3	3	3	3	3
CO2	3	2	2	2	3	2	2	2	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	2	3	3	2	2	2	3	3	3	3	2	2
CO5	3	2	2	2	2	2	2	2	3	3	3	3	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTP81 - PROJECT WORK 2 PHASE- II

Programme & Branch	B.TECH. – Food Technology		Sem.	Category	L	T	P	Credit
Prerequisites	Nil		8	EC	0	0	14	7

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify and define the problems that need to be solved	Applying (K3)
CO2	select appropriate literature and frame the objectives	Applying (K3)
CO3	develop/ design value added food products and equipments using research tools and methods	Creating (K6)
CO4	analyze the experimental data and derive the valid conclusion	Analyzing (K4)
CO5	elaborate the project in the form of oral presentation, report and technical paper publications	Creating (K6)

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Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	2	3	2	3	3	3	3	3	3
CO2	3	2	2	2	3	2	2	2	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	2	3	3	2	2	2	3	3	3	3	2	2
CO5	3	2	2	2	2	2	2	2	3	3	3	3	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20FTE01 - FOOD SCIENCE AND NUTRITION

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	**Food Chemistry**	5	PE	3	0	0	3

Preamble	This course will deal about the importance of nutrients and its assimilation, energy balance and nutrition for different age groups

Unit - I	**Food Groups and Nutrition:**	9

Definition, six classes of nutrients, RDA, nutritional status and its assessment, nutritional requirement, malnutrition – over nutrition and under nutrition. Balanced diet: Diet planning principles, dietary guidelines; food groups; Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption and transport of nutrients

Unit - II	**Carbohydrates - Sugars, Starch and Fiber:**	9

Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, recommendations of sugar intake for health, health effects of fiber and starch intake, artificial sweeteners; Nutrition and Diabetes, GTT

Unit - III	**Lipids and Proteins:**	9

Food Sources, Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids - n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Digestion and absorption of proteins; Functions of proteins; amino acids; Protein quality, methods of assessing protein quality; Recommended intakes of proteins; protein and amino acid supplements; Protein Energy Malnutrition - Marasmus and Kwashiorkor.

Unit - IV	**Energy Value, Energy Balance and Body Composition:**	9

Calorific value of foods; basal metabolism, specific dynamic action of foods, Protein efficiency ratio, Net protein utilization, physiological energy value of foods. Energy balance – components – energy intake, energy expenditure, energy requirement. Body composition – Five levels of body composition – body composition techniques. Obesity- BMR and BMI calculations.

Unit - V	**Nutrition for Different Age Groups:**	9

Factors to be considered in meal/menu planning. Pregnancy - nutrition requirements and food selection. Lactation - nutritional requirements. Infancy - nutritional requirements, breast feeding, infant formula. Introduction of supplementary foods. Early childhood. (Toddlers and Preschoolers) - Growth and nutrient needs, nutritional related problems, Feeding Pattern. School children - Nutritional requirements, Importance of snacks, school lunch. Adolescence - Growth, Nutrient needs, food choice, eating habits, factors influencing. Geriatic Nutrition - Factors affecting food intake and nutrients use, nutrient needs, nutrition related problems.

Total:45

TEXT BOOK:

1.	Srilakshmi B, "Nutrition Science", 6th Edition, New Age International Publishers, New Delhi, 2018.

REFERENCES:

1.	Mann Jim and Stewart Truswell (Eds), "Essentials of Human Nutrition", 5th Edition, Oxford University Press, Oxford, 2017.
2.	Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy and Hester H. Vorster, "Introduction to Human Nutrition", 2nd Edition, Wiley Blackwell, UK, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the physiological and metabolic functions of nutrients	Understanding (K2)
CO2	select appropriate carbohydrate diet based on their health effects	Applying (K3)
CO3	identify the lipids and proteins based on their nutritional value	Applying (K3)
CO4	interpret the energy value of foods and body composition and explain the energy balance	Understanding (K2)
CO5	examine nutrition requirement based on different age groups	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1		3							3	1
CO2	3	3	1	1		3							1	3
CO3	3	3	1	1		3					1		1	3
CO4	3	3	1	1		3					1		3	2
CO5	3	3	1	1		3					1		3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30				100
CAT2	20	40	40				100
CAT3	10	40	10	40			100
ESE	20	40	20	20			100

 * ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE02 - TECHNOLOGY OF SNACK AND EXTRUDED FOODS

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PE	3	0	0	3

Preamble	To have a knowledge on different categories of snack products including the process technology.	
Unit - I	**Introduction:**	**9**
Current status of snack food industry in India. Types of snack food – Raw Vegetable Snack, Formed dough products from potato and maize derivatives, Half Products, Directly expanded extruded snack, Puffed Snacks and other. Types and Functions of ingredients – structure forming materials, dispersed phase/filling materials, plasticizers/lubricants, soluble solids, nucleating substances, coloring and flavouring substances.		
Unit - II	**Potato and Rice Based Snacks:**	**9**
Potato Chip - Pre cleaning and peeling, slicing, drying/frying, salting and seasoning, quality control. Fabricated potato snacks – potato flakes, potato granules, potato starch, ground and crushed dehydrated potato. Rice based Snacks – Products using whole grains – Gun puffed rice. Products using flours.		
Unit - III	**Corn Based Snacks:**	**9**
Tortilla chip – Corn soaking and smoking, Grinding, Masa flour, Sheeting and Cutting, Baking and Frying. Popcorn – Popping methods, oil popping and dry popping. Commercial and industrial popcorn process. Flavorings and Applicators.Masa based snacks. Quality control for snack foods.		
Unit - IV	**Extrusion Based Snacks:**	**9**
Extruder types - single and twin screw, single and multiple die extruders. Pre-conditioning of raw materials used in extrusion process. Second generation and Third generation snacks, Co extruded snacks, Breakfast cereals - Type and processing. Texturized vegetable protein - Definition and processing.		
Unit - V	**Pasta Products:**	**9**
Pasta and Precooked pasta - Raw materials. Preparation of raw materials for extrusion and processing. Types of pasta products - Spaghetti, noodles, macaroni and similar products. Dry and frozen pasta products.		

Total: 45

TEXT BOOK:

1.	Edmund W. Lusas and Lloyd W. Rooney, "Snack Food Processing", 1st Edition, CRC Press, Florida, 2001.

REFERENCES:

1.	Robin Guy, "Extrusion cooking: Technologies and Applications", 1st Edition, CRC Press, Florida, 2001.
2.	Panda H, "The Complete Technology Book on Snack Foods", 1st Edition, National Institute of Industrial Research, New Delhi, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify types of snacks and choose appropriate ingredient based on their functionality	Understanding (K2)
CO2	make use of potato and rice for the production of suitable snack foods	Applying (K3)
CO3	select suitable techniques for production of corn based snacks	Applying (K3)
CO4	explain the principles of extruder and processing techniques for extruded foods	Understanding (K2)
CO5	classify pasta products and explain the steps involved in their production	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1									2	3	1
CO2	2	2	2	1								2	3	1
CO3	2	2	2	1								2	3	1
CO4	2	2	2	1								2	3	1
CO5	2	2	2	1								2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	30	50				100
CAT3	30	70					100
ESE	25	30	45				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE03 - NANOTECHNOLOGY IN FOOD PROCESSING

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PE	3	0	0	3

Preamble	To provide knowledge about the synthesis of nano materials, its characterization and applications of nano particles in food processing and food packaging.

Unit - I	Introduction to Nanotechnology:	9

Introduction to Nanotechnology: Introduction to nano particles and nanotechnology, naturally occurring food nano substances, challenges for nutrient nano encapsulation, nano food particles and their bioavailability, designing food nano structures, public perception of nanotechnology food products

Unit - II	Synthesis of Nano Materials:	9

Synthesis of Nano Materials: Introduction to synthesis of nanostructure materials, Bottom-up approach and Top-down approach. Physical methods - ball milling, sputtering, evaporation. Chemical methods - photochemical synthesis, electrochemical synthesis, co-precipitation method. Thermolysis route - spray pyrolysis. Biological methods – bacteria, fungi and actinomycetes.

Unit - III	Nanotechnology in Food:	9

Nanotechnology in Food: Nanoparticles in functional foods, engineered nanoparticles in beverages, nanotechnology in meat processing, nanoemulsion formation, potential applications of milk nanotubes, nano engineered membranes, application of nanoparticles in delivery of flavors and aroma compounds.

Unit - IV	Nanotechnology in Food Packaging:	9

Nanotechnology in Food Packaging: Bionano composites for food preservation, intelligent packaging, high barrier plastics, biodegradable food packaging nanocomposites, bioactive food packaging with nano diamond particles, nano materials incorporated flexible packaging materials for high pressure processing, new approaches in antibacterial food packaging, nano sensors for food quality.

Unit - V	Nanotechnology in Food Safety and Challenges in Nanomaterials Analysis:	9

Nanotechnology in Food Safety and Challenges in Nanomaterials Analysis: Nano technology based rapid detection of chemical and biochemical contents in food, separation of food based pathogens using magnetic nanoparticles, challenges in nano materials analysis, sample pre-treatment methods, characterization of nano materials in food and biological matrices, nanomaterial detection and quantification methods.

Total:45

TEXT BOOK:

1.	QasimChaudhry, Laurence Castle and Richard Watkins, "Nanotechnologies in Food", 1st Edition, RSC Publishing, UK, 2017.

REFERENCES:

1.	Rai M., Ribeiro C., Mattoso L., and Duran N, "Nanotechnologies in Food and Agriculture", 1st Edition, Springer International Publishing, Switzerland, 2015.
2.	Guozhong Cao and Ying Wang, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", 2nd Edition, World Scientific Publishing Co, Singapore, 2011.
3.	Qingrong Huang, "Nanotechnology in the Food, Beverage and Nutraceutical Industries", 1st Edition, Wood head Publishing, UK, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the fundamentals of nanotechnology and the challenges / public perception of nano particles in food	Understanding (K2)
CO2	make use of appropriate method for manufacturing nano particles	Applying (K3)
CO3	examine the food quality issues and recommend suitable nanotechnology based solutions	Applying (K3)
CO4	extend shelf life of food by making use of nano materials incorporated packaging	Analyzing (K4)
CO5	apply instrumental techniques for characterization of nano particles and make use of nanotechnology in rapid food analysis	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		2	1						2	3	2
CO2	3	2	1		2	1						2	3	2
CO3	3	3	1	1	2	1						2	3	2
CO4	3	3	1	1	2	1	1					2	3	2
CO5	3	3	1	1	2	1	1					2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	60	20				100
CAT3	20	50	20	10			100
ESE	20	50	20	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE04 - FERMENTATION TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food microbiology, Food chemistry	5	PE	3	0	0	3

Preamble	To provide an idea about the concepts of fermentation process and products	
Unit - I	**Introduction and Food Fermentation:**	**9**

Introduction: Basic principles of food fermentation, Properties of fermented foods. Food Fermentation: Origin and history of food fermentation, Micro-organisms for fermentation, Starter Cultures and fermented products, Inoculum development for industrial fermentations, Criteria for transfer of Inoculums.

Unit - II	**Fermentation media:**	**9**

Fermentation media: Natural and Synthetic media; Basic components of media -Role of buffers in media. Sterilization: Sterilization of media and air-Calculation of del factor, Calculation of holding time at constant temperature.

Unit - III	**Types of Fermentation & Design of fermenter:**	**9**

Types of Fermentation & Design of fermenter: Types - submerged, solid state, batch, fed- batch and continuous fermentations. Design of Fermenter: Fermenter construction- construction material, Temperature controls, Aeration and agitation systems- Oxygen requirement, Oxygen supply, determination of KLa values & factors affecting the operation of fermenter.

Unit - IV	**Recovery and Purification of Fermentation products:**	**9**

Recovery and Purification of Fermentation products: Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, membrane process, chromatography, drying and crystallization.

Unit - V	**Production of Fermented Products:**	**9**

Production of Fermented Food Products: Cultured dairy products- Yoghurt, sour cream, Kefir. Meat fermentation-Sausages. Asian fermented foods- Koji, Soy sauce, Natto, Tempeh, and Miso. Industrial production of beer, wine and spirits. Production of Metabolites: Production of vitamins, amino acids, organic acids, enzymes, baker's yeast, Nisin, Xylitol, xanthan gum.

Total:45

TEXT BOOK:

1.	Stanbury P.F, Whitaker A. and Hall S.J , "Principles of Fermentation Technology", 2nd Edition, worth Heinemann, New York, 2003.

REFERENCES:

1.	Robert W. Hutkins, "Microbiology and Technology of Fermented Foods", 2nd Edition, CRC Press, UK, 2004.
2.	Hui Y.H.,, Lisbeth Meunier Goddik, JytteJosephsen, Wai Kit Nip and Peggy S. Stanfield, "Handbook of Food and Beverage Fermentation Technology", 2nd Edition, CRC Press, UK, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the principles and concepts of fermentation	Understanding (K2)
CO2	select suitable media component and sterilization methods	Applying (K3)
CO3	identify the suitable fermentation process and construction of fermenter	Applying (K3)
CO4	choose appropriate techniques for recovery of fermented products	Applying (K3)
CO5	illustrate the production of different fermented products	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		1							1	2	1
CO2	3	2	2	2	2							1	2	2
CO3	3	2	2	2	2							1	3	2
CO4	3	2	2		2							1	3	2
CO5	3	2	1		1							1	3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	50	30				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE05 - FOOD STORAGE AND INFESTATION CONTROL

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PE	3	0	0	3

Preamble	To understand about the effect of insects and pest on stored products and to learn about the methods to control pest infestation

Unit - I	Fundamentals of Storage Infestation:	9

Fundamentals of Storage Infestation: Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post-harvest losses - total production of food grains in India. Scientific and socio-economic factors responsible for grain losses. Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products.

Unit - II	Ecology of Insects and Storage Losses:	9

Ecology of Insects and Storage Losses: Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes..

Unit - III	Grain Storage and Management:	9

Grain Storage and Management: Grain storage, Types of storage structures - traditional, improved and modern storage structures in current usage. Ideal seeds and commodities storage conditions. Important rodent pests associated with stored grains and their non-chemical and chemical control. Pest Birds – role and its management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods.

Unit - IV	Pest Control Measures:	9

Pest Control Measures: Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative. Pesticides – characteristics, uses and precautions in handling. Integrated approaches to stored grain pest management.

Unit - V	Quality Control in Grains:	9

Quality Control in Grains: Detection of insect infestation in stored food grains, losses in stored food grains – weevilled and unweevilled grains, determination of moisture content in stored food grains, Quality control aspects in FCI godowns, central warehouse. Demonstration of preventive and curative measures including fumigation techniques; treatment of packing materials and their effect on seed quality.

Total:45

TEXT BOOK:

1.	Narayanasamy P., Mohan S &Awaknavar J. S, "Pest Management in Store Grains", 1st Edition, Satish Serial Publishing House, New Delhi, 2009.

REFERENCES:

1.	Nair K.R, "Integrated Production and Pest Management", 1st Edition, Gene-Tech Books publisher, New Delhi, 2009.
2.	Hagstrum D.W. & Subramanyam B, "Fundamentals of Stored Product Entomology", 1st Edition, American Association of Cereal Chemists Inc, USA, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify possible sources of pest infestation in storage	Applying (K3)
CO2	interpret ecology of region specific insects and analyze its impact on storage	Analyzing (K4)
CO3	choose appropriate storage structures and preventive measures for pests	Applying (K3)
CO4	select integrated pest management approach and curative measures in grain storage	Applying (K3)
CO5	adapt suitable quality control techniques in grain storage	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		1						1		3
CO2	3	2	2	2		1						1		3
CO3	3	2	2	2	2	2						1	1	3
CO4	3	2	2	1	2	2						1	1	3
CO5	3	2	2	1	1	3						2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	40	20			100
CAT2	30	20	40	10			100
CAT3	20	60	20				100
ESE	35	20	40	5			100

 * ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE06 - MODERN SEPARATION PROCESS

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Process Engineering I , Food Process Engineering II	7	PE	3	0	0	3

Preamble	To help students to learn about different separation techniques with its potential application.

Unit - I	Mechanism of Separation and Filtration Processes:	9

Review of conventional processes. Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances. Process concept, theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid – liquid separations involving a second liquid, Sirofloc filter.

Unit - II	Membrane based separation technique (MBSTs):	9

Physical and chemical properties of membranes, Techniques of membrane preparation, membrane characterization, various types of membranes and modules. Osmosis and osmotic pressure. Working principle, operation and design of reverse osmosis, ultrafiltration, microfiltration, electrodialysis and pervaporation. Gaseous separation by membranes, Membrane fouling – cleaning techniques.

Unit - III	Adsorption and Chromatography:	9

Adsorption: Mechanism, Types and choice of adsorbents, adsorption techniques–pressure swing and temperature swing cycles. Chromatography: Theory, paper chromatography, TLC, GC, HPLC, Affinity and Immuno-chromatography.

Unit - IV	Ionic Separation and Permeation:	9

Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electrodialysis. Separations involving pervaporation and permeation techniques for solids, liquids and gases.

Unit - V	Other Separation Processes:	9

Zone melting, Adductive crystallization, Supercritical fluid extraction, Oil spill Management, application of modern separation techniques for industrial effluent treatment.

Total:45

TEXT BOOK:

1.	Seader J.D., Ernest J. Henley and Keith Roper D., "Separation Process Principles", 3rd Edition, John Wiley and Sons Inc., New York, 2011.

REFERENCES:

1.	Roussel Ronald W., "Handbook of Separation Process Technology", 1st Edition, John Wiley, New York, 2008.
2.	Humphrey Jimmy L. and George E. Keller II., "Separation Process Technology", 1st Edition, McGraw-Hill Publishing Company Ltd., USA, 1997.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the concepts of separation and filtration techniques	Understanding (K2)
CO2	select suitable membrane process and cleaning techniques	Applying (K3)
CO3	classify and adapt appropriate adsorption and chromatography techniques	Understanding (K2)
CO4	apply the concepts of ionic separation and permeation	Applying (K3)
CO5	choose appropriate techniques for effluent treatment	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			1	2					1	2	1
CO2	3	2	2		3	1	2					2	3	2
CO3	3	2	3		3	1	2					1	2	2
CO4	3	2	3		3	1	2					1	2	1
CO5	3	2	2			2	3					2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	10	60	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE07 - BIOPROCESS ENGINEERING

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Food Microbiology, Food Process calculations, Food Process Engineering II	7	PE	3	0	0	3

Preamble	To provide the concepts of bioreactors, sterilization kinetics and models, stoichiometry of cell growth and product formation, rheological properties of fermented fluids and bio-product recovery methods.	
Unit - I	**Introduction and Design of Novel Bioreactors:**	**9**
Role of a bioprocess engineer, Kinetics of microbial growth, substrate utilization and product formation. packed bed bioreactors, Bubble-column bioreactors, fluidized bed bioreactors, trickle bed bioreactors, airlift loop bioreactors, photo bioreactors,- Batch, fed-batch and continuous fermentations- ideal reactors for kinetics measurements- Ideal batch reactor, fed-batch reactors.		
Unit - II	**Sterilization Kinetics and Monod chemostat model:**	**9**
Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous. Kinetic modeling of cell growth. Models with growth inhibitors -substrate inhibition, product inhibition and inhibition by toxic compounds.		
Unit - III	**Stoichiometry of Cell Growth and Product Formation:**	**9**
Elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation.		
Unit - IV	**Rheology of fermentation fluids and Mass Transfer in Bio-processing operations:**	**9**
Newtonian and Non -Newtonian fluids, Aeration and agitation, power requirement for gassed and ungassed systems, time calculation for mixing. Types of Mass transfer. Heat transfer in Bio-processing operations.		
Unit - V	**Bio Product Recovery Methods and Applications in Food Industry:**	**9**
Filtration, sedimentation, centrifugation, precipitation, cell disruption, chromatography, crystallization, lyophillisation, drying. Lactic Acid Production, Citric Acid Production, HFCS Production, Baker Yeast Production.		

Total:45

TEXT BOOK:

1.	Michael LShuler,Fikret Kargı, Matthew DeLisa, "Bioprocess Engineering Basic Concepts", 3rd Edition, Prentice Hall, India, 2017.

REFERENCES:

1.	Paulin M. Doran, "Bioprocess Engineering Principles", 2nd Edition, Elsevier Science & Technology, India, 2012.
2.	Mukesh Doble, Sathyanarayana , Gummadi N, "Biochemical Engineering", 1st Edition, Prentice Hall , India, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the kinetics of microbial growth and types of novel reactors	Understanding (K2)
CO2	outline the concepts of sterilization kinetics and monod chemostat models	Understanding (K2)
CO3	apply the principle of stochiometric concepts in cell growth and product formation	Applying (K3)
CO4	make use of the concepts of rheology and heat mass transfer for the fermentation fluids	Applying (K3)
CO5	integrate the various bio product recovery methods and its application in food industries	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2							1	1	2
CO2	3	2	2	1	1							1	1	1
CO3	3	3	2	2	1							1	2	2
CO4	3	3	3	2	2							1	2	1
CO5	3	3	3	2	3							1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	30	30	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE08 - EMERGING TECHNOLOGIES IN FOOD PROCESSING

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Process Engineering I, Food Process Engineering II	7	PE	3	0	0	3

Preamble	To impart knowledge effectively in various novel methods of food processing utilizing their advantages for food processing and preservation

Unit - I	High Pressure Processing and Pulsed Electric Field:	9

High Pressure Processing of Foods: High Pressure Processing–Principle - Description, Packaging requirements, Uses and Effects on food quality. High Pressure Regulations. Other applications of high pressure - High pressure freezing, High Pressure thawing, High Pressure non-frozen storage. Application and limitations. Pulsed Electric Field Processing: Principle - Mechanism of action. PEF treatment systems – processing parameters. Applications. Safety aspects, Problems and challenges in PEF.

Unit - II	High Intensity Pulsed Light Technology and Irradiation of Foods:	9

High Intensity Pulsed Light Technology: Principles of Pulsed Light Technology, Effect of Pulsed Light Technology on food products, enzymes and food properties. PLT systems. Irradiation of Foods: Fundamentals of food irradiation - Definition, Doses of Irradiation, Legal aspects .Biological effects of irradiation – effect on micro-organisms, parasites and insects, viruses, ripening and sprouting inhibition.

Unit - III	Ultrasound and Ozonation:	9

Ultrasound: Fundamentals of ultrasound, ultrasonic processing equipment, Inactivation of micro-organisms and enzymes. Application- mixing and homogenization, foam formation and destruction, precipitation of airborne powders, filtration and drying, extraction. Ozonation: Solubility, stability and reactivity of ozone. Antimicrobial properties of ozone. Ozone Treatment System. Food applications.

Unit - IV	Ohmic and Di electric Heating:	9

Ohmic Heating - Fundamentals, electrical conductivity. Generic Configurations -Batch Configuration, Transverse Ohmic heating and Collinear Ohmic heating. Product suitability for thermal treatments. Di-electrical Heating: Dielectric properties of foods. Dielectric heating, difference between MW and RF. Microwave heating – working principle. Microwave processing of foods – baking, thawing, drying, pasteurization and sterilization. Radio-frequency heating – material properties, adopting RF technology, heating and drying application. Limitations of Dielectric and RF heating.

Unit - V	Novel Hybrid Drying Technologies, Automation and Cold Plasma:	9

Novel Hybrid Drying Technologies: Need for hybrid drying systems. Hybrid systems - Heat pump drying, fluidized bed drying, combined microwave and vacuum drying, infra-red drying, superheated steam drying, pressure regulating drying, rotating jet spouted bed drying. Automation: Automation process control for food industry – introduction. Recent trends in tools of automation in food processing – Computer vision systems, On-line sensors, Expert systems, Robot Technology, Computer Integrated manufacturing. Cold Plasma: Plasma-properties-chemistry-generation methods-application-effects-limitations and toxicology

Total:45

TEXT BOOK:

1.	Da-Wen Sun, "Emerging Technologies for Food Processing", 2nd Edition, Elsevier Academic Press, London, 2014.

REFERENCES:

1.	Han, Jung H, "Packaging for Non-thermal Processing of Food", 1st Edition, Wiley-Blackwell, Oxford, 2007.
2.	Mujumdar A.S, "Handbook of Industrial drying", 4th Edition, CRC Press, UK, 2014.
3.	Misra N.N., Oliver Schluter and Patrick J. Cullen, "Cold plasma in Food and Agriculture: Fundamentals and Applications", 1st Edition, Academic Press, London, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concepts of high pressure processing and pulsed electrical field for food processing.	Applying (K3)
CO2	make use of pulsed light technology and irradiation for food processing and preservation	Applying (K3)
CO3	utilize ultrasound and ozone techniques for food processing	Applying (K3)
CO4	apply ohmic and dielectric heating principles in food processing	Applying (K3)
CO5	choose novel drying techniques and adapt automation in food processing	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		3	1						2	3	3
CO2	3	2	2		3	1						2	3	3
CO3	3	2	2		3	1						2	3	3
CO4	3	2	2		3	1						2	3	3
CO5	3	2	2		3	1						2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	20	40				100
CAT2	40	20	40				100
CAT3	40	20	40				100
ESE	40	20	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE09 - PLANTATION AND SPICE PRODUCTS TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To provide an idea about the plantation crop ,spices and their processing with special ingredients as flavouring material quality.

Unit - I	Plantation Crops:	9

Plantation Crops: Description of various types of Plantation crops. Processing of tea – Manufacturing of black tea, CTC tea Green tea, Oolong tea, flavoured tea. Grading of Tea. Coffee– Occurrence, Manufacturing of coffee powder, instant coffee. Cocoa Processing – Cocoa liquor, cocoa powder manufacturing. Coconut– Processing and by products. Cashew nut and Oil palm Processing. Processing of tuber crops – tapioca. Processing of potatoes-processed potato products.

Unit - II	Spices and Condiments:	9

Spices and Condiments: Description of various types of spices and condiments ,their composition, functional properties, flavouring agents. Nutritive value of major spices and their health benefits. Importance in culinary preparations.

Unit - III	Processing of spices:	9

Processing of spices–Pepper, Chilli, Turmeric, Cardamom, Cinnamon, Clove ,Vanilla and Ginger. Spices Products–Liquid products and Solid Products. Spice Oils–Concept and importance. Extraction methods-Solvent extraction, Steam distillation. Oleoresins - Extraction, Quality and Application of oleoresins. Importance of Cryogenic grinding of spices

Unit - IV	Herbs & Flavouring materials:	9

Herbs & Flavouring materials: Description of various types of herbs .Basil, Cilantro, Dill, Coriander, Mint, Oregano, Borage, Thyme, bilva leaves,Safflower. Nutritive value and health benefits. Processing and post-harvest handling.

Unit - V	Flavouring materials of natural origin:	9

Flavouring materials of natural origin: Natural flavours, sources of natural flavouring materials – Herbs and spices .Microbiology of spices, gas sterilization of spices, gamma irradiation, Heat treatment. Encapsulation of spice based flavours – methods and recent trends, Seasoning blend duplication and tricks.

Total:45

TEXT BOOK:

1. Kumar N., "Introduction to spices, plantation crops, medicinal and aromatic plants", 2nd Edition, Oxford and IBH Publishing, New Delhi, 2006.

REFERENCES:

1.	Panda H.,"Handbook on Spices and Condiments (Cultivation, Processing and Extraction)", 2nd Edition, National Institute of Industrial Research, New Delhi, 2010.
2.	Peter K.V.,"Handbook of Herbs and Spices", 2nd Edition, Wood head Publishing,USA,2012.
3.	Minifie Bernard W., "Chocolate, Cocoa and Confectionery Technology", 3rd Edition, Aspen publication, USA, 1999.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Demonstrate the processing stages involved in plantation processing	Understanding(K2)
CO2	Utilize functional properties of spices and herbs in product development	Applying(K3)
CO3	Select processing steps required for spices processing	Applying(K3)
CO4	Choose processing steps required for herbs processing	Applying(K3)
CO5	Adapt suitable flavouring materials for food processing	Applying(K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		1	1	1					1	2	2
CO2	3	2	1		1	1	1	1				1	2	2
CO3	3	2	2		2	1	1	1				1	2	2
CO4	3	2	2		2	1	1	1				1	2	2
CO5	3	2	2		2	2	2	1				2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	25	30	45				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE10 - ENZYMES IN FOOD PROCESSING

Programme & Branch	B.TECH. – Food Technology		Sem.	Category	L	T	P	Credit
Prerequisites	Food chemistry		7	PE	3	0	0	3

Preamble	To learn about enzymes and their application in processing and development of food products.	
Unit - I	**Enzyme kinetics and Production of industrial enzymes:**	**9**
	Enzyme kinetics: Enzyme-Classification and Nomenclature, Units of Activity, General Characteristics. Enzyme Kinetics - Michaelis Menden Equation, Linear Plots / Km and Vmax. Production of industrial enzymes: Sources of enzymes, microbial fermentation and downstream processing, Enzyme formulation.	
Unit - II	**Enzymes in milk processing and brewing industry:**	**9**
	Milk Processing: Milk clotting enzymes, Lactoperoxidase, Cheese-ripening enzymes, Lysozyme, Lactase, Lipase, Transglutaminase. Brewing: Malting, Brewhouse processing, Enzyme applications and their role during fermentation, Beer stabilization.	
Unit - III	**Enzymes in non alcoholic beverage:**	**9**
	Enzymes in non alcoholic beverage: Application of enzymes in tea and cocoa processing. Role of the enzymes in fruit juice production, factors affecting the enzymatic activity. Enzymatic clarification of apple and guava juices, factors affecting the clarification of fruit juices.	
Unit - IV	**Enzymes in baking industry:**	**9**
	Enzymes in baking industry: Enzymes for baking industry, Use of the proteinases, lipases and pentosans in baking industry, Starch degrading enzymes: sources, analysis and application of starch degrading enzymes. Hemicellulase, xylanases: sources, analysis and application.	
Unit - V	**Enzymes in meat processing:**	**9**
	Enzymes in meat processing: Enzymes used for meat processing: protease and peptidase, lipases, trans glutaminase, oxidative enzyme. Meat tenderization with added enzyme, Enzymatic generation of flavour in meat products, Restructuring of unheat meat.	

Total:45

TEXT BOOK:

1.	Robert J. Whitehurst & Maarten van oort, "Enzymes in Food Technology", 2nd Edition, John Wiley & Sons, UK, 2009.

REFERENCES:

1.	Muthusamy Chandrasekaran, "Enzymes in Food and Beverage Processing", 1st Edition, CRC Press, USA, 2016.
2.	Robert Rastall, "Novel Enzyme Technology for Food Applications", 1st Edition, Wood head Publications, USA, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the enzyme kinetics and production of industrial enzymes	Understanding (K2)
CO2	select suitable enzymes for milk processing and brewing	Applying (K3)
CO3	choose appropriate enzymes for non alcoholic beverage production	Applying (K3)
CO4	apply and relate the effect of enzymes in baking process	Applying (K3)
CO5	make use of enzymes in processing of meat and meat products	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								2	2	1
CO2	3	2	3	1								2	3	2
CO3	3	2	3	1								2	3	2
CO4	3	2	3	1								2	3	2
CO5	3	2	3	1								2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	30	40	30				100

* **±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20GEE01 - FUNDAMENTALS OF RESEARCH
(Common to All BE/BTech Engineering & Technology Branches)

Programme & Branch	B.Tech. & Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3
Preamble	This course familiarize the fundamental concepts/techniques adopted in research, problem formulation and also disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.						

Unit - I	Introduction to Research:	9

Introduction to Research: Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords.

Unit - II	Literature Review:	9

Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.

Unit - III	Research Methodology:	9

Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations.

Unit - IV	Journals and Papers:	9

Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study.

Unit - V	Reports and Presentations:	9

Reports and Presentations: How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools.

Total: 45

TEXT BOOK:

1.	Walliman Nicholas, "Research Methods: The basics", Routledge, 2017.

REFERENCES:

1.	Melville S., Goddard W., "Research Methodology: An Introduction For Science and Engineering Students", Kenwyn: Juta & Co Ltd.,1996.
2.	Kumar Ranjit, "Research Methodology: A step-by-step guide for beginners", SAGE Publications Ltd., 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	list the various stages in research and categorize the quality of journals.	Analyzing (K4)
CO2	formulate a research problem from published literature/journal papers	Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format	Creating (K6)
CO4	select suitable journal and submit a research paper.	Applying (K3)
CO5	compile a research report and the presentation	Applying (K3)

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1		3	3	3	2	2	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		40	35	25			100
CAT2		30	40	30			100
CAT3				50	50		100
ESE		25	25	25	25		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE11 - DAIRY PRODUCTS TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Dairy Technology	7	PE	3	0	0	3

Preamble	To explore the technology of variety of products and by-products developed from milk.	
Unit - I	**Coagulated Milk Products and Fermented milk products:**	**9**

Definitions, Classification, Paneer: Types of paneer, Basic operations in Paneer Production; Cheese: Types of cheese, Basic operations in Cheese Production.
Definitions; Classification; Yoghurt: Types, Yoghurt Production- significance of each processing steps; Dahi: Types of dahi, Dahi Production; Preparation of Cultured Butter Milk.

Unit - II	**Traditional dairy products:**	**9**

Classification of traditional dairy products, Khoa: Definition, varieties and standards, Methods of preparation of khoa, Gulab jamun: Product Description, Method of Preparation, Quality; Peda: Product Description, Method of Preparation, Quality; Burfi: Product Description, Method of Preparation, Quality; Shrikhand: Product Description, Method of Preparation, Quality.

Unit - III	**Condensed Milk and Dried Milk:**	**9**

Definition, Classification, Legal Standards for Evaporated and Condensed Milks, Manufacture of Sweetened Condensed Milk, Manufacture of Evaporated Milk.
Definition, Classification, Legal Standards for dried milks, Manufacture of Non Fat Dry Milk, Manufacture of Whole Milk Powder, Manufacture of Instant Dried Milks.

Unit - IV	**Fat Rich Dairy Products:**	**9**

Principles and methods of cream separation, Processing of cream, Consumer cream products; Composition and classification of butter, Process outlines of butter making, Continuous Butter Making; Methods of ghee preparation, Butter oil.

Unit - V	**Frozen dairy products and Dairy By-products:**	**9**

Definition, Classification, Composition of Ice cream, Other frozen desserts, Technological aspects of ice cream manufacture, Dried ice cream mix: Composition, Technology, Uses
Definition, Types; Caseinates: Composition, Process of manufacture, Whey Protein products: Classification, Process of manufacture.

Total:45

TEXT BOOK:

1.	Sukumar De, "Outlines of Dairy Technology", 1st Edition, Royal Oxford University Press, New Delhi, 2001

REFERENCES:

1.	Edgar Spreer, "Milk and Dairy Product Technology", 1st Edition, Routledge, New York, 1998.
2.	Pieter Walstra, Jan T. M. Wouters, Tom J. Geurts, "Dairy Science and Technology", 2nd Edition, CRC Press, UK, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the technology of coagulated milk products and fermented milk products	Understanding (K2)
CO2	summarize the manufacturing of frozen dairy products and dairy by-products	Understanding (K2)
CO3	select suitable thermal methods for extension of shelf life of milk	Applying (K3)
CO4	outline the technology of fat-rich dairy products	Understanding (K2)
CO5	explain the production and examine the quality of different traditional dairy products	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		1							1	2	1
CO2	3	2	2	2	2							1	2	2
CO3	3	2	2	2	2							1	3	2
CO4	3	2	2		2							1	3	2
CO5	3	2	1		1							1	3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	40	20				100
CAT3	40	60					100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE12 - TECHNOLOGY OF FATS AND OILS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry	7	PE	3	0	0	3

Preamble	To provide insight of the basic chemistry, properties and processing of fats and oils.

Unit - I	Properties of Oils and Fats:	9

Properties of Oils and Fats: Oils and fats – sources, composition. Nutritional importance of fats and oils. Physical properties of fats and oils - color, odour, consistency, melting point, flash point, smoke point and refractive index. Chemical properties of fats and oils - iodine value, saponification value, free fatty acids, peroxide value.

Unit - II	Vegetable Oil and Animal Fat Production:	9

Vegetable Oil and Animal Fat Production: Industrial production of oils- seed handling and storage. Preparation of seed for extraction of oil. Processing- peanut oil, rice bran oil, sunflower oil and soy bean oil. Production of cod liver oil. Method of extraction- cold pressing and hot pressing, Equipments- Filter press, hydraulic press. Production of margarine. Production of Lard.

Unit - III	Solvent Extraction and Refining of Oils:	9

Solvent Extraction and Refining of Oils: Solvent extraction – prepress and direct extraction, removal and recovery of solvent from miscella and extracted residue. Physical and Chemical Refining: Degumming - types, Neutralization, dewaxing/winterization, bleaching, deodorizing.

Unit - IV	Modification of Oils and Modified Fat Products:	9

Modification of Oils: Methods- Fractionation, Blending, Hydrogenation, Interesterification. Modified Fat products: Margarines, spreads, mayonnaise. Shortenings in bakery products and confectionery lipids. Fat substitutes and its types, Non edible fat/ oil products.
Design and Application of Fat-Based Surfactants: Introduction to Surface and Interfacial Activity - Emulsion Formation and Stabilization - Surface Activity - Applications of Surface Active Materials. Micro and nano emulsion formation methods and applications

Unit - V	Frying and Storage of Oil:	9

Frying and Storage of Oil: Changes during storage of oil. Role of fat or oil in frying. Selection of frying oil. Applications of frying oil. Rancidity - atmospheric oxidation and enzyme action, Prevention of rancidity. Quality standards of oil, Packaging of oils and fats.

Total:45

TEXT BOOK:

1.	Fereidoon Shahidi, "Bailey's Industrial Oil and Fat Products", 6th Edition, Wiley - Interscience, New Jersey, 2005.

REFERENCES:

1.	Richard D. O'Brien, "Fats and Oils: Formulating and Processing for Applications", 3rd Edition, CRC Press, London, 2010.
2.	Wolf Hamm & Richard J. Hamilton, "Edible Oil Processing", 2nd Edition, Wiley - Blackwell, UK, 2013.
3.	O'Brien, Richard D, Walter E. Farr, and Peter J. Wan. "Introduction to Fats and Oils Technology", 2nd Edition, Champaign, Ill: AOCS Press, 2000

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the physical and chemical properties of fats and oils	Understanding (K2)
CO2	recommend suitable mechanical methods for oil extraction	Applying (K3)
CO3	apply solvent extraction and refining techniques to improve the quality of oil	Applying (K3)
CO4	develop modified fat/ oil products	Applying (K3)
CO5	analyze the changes occurred during frying and storage of fats/oils	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2		1							1	1
CO2	3	2	2		3							2	3	2
CO3	3	2	2		3							2	3	2
CO4	3	2	3		3							2	3	2
CO5	3	2	2		1	1		2				2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	40	40				100
CAT3	16	44	20	20			100
ESE	20	30	30	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE13 – TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To learn the techniques involved in milling of various cereals, pulses, and oil seeds along with the recent advancements

Unit - I	Grain Properties:	9

Grain Properties: Grains - Definition. Importance. Physical properties of grains. Structure, Composition and Nutritional value – paddy, wheat, maize, millet, oat, sorghum. Anti-nutritional factors and its methods of reduction. Grain storage systems - farm level storage, bagged storage, bulk storage, hermetic storage, outdoor storage. Losses during storage, Grain protection methods – physical and chemical methods. Integrated stored grain pest management

Unit - II	Milling of Paddy:	9

Milling of Paddy: Rice milling flow sheet. Cleaning. Parboiling- traditional and improved methods, Physio–chemical changes during parboiling, Effect of parboiling on rice quality. Husking- Methods of husking, Huskers/Shellers – impact type, centrifugal dehusker, under runner disc huller, rubber roll Sheller. Separation – indented tray and compartment type separator. Whitening – friction type and abrasive type whiteners. Color sorter. New quality control instruments. Byproducts from rice milling.

Unit - III	Milling of Wheat:	9

Milling of Wheat: Types of wheat. Wheat milling – Simple and detailed flow sheet. Cleaning, Entoleter. Preparation of Wheat for Milling – wheat blending, tempering or conditioning, Chakki milling, Roller milling – break rolls and reduction rolls, operation and corrugation specification, Sifting – Plan sifters, Purifying - purifier. Milling performance evaluation. Functional properties of flour. Flour treatment – Enrichment, Enhancement of flour appearance, Improvement of functional properties. By products from wheat milling

Unit - IV	Processing of Corn, Millet and Sorghum:	9

Processing of Corn: Types of corn. Dry milling – Tempering, dehulling, degermination and milling. Wet milling – Steeping, Germ, fiber, starch and gluten separation, starch refinement. By products from corn milling. Millet and Sorghum Processing: Types of millets. Sorghum and millet processing - cleaning, decortication, milling and classification, dry milled fractions. Food and Feed uses

Unit - V	Milling of Pulses and Oil Seeds:	9

Milling of Pulses: Legumes – Structure, Types, Nutritional and Anti-nutritional factors. Pulse Milling – Conditioning, Pitting, Oil/water treatment, drying, dehusking – TADD, CIAE design, Schule design, CFTRI design, Husk separation and grading, Splitting – Equipments. Milling - Dry and wet milling, Modern milling. Dehulling efficiency. Milling of Oil Seeds: Types of Oil seeds. Oil seed processing - Mechanical extraction – Hydraulic press, Screw press, Filter press. Mechanical extraction of coconut oil and palm oil. Cold pressing and Hot Pressing. Solvent extraction, Factors influencing extraction. Refining of oil. Hydrogenation. Winterization. Byproducts of oil extraction.

Total:45

TEXT BOOK:

1.	Chakraverty A, "Post-Harvest Technology of Cereals, Pulses and Oil Seeds", 3rd Edition, Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, 2017.

REFERENCES:

1.	Kulp K. & Pont J.G, "Handbook of Cereal Science and Technology", 2nd Edition, Marcel Dekker Inc, New York, 2000.
2.	Sahay K.M. & Singh K. K, "Unit Operations of Agricultural Processing", 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline grain properties and storage structures	Understanding (K2)
CO2	select suitable parboiling and milling methods for paddy	Applying (K3)
CO3	identify appropriate techniques for wheat milling and its enrichment	Applying (K3)
CO4	summarize the process involved in corn, sorghum and millet processing	Understanding (K2)
CO5	choose suitable technologies for processing of pulses and oil seeds	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1				1				1	3	2
CO2	3	3	2	1	1			1				2	3	3
CO3	3	3	2	1				1				2	3	3
CO4	3	3	2	1				1				2	3	3
CO5	3	3	2	1	1			1				2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	60	20				100
CAT3	30	60	10				100
ESE	20	65	15				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE14 - MEAT, FISH AND POULTRY PROCESSING

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry, Food Microbiology, Food Process Engineering I	7	PE	3	0	0	3

Preamble	To educate the students about processing, preservation, product development from meat, fish, poultry meat and egg and also ensuring quality

Unit - I	Meat Processing:	9

Types of meat and its sources, composition, structure of meat. Ante mortem handling, types of stunning, slaughtering of animals, inspection and grading of meat. Post-mortem changes of meat. Meat - tenderization, aging. Meat quality evaluation. Preservation of meat- curing, drying. Processed meat products - hamburgers, sausages and meat balls

Unit - II	Fish Processing:	9

Types of fish, composition and nutritive value of fish. Harvesting of fish. Spoilage factors of fish. Post-mortem changes in fish. Preservation - freezing and individual quick freezing. Canning and smoking operations. Salting, drying of fish and pickling.

Unit - III	Poultry Processing:	9

Types and characteristics of poultry products. Unit operation in poultry processing. Pre-slaughter factors affecting poultry meat quality. Factors affecting the shelf-life of poultry meat. Sensory quality of poultry meat- colour, texture and flavour. Preservation techniques: chemical treatments, heating-microwave & IR, freeze drying and irradiation.

Unit - IV	Egg Processing:	9

Structure, composition, nutritive value of egg. Functional properties of eggs, Factors affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing-spray drying, foam mat drying.

Unit – V	Hygiene and Sanitation:	9

Modern abbatoirs, slaughterhouse and its features. Handling and maintenance of tools and core equipment. Cleaning and sanitation in meat plants. Food safety measures – GMP, GHP and HACCP in meat industries.

Total:45

TEXT BOOK:

1.	Warriss P.D., "Meat Science: An Introductory Text", 2nd Edition, CABI Publications, UK, 2009.

REFERENCES:

1.	Hui Y. H., "Handbook of Meat and Meat Processing", 2nd Edition, CRC Press, USA, 2012.
2.	George M. Hall., "Fish Processing: Sustainability and New Opportunities", 1st Edition, Wiley Blackwell Publications, USA, 2011.
3.	Isabel Guerrero-Legarreta., "Handbook of Poultry Science and Technology: Secondary Processing", 1st Edition, John Wiley and Sons Publications, UK, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Outline the handling and processing of meat	Understanding (K2)
CO2	Make use of fish processing and preservation techniques	Applying (K3)
CO3	Apply suitable processing techniques for poultry products development	Applying (K3)
CO4	Make use of appropriate techniques for egg preservation	Applying (K3)
CO5	Select suitable hygiene and sanitation procedures for meat industry	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2							1	3	2
CO2	3	3	2		2							1	3	2
CO3	3	3	2		2							1	3	2
CO4	3	3	2		2							1	3	2
CO5	3	3	2		2							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	60	10				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE15 - WASTE MANAGEMENT AND BY-PRODUCT UTILIZATION IN FOOD INDUSTRIES

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To provide an insight on utilization of food industrial waste for developing valuable products

Unit – I	Introduction on Waste and disposal strategies:	9

Introduction : Different Sources of waste from Food Industries and their availability in India, nature of different waste, potentials and prospects of developing by products in India. Characteristics of Industrial Waste and disposal strategies : Classification of waste, characterization of waste, magnitude of waste generation in different food processing industries, importance of waste management, Economical aspects of waste treatment and disposal, Strategies for minimizing waste, Application of 3R's and Life Cycle Assessment (LCA).

Unit – II	Waste utilization in Cereal Food Industries:	9

Waste utilization in Cereal Food Industries: Waste utilization from rice mill – thermal and biotechnological uses of rice husk- pyrolysis and gasification of rice husk- cement preparation and different thermal applications- utilization of rice bran- stabilization – defatted bran utilization.

Unit – III	By Products from Oil Seed and Tuber Processing Industries:	9

By Products from Oil Seed and Tuber Processing Industries: Oil processing industries – Introduction, De-oiled cake, animal feed, fertilizer, bio sorbents, waxes, soap stock, cocoa butter replacer. Tuber processing industries- Introduction, enzyme production, biogas, bakers yeast, bio-ethanol, animal feed, corn syrup, organic acids, nutraceuticals.

Unit - IV	By Products from Animal Product based Industries:	9

By Products from Animal Product based Industries: Dairy industry - Introduction- opportunities – whey, bio surfactants, bacteriocin. Meat, fish, poultry processing industries- bio active peptide, protein extract, gelatin, heparin, pepsin, bio molecule from bone and blood, keratin form animal hair, bone meal, meat meal, chondroitinsulfate, squalene, fish oil, micro nutrients- vitamins and minerals, pigments.

Unit - V	Utilization of Fruits, Vegetables and Food Packaging Waste:	9

Utilization of Fruits and Vegetables waste: processes for waste utilization from fruits and vegetable industries – Pectin, essential oils, antioxidants, and organic acids. Distillation for production of alcohol, SCP production, by products of sugar industry. Handling of Food Packaging Waste: Handling and treatment, far waste, incineration of solid food waste and its disposal.

Total: 45

TEXT BOOK:

1.	Vasso Oreopoulou & Winfried Russ, "Utilization of By-Products and Treatment of Waste in the Food Industry", 1st Edition, Springer Science and Business Media, USA, 2006.

REFERENCES:

1.	Chandrasekaran M., "Valorization of Food Processing By-Products", 1st Edition, CRC Press, USA, 2016.
2.	Keith Waldron, "Handbook of waste management and co-product recovery in food processing", 1st Edition, Wood head Publishing Ltd, England, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	classify food waste and explain the strategies for waste minimization	Understanding (K2)
CO2	utilize the wastes from cereal industries for developing byproducts	Applying (K3)
CO3	make use of wastes from oilseeds and tuber processing industries for developing byproducts	Applying (K3)
CO4	utilize the animal processing industries waste for developing byproducts	Applying (K3)
CO5	apply the concept of waste utilization of fruit and vegetable, sugar and packaging industries	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1		1		2					1	2	2
CO2	3	2	1	1	1		2					1	3	2
CO3	3	2	1	1			2					1	3	2
CO4	3	2	1	1			2					1	3	2
CO5	3	2	1	1	1		2					1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	32	50	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE16 - ENERGY MANAGEMENT IN PROCESS INDUSTRIES

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	Heat transfer operations	7	PE	3	0	0	3

Preamble	To provide the knowledge on energy management, audit and conservation in many systems.

Unit - I	Energy Basics:	9

Energy Scenario: Commercial and Non Commercial Energy, Primary Energy Resources, Commercial Energy Production, Energy Needs of Growing Economy, Energy and Environment. Basics of Energy and its various forms: Electricity basics: DC & AC currents, Electricity tariff, Load management and Maximum demand control, Power factor. Thermal basics: Thermal energy contents of fuel, Temperature & Pressure, Heat capacity, Sensible and Latent heat, Evaporation, Condensation, Steam, Moist air and Humidity & Heat transfer. Global Environmental Concerns: United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development.

Unit - II	Energy Management and audits:	9

Definition, Energy audit- need, Types of energy audit. Material and Energy balance: Facility as an energy system, Methods for preparingProcess flow, Material and energy balance diagrams. Energy Monitoring and Targeting. Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return ; Cash flows, Risk and sensitivity analysis.

Unit - III	Energy conservation in Electrical Systems and Compressed air system:	9

Basics of Electrical System: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit. Electric motors: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities with energy. Types of air compressors, Compressor efficiency, efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test, Factors affecting the performance and efficiency.

Unit - IV	Energy conservation in Thermal systems and Waste Heat Recovery:	9

Boilers: Types, Combustion in boilers, Performances evaluation, Analysis of losses, Feed water treatment, Blow down, Energy conservation opportunities. Steam System: Properties of steam, Assessment of steam distribution losses, Steam leak-ages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, Advantages and applications, commercially viable waste heat recovery devices, saving potential.

Unit - V	Energy conservation in Food Process Industries:	9

Dairy Processing - Potential Energy Conservation measures in pasteurization, cooling, concentration and drying. Fruit and Vegetable Processing –energy flow in canned products, energy conservation measures in blanching, pasteurization, sterilization. Energy conservation in Baking and confectionery units. Thermo chemical Conversion of Food Processing Wastes for Energy Utilization – pyrolysis, gasification and liquefaction. .

Total:45

TEXT BOOK:

1. Beggs Clive, "Energy: Management Supply and Conservation", 2nd Edition, Butterworth-Heinemann, USA, 2002.

REFERENCES:

1. Lijun Wang, "Energy Efficiency and Management in Food Processing Facilities", 1st Edition, CRC Press, USA, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 identify energy sources and analyze the energy consumption	Applying (K3)
CO2 plan and perform energy audits and survey	Applying (K3)
CO3 identify energy conservation opportunities in electrical systems	Applying (K3)
CO4 recommend energy conservation measures in thermal systems	Evaluating (K5)
CO5 apply energy conservation practices in food industries	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2			2					1	1	
CO2	3	2	3	2								1	1	
CO3	3	2	3	2	2							1	1	2
CO4	3	2	3	2	2							1	1	2
CO5	3			2	2							1	1	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	30	40	30				100
CAT3	20	30	30	10	10		100
ESE	30	40	10	10	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE17 - PROCESS INSTRUMENTATION AND CONTROL

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	To impart knowledge on Laplace transformation for first and second order system, controllers, computer based automation and instrumentation in process industries.	
Unit - I	**Laplace Transform and First Order System:**	9

Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, Linearization and its application in process control.

Unit - II	**Second Order System:**	9

Second order systems - Interacting system and non-interacting system, manometer, damped oscillator, dynamic response of second order system, Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems.

Unit - III	**Controllers, Dynamic Response and its Stability:**	9

Controllers - Proportional, Proportional Integral, Proportional Derivative and Proportional Integral Derivative (PID). Dynamic behavior of feedback controlled processes. Effect of proportional, Integral, Derivative and composite control actions on the response of controlled processes. Stability for linear systems, Routh stability criterion and its limitations. Introduction to control system design by frequency, Bode diagram

Unit - IV	**Automation:**	9

Control components of SCADA, working of SCADA, comparison of SCADA with DCS, comparison of PLC with RTU, Application and advantages of SCADA, Sensors and its classification.

Unit - V	**Process Instruments:**	9

Principles of measurements - Static and dynamic response of instruments, Temperature measurements – Expansion Thermometer, filled system thermometers, thermocouple, optical pyrometers, radiation pyrometers. Pressure measurements - Manometers, bourdon gauge and bellows gauge, pressure measurement by vacuum. – Mccleod guage, Piraniguage. Level measurement – sight glass level indicator, float and tape liquid level gauge.

Total: 45

TEXT BOOK:

1.	Vyas, R.P, "Process Control and Instrumentation", 8th Edition, Dennet & Co, India, 2015.

REFERENCES:

1.	Stephanopoulos, S.G., "Chemical Process Control: An Introduction to Theory and Practice", 1st Edition, Prentice Hall of India, New Delhi, 2011.
2.	Donald R. Cough anowr and Steven E. LeBlanc, "Process Systems Analysis and Control", 3rd Edition, Tata McGraw Hill Company Ltd., New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 make use of Laplace transformation for first order systems	Applying (K3)
CO2 apply Laplace Transformation for second order systems and determine its dynamic behavior	Applying (K3)
CO3 interpret the concepts of feedback controller and determine its dynamic response and stability	Evaluating (K5)
CO4 summarize the concept of computer based controls in automation	Understanding (K2)
CO5 select temperature, pressure and level measuring instruments	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2							1	1	2
CO2	3	2	2	2	2							1	2	2
CO3	3	2	2	2	2							1	2	3
CO4	2	2	1	2	2							1	1	2
CO5	3	2	2	1	1							1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	60				100
CAT2	10	20	40	20	10		100
CAT3	20	20	60				100
ESE	10	20	40	20	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE18 - FUNDAMENTALS OF COMPUTATION FLUID DYNAMICS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Heat transfer operations, Mass transfer in food processing operations	7	PE	3	0	0	3

Preamble	To impart knowledge about application of computational fluid dynamics in various fields of food processing.

Unit - I	Introduction to CFD:	9

Introduction to CFD : Theory of CFD modeling - Conservation of mass, Momentum Equation, Energy Equation, Navier Stokes Equation. Classification of simple PDEs and fluid flow equations

Unit - II	Turbulence and Modeling:	9

Turbulence and Modeling: Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows - Free turbulence models, turbulent flow calculations, Direct numerical simulation.

Unit - III	The Finite Volume Method for Diffusion Problems:	9

The Finite Volume Method for Diffusion Problems: Introduction - One dimensional steady state diffusion, two dimensional and three dimensional diffusions. The central differencing scheme, The upwind differencing scheme, the hybrid differencing scheme, the power-law scheme, higher order differencing schemes.

Unit - IV	CFD Analysis:	9

CFD software packages and tools, CFD analysis – Preprocessing, solving and post processing, CFD Applications in Food Processing, Spray Drying-Air Flow Pattern, Atomization, air-particle interaction, Residence time of the particle, Modeling in Bread Baking Process

Unit - V	Applications of CFD:	9

Applications of CFD: Canning of foods, Canned solid liquid food mixtures, Bacterial Deactivation kinetics, analysis of fluid flow pattern during sterilization, Thermal processing of canned foods, Other applications in food processing.

Total:45

TEXT BOOK:

1.	Anandharamakrishnan C, "Computational Fluid Dynamics Applications in Food Processing", Springer Science and Business Media, Germany, 2013.

REFERENCES:

1.	Versteeg H.K. and Malalasekara W., "An Introduction to Computational Fluid Dynamics", 2nd Edition, Pearson Education Ltd., England, 2007.
2.	Da-Wen Sun, "Computational Fluid Dynamics in Food Processing", 1st Edition CRC Press, New York, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the equations involved in CFD modelling	Understanding (K2)
CO2	apply the turbulence model in fluid flow operations	Applying (K3)
CO3	make use of finite volume method for developing solution of steady state diffusion processes	Applying (K3)
CO4	infer the application of CFD in spray drying and bread baking processes	Analyzing (K4)
CO5	interpret the various applications of CFD in food processing	Evaluating (K5)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1		2							1		1
CO2	3	2	1	3	3							1		1
CO3	3	2	1	3	3							1		1
CO4	3	3	2	3	3							2	3	
CO5	3	3	3	3	3							2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	10	10	30	30	20		100
ESE	10	20	30	30	10		100

* **±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20FTE19 - REACTION ENGINEERING

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To give knowledge on reaction kinetic principles and different type of reactors.	
Unit - I	**Kinetics of Homogeneous reactions:**	**9**

Kinetics of Homogeneous reactions: Reaction Kinetics, Classification of reaction systems, Rate equation, Rate constant, Reaction Mechanism, Order of the reaction, Kinetic models for non-elementary reaction, Testing kinetic model. Temperature dependent term of a rate equation: Arrhenius law, collision theory and transition theory.

Unit - II	**Analysis of Batch Reactor Data:**	**9**

Analysis of Batch Reactor Data: Analysis of experimental reactor data, Integral and differential method, constant volume batch rector, and varying volume batch reactor, Integral method analysis of rate data, Integral rate equation for different order reactions: constant and variable volume systems, Temperature and reaction rate..

Unit - III	**Ideal Reaction for a Single Reactor:**	**9**

Ideal Reaction for a Single Reactor: Ideal reactors: Batch, Semi-batch, Steady state plug flow reactor, Steady state mixed flow reactor.

Unit - IV	**Design for Single and Multiple Reactions:**	**9**

Design for Single Reactions: Size comparison of Single reactors, multiple reactor system, Recycle rector Design for Multiple Reactions: Reactions in Parallel, Reactions in Series, Yield and Selectivity, Qualitative treatment: Plug flow, Batch and Mixed flow reactor, Product distribution.

Unit - V	**Non Ideal Flow:**	**9**

Non-ideal flow: The residence time distribution as a factor performance; residence time functions and relationship between them in reactor. Models for non-ideal flow: Dispersion model and Tank in series model.

Total:45

TEXT BOOK:

1.	Levenspiel O, "Chemical Reaction Engineering", 3rd Edition, Wiley India Pvt. Ltd, New Delhi, 2006.

REFERENCES:

1.	Scott Fogler H, "Essentials of Chemical Reaction Engineering", 1st Edition, Prentice Hall, US, 2010.
2.	Smith, J. M, "Chemical Engineering Kinetics", 3rd Edition, McGraw-Hill, New York, 1981.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 infer reaction kinetics and mechanism	Understanding (K2)
CO2 analyze batch reactor data	Analyzing (K4)
CO3 understand ideal reactors and develop performance equation	Applying (K3)
CO4 examine reactor system for single and multiple reaction	Applying (K3)
CO5 understand different non ideal flow models and perform RTD Analysis	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1							1	3	2
CO2	3	3	2	3	2							1	3	2
CO3	3	3	2	2	1							1	3	2
CO4	3	3	2	3	1							1	3	2
CO5	3	3	2	2	2							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	40	20			100
CAT2	10	20	50	20			100
CAT3	30	20	50				100
ESE	20	20	40	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE20 - MODELING, SIMULATION AND SOFT TOOLS FOR FOOD TECHNOLOGISTS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To impart knowledge on modeling and simulation of different food processing operations	
Unit - I	**Introduction to Modeling:**	**9**

Introduction to Modeling: Definition of terms: System, Entity, attributes, activity, state of systems. Physical, Mathematical and Chemical Systems. Modeling - Principles of model formulation, Representation of Model, Fundamental Laws, Types of Modeling Equations, Black Box Principles, Boundary Condition, Validation of model. Benefits of modeling in food processing

Unit - II	**Models in Fermentation and Modified Atmospheric Packaging:**	**9**

Models in Fermentation: Introduction, Biological models - Genetic models, growth models, killing-off models and productions models. Technological models - heat transfer models, oxygen transfer models and mixing models. Economic models and mixed models. Models in Modified Atmospheric Packaging: Principle and methods, macro, micro and meso level models.

Unit - III	**Modeling of Cooling and Freezing Processes:**	**9**

Modeling of Cooling and Freezing Processes: Introduction, modeling product heat load during cooling - single tank model and tank network model. Modeling product heat load during freezing. Numerical solution of heat conduction equation with phase change. Finite different models and element model. Modeling of combined heat and mass transfer - porous, non-porous foods, foods with impermeable skin and frozen foods

Unit - IV	**Modeling of Thermal Process:**	**9**

Modeling of Thermal Process: Types, basic equations - Microbiological and quality kinetics, thermal transport equations. Conduction equations, complex models for non-uniformity and convective flows, sterilization of liquids foods and foods containing particulates. Models for microwave and ohmic heating. Models for heat transfer equipments – evaporators, heat Exchangers.

Unit - V	**Soft Tools for Modeling of Food Processes:**	**9**

Soft Tools for Modeling of Food Processes: Soft tools for Sensory analysis, Mathematical analysis, data treatment tools, design tools and software

Total:45

TEXT BOOK:

1.	Tijskens L.M.M., Hertog T.M. & Nicolai B.M, "Food Process Modeling", 1st Edition, CRC Press, UK, 2001.

REFERENCES:

1.	Babu B.V, "Process Plant Simulation", 1st Edition, Oxford University Press, New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the concepts of modeling in food processing	Understanding (K2)
CO2	illustrate the modeling concepts in fermentation and MAP	Understanding (K2)
CO3	choose suitable mathematical models in cooling and freezing processes of foods	Applying (K3)
CO4	select the models to be used in thermal processing of foods	Applying (K3)
CO5	make use of appropriate software for modeling processes	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1	1	2
CO2	3	3	2	2	1							1	2	2
CO3	3	3	2	2	1							1	2	2
CO4	3	3	2	2	1							1	2	2
CO5	3	3	2	3	3							3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	20	40				100
CAT3	40	20	40				100
ESE	40	20	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE21 - PRODUCTION OF FIELD AND HORTICULTURE CROPS

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	To provides an insight on role of agricultural practices on production of field and horticultural crops.	
Unit - I	**Agronomy:**	**9**

Definition of agriculture and agronomy – Factors affecting crop growth – climate and weather parameters – Soil fertility and productivity. Crops – Classification, Crop adaptation and Distribution – Principles of plant distribution, Theories governing adaptation, Major Crops. Intensive cropping – Multiple cropping, Intercropping, Multistoried cropping. Crop Rotation, Cropping Patterns & Systems, Crop Production. Seasons and System of Farming

Unit - II	**Soils:**	**9**

Soil Phases – Liquid, Solid, Gaseous. Properties of soils – Physical Properties, Soil / Irrigability, Soil Water. Major soils in India – Alluvial, Black Soils, Red soils, Desert soils, Tarai soils, Saline and acid soils. Major soils in southern India

Unit - III	**Tillage & Seeds Sowing:**	**9**

Characteristics of good tillage – Types of tillage – Modern Concepts of tillage – Tillage implements – Primary, Secondary, inter cultural and special purpose. Seeds - Seed rate - Sowing methods - Germination - Crop stand establishment - Planting geometry

Unit - IV	**Irrigation and water management:**	**9**

Source of water – Surface and sub- surface. Crop water requirement, Irrigation requirement. Methods of irrigation – Gravity, Tank and Lift irrigation. Irrigation schedule and management. Measurement of irrigation. Soil moisture constants.

Unit - V	**Nutrient Management:**	**9**

Classification of Essential Elements - Based on the Relative Quantity, Chemical Nature, General Function, Mobility in Plants. Nutrients–Role, Deficiency, Method of Control and Toxicity - Organic Manures - Green Manure and Green Leaf Manure - Fertilizers - Classification - Bio Fertilizers - Factors Affecting Manures and Fertilizers Use - Time of Application - Method of Application - Integrated Nutrient Management.

Total:45

TEXT BOOK:

1.	Chandrasekaran, B., K. Annadurai and E. Somasundaram, "A Text book of Agronomy", 1st Edition, publishers, Scientific publishershers, Jodhpur, 2005.

REFERENCES:

1.	Yellamanda Reddy. T and G.H SankaraReddi, "Principles of Agronomy", 1st Edition, Kalyani publishers, Ludhiana, 2007.
2.	Mukund Joshi, "Text book of field crops", 1st Edition, PHI learning Pvt. Ltd, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 explain the crop characteristics and crop production	Understanding (K2)
CO2 select soils type suitable for particular crop production	Applying (K3)
CO3 identify the tillage methods and sowing methods	Applying (K3)
CO4 estimate irrigation and crop water requirement	Applying (K3)
CO5 explain the source, classify and method of nutrients	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2								1	1	1
CO2	3	2	3	2								1	1	1
CO3	3	2	3	2								1	1	2
CO4	3	2	3	2								1	1	2
CO5	3	2	3	2								1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	16	40	44				100
CAT3	30	40	30				100
ESE	30	40	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE22 - CANE SUGAR TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Heat transfer operations, Food Process Engineering I, Food Process Engineering II	7	PE	3	0	0	3

Preamble	To provides the knowledge on various unit operations involved in the sugar cane processing and its by-products

Unit - I	Introduction and Pre-processing Operation:	9

Introduction and Pre-processing Operation: Overview of sugar industry - composition of sugarcane, sugarcane parts and growth phase, manufacturing process of sugarcane juice, types of cane sugar, terminology. Harvesting indices, Cane cutting – Manual and Mechanical, Transportation, Cane conveyor, Washing, Shredding.

Unit - II	Juice Extraction:	9

Juice Extraction: Crushing –Types of crushers, crushing efficiency. Extraction of juice – methods. Accumulators – types. Maceration. Theory of cane diffusivity. Types of diffusers. Factors influencing Extraction of cane juice. Operating conditions and their influence on sucrose extraction, Weighing of juice - Maxwell Boulogne Scale and Magnetic Flow Meters.

Unit - III	Juice Clarification and Concentration:	9

Juice Clarification: Importance, methods, clarifying agent, bleaching agent. Role of pH, non-sugars, colloids and gums in cane juice clarification. Lime - specification, storage. Preparation of Milk of Lime (MOL), clarifier types, MOL tanks, lime pumps, use of hydrated lime powder. Sulphur -specification and storage, production of sulphur dioxide gas. Juice Concentration: Importance- types of heaters- construction and working of tubular heater, Direct Contact Heater (DCH), Plate Heater (PHE), advantages and disadvantages. Evaporator- types- performance measures.

Unit - IV	Crystallization and Refining:	9

Crystallization and Refining: Sugar boiling, Nucleation and crystal growth, super saturation and meta stable stage, seeding – shock seeding, true seeding. Crystallizers. Refining - Brown sugar, importance of refining, Affination, clarification, carbonation, sulphitation, phosphitation, decolorization, centrifugation - dewatering of sugar. Drying. Bagging and storage. Factors affecting sugar refining process.

Unit - V	Manufacturing of Jaggery/ Gur and other by products:	9

Manufacturing of Jaggery/ Gur and other by products: Extraction of Juice, Clarification of Gur, Concentration of Juice, Drying and grading of Gur, Storage of Gur. Byproducts - Drying and uses of Bagasse - Back strap Molasses - Characteristics of Molasses. Direct Utilization of Molasses - Distilling Industries - Applications in animal feed – Biogas – Biofertilizers production- Inverted syrup.

Total:45

TEXT BOOK:

1. Kulkarni D.P, "Cane Sugar Manufacture in India", 1st Edition, The Sugar Technologists Association of India, 2009.

REFERENCES:

1. Heriot T.H.P, "The Manufacture of Sugar from the Cane and Beet", 1st Edition, Read Books, New York, 2008.
2. Peter Rein, "Cane Sugar Engineering", 2nd Edition, Verlag Dr. Albert Bartens KG, Germany, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 outline sugarcane constituents and pre-processing operations	Understanding (K2)
CO2 make use of suitable sugarcane juice extraction process	Applying (K3)
CO3 choose appropriate clarification and concentration methods for sugarcane juice	Applying (K3)
CO4 plan sequential steps involved in sugar crystallization and refining	Applying (K3)
CO5 apply the acquired knowledge for manufacturing of cane sugar by-products	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1		1							1	2	1
CO2	3	2	1		2							1	3	2
CO3	3	2	1		2							1	3	2
CO4	3	2	1		2							1	3	2
CO5	3	2	1		1		1					2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	30	40	30				100
CAT3	24	56	20				100
ESE	40	30	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE23 - BEVERAGE TECHNOLOGY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Process Engineering I, Food Chemistry	7	PE	3	0	0	3

Preamble	To gain knowledge on process involved in development of different beverages and quality assessment.	
Unit - I	**Introduction**:	**9**

Current status of beverage industry in India- Types of beverages- Non-Alcoholic and Alcoholic. Nutritional and therapeutic benefits. Raw materials - Water, Sweeteners, Bulking agents, Acidulants, Emulsifiers, Stabilizers, Flavoring and Coloring agents.

Unit - II	**Non Alcoholic Beverages**:	**9**

Natural Fruit based beverages, Fermented non alcoholic beverages (kombucha, kefir), Synthetic/Artificial beverages. Carbonated beverages- Properties of carbon dioxide, carbonation – carbonators. Preparation of syrup, filling and packaging. Measurement of carbonation. Dairy based beverages – whey based beverages and flavored milk.

Unit - III	**Alcoholic Beverages:**	**9**

Types of alcoholic beverages. Wine – types – production and defects. Beer – Types – Production and defects. Distilled beverages – Brandy, Whiskey, Rum, Gin – Production and defects.

Unit - IV	**Specialty Beverages:**	**9**

Coffee and Instant Coffee production. Recent trends in coffee based beverages – Cappuccino, Mocha, Espresso and Latte. Production of Tea based beverages – Instant Tea, Tea Concentrates, RTD Tea beverages. Malt beverages– Branded malt beverages in market. Cocoa Based Beverages. Traditional Beverages – Neeri, Sugar cane juice, Tender coconut water and Herbal water. Sport beverages – Physiological needs and formulation.

Unit - V	**Quality Assurance in Beverage Industry:**	**9**

Effective application of quality controls- Sanitation and Hygiene in Beverage industries. Quality of water in beverages. Threshold limits of ingredients according to FSSAI, EFSA & FDA. Packaging standards for beverages and recent trends.

Total: 45

TEXT BOOK:

1.	Philip R. Ashurst, **"**Chemistry and Technology of Soft Drinks and Fruit Juices", 2nd Edition, Blackwell Publishing Ltd., UK, 2005.

REFERENCES:

1.	Paquin P., "Functional and Speciality Beverage Technology", 1st Edition, Wood Head Publishing in Food Science Technology and Nutrition, USA, 2009.
2.	Bamforth, "Brewing: New Technologies", 1st Edition, Woodhead Publishing Limited, England, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the ingredients for production of beverages	Understanding (K2)
CO2	make use of suitable techniques for development of non-alcoholic beverages	Applying (K3)
CO3	explain the production of alcoholic beverages and identify the defects	Applying (K3)
CO4	apply the knowledge of processing specialty beverages	Applying (K3)
CO5	apply the regulatory aspects for the quality control in beverage industry	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										2	1
CO2	3	2	2		1	1						1	3	2
CO3	3	2	2		1							1	3	2
CO4	3	2	2		1							1	3	2
CO5	3	2	3			2		2				2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1 50 Marks	20	60	20				100
CAT2 50 Marks	20	40	40				100
CAT3 50 Marks	20	40	40				100
ESE 100 Marks	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE24 - TRADITIONAL FOODS

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To learn about the popular indigenous foods of India and other countries and also improvisation of such foods.

Unit - I	Introduction about Traditional Foods	9

Introduction, Definitions of traditional foods, History of Indian Foods, Traditional classification of Indian Foods. Concepts of Ayurveda in health foods. Role of traditional foods in meeting macro and micronutrients, role in dietary patterns. Traditional foods versus Junk foods. Benefits of traditional foods. List of traditional foods of India and around the world. Fermented and unfermented traditional foods.

Unit - II	Grain Based Traditional Foods	9

Traditional cereal and legume based foods - Idli, Dosa, Dhokla, Selroti, Sez, Khaman, Bhattejaanr, Anarshe, Balam, Kishk, Soy sauce, Kinema, Tarhana, Hawaijar, Ogi, Kenkey, Pozol, Injera, Kisera. Traditional millet based foods. Traditional cereal-based fermented beverages - Beer, sake, Koozhu, Bouza, Chicha, Mahewu, Boza, Kunu-zaki.

Unit - III	Fruits, Vegetables, Dairy, Meat and fish based Traditional Foods	9

Sauerkraut, Fermented or Pickled cucumber, Kimchi, Traditional cassava foods - Fufu, Mingao, Farinha, Cassava rice, Sago wafers, Macroni, Gari. Traditional Dairy Foods: Traditional and improved methods of Khoa, Chhana, Paneer, Shrikhand, Ghee. meat, fish based traditional and fermented foods.

Unit - IV	Minimal Processing and Health aspects of Traditional Foods	9

Minimal Processing of Traditional Foods - Photochemical and non-photochemical processes Health Aspects of Traditional 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

Unit - V	Laws and Regulations of Traditional Foods: Past, Present and Future	9

Introduction, Development of Food Regulations and Food Law, From Past to Present: A Global Perspective, Current Frameworks and Issues-Food safety and international standards, Trade standards and regulation of Middle east, Africa, china and south east asia and latin America, Intellectual Property: Geographical Indications (GIs),The Future: Traditional Foods in a Global Marketplace.

Total: 45

TEXT BOOK:

1.	McElhatton, Anna & El Idrissi, Mustapha Missbah , "Modernization of traditional food processes and products", 1st Edition, Springer, USA, 2016.

REFERENCES:

1.	Mohammed Al-Khusaibi, Nasser Al-Habsi & Mohammad Shafiur Rahman, "Traditional Foods: History, Preparation, Processing and Safety", 1st Edition, Springer, UK, 2019.
2.	V.K. Joshi., "Indigenous Fermented Foods of South Asia", 1st Edition, CRC Press, 2016.
3.	Jyoti Prakash Tamang, Kasipathy Kailasapathy , "Fermented Foods and Beverages of the World", 1st Edition, CRC Press, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Outline the historical and traditional perspective of foods and food habits	Understanding (K2)
CO2	Explain the preparation of grain based tradition foods	Understanding (K2)
CO3	Illustrate production of fruits and vegetables, dairy based traditional foods	Understanding (K2)
CO4	Apply minimal processing techniques in traditional foods in concern with health aspects	Applying (K3)
CO5	Summarize the laws and regulations related to traditional foods	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1									1	1	1
CO2	3	2	2		1							1	2	1
CO3	3	2	2		1							1	2	1
CO4	3	2	2		1							1	2	1
CO5	1	2	1		1	2		3				1	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	20	40	40				100
ESE	40	40	20				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE25 - AGRI BUSINESS MANAGEMENT AND RETAIL MARKETING

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To understand the management aspects of agricultural business and retail operations.	
Unit - I	**Introduction on Agribusiness and Marketing:**	**9**

Definition, Structure, Features of agribusiness, Importance of agribusiness, Role of agriculture in Indian economy, Linkages among sub Marketing and distribution in Agribusiness: Marketing of agriculture inputs, models and theories of agricultural marketing, Characteristics of production, consumption and marketable surplus of agribusiness in India. Distribution management – storage, warehousing and transportation management of agricultural products; marketing agencies/intermediaries

Unit - II	**Export and Financial in Agribusiness:**	**9**

objectives of pricing policies, Marketing policies and practice for agribusiness - determinants of price, Export of Agro products: legal requirements, steps and issues, Selection of market and channels of Export. Financial in Agribusiness: Assessment of financial requirement of agribusiness unit, Working capital management - concept and components of working capital, need for working capital in agribusiness, inventory for agribusiness. agribusiness financing systems - functioning of cooperative credit institutions, commercial banks, regional rural banks, NABARD

Unit - III	**Small scale Agribusiness and Retailing:**	**9**

Small Scale Industry in Indian Economy, Development: definition, importance, growth stages, and entrepreneurial opportunities in modern agriculture. Overview of retailing: Concept of retailing, importance of developing and applying retail strategy, strategic options for retailers, types of retail markets, Forms of retailing: direct marketing, electronic retailing, Retailing implications of consumer demographics and lifestyles, consumer decision making process.

Unit - IV	**Retail Management and Planning:**	**9**

Retail management: definition, importance and elements, functions of retail manager, Retail planning: definition, characteristics, importance, classification of retail planning, steps in planning, identification of consumer characteristics and needs, Considerations in planning retail strategy mix, food-oriented retailers. Managing retail business: Setting up retail organization, Strategic Profit model of asset management, blueprint of retail business operation.

Unit - V	**Retail Organization and Directing:**	**9**

Organization- definition, characteristics, importance, steps in retail organization process, Directing: Supervision, leadership, functions of leader, types of communication, Nature of communication.

Total:45

TEXT BOOK:

1.	David Van Fleet, Ella Van Fleet & George J. Seperich, "Agribusiness: Principles of Management", 1st Edition, Cengage Learning, USA, 2013.

REFERENCES:

1.	Barton A Weitz, Dhruv Grewal & Micheal Levy, "Retailing Management", 9th Edition, McGraw-Hill Education, New Delhi, 2013.
2.	Barry R. Berman, Joel R. Evans & Patrali M. Chatterjee, "Retail Management", 13th Edition, Pearson Education Limited, UK, 2017.
3.	Jay T. Akridge, Freddie Barnard & Frank J. Dooley, "Agribusiness Management", 4th Edition, Routledge, New York, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the importance of agribusiness industry, working of retailing works and factors influencing it	Understanding (K2)
CO2	summarize the contribution of small scale agri-industry and sustainable competitive advantage through optimization of available resources	Understanding (K2)
CO3	plan and identifying more insight about consumer buying segment	Applying (K3)
CO4	make use of good communication, team-building, leadership and applied management skills to develop a business	Applying (K3)
CO5	develop management skills relevant for human capital use and plan merchandise presentation to influence customer's buying decision	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2								1	1	2		2
CO2	2	2								2	1	2		2
CO3	2	2	1							1	1	2		2
CO4	2	2	1							2	2	2		2
CO5	2	2	2							2	2	2		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	60	10				100
CAT3	20	60	20				100
ESE	20	60	20				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE26 - FOOD ADDITIVES AND NUTRACEUTICALS

Programme & Branch	B.TECH. – FOOD TECHNOLOGY	Sem.	Category	L	T	P	Credit
Prerequisites	**Food Chemistry**	8	PE	3	0	0	3

Preamble	To provide deeper insight to students on role of food additives and nutraceuticals on food Product Development.

Unit - I	**Food Additives Introduction:**	**9**

Definition; Types and their function in food processing; Preservatives –definition; natural preservatives; chemical preservatives; acidulants and low pH –organic acids and esters; sulphur dioxide and its salts; nitrites; antibiotics; surface preservation; Permitted preservatives in foods –Antioxidants; natural and synthetic antioxidants; mechanism of antioxidant function; primary and secondary antioxidants; selection and application of antioxidants in foods; evaluation of antioxidant effectiveness –permitted antioxidants in foods. Sequestarants and its functions.

Unit - II	**Food Colorants, Flavors, Emulsifiers and Stabilizers:**	**9**

Natural and synthetic colorants; inorganic pigments; application of colors in food industry; Non permitted colorants restriction on the use of colors in foods. Flavoring agents –concept of flavors in foods; natural flavors; nature identical flavors; artificial flavoring substances; restrictions on the use of flavoring agents in Foods. Emulsifiers and Stabilizers - Definition, properties of HLB value; function of emulsifiers and stabilizers in foods; permitted emulsifiers and stabilizers used in foods; - polyols –physical and chemical properties of polyols, application in food industry, permitted polyols in foods.

Unit - III	**Safety, Regulation and Quality Standards:**	**9**

Safety limits of Food additives; FSSAI regulations And GRAS additives Risk assessment and risk benefit Indices of human exposure, acute toxicity, mutagenicity and carcinogenicity, reproductive and developmental toxicity, teratogenicity, neurotoxicity and behavioral effect, immune toxicity. Determination of the limit for addition – NOEL – Method of determining toxicity – LD50. FSSAI regulations and GRAS additives.

Unit - IV	**Functional Foods and Nutraceuticals:**	**9**

Introduction, definition. Difference between functional foods and nutraceuticals. Examples for fortified functional foods. Plant and animal based nutraceuticals. Health benefits of Polyphenols, Flavonoids, Omega-3 Fatty Acids, Carotenoids. Technologies to recover Nutraceuticals compounds: Distillation, ultrahydrostatic pressure treatment, dense carbon-di-oxide treatment, encapsulation of nutraceuticals – materials, mechanical processes and chemical based processes, nano encapsulation.

Unit - V	**Role in Health Promotion and Disease Prevention:**	**9**

Nutraceuticals in prevention and treatment of gastrointestinal disorder, Probiotics Cardiovascular and Chronic Diseases. End User Market Products with current product updates - supplements forms- tablets, capsules, powders, soft gels, gel caps, liquids; Nutraceuticals currently available in the market, regulation for nutraceuticals.

Total:45

TEXT BOOK:

1.	Wildman, Robert E.C, "Book of Nutraceuticals and Functional Foods", 2nd Edition, CRC Press, New York, 2006.

REFERENCES:

1.	Belitz H.D., Grosch W. and Schieberle P, "Food Chemistry", 3rd Edition, Springer-Verley, Berlin, 2004.
2.	Clare M. Hasler, "Regulation of Functional Foods and Nutraceuticals: A Global Perspective", 1st Edition, Wiley, Chicago, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 Select appropriate preservatives and antioxidants.	Understanding (K2)
CO2 Choose suitable food colours, flavours, emulsifiers and stabilizers	Applying (K3)
CO3 Relate the safety, regulations and quality standards to food additives in food processing	Understanding (K2)
CO4 Identify technology to recover nutraceuticals.	Applying (K3)
CO5 Identify the effect of nutraceuticals in health promotion and disease prevention	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1										3	3
CO2	3	3	1										3	3
CO3	3	3	2		1								1	3
CO4	3	3	1		1								3	3
CO5	3	3	2		1								2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	50	30				100
CAT3	20	20	60				100
ESE	30	30	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE27 - FOOD ALLERGENS AND TOXICOLOGY

Programme &Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food Chemistry , Food microbiology	8	PE	3	0	0	3

Preamble	To provide knowledge on toxicology related to food and the human food chain.	
Unit - I	**Introduction to Food Toxicology:**	**9**

Definition and need for understanding food toxicology; Hazards -Microbiological, nutritional and environmental. Basics of immune response - humoral and cell mediated response. Allergen and mechanism of allergic response.

Unit - II	**Natural Toxins, Food Allergy and Sensitivity:**	**9**

Toxins–Natural toxin in animal and plant foods. Microbial toxins- toxin characteristics. Chemistry of food allergens, celiac disease, asthma, food disorders associated with metabolism- lactose intolerance, favism. Antitoxicants in foods and their functions

Unit - III	**Toxicants Formed During Food Processing:**	**9**

Intentional direct additives: preservatives, nitrite and N- nitroso compounds, 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

Unit - IV	**Assessment of Toxicants in Food Sampling:**	**9**

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, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.

Unit - V	**Instrumentation Techniques to Detect Toxins:**	**9**

Chromatography, Principles, procedure and applications of Thin layer chromatography, Gas chromatography column chromatography, Ion exchange chromatography and High performance liquid chromatography. Spectrophotometry, Principles, Instrumentation and applications of Atomic Absorption Spectrophotometry (AAS) and Atomic Emission Spectrophotometry (AES).

Total:45

TEXT BOOK:

1.	Helferich, William and Carl K. Winter, "Food Toxicology", 1st Edition, CRC Press, New York Washington, 2001.

REFERENCES:

1.	Labbe, Ronald G. and Santos Garcia, "Guide to Food Borne Pathogens", 2nd Edition, John Wiley and Sons, UK, 2001.
2.	Cliver, Dean O., and Hans P. Riemann, "Food Borne Diseases", 2nd Edition, Academic Press, London, 2002.
3.	Maleki, Soheila J. A., Wesley Burks, and RickiM.Helm, "Food Allergy", 1st Edition, ASM Press, USA, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the concepts of food toxicology	Understanding (K2)
CO2	classify toxins, allergens and interpret its sensitivity in human food chain	Understanding (K2)
CO3	identify toxicants formed during food processing	Applying (K3)
CO4	analyse the risks involved in human exposure to toxicants	Analyzing (K4)
CO5	select suitable method for detection of toxins	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			2	1							3
CO2	3	2	2			3	1					1		3
CO3	3	2	3	2	1	3	2					1	2	3
CO4	3	2	3	2	2	3	2					1	2	3
CO5	3	2	3	2	3	1						2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	40	20				100
CAT3	30	40	20	10			100
ESE	30	35	25	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE28 - FOOD PROCESS PLANT LAYOUT AND SAFETY

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	To give the knowledge about the plant layout and design considerations, different hazards and Industrial safety

Unit - I	**Introduction and Plant Location:**	**9**

Introduction: Classifications of food industries - Plant design concepts - situations giving rise to plant design problems - general design considerations - differences in design of food processing and non-food processing plants. Feasibility study: Steps involved including planning of the study - collection of information - information flow diagrams – market analysis, technical analysis and preparation of feasibility report. Plant location: Factors affecting plant location, their interaction with plant location, theory models for evaluation of alternate locations. Plant size: Economic plant size - factors affecting the plant size - raw materials availability, market demand, competition in the market - return on investments. Procedures for estimation of economic plant size - break even analysis and optimization techniques

Unit - II	**Plant Layout, Equipment selection and Utilities:**	**9**

Plant Layout: considerations involved in planning an efficient layout. Types of layouts. Preparation and development of layout for different food processing Industries. Equipment symbols-flow sheet symbols - electrical symbols - graphic symbols for piping systems including pipe fitting and valves. Standards for space requirements - distances between critical plant areas and for setting different plant facilities. Development of the pilot layout: Size and structure of the pilot plant, minimum and maximum size, types and applications. Equipment selection and Utilities: Process equipment - material handling equipment – service equipment- valves and fittings - instruments and controls- considerations involved in equipment selection. Services and Utilities: Estimation of Services such as Cafeteria, locker rooms, water closets, sinks, parking lots, exercise area. Office Layout. Line Balancing and Line balancing techniques

Unit - III	**Food Plant Building and Construction:**	**9**

Food Plant Building: General requirements and considerations for construction, materials and floors. Drains and drain layout. Ventilation, fly control, mould prevention, illumination in food plants. Requirements of the steam, refrigeration, water, electricity, Cleaning , sanitization, CIP system, dust removal and fire protection. Materials of construction and colour coding: Characteristics of suitable construction material: Stainless steel, Aluminum, Nickel and Monel, Plastic Materials. Maintenance of Food Plant Building: Safety Colour Code, Roof Inspection, Care of Concrete floors. Colour Coding: Colour – Code System - Specific Hazards Colour codes for buried pipes and cables. Colour Scheme for pipes.

Unit - IV	**Industrial Safety and Safety Performance:**	**9**

Industrial Safety: Process industries, potential hazards, toxic chemicals and physical safety analysis, high pressure, high temperature operation, radioactive materials, safe handling and operation of machineries. Safety Performance: Safety Appraisal, effective steps to implement safety procedures, periodic inspection and safety procedures; proper selection and replacement of handling equipment, personal protective equipments.

Unit - V	**Accidents, Health Hazards and Legal Aspects:**	**9**

Accidents: Industrial accidents–accident costs–identification of accident spots, remedial measures, identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fire prevention and fire protection. Health Hazards And Legal Aspects: Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – Labour welfare act – ESI Act – Workmen Compensation Act.

TEXT BOOK: **Total:45**

1.	Sean Moran , "Process plant layout", 2nd Edition, Butterworth-Helnemann, New York, 2017.
REFERENCES:	
1.	Basudev panda , "Industrial Safety Health Environment and Security", 1st Edition, Laxmi publications, New Delhi, 2013.
2.	George D.Saravacor, Athanasios E.Kostropoulos, "Design Food Processes and Food Processing Plants", 1st Edition, Springer, New York , 2012.
3.	Antonio Lopez-Gomez, Gustavov.Barbosa-Canovas , "Food Plant Design", 1st Edition, CRC Press , New Delhi, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	identify suitable plant location and feasibility for food Industries.	Applying (K3)
CO2	select suitable plant layout for food processing industries	Applying (K3)
CO3	infer the requirements of food industry and food process equipment construction	Understanding (K2)
CO4	apply the acquired knowledge for prevention of industrial hazards	Applying (K3)
CO5	outline the health hazards and legal aspects in industries	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1		1	1					1	2	2
CO2	3	2	3	1		1	2					1	2	3
CO3	3	2	3			3	2					2	2	3
CO4	3	1	3			3	3					1	1	3
CO5	3	1	2			3	2					1	1	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	40	40	20				100
CAT3	40	40	20				100
ESE	30	40	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE29 - INDUSTRIAL WASTE WATER TREATMENT

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	To provide knowledge on treatment of different industrial effluents	
Unit - I	**Physical Methods:**	**9**

Introduction: Classification and characterization of wastes from different industries. Need for treating wastes, COD, BOD content Physical Methods: Principles of Screening – Mixing, Equalization – Sedimentation - Filtration, back washing – Accelerated gravity separation – Evaporation- Adsorption– Principles, - Membrane separation - Reverse Osmosis, nanofiltration, ultrafiltration – electrodialysis.

Unit - II	**Chemical Methods:**	**9**

Chemical Methods: Principles of Chemical treatment – Coagulation, flocculation, Precipitation, floatation. Ion exchange, Electrolytic methods, Solvent extraction, ozonation, advances oxidation/reduction –disinfection.

Unit - III	**Aerobic Biological Treatment:**	**9**

Biological Treatment - Aerobic: Objectives of biological treatment – significance – kinetics of biological growth. Biological treatment process: aerobic suspended growth treatment process-activated sludge process, aerated lagoons, stabilization ponds, oxidation ditch - aerobic attached growth treatment process-trickling filters.

Unit - IV	**Anaerobic Biological Treatment:**	**9**

Biological Treatment- Anaerobic: Suspended growth treatment process-anaerobic digestion, USAB reactors Anaerobic attached growth treatment process-Rotating biological contactors anaerobic, filter process expanded bed..

Unit - V	**Solid Waste Management and Design of Wastewater Plant:**	**9**

Solid Waste Management: Sludge treatment process- sludge thickening, sludge digestion, sludge conditioning, sludge dewatering, thermal reduction and disposal of sludge. Composting, incineration, Pyrolysis, Briquetting. Design Aspects: Selection of unit operations and processes - Design of water treatment plant units – aerators, flocculation, clarifier, filters, chlorinators and thickeners.

Total:45

TEXT BOOK:

1.	Metcalf & Eddy, "Waste water Engineering, Treatment and Reuse", 4th Edition, Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

1.	Qasim S.R., Motley E.M & Zhu G, "Water Works Engineering: Planning, Design and Operation", 2nd Edition, Prentice Hall, New Delhi, 2006.
2.	Lawrence K. Wang, Yung-Tse Hung & Nazih K. Shammas , "Handbook of Environmental Engineering Physicochemical Treatment Processes", 1st Edition, Springer Science & Business Media, New Jersey, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify different industrial wastes and choose appropriate physical method of treatment	Applying (K3)
CO2	select suitable chemical method for waste water treatment	Applying (K3)
CO3	elaborate waste water treatment by aerobic method	Understanding (K2)
CO4	interpret anaerobic treatment of industrial effluent	Understanding (K2)
CO5	plan a wastewater treatment unit and manage solid waste	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1		2	2					1	1	2
CO2	3	1	1	1		2	2					1	1	2
CO3	3	2	1	1		2	2					1	1	2
CO4	3	2	1	1		2	2					1	1	2
CO5	3	1	2	2		2	2					1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTE30 - ANALYTICAL INSTRUMENTS IN FOOD INDUSTRIES

Programme & Branch	B.TECH. – Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Food chemistry	8	PE	3	0	0	3

Preamble	To provide knowledge on role of analytical instruments in food industries.	
Unit - I	**Spectrometry:**	**9**

Spectrometry: Classification of Instrumental methods– Electromagnetic radiation – electromagnetic spectrum, Interaction of electromagnetic radiation with matter. Colorimetry and Visible spectrometry – Theory, Block diagram aspects of Instrumentation and applications. Ultra violet spectroscopy – Theory, instrumentation - Single and Double beam, applications. Infrared spectroscopy – Theory, Fundamental Vibrations, Instrumentation, Applications.

Unit - II	**NMR spectroscopy, Flame photometery and Thermal methods:**	**9**

NMR spectroscopy &Flame photometery: NMR spectroscopy - Principle, Chemical shift, Instrumentation, applications. Flame photometer: Principle, Instrumentation and applications. Thermal methods – Thermogravimetry, Differential thermal analysis, Differential Scanning Calorimetry, Instrumentation and Applications..

Unit - III	**XRD, Atomic Absorption Spectroscopy, Polarimetry and Refractometry:**	**9**

X-Ray &Atomic Absorption Spectroscopy: X-ray diffraction Principle, Instrumentation, various methods of diffraction and applications. Atomic Absorption Spectroscopy: Theory, Instrumentation, applications. Polarimetry and Refractometry: Introduction on specific rotation, optical activity, refractive index, Principle and instrumentation. Saccharimetry- Analysis of Sugar.

Unit - IV	**Conductance, Potential measurements & Electrophoresis:**	**9**

Conductance, Potential measurements & Electrophoresis: Definitions, conductance measurements, applications, Types, advantages and disadvantages of Conductometric titrations. Potential measurements: pH determination, Potentiometric Titrations. Electrophoresis: Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, PAGE and SDS –PAGE.

Unit - V	**Chromatographic Techniques:**	**9**

Chromatographic Techniques: Paper chromatography, Thin Layer Chromatography, Column Chromatography - Gel permeation chromatography, Gas chromatography, HPLC- Principle, Reverse and Normal Phase, Instrumentation and Applications.

Total:45

TEXT BOOK:

1. Chatwal, Gurdeep R & Anand, Sham K, "Instrumentation Methods of Chemical Analysis", Himalaya Publications, Bombay, 2003.

REFERENCES:

1. Skoog Douglas A., West Donald M., Holler F James & Crouch Stanley R, "Analytical Chemistry: An Introduction", 7th Edition, South-Western, Australia, 2000.
2. Willard H.H., Merritt L.L., Dean J.A & Settle F.A, "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, New Delhi, 1988.
3. Rouessac F, "Chemical Analysis: Modern International Method and Techniques", 7th Edition, Wiley, New Delhi, 1999.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 summarize the interaction of electromagnetic radiation with matter and UV-Visible, IR usage	Understanding (K2)
CO2 apply AAS, NMR & Thermal techniques to analyze different food materials.	Applying (K3)
CO3 utilize X- ray diffraction, flame photometery and Polarimetry techniques to analyse food materials	Applying (K3)
CO4 make use of conductance, potential measurement and electrophoresis for analysis and separation of components.	Applying (K3)
CO5 separate and analyse food materials by different chromatographic techniques	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3	2							2	2	3
CO2	3	3		2	2							1	1	3
CO3	3	3		3	2							2	2	3
CO4	3	3		2	2							2	1	3
CO5	3	3		3	2							2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY						
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	40	40	20				100
CAT3	30	40	20	10			100
ESE	20	30	30	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO01 - BAKING TECHNOLOGY
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	OE	3	0	2	4

Preamble	To gain knowledge on science and technology of various bakery products

Unit - I	**Science Behind Baking:**	**9**

Science Behind Baking: Current status of Bakery Industry in India, Classification of bakery products. Bakery ingredients and their functions-flour, yeast, sugar, fat, egg, water, salt, coloring agents, flavoring agents, milk, milk powder, emulsifiers, leaveners, antioxidants and improver.

Unit - II	**Bakery Equipment:**	**9**

Equipment: Handling of ingredients- dough mixers, dividers, rounder, sheeter, laminating equipment, fermentation enclosures and brew equipment, ovens and slicers. Rheology of dough-Farinograph, Amylograph, Alveograph, and Extensograph.

Unit - III	**Bread Making Process:**	**9**

Bread Making Process: Chemistry of dough development. Bread making methods - Straight dough/Bulk Fermentation, sponge and dough, activated dough development, Chorley wood bread process. No time process Characteristics of good bread- Internal and external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.

Unit - IV	**Biscuit and cookies:**	**9**

Biscuit and cookies: Comparison of Biscuits and Cookies, Types of Dough - Developed dough, short dough's, semi-sweet, enzyme modified dough and batters. Methods of biscuit and cookie manufacture. Stability of biscuit and cookie products. Quality attributes in cookies and biscuits.

Unit - V	**Cakes and other bakery products:**	**9**

Cakes and other bakery products: Cake – Types, Cake making- Ingredients and their function, Methods for different types of cakes manufacture, Faults in cake manufacture, Miscellaneous bakery products production - Wafers, puff pastry, and chemically leavened bakery products, Quality attributes of bakery products.

List of Exercises / Experiments :

1.	Estimation of quality parameters of bakery ingredients.
2.	Estimation of wet and dry gluten content of wheat flour.
3.	Determination of dough rising capacity of yeast.
4.	Estimation of diastatic activity and maltose value of flour
5.	Estimation of water absorption power, alkaline water retention and sedimentation value of flour.
6.	Preparation and analysis of bread.
7.	Preparation and analysis of biscuits.
8.	Preparation and analysis of cake.
9.	Preparation and analysis of cookies.
10.	Preparation and analysis of puff pastry.

Lecture: 45, Practical:15, Total:60

TEXT BOOK:

1.	Samuel A. Matz, "Bakery Technology and Engineering", 3rd Edition, Chapman and Hall, London, 2005.

REFERENCES:

1.	Cauvain Stanley P & Young Linda S, "Technology of Bread Making", 3rd Edition, Springer, US, 2015.
2.	Servet Gulum Sumnu& Serpil Sahin, "Food Engineering Aspects of Baking Sweet Goods", 1st Edition, CRC Press, USA, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the role of ingredients for production of bakery products	Understanding (K2)
CO2	select appropriate equipment for baking process	Applying (K3)
CO3	identify and apply processing techniques for bread manufacturing process	Applying (K3)
CO4	choose suitable processing techniques for preparation of biscuits and cookies	Applying (K3)
CO5	make use of various methods for cakes, wafers and pastry	Applying (K3)
CO6	analyze the quality of ingredients used for in preparation of bakery products	Analyzing (K4), Precision (S3)
CO7	evaluate the quality of flour based on gluten content, sedimentation value and diastatic activity	Evaluating (K5), Precision (S3)
CO8	prepare bakery product and evaluate it sensory characteristics	Evaluating (K5), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									2	2	2
CO2	3	2	1		1	1						2	3	1
CO3	3	3	2	1	1	1						2	3	1
CO4	3	3	2	1	1	1						2	3	1
CO5	3	3	2	1	1	1						2	3	1
CO6	3	3	2	3		1			3	2	2	1	2	3
CO7	3	3	2	3		1			3	2	2	2	2	3
CO8	3	3	3	3		1			3	2	2	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	30	35	35				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO02 - FOOD PROCESSING TECHNOLOGY
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	OE	3	1	0	4

Preamble	To provide insight about the processing and preservation methods used for various food materials.	
Unit - I	**Introduction:**	**9+3**

Scope of food science and technology, Food - Definitions and functions, Sources of food, scope and benefit of industrial food preservation, Constituents of foods, RDA, malnutrition and balanced diet. perishable, non-perishable food commodities, Food as source of energy.

Unit - II	**Ambient Temperature processing:**	**9+3**

Size reduction of solids, size reduction of liquids, mixing, forming, separation- centrifugation, filtration, extraction, concentration - theory and equipments.

Unit - III	**High temperature preservation:**	**9+3**

Introduction, Principles and methods - Canning& retorting, – flowsheet, blanching, pasteurization - packed and unpacked foods, Sterilization - in-container and UHT sterilization, evaporation and distillation - theory and equipments, drying and dehydration - mechanism and types.

Unit - IV	**Low temperature preservation:**	**9+3**

Introduction-need &methods - Chilling and Freezing - theory and equipments, principle and effect on food quality, refrigerated and cold storage. Controlled atmosphere and modified atmosphere storage, Freeze concentration.

Unit - V	**Food Fermentation and Irradiation**	**9+3**

Theory of fermentation, Types of Fermentation, equipments, effect on foods, fermented food products - soy sauce, curd, sauerkraut, vinegar - role in human health.
Theory and mechanism of action, sources of irradiation, equipments, applications in foods, effect on food materials.

Lecture: 45, Tutorial :15, Total:60

TEXT BOOK:

1. Fellows P.J., **"Food processing Technology: Principles and Practice",** 3rd Edition, Woodhead Publishing Ltd., New Delhi, 2009.

REFERENCES:

1. Paul Singh R and Dennis R. Heldman, **"Introduction to Food Process Engineering"**, 5th Edition, Academic Press, USA, 2014
2. Sivasankar, B., "Food Processing and Preservation**"**, Prentice Hall of India, New Delhi, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 Classify different sources and types of food products	Understanding (K2)
CO2 Explain various ambient temperature processing of foods	Understanding(K2)
CO3 Select suitable high temperature preservation techniques	Applying (K3)
CO4 Make use of various low temperature food preservation techniques	Applying (K3)
CO5 Classify the types of fermentation, irradiation and interpret their role on food quality	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1	3	1
CO2	3	3	1	1								1	1	3
CO3	3	3	2	1								1	1	3
CO4	3	3	2	1								1	3	2
CO5	3	3	1	1								1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	40	40				100
CAT3	20	30	30	20			100
ESE	20	30	30	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO03 - PROCESSING OF MILK AND MILK PRODUCTS
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	0	2	4

Preamble	To impart the knowledge on milk processing and to exploit new uses for milk and its components	
Unit - I	**Processing of market milk:**	**9**
Practices for reception, chilling, clarification, and storage of raw milk. Homogenization of milk: Definition, pretreatment of milk, theories of homogenization, synchronization of homogenization with HTST; Pasteurization of milk: Definition, Classification and Process flow		
Unit - II	**Manufacture of special milks:**	**9**
Reconstituted and recombined milks, Flavoured milks, homogenized/ vitaminized milks. Lactose-hydrolysed milk. Aseptic packaging: Types of packaging approaches for sterilization of packages. Filling systems.		
Unit - III	**Manufacture of Coagulated products:**	**9**
Channa and paneer: Preparation and preservation; Prospects for mechanization of paneer manufacturing/packaging process, innovative approaches and integration with emerging technologies, Physico-chemical changes during manufacture and storage of paneer and channa		
Unit - IV	**Technology of fat-rich dairy products:**	**9**
Technology of Butter manufacturing, over-run in butter, control of fat loss, defects in butter, rheology of butter. Technology of ghee manufacturing, innovations in ghee manufacturing process, packaging of ghee; Manufacture of butter oil		
Unit - V	**Manufacture of Cheese:**	**9**
Cheddar, Gouda, Swiss, Mozzarella, Cottage cheese, Changes during manufacture and ripening of Cheddar Cheese, factors leading to losses during processing and handling; Manufacture of processed Cheese, Cheese spread and Processed Cheese foods.		

List of Exercises / Experiments :

1.	Preparation of homogenized market milk.
2.	Preparation of sterilized milk.
3.	Preparation of flavoured milk
4.	Preparation of channa.
5.	Preparation of paneer.
6.	Preparation of butter.
7.	Preparation of ghee.
8.	Preparation of cheddar cheese.
9.	Preparation of mozzarella cheese.
10.	Preparation of processed cheese.

Lecture: 45, Practical: 15, Total: 60

TEXT BOOK:

1.	Sukumar De, "Outlines of Dairy Technology", 7th Edition Royal Oxford University Press, New Delhi, 2010.

REFERENCES:

1.	Laboratory Manual
2.	Birendra Kumar Mishra, "Dairy and Food Processing Industry: Recent Trends", Astral International, 2014
3.	Y. H. Hui, "Dairy Science and Technology Handbook: Applications Science, Technology and Engineering",3rd Edition, Wiley, New Delhi, 2014

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand various aspects of milk process operations and physico-chemical properties of milk	Understanding (K2)
CO2	make use of technical knowledge in manufacture of special milks.	Applying (K3)
CO3	utilize technical knowledge in manufacture of coagulated milk products.	Applying (K3)
CO4	apply the technical knowledge in manufacture of fat rich dairy products.	Applying (K3)
CO5	make use of technical knowledge in manufacture of cheese and cheese products.	Applying (K3)
CO6	utilize the technical knowledge in preparation of homogenized milk	Applying (K3)
CO7	utilize the technical knowledge in preparation of paneer.	Applying (K3)
CO8	utilize the technical knowledge in preparation of butter.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1			1						1	2	1
CO2	3	2	2		2	1						2	3	2
CO3	3	2	2		2	2		1				2	3	3
CO4	3	2	2			2		1				2	3	2
CO5	3	2	2			2		1				2	3	2
CO6	3	2							3	2		1	3	2
CO7	3	2							3	2		1	3	2
CO8	3	2	1			1		1	3	2		1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	40	40	20				100
CAT3	40	40	20				100
ESE	40	40	20				100

* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)

20FTO04 - PROCESSING OF FRUITS AND VEGETABLES
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	0	2	4

Preamble	To provide the outline about physiology, post harvest changes, preservation and processing of various fruits and vegetables products

Unit - I	Physiology and post harvest changes of fruits and vegetables:	9

Scope of Fruits and Vegetables Processing Industry in India and World-present status. Classification of Fruits and Vegetables, Physiological Development, Harvesting methods, Postharvest changes of fruits and vegetables, Methods of reducing post harvest changes.

Unit - II	Preprocessing Operations and Storage Methods:	9

Precooling, Evaporative Cooling, Washing, Peeling, Grading, Blanching. Storage methods: Storage of fruit and vegetables - under ambient conditions, low temperature storage.

Unit - III	Preservation of Fruits and Vegetables products:	9

Chilling, Freezing, Pasteurization, Sterilization, Irradiation, Waxing, Edible coating, Controlled Atmospheric Storage (CAS), Modified Atmospheric Storage (MAS).

Unit - IV	Fruit beverages:	9

Classification of fruit beverages, Juice, Squash, cordial, Juice concentrate, nectar, Ready to Serve (RTS). Fermented fruit beverages – Wine, vinegar production. Juice making equipment.

Unit - V	Processing of fruits and vegetables products:	9

Production of Intermediate Moisture Foods (IMF) - jam, jellies and marmalades, Defects in Jam and Jelly. Candied preserve, fruit bar, tutti fruity, fruit powder, Fermented vegetables products – Pickle, sauerkraut.

List of Exercises / Experiments:

1.	Studies on blanching treatment on the fruits and vegetables
2.	Determination and comparison of peeling efficiency of different peeling methods
3.	Studies on waxing /edible coating of fruits and vegetables
4.	Preparation and analysis of squash
5.	Determination of juice extraction efficiency of screw press and pulper
6.	Preparation of jam and comparison with commercial product
7.	Preparation of jelly
8.	Preparation of fruit bar
9.	Preparation and study on characteristics of sauce.
10.	Preparation and analysis of fruit powder

Lecture: 45, Practical:15, Total:60

TEXT BOOK:

1.	Srivastava R.P & Sanjeev Kumar, "Fruit and Vegetable Preservation: Principles and Practices", 3rd Edition, CBS Publishers & Distributors, New Delhi, 2014.

REFERENCES:

1.	Rajarathnam S & Ramteke R.S, "Advances in Preservation and Processing Technologies of Fruits and Vegetables", 1st Edition, New India Publishing Agency, New Delhi, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret physiological and post harvest changes in fruits and vegetables	Understanding (K2)
CO2	select suitable storage and pre processing for fruits and vegetables	Applying (K3)
CO3	choose suitable preservation techniques employed for fruits and vegetables	Applying (K3)
CO4	make use of techniques to process different fruit beverages	Applying (K3)
CO5	develop various fruits and vegetable products	Applying (K3)
CO6	interpret the changes of fruits and vegetables upon blanching	Analyzing (K4), Manipulation (S2)
CO7	assess the performance of fruit processing equipments	Evaluating (K5), Precision (S3)
CO8	prepare and evaluate the characteristics of fruit/ vegetable based products	Evaluating (K5), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1			1						2	2	1
CO2	3	2	2		2	1						2	3	2
CO3	3	2	2		2	2		1				2	3	2
CO4	3	2	2			2		1				2	3	2
CO5	3	2	2			2		1				2	3	2
CO6	3	2							3	2		2	3	2
CO7	3	2							3	2		2	3	2
CO8	3	2	1			1		1	3	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	30	40	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO05 - PRINCIPLES OF FOOD SAFETY
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	To give insight on food hazards, safety aspect in food processing and regulations on food safety.	
Unit - I	**Introduction:**	**9**
Food safety- Definition; General principles of food safety. Need for 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.		
Unit - II	**Physical and Chemical food hazard :**	**9**
Metals, mineral (soil, engine oil, stones), plant (leaves, twigs, pods and skins), animal (hair, bone, excreta, blood, insects, larvae).Major pathways by which chemical residues and contaminants enter the food chain, Agrochemicals and veterinary drugs, packaging materials, process equipment and ingredient impurities. Food Adulterants, Food additives- permissible limits, concept of safe food.		
Unit - III	**Safety operations in Food processing :**	**9**
Plant Sanitation- Sanitizers, Cleaning chemistry CIP, Sanitation equipment. Personal hygiene, Good Manufacturing Practices: Prerequisites for Food Safety. HACCP-Concepts, implementation. Safety and Innovative Food Packaging. The Principles of Modern Food Hygiene.		
Unit - IV	**Safety Aspects of Water:**	**9**
Safety aspects of drinking water (microbiological and chemical) - the epidemiological triangle diseases caused by drinking of contaminated water , risks and advantages of chlorination of water ,bottled water - origin of water- nutritional and physiological aspect – setting of guideline values (microbiological and chemical), Regulations for bottled water.		
Unit - V	**Food Safety Regulations:**	**9**
History of Food Safety Regulation. Food safety and Standards Act (FSSAI) – organizational chart – role of individual authority –principles to be followed - Enforcement of the act – Licensing and registration of food business – Food safety officer and their powers. Food safety Management Systems.		

Total:45

TEXT BOOK:

1.	Schmidt, R.H. and Rodrick, G.E.**"Food Safety Handbook"** 2nd Edition, John Wiley & Sons Inc, New Jersy, 2005.

REFERENCES:

1.	Kees A. van der Heijden **"**International Food Safety Handbook: Science, International Regulation, and Control", 1st Edition, CRC Press, 1999.
2.	Rajesh Mehta and J. George "Food Safety Regulation Concerns and Trade- The Developing Country Perspective", 1st Edition , Macmillan India Ltd., New Delhi, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 outline the concept of food safety and appraise on microbial food safety	Understanding (K 2)
CO2 interpret physical and chemical food hazards	Understanding(K2)
CO3 identify implementation of suitable safety protocols in food processing	Applying (K3)
CO4 infer the safety aspects of water	Understanding (K2)
CO5 summarize the food safety regulations	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3			3	2	2				1	1	3
CO2	3	1	3			3	1	2				1	1	3
CO3	3	2	3			3	2	2				2	2	3
CO4	3	2	3		2	3	2	2				1	1	3
CO5	3	2	3			3	1	2				2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	40	40				100
CAT3	40	60					100
ESE	25	40	35				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO06 - FUNDAMENTALS OF FOOD PACKAGING AND STORAGE
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	To provide the knowledge about food packaging materials, methods and storage practices will be delivered by this course.

Unit - I	Food Packaging Materials:	9

Definitions and basic functions of a food package. Role of packaging. Packaging materials and their types - Paper-based packing, Metal packaging, Glass containers, Plastics, Natural materials. Food package design and development.

Unit - II	Food Packaging Closures and sealing systems:	9

Closures – functions, construction, types. Heat Sealing – Conductance, Impulse, Dielectric, Induction, Ultrasonic, Hot-Wire and Hot-Knife Sealing. Peelable Seals - Adhesive, Cohesive and Delamination Peels, Heat Seal Coatings, Nano composite Heat Sealants. Cold Seals. Packaging operations - bottling, canning, wrapping, cartooning, form fill sealing.

Unit - III	Packaging materials performance:	9

Physical and physico-chemical processes affecting product quality, migration from packaging to foods. Logistics activity - specific and integration issues. Distribution performance testing. Package standards and regulation. Printing Processes, Inks, Adhesives and Labeling of Packaging Materials. Bar coding.

Unit - IV	Grain storage engineering:	9

Storage of grains – biochemical changes during storage – production, distribution and storage capacity – ecology, storage factors affecting losses, storage requirements, bag and bulk storage – rat proof godowns and rodent control –method of stacking – preventive method, bio-engineering properties of stored products – function

Unit - V	Cold, MA & CA Storages:	9

Cold storage, Controlled and Modified atmosphere storage Cold storage, Controlled and Modified atmosphere storage – effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities Determination of cooling load.

Total:45

TEXT BOOK:

1. Richard Coles and Mark J. Kirwan, "Food and Beverage Packaging Technology", 2nd Edition, Blackwell Publishing Asia Pty Ltd, CRC press, USA, 2011.
2. Narayanasamy P., Mohan S and Awaknavar J. S, "Pest Management in Store Grains", 1st Edition, Satish Serial Publishing House, New Delhi, 2009.

REFERENCES:

1. Han Jung H., "Innovations in Food Packaging", 2nd Edition, Academic Press, USA 2013.
2. Robertson Gordon L, "Packaging: Principles and Practice", 3rd Edition, Marcel Dekker Inc, USA, 2012.
3. Nair K.R., "Integrated Production and Pest Management", 1st Edition, Gene-Tech Books publisher, Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 explain about the functions and types of food packaging	Understanding (K2)
CO2 make use of suitable sealing method depending on the application	Applying (K3)
CO3 infer the interaction between food, packaging material and labels	Understanding (K2)
CO4 select appropriate storage structures and preventive measures for pests	Applying (K3)
CO5 adapt suitable storage methods for grain storage	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1					1				1	1	2
CO2	3	3	2			1						1	2	3
CO3	3	3	2			1	1					1	2	3
CO4	3	3	2			1						1	2	3
CO5	3	3	2		1	1						2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	30	40	30				100
CAT3	20	30	50				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To provide the knowledge about the different types of food ingredients used in food products

Unit - I	**Macro Nutrients:**	9

Introduction to Macronutrients: Carbohydrates: classification - chemical composition and structure properties, nutritive roles – Important carbohydrates as ingredients in food application. Protein and Amino acids: classification, essential amino acids- protein structure, properties and application. Lipids: Classification – Nutritive importance- properties and food applications.

Unit - II	**Food: Additives-I:**	9

Food: Additives-I: Definition, need and classification of food additives. Sweeteners: Classification- Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role in food processing. Stabilizers, Thickeners and Emulsifiers: Introduction; types; applications in food processing; leavening agents, flour improving agents. Anti-caking agents and Humectants: Introduction; Types; Role in food processing.

Unit - III	**Food Additives-II:**	9

Food Additives-II: Acidulants - Introduction; types; Role in food processing. Preservatives: Introduction; Classification- Natural & chemical preservatives; Mode of action; Role in Food processing. Antioxidants: Introduction; Types of antioxidants -natural & synthetic; Mode of action in foods; Chelating agents- Naturally & synthetic; Mode of action in foods; Applications of antioxidants and chelating agents. Antimicrobial Agents: Classification- Role- application in foods.

Unit - IV	**Food Colorant and Flavorant:**	9

Food colorants: Introduction; Natural & Synthetic food colorants; classification- Chemical nature; Impact on health-legal aspects- application in foods processing. Flavoring agents: Introduction; Classification of flavors- natural & synthetic; flavor enhancer/ potentiator; Importance of taste and flavours; Role of flavoring agents in food processing.

Unit - V	**Nutraceuticals and phytochemicals:**	9

Nutraceuticals and phytochemicals: Definition, Classification. Dietary supplements, Functional foods - their legislation and health claims, Natural occurrence of certain phytochemicals. Antioxidants, flavonoids, omega –3 fatty acids, carotenoids, dietary fiber, phytoestrogens; Nutraceuticals for effective control of disease. Role of nutraceuticals on health. Safety, adverse effect and interactions of nutraceuticals.

Total: 45

TEXT BOOK:

1.	Shakuntala Manay, N. & Shadaksharaswamy, "Food Facts and Principles", 3rd Edition, New Age International (P) Limited, New Delhi, 2008.

REFERENCES:

1.	Branen, A.L., Davidson, P.M. & Salminen S, "Food Additives", 2nd Edition, Marcel Dekker, New York, 2001.
2.	Wildman, Robert E.C., Robert Wildman & Taylor C. Wallace (Eds), "Handbook of Nutraceuticals and Functional Foods", 2nd Edition, CRC Press, New York, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
CO1 classify macro nutrients and infer their nature	Understanding (K2)
CO2 apply the food additives to improve the quality of food product	Applying (K3)
CO3 choose the food additives to improve the shelf life of food product	Applying (K3)
CO4 select the food colors and flavors to improve the acceptability of the food product	Applying (K3)
CO5 summarize various functional foods and nutraceuticals	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1			1						1	2	2
CO2	3	2	1			1						1	2	2
CO3	3	2	1			1						1	2	2
CO4	3	2	2			1						1	2	2
CO5	3	2	2			2						2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	30	50				100
CAT3	20	40	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

20FTO08 - FOOD AND NUTRITION
(Offered by Department of Food Technology)

Programme & Branch	All BE/BTech Engineering & Technology branches except Food Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To impart knowledge on importance of nutrients and its assimilation, energy in human nutrition and nutrition during life cycle.

Unit - I	Introduction to Food and Nutrition:	9

Definition, six classes of nutrients, RDA-General Principles of Deriving RDA, Reference Body Weights of Indians, Reference Person, Recommended Dietary Allowances for Indians, Uses and limitations of RDA. Nutritional status and its assessment, malnutrition – over nutrition and under nutrition, deficiency disease. Protein Energy Malnutrition - Marasmus and Kwashiorkor. Functions of food, Functions of Nutrients, Balanced diet.

Unit - II	Digestion, absorption and Transport of Carbohydrates :	9

Basic concept: Digestion in mouth, stomach, pancreas, bile, intestine. Digestion, absorption and transport of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, recommendations of sugar intake for health, health effects of dietary fiber, artificial sweeteners.

Unit - III	Digestion, absorption and Transport of Lipids and Proteins:	9

Food Sources, Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids - ω-3 and ω-6 fatty acids; trans fatty acids, Health effects and recommended intakes of lipids. Digestion and absorption of proteins; Functions of proteins; amino acids; Protein quality, methods of assessing protein quality; Recommended intakes of proteins.

Unit - IV	Energy in Human nutrition:	9

Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, BMR. and its regulation, specific dynamic action of foods, Obesity and BMI calculations..

Unit - V	Nutrition during life cycle:	9

Factors to be considered in meal/menu planning. Pregnancy -Nutritional requirements and modification of existing diet and supplementation, Lactation - nutritional requirements, breast feeding, infant formula, Infancy - nutritional requirements. Introduction of supplementary foods. Nutritional needs of toddlers, preschool, school going children- and adolescents - Dietary management. Geriatic Nutrition - Factors affecting food intake and nutrients use, nutrient needs.

Total:45

TEXT BOOK:

1.	Swaminathan,M. "Handbook of Food and Nutrition", 1st Edition, The Bangalore Press, 2018

REFERENCES:

1.	Sumanti R. Mudambi, Rajagopal, M.V., "Fundamentals of Food, Nutrition and Diet Therapy", 6th Edition, New Age International Publishers, New Delhi, 2018
2.	Srilakshmi B., "Nutrition Science", 6th Edition, New Age International Publishers, New Delhi,2018

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the physiological and metabolic functions of nutrients	Understanding(K2)
CO2	select appropriate carbohydrate diet based on their health effects	Applying (K3)
CO3	classify and choose lipids and proteins based on their nutritional value	Applying (K3)
CO4	explain energy requirement for human	Understanding (K2)
CO5	infer the nutrition requirement during life cycle	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1			3							3	1
CO2	3	3	2			2						1	1	3
CO3	3	3	2			2						1	1	3
CO4	3	3	2			1						1	3	2
CO5	3	2	3			2						2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	30	50				100
CAT3	20	40	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)