

KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA



REGULATIONS, CURRICULUM & SYLLABI - 2018

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

(For the students admitted during 2018 - 2019 and onwards)

BACHELOR OF TECHNOLOGY IN FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY





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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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Food Technology will

- 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 |
| MS4 | 3 | 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 |
| PEO4 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial



KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(Autonomous)

REGULATIONS 2018

(Revision: 4)

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 2018 – 2019 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 |
| BTech | Chemical Engineering |
| | Information Technology |
| | Food Technology |

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.

(OR)



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/industrial 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/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship in Industry or elsewhere
- viii. Audit Courses (AC)
- ix. Mandatory Courses (MC)

4.2 Credit Assignment

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 programme shall vary from 168 to 173 as per the chosen programme of study.



4.3 Employability Enhancement Courses

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

4.3.1 Professional Skills Training/Industrial Training/ Entrepreneurs/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.

(OR)

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.

(OR)

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 and 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 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 courses or dropping of already registered additional elective 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) and 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.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Comprehensive Test and Viva, Project Work, Professional Skills 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 | 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. | Practical / Professional Skills Training / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work I Phase I / Mandatory Course/ Industrial Training/Universal Human Values | 100 | --- |
| 4. | Project Work I Phase II / Project Work II/ Internships | 50 | 50 |
| 5. | Value Added Course | The distribution of marks shall be decided based on the credit weightage assigned | |
| 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 the continuous assessment shall be for 100 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' records maintained.



7.5.1 The apportionment of continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course.

| Type | Max. Marks | Remarks |
|---|------------|----------------------------------|
| Assessment based on rubrics for each experiment | 50 | Absolute Mark System |
| Assessment Test | 50 | |
| Total | 100 | Rounded off to one decimal place |

7.6 Project Work II / Project Work I 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/ Project Work I 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 | Super visor | Review Committee (excluding Super visor) | Super visor | Review Committee (excluding Super visor) | Super visor | Ext. Exr. | Super visor | 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 end semester examination of 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 supervisor 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 | Super visor | Review Committee (excluding supervisor) | Super visor | Review Committee (excluding supervisor) | Super visor | Review Committee | Super visor | Review Committee |
| | | | | | | | | |

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 and 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 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 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 Universal Human Values

The course imparting the human values shall be taught for all candidates who have joined in various branches of all BE/BTech programmes. This course shall carry a maximum of 100 marks and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits by successfully completing this course. Two continuous assessment tests will be conducted and the average marks will be taken for the GPA and CGPA calculations.

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 entrepreneurship/ 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 and satisfy the attendance requirements.



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.

**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.

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:

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

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

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

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-2018 (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 or a candidate 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

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.

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.

All amendments until the 16th Academic council meeting have been incorporated.



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 | 3 | 4 | | 1 | | 2 | 3 | | 13 | 7.56 |
| BS | 11 | 11 | 4 | 4 | | | | | 30 | 17.44 |
| ES | 7 | 3 | 8 | | | | | | 18 | 10.47 |
| PC | | 3 | 13 | 20 | 16 | 12 | | | 64 | 37.29 |
| PE | | | | | | 3 | 9 | 3 | 15 | 8.72 |
| OE | | | | | 4 | 4 | 3 | 3 | 14 | 8.14 |
| EC | | | | | 2 | 4 | 6 | 6 | 18 | 10.47 |
| Semester wise Total | 21 | 21 | 25 | 25 | 22 | 23 | 23 | 12 | 172 | 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. | 18EGT11 | English for Communication I | 3 | 0 | 0 | 3 | I |
| 2. | 18EGT21 | English for Communication II | 3 | 0 | 0 | 3 | II |
| 3. | 18VEC11 | Value Education | 2 | 0 | 1 | 1 | II |
| 4. | 18EGL31 | English for Workplace Communication | 0 | 0 | 2 | 1 | IV |
| 5. | 18GET51 | Universal Human Values | 2 | 0 | 0 | 2 | V |
| 6. | 18MBT71 | Engineering Economics and 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. | 18MAC11 | Mathematics I | 3 | 1* | 2* | 4 | I |



| | | | | | | | |
|-----------------------------------|---------|--|---|----|----|-----------|-----|
| 2. | 18PHC11 | Applied Physics | 3 | 0 | 2* | 3.5 | I |
| 3. | 18CYC11 | Applied Chemistry | 3 | 0 | 2* | 3.5 | I |
| 4. | 18MAC21 | Mathematics II | 3 | 1* | 2* | 4 | II |
| 5. | 18PHC27 | Physics of Materials | 3 | 0 | 2* | 3.5 | II |
| 6. | 18CYC27 | Environmental Chemistry and Sustainability | 3 | 0 | 2* | 3.5 | II |
| 7. | 18MAC31 | Mathematics III | 3 | 1* | 2* | 4 | III |
| 8. | 18MAC41 | Statistics and Numerical Methods | 3 | 1* | 2* | 4 | IV |
| Total Credits to be earned | | | | | | 30 | |

| ENGINEERING SCIENCE (ES) | | | | | | | |
|-----------------------------------|-------------|---|---|---|---|-----------|-----|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| 1. | 18GET11 | Introduction to Engineering | 3 | 0 | 0 | 3 | I |
| 2. | 18MEC11 | Engineering Drawing | 2 | 0 | 2 | 3 | I |
| 3. | 18MEL11 | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | I |
| 4. | 18CSC11 | Problem Solving and Programming | 2 | 0 | 2 | 3 | II |
| 5. | 18FTT32 | Fluid Mechanics in food processing operations | 3 | 1 | 0 | 4 | III |
| 6. | 18FTT33 | Process Engineering Thermodynamics | 3 | 1 | 0 | 4 | III |
| Total Credits to be earned | | | | | | 18 | |

| PROFESSIONAL CORE (PC) | | | | | | | |
|-------------------------------|-------------|---|---|---|---|---|-----|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| 1. | 18FTT21 | Fundamentals of Biochemistry | 3 | 0 | 0 | 3 | II |
| 2. | 18FTT31 | Food Process Calculations | 3 | 1 | 0 | 4 | III |
| 3. | 18FTT34 | Food Chemistry | 3 | 0 | 0 | 3 | III |
| 4. | 18FTT35 | Food Microbiology | 3 | 0 | 0 | 3 | III |
| 5. | 18FTL31 | Fluid Flow Laboratory | 0 | 0 | 3 | 1 | III |
| 6. | 18FTL32 | Food Chemistry Laboratory | 0 | 0 | 3 | 1 | III |
| 7. | 18FTL33 | Food Microbiology Laboratory | 0 | 0 | 3 | 1 | III |
| 8. | 18FTT41 | Food science and Nutrition | 3 | 0 | 0 | 3 | IV |
| 9. | 18FTT42 | Heat Transfer in Food Processing Operations | 3 | 1 | 0 | 4 | IV |
| 10. | 18FTT43 | Mass Transfer in Food Processing Operations | 3 | 1 | 0 | 4 | IV |
| 11. | 18FTT44 | Food Process Engineering I | 3 | 1 | 0 | 4 | IV |



| | | | | | | | |
|-----------------------------------|---------|--|---|---|---|----|----|
| 12. | 18FTT45 | Engineering Properties of Food Materials | 3 | 0 | 0 | 3 | IV |
| 13. | 18FTL41 | Heat and Mass Transfer Laboratory | 0 | 0 | 3 | 1 | IV |
| 14. | 18FTL42 | Food Process Engineering I Laboratory | 0 | 0 | 3 | 1 | IV |
| 15. | 18FTT51 | Food Process Engineering - II | 3 | 0 | 0 | 3 | V |
| 16. | 18FTT52 | Fruits and Vegetables Processing Technology | 3 | 0 | 0 | 3 | V |
| 17. | 18FTT53 | Process Control and Instrumentation | 3 | 1 | 0 | 4 | V |
| 18. | 18FTT54 | Food Packaging Technology | 3 | 0 | 0 | 3 | V |
| 19. | 18FTL51 | Food Process Engineering II Laboratory | 0 | 0 | 2 | 1 | V |
| 20. | 18FTL52 | Fruits and Vegetables Processing Technology Laboratory | 0 | 0 | 2 | 1 | V |
| 21. | 18FTL53 | Food Process Equipment Design and Drawing Laboratory | 0 | 0 | 2 | 1 | V |
| 22. | 18FTT62 | Dairy Technology | 3 | 0 | 0 | 3 | VI |
| 23. | 18FTT61 | Baking and Confectionery Technology | 3 | 0 | 0 | 3 | VI |
| 24. | 18FTT63 | Food Quality And Safety | 3 | 0 | 0 | 3 | VI |
| 25. | 18FTL61 | Baking and Confectionery Technology Laboratory | 0 | 0 | 2 | 1 | VI |
| 26. | 18FTL62 | Dairy Technology Laboratory | 0 | 0 | 2 | 1 | VI |
| 27. | 18FTL63 | Food Analysis Laboratory | 0 | 0 | 2 | 1 | VI |
| Total Credits to be earned | | | | | | 64 | |

| PROFESSIONAL ELECTIVE (PE) | | | | | | | |
|-----------------------------------|-------------|--|---|---|---|---|-----|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| Elective – I | | | | | | | |
| 1. | 18FTE01 | Technology of Snack and Extruded Foods | 3 | 0 | 0 | 3 | VI |
| 2. | 18FTE02 | Food Additives and Nutraceuticals | 3 | 0 | 0 | 3 | VI |
| 3. | 18FTE03 | Production of Field and Horticulture Crops | 3 | 0 | 0 | 3 | VI |
| 4. | 18FTE04 | Bioprocess Engineering | 3 | 0 | 0 | 3 | VI |
| 5. | 18FTE05 | Energy Management in Process Industries | 3 | 0 | 0 | 3 | VI |
| 6. | 18FTE06 | Refrigeration and Cold Chain Management | 3 | 0 | 0 | 3 | VI |
| Elective – II | | | | | | | |
| 9. | 18FTE07 | Modern Separation Process | 3 | 0 | 0 | 3 | VII |
| 10. | 18FTE08 | Emerging Technologies in Food Processing | 3 | 0 | 0 | 3 | VII |
| 11. | 18FTE09 | Food Allergens and Toxicology | 3 | 0 | 0 | 3 | VII |
| 12. | 18FTE10 | Food Process Plant Layout and Safety | 3 | 0 | 0 | 3 | VII |
| 13. | 18FTE11 | Fundamentals of Computation Fluid Dynamics | 3 | 0 | 0 | 3 | VII |
| 14. | 18FTE12 | Nanotechnology in Food Processing | 3 | 0 | 0 | 3 | VII |



| Elective - III | | | | | | | |
|-----------------------------------|---------|--|---|---|---|-----------|------|
| 18. | 18FTE13 | Plantation and Spices Products Technology | 3 | 0 | 0 | 3 | VII |
| 19. | 18FTE14 | Reaction Engineering | 3 | 0 | 0 | 3 | VII |
| 20. | 18FTE15 | Fermentation Technology | 3 | 0 | 0 | 3 | VII |
| 21. | 18FTE16 | Dairy Products Technology | 3 | 0 | 0 | 3 | VII |
| 22. | 18FTE17 | Modeling, Simulation and Soft Tools for Food Technologists | 3 | 0 | 0 | 3 | VII |
| 23. | 18FTE18 | Cane Sugar Technology | 3 | 0 | 0 | 3 | VII |
| Elective – IV | | | | | | | |
| 26. | 18FTE19 | Beverage Technology | 3 | 0 | 0 | 3 | VII |
| 27. | 18FTE20 | Food Storage and Infestation Control | 3 | 0 | 0 | 3 | VII |
| 28. | 18FTE21 | Traditional Foods | 3 | 0 | 0 | 3 | VII |
| 29. | 18FTE22 | Technology of Fats and Oils | 3 | 0 | 0 | 3 | VII |
| 30. | 18FTE23 | Agri Business Management and Retail marketing | 3 | 0 | 0 | 3 | VII |
| 31. | 18FTE24 | Technology of Cereals, Pulses and Oil Seeds | 3 | 0 | 0 | 3 | VII |
| 32. | 18GEE01 | Fundamentals of Research | 3 | 0 | 0 | 3 | VII |
| Elective - V | | | | | | | |
| 33. | 18MBE49 | Entrepreneurship Development | 3 | 0 | 0 | 3 | VIII |
| 34. | 18FTE25 | Analytical Instruments in Food Industries | 3 | 0 | 0 | 3 | VIII |
| 35. | 18FTE26 | Industrial Waste Water Treatment | 3 | 0 | 0 | 3 | VIII |
| 36. | 18FTE27 | Enzymes in Food Processing | 3 | 0 | 0 | 3 | VIII |
| 37. | 18FTE28 | Meat, Fish and Poultry Processing | 3 | 0 | 0 | 3 | VIII |
| 38. | 18FTE29 | Waste Management and By-Product Utilization in Food Industries | 3 | 0 | 0 | 3 | VIII |
| Total Credits to be earned | | | | | | 15 | |

| EMPLOYABILITY ENHANCEMENT COURSES (EC) | | | | | | | |
|--|----------------------|--|---|---|----|-----------|-----|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| 1. | 18GEL51/ 18GEI 51 | Professional Skills Training I / Industrial Training I | 0 | 0 | 0 | 2 | V |
| 2. | 18GEL61/ 18GEI 61 | Professional Skills Training II / Industrial Training II | 0 | 0 | 0 | 2 | VI |
| 3. | 18GEP71 | Comprehensive Test and Viva | 0 | 0 | 0 | 2 | VII |
| 4. | 18FTP61 | Project Work I Phase I | 0 | 0 | 6 | 2 | II |
| 5. | 18FTP71 | Project Work I Phase II | 0 | 0 | 12 | 4 | III |
| 6. | 18FTP81 | Project Work II | 0 | 0 | 18 | 6 | IV |
| Total Credits to be earned | | | | | | 18 | |



| OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE) | | | | | | | |
|---|-------------|--|---|---|---|---|------|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| 1. | 18FTO01 | Food Processing Technology | 3 | 1 | 0 | 4 | V |
| 2. | 18FTO02 | Baking Technology | 3 | 0 | 2 | 4 | V |
| 3. | 18FTO03 | Processing Of Milk And Milk Products | 3 | 0 | 2 | 4 | VI |
| 4. | 18FTO04 | Processing Of Fruits And Vegetables | 3 | 0 | 2 | 4 | VI |
| 5. | 18FTO05 | Principles Of Food Safety | 3 | 0 | 0 | 3 | VII |
| 6. | 18FTO06 | Food And Nutrition | 3 | 0 | 0 | 3 | VII |
| 7. | 18FTO07 | Food Ingredients | 3 | 0 | 0 | 3 | VIII |
| 8. | 18FTO08 | Fundamentals of Food Packaging and Storage | 3 | 0 | 0 | 3 | VIII |

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)

| S. No. | Course Code | Course Name | L | T | P | C | OFFERED BY |
|-------------------|-------------|--|---|---|---|---|------------|
| SEMESTER V | | | | | | | |
| 9. | 18MAO01 | Mathematical Foundations of Machine Learning | 3 | 1 | 0 | 4 | MATHS |
| 10. | 18PHO01 | Thin film Technology | 3 | 1 | 0 | 4 | PHYSICS |
| 11. | 18CYO01 | Corrosion Science and Engineering | 3 | 1 | 0 | 4 | CHEMISTRY |
| 12. | 18CEO01 | Remote Sensing and its Applications | 3 | 0 | 2 | 4 | CIVIL |
| 13. | 18MEO01 | Renewable Energy Sources | 3 | 0 | 2 | 4 | MECH |
| 14. | 18MTO01 | Design of Mechatronics Systems | 3 | 1 | 0 | 4 | MTS |
| 15. | 18AUO01 | Automotive Engineering | 3 | 0 | 2 | 4 | AUTO |
| 16. | 18ECO01 | PCB Design and Fabrication | 3 | 0 | 2 | 4 | ECE |
| 17. | 18ECO02 | Neural Networks and Fuzzy Logic for Engineering Applications | 3 | 0 | 2 | 4 | ECE |
| 18. | 18EEO01 | Electrical Wiring and Lighting | 3 | 1 | 0 | 4 | EEE |
| 19. | 18EEO02 | Solar and Wind Energy Systems | 3 | 1 | 0 | 4 | EEE |
| 20. | 18EIO01 | Neural Networks and Deep Learning | 3 | 1 | 0 | 4 | EIE |
| 21. | 18CSO01 | Data Structures and its Applications | 3 | 0 | 2 | 4 | CSE |
| 22. | 18CSO02 | Formal Languages and Automata Theory | 3 | 1 | 0 | 4 | CSE |
| 23. | 18CSO03 | Computational Science for Engineers | 3 | 1 | 0 | 4 | CSE |
| 24. | 18ITO01 | Python Programming | 3 | 0 | 2 | 4 | IT |
| 25. | 18ITO02 | Advanced Java Programming | 3 | 0 | 2 | 4 | IT |
| 26. | 18CHO01 | Polymer Technology | 3 | 1 | 0 | 4 | CHEM |



| | | | | | | | |
|-----|---------|--|---|---|---|---|-----------|
| 27. | 18CHO02 | Introduction to Drugs and Pharmaceuticals Technology | 3 | 1 | 0 | 4 | CHEM |
| | | SEMESTER VI | | | | | |
| 28. | 18MAO02 | Graph Theory and its Applications | 3 | 1 | 0 | 4 | MATHS |
| 29. | 18MAO03 | Number Theory and Cryptography | 3 | 1 | 0 | 4 | MATHS |
| 30. | 18CYO02 | Instrumental Methods of Analysis | 3 | 1 | 0 | 4 | CHEMISTRY |
| 31. | 18CEO02 | Disaster Management | 3 | 1 | 0 | 4 | CIVIL |
| 32. | 18MEO02 | Design of Experiments | 3 | 0 | 2 | 4 | MECH |
| 33. | 18MTO02 | Factory Automation | 3 | 0 | 2 | 4 | MTS |
| 34. | 18MTO03 | Data Acquisition and Virtual Instrumentation | 3 | 0 | 2 | 4 | MTS |
| 35. | 18AUO02 | Autonomous Vehicles | 3 | 1 | 0 | 4 | AUTO |
| 36. | 18ECO03 | Principles of Quantum Computing | 3 | 0 | 2 | 4 | ECE |
| 37. | 18EEO03 | Energy Conservation and Management | 3 | 1 | 0 | 4 | EEE |
| 38. | 18EIO02 | Digital Image Processing and Its Applications | 3 | 1 | 0 | 4 | EIE |
| 39. | 18EIO03 | Industrial Automation | 3 | 1 | 0 | 4 | EIE |
| 40. | 18CSO04 | Web Engineering | 3 | 0 | 2 | 4 | CSE |
| 41. | 18CSO05 | Foundations of Data Analytics | 3 | 1 | 0 | 4 | CSE |
| 42. | 18CSO06 | Nature Inspired Optimization Techniques | 3 | 1 | 0 | 4 | CSE |
| 43. | 18CSO07 | Introducing Data Science | 3 | 1 | 0 | 4 | CSE |
| 44. | 18ITO03 | Java Programming | 3 | 1 | 0 | 4 | IT |
| 45. | 18ITO04 | Next Generation Databases | 3 | 1 | 0 | 4 | IT |
| 46. | 18CHO03 | Bio Energy Resources | 3 | 1 | 0 | 4 | CHEM |
| 47. | 18CHO04 | Fundamentals of Nanoscience and Nanotechnology | 3 | 1 | 0 | 4 | CHEM |
| | | SEMESTER VII | | | | | |
| 48. | 18MAO04 | Advanced Linear Algebra | 3 | 0 | 0 | 3 | MATHS |
| 49. | 18MAO05 | Optimization Techniques | 3 | 0 | 0 | 3 | MATHS |
| 50. | 18PHO02 | Structural and Optical Characterization of Materials | 3 | 0 | 0 | 3 | PHYSICS |
| 51. | 18CYO03 | Waste and Hazardous Waste Management | 3 | 0 | 0 | 3 | CHEMISTRY |
| 52. | 18CEO03 | Introduction to Smart Cities | 3 | 0 | 0 | 3 | CIVIL |
| 53. | 18CEO04 | Environmental Health and Safety | 3 | 0 | 0 | 3 | CIVIL |
| 54. | 18MEO03 | Fundamentals of Ergonomics | 3 | 0 | 0 | 3 | MECH |
| 55. | 18MEO04 | Principles of Management and Industrial Psychology | 3 | 0 | 0 | 3 | MECH |
| 56. | 18MTO04 | 3D Printing and Design | 3 | 0 | 0 | 3 | MTS |



| | | | | | | | |
|-----|---------|---|---|---|---|---|-------|
| 57. | 18MTO05 | Drone System Technology | 3 | 0 | 0 | 3 | MTS |
| 58. | 18AUO03 | Alternate Fuels for Automobile | 3 | 0 | 0 | 3 | AUTO |
| 59. | 18ECO04 | Electronic Hardware and Troubleshooting | 2 | 0 | 2 | 3 | ECE |
| 60. | 18ECO05 | Principles of Communication Techniques | 3 | 0 | 0 | 3 | ECE |
| 61. | 18EEO04 | Micro Grid and Smart Grid | 3 | 0 | 0 | 3 | EEE |
| 62. | 18EEO05 | Electrical Safety | 3 | 0 | 0 | 3 | EEE |
| 63. | 18EIO04 | Biomedical Instrumentation and Applications | 3 | 0 | 0 | 3 | EIE |
| 64. | 18EIO05 | PLC Programming and Its Applications | 3 | 0 | 0 | 3 | EIE |
| 65. | 18CSO08 | Artificial intelligence and its applications | 3 | 0 | 0 | 3 | CSE |
| 66. | 18ITO05 | Business Continuity Planning | 3 | 0 | 0 | 3 | IT |
| 67. | 18ITO06 | Mobile Application Development | 3 | 0 | 0 | 3 | IT |
| 68. | 18CHO05 | Enzyme Engineering | 3 | 0 | 0 | 3 | CHEM |
| 69. | 18CHO06 | Nuclear Engineering | 3 | 0 | 0 | 3 | CHEM |
| | | SEMESTER VIII | | | | | |
| 70. | 18CEO05 | Infrastructure Planning and Management | 3 | 0 | 0 | 3 | CIVIL |
| 71. | 18CEO06 | Environmental Laws and Policy | 3 | 0 | 0 | 3 | CIVIL |
| 72. | 18MEO05 | Safety Measures for Engineers | 3 | 0 | 0 | 3 | MECH |
| 73. | 18MEO06 | Energy Conservation in Thermal Equipments | 3 | 0 | 0 | 3 | MECH |
| 74. | 18MTO06 | Robotics | 3 | 0 | 0 | 3 | MTS |
| 75. | 18MTO07 | Virtual and Augment Reality in Industry 4.0 | 3 | 0 | 0 | 3 | MTS |
| 76. | 18AUO04 | Automotive Electronics | 3 | 0 | 0 | 3 | AUTO |
| 77. | 18AUO05 | Vehicle Maintenance | 3 | 0 | 0 | 3 | AUTO |
| 78. | 18ECO06 | Bioinspired Computing Technologies | 2 | 0 | 2 | 3 | ECE |
| 79. | 18EEO06 | Electric Vehicle | 3 | 0 | 0 | 3 | EEE |
| 80. | 18EIO06 | Measurements and Instrumentation | 3 | 0 | 0 | 3 | EIE |
| 81. | 18EIO07 | Graphical Programming using Virtual Instrumentation | 3 | 0 | 0 | 3 | EIE |
| 82. | 18CSO09 | Applied Machine Learning | 3 | 0 | 0 | 3 | CSE |
| 83. | 18CSO10 | Fundamentals of Blockchain | 3 | 0 | 0 | 3 | CSE |
| 84. | 18CSO11 | Fundamentals of Internet of Things | 3 | 0 | 0 | 3 | CSE |
| 85. | 18ITO07 | Essentials of Information Technology | 3 | 0 | 0 | 3 | IT |
| 86. | 18ITO08 | Virtual and Augmented Reality Frameworks | 3 | 0 | 0 | 3 | IT |
| 87. | 18CHO07 | Fertilizer Technology | 3 | 0 | 0 | 3 | CHEM |

**GENERAL OPEN ELECTIVE
(Common to All BE/BTech branches)**

| | | GENERAL OPEN ELECTIVE | L | T | P | C | Offering Department | Semester |
|-----|---------|---|---|---|---|---|---------------------|----------------------|
| 88. | 18GEO01 | German Language Level 1 | 4 | 0 | 0 | 4 | ECE | V/ VI/ VII/ VIII |
| 89. | 18GEO02 | Japanese Language Level 1 | 4 | 0 | 0 | 4 | ECE | V/ VI/ VII/ VIII |
| 90. | 18GEO03 | Design Thinking for Engineers | 3 | 0 | 0 | 3 | CSE | VI |
| 91. | 18GEO04 | Innovation and Business Model Development | 3 | 0 | 0 | 3 | MTS | VIII |
| 92. | 18GEO05 | German Language Level 2 | 4 | 0 | 0 | 4 | ECE | V/ VI/ VII/ VIII |
| 93. | 18GEO06 | German Language Level 3 | 3 | 0 | 0 | 3 | ECE | V/ VI/ VII/ VIII |
| 94. | 18GEO07 | German Language Level 4 | 3 | 0 | 0 | 3 | ECE | V/ VI/ VII/ VIII |
| 95. | 18GEO08 | Japanese Language Level 2 | 4 | 0 | 0 | 4 | ECE | V/ VI/ VII / VIII |
| 96. | 18GEO09 | Japanese Language Level 3 | 3 | 0 | 0 | 3 | ECE | V/ VI/ VII / VIII |
| 97. | 18GEO10 | Japanese Language Level 4 | 3 | 0 | 0 | 3 | ECE | V/ VI/ VII / VIII |
| 98. | 18GEO11 | NCC Studies (Army Wing) – I | 3 | 0 | 2 | 4 | EEE | V/ VI |
| 99. | 18GEO12 | NCC Studies (Air Wing) – I | 3 | 0 | 2 | 4 | IT | V / VI |

**KEC R2018: SCHEDULING OF COURSES – B.Tech (Food Technology)****Total Credits : 172**

| Sem. | Course1 | Course2 | Course3 | Course4 | Course5 | Course6 | Course7 | Course8 | Course9 | Course10 | Credits |
|------|--|---|---|---|--|--|--|--|--|--|-----------|
| I | 18EGT11 English for Communication I (3-0-0-3) | 18MAC11 Mathematics I (3-1*-2*-4) | 18PHC11 Applied Physics (3-0-2*-3.5) | 18CYC11 Applied Chemistry (3-0-2*-3.5) | 18GET11 Introduction to Engineering (3-0-0-3) | 18MEC11 Engineering Drawing (2-0-2-3) | 18MEL11 Engineering Practices Laboratory (0-0-2-1) | | | | 21 |
| II | 18EGT21 English for Communication II (3-0-0-3) | 18MAC21 Mathematics II (3-1*-2*-4) | 18PHC27 Physics of Materials (3-0-2*-3.5) | 18CYC27 Environmental Chemistry and Sustainability (3-0-2*-3.5) | 18CSC11 Problem Solving and Programming (2-0-2-3) | 18FTT21 Fundamentals of Biochemistry (3-0-0-3) | 18VEC11 Value Education (2-0-1-1) | | | | 21 |
| III | 18MAC31 Mathematics III (3-1*-2*-4) | 18MET31 Engineering Mechanics (3-1-0-4) | 18FTT31 Food Process Calculations (3-1-0-4) | 18FTT32 Fluid Mechanics in food processing operations (3-0-0-3) | 18FTT33 Process Engineering Thermodynamics (3-0-0-3) | 18FTT34 Food Chemistry (3-0-0-3) | 18FTT35 Food Microbiology (3-0-0-3) | 18FTL31 Fluid Flow Laboratory (0-0-2-1) | 18FTL32 Food Chemistry Laboratory (0-0-2-1) | 18FTL33 Food Microbiology Laboratory (0-0-2-1) | 25 |
| IV | 18MAC41 Statistics and Numerical Methods (3-1-2*-4) | 18FTT41 Food science and Nutrition (3-1-0-4) | 18FTT42 Heat Transfer in Food Processing Operations (3-1-0-4) | 18FTT43 Mass Transfer in Food Processing Operations (3-1-0-4) | 18FTT44 Food Process Engineering I (3-0-0-3) | 18FTT45 Engineering Properties of Food Materials (3-0-0-3) | 18FTL41 Heat and Mass Transfer Laboratory (0-0-2-1) | 18FTL42 Food Process Engineering I Laboratory (0-0-2-1) | 18EGL31 English for Workplace Communication (0-0-2-1) | | 25 |
| V | 18FTT51 Food Process Engineering II (3-1-0-4) | 18FTT52 Fruit and Vegetable Processing Technology (3-0-0-3) | 18FTT53 Process Control and Instrumentation (3-0-0-3) | 18FTT54 Food Packaging Technology (3-0-0-3) | Open Elective I (3-1/0-0/2-4) | 18FTL51 Food Process Engineering II Laboratory (0-0-2-1) | 18FTL52 Fruits and Vegetables Processing Technology Laboratory (0-0-2-1) | 18FTL53 Food Process Equipment Design and Drawing Laboratory (0-0-2-1) | 18GEL51 / 18GEI51 Professional Skills Training 1 / Industrial Training 1 (0-0-0-2) | 18GET51 Universal Human Values (2-0-0-2) | 24 |
| VI | 18FTT61 Baking and Confectionery Technology (3-0-0-3) | 18FTT62 Dairy Technology (3-0-0-3) | 18FTT63 Food Quality and Safety (3-0-0-3) | Professional Elective I (3-0-0-3) | Open Elective II (3-1/0-0/2-4) | 18FTL61 Baking and Confectionery Technology Laboratory (0-0-2-1) | 18FTL62 Dairy Technology Laboratory (0-0-2-1) | 18FTL63 Food Analysis Laboratory (0-0-2-1) | 18GEL61 / 18GEI61 Professional Skills Training II / Industrial Training II (0-0-0-2) | 18FTP61 Project Work I Phase I (0-0-4-2) | 23 |
| VII | 18MBT71 Engineering Economics and Management (3-0-0-3) | Open Elective III (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) | 18GEP71 Comprehensive Test and Viva (0-0-0-2) | 18FTP71 Project Work I Phase II (0-0-8-4) | | | | 21 |
| VIII | Open Elective IV (3-0-0-3) | Professional Elective V (3-0-0-3) | 18FTP81 Project Work II (0-0-12-6) | | | | | | | | 12 |



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 | 18EGT11 | English for Communication I | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 1 | 18MAC11 | Mathematics I | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 1 | 18PHC11 | Applied Physics | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 1 | 18CYC11 | Applied Chemistry | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 1 | 18GET11 | Introduction to Engineering | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |
| 1 | 18MEC11 | Engineering Drawing | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1 | 18MEL11 | Engineering Practices Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | | |
| 2 | 18EGT21 | English for Communication II | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 2 | 18MAC21 | Mathematics II | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | |
| 2 | 18PHC27 | Physics of Materials | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 2 | 18CYC27 | Environmental Chemistry and Sustainability | ✓ | ✓ | ✓ | ✓ | | | ✓ | | | | | | | |
| 2 | 18CSC11 | Problem Solving and Programming | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | | | |
| 2 | 18FTT21 | Fundamentals of Biochemistry | ✓ | ✓ | | | | ✓ | | | | | ✓ | | ✓ | ✓ |
| 2 | 18MAC31 | Engineering Mathematics - III | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 3 | 18FTT31 | Food Process Calculations | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | 18FTT32 | Fluid Mechanics in food processing operations | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | | ✓ |
| 3 | 18FTT33 | Process Engineering Thermodynamics | ✓ | ✓ | ✓ | | | | ✓ | | | ✓ | | ✓ | | ✓ |
| 3 | 18FTT34 | Food Chemistry | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | ✓ | | ✓ | ✓ | ✓ |
| 3 | 18FTT35 | Food Microbiology | ✓ | ✓ | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | ✓ |
| 3 | 18FTL31 | Fluid Flow Laboratory | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | |
| 3 | 18FTL32 | Food Chemistry Laboratory | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | ✓ | | ✓ |
| 3 | 18FTL33 | Food Microbiology Laboratory | ✓ | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | ✓ | ✓ |
| 4 | 18MAC41 | Statistics and Numerical Methods | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 4 | 18FTT41 | Food science and Nutrition | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |

| Sem | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|---------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 4 | 18FTT42 | Heat Transfer in Food Processing Operations | ✓ | ✓ | ✓ | | | ✓ | | | | ✓ | | ✓ | | ✓ |
| 4 | 18FTT43 | Mass Transfer in Food Processing Operations | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 4 | 18FTT44 | Food Process Engineering I | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | | ✓ |
| 4 | 18FTT45 | Engineering Properties of Food Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| 4 | 18FTL41 | Heat and Mass Transfer Laboratory | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | | ✓ | ✓ |
| 4 | 18FTL42 | Food Process Engineering I Laboratory | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | | ✓ | ✓ |
| 4 | 18EGL31 | English for Workplace Communication | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 5 | 18FTT51 | Food Process Engineering II | ✓ | ✓ | | | ✓ | | ✓ | | | ✓ | | ✓ | | ✓ |
| 5 | 18FTT52 | Fruit and Vegetable Processing Technology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |
| 5 | 18FTT53 | Process Control and Instrumentation | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | | ✓ |
| 5 | 18FTT54 | Food Packaging Technology | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ | ✓ |
| 5 | 18FTL51 | Food Process Engineering II Laboratory | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 5 | 18FTL52 | Fruits and Vegetables Processing Technology Laboratory | ✓ | ✓ | | | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 5 | 18FTL53 | Food Process Equipment Design and Drawing Laboratory | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 5 | 18GEL51/ 18GEI51 | Professional Skills Training I/ Industrial Training II | ✓ | ✓ | | ✓ | | | | | ✓ | | | ✓ | ✓ | ✓ |
| 5 | 18GET51 | Universal Human Values: Understanding Harmony | | | | | | | | | | | | | | |
| 6 | 18FTT61 | Baking and Confectionery Technology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 6 | 18FTT62 | Dairy Technology | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | | ✓ |
| 6 | 18FTT63 | Food Quality and Safety | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 6 | 18FTL61 | Baking and Confectionery Technology Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 6 | 18FTL62 | Dairy Technology Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 6 | 18FTL63 | Food Analysis Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 7 | 18GEL61/ 18GEI61 | Professional Skills Training II / Industrial Training II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | 18MEP61 | Project Work I Phase I | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18MBT71 | Engineering Economics and Management | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18GEP71 | Comprehensive Test and Viva | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18MEP71 | Project Work I Phase II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |



| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 8 | 18MEP81 | Project Work II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Professional Elective Courses | | | | | | | | | | | | | | |
| 6 | 18FTE01 | Technology of Snack and Extruded Foods | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ |
| 6 | 18FTE02 | Food Additives and Nutraceuticals | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 6 | 18FTE03 | Production of Field and Horticulture Crops | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | | ✓ | ✓ | ✓ |
| 6 | 18FTE04 | Bioprocess Engineering | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | ✓ | | ✓ | | ✓ |
| 6 | 18FTE05 | Energy Management in Process Industries | ✓ | ✓ | | | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 6 | 18FTE06 | Refrigeration and Cold Chain Management | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |
| 6 | 18FTE07 | Modern Separation Process | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | ✓ |
| 6 | 18FTE08 | Emerging Technologies in Food Processing | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| 7 | 18FTE09 | Food Allergens and Toxicology | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ |
| 7 | 18FTE10 | Food Process Plant Layout and Safety | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | | ✓ |
| 7 | 18FTE11 | Fundamentals of Computation Fluid Dynamics | ✓ | ✓ | ✓ | | | | ✓ | | | | | | ✓ | ✓ |
| 7 | 18FTE12 | Nanotechnology in Food Processing | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE13 | Plantation and Spices Products Technology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE14 | Reaction Engineering | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE15 | Fermentation Technology | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18FTE16 | Dairy Products Technology | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18FTE17 | Modeling, Simulation and Soft Tools for Food Technologists | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 18FTE18 | Cane Sugar Technology | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE19 | Beverage Technology | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE20 | Food Storage and Infestation Control | ✓ | | ✓ | | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |
| 7 | 18FTE21 | Traditional Foods | ✓ | ✓ | ✓ | | | | ✓ | | | ✓ | | | ✓ | ✓ |
| 7 | 18FTE22 | Technology of Fats and Oils | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | ✓ |
| 7 | 18FTE23 | Agri Business Management and Retail marketing | ✓ | ✓ | | | | ✓ | | | | | ✓ | | ✓ | ✓ |
| 7 | 18FTE24 | Technology of Cereals, Pulses and Oil Seeds | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | ✓ |



| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 8 | 18MBE49 | Entrepreneurship Development | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | | ✓ | ✓ |
| 8 | 18FTE25 | Analytical Instruments in Food Industries | ✓ | | ✓ | | | | ✓ | | | ✓ | | ✓ | | ✓ |
| 8 | 18FTE26 | Industrial Waste Water Treatment | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | | ✓ | | ✓ |
| 8 | 18FTE27 | Enzymes in Food Processing | ✓ | ✓ | | | ✓ | | | | | ✓ | | ✓ | ✓ | ✓ |
| 8 | 18FTE28 | Meat, Fish and Poultry Processing | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | ✓ |
| 8 | 18FTE29 | Waste Management and By-Product Utilization in Food Industries | ✓ | ✓ | ✓ | | | | | | | | | ✓ | | ✓ |

| Open Elective Courses | | | | | | | | | | | | | | | | |
|-----------------------|---------|--|---|---|---|---|---|---|---|--|---|---|--|---|--|--|
| 5 | 18MAO01 | Mathematical Foundations of Machine Learning | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | 18PHO01 | Thin film Technology | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 5 | 18CYO01 | Corrosion Science and Engineering | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 5 | 18CEO01 | Remote Sensing and its Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | 18MEO01 | Renewable Energy Sources | ✓ | ✓ | ✓ | ✓ | | | ✓ | | | ✓ | | ✓ | | |
| 5 | 18MTO01 | Design of Mechatronics Systems | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | |
| 5 | 18AUO01 | Automotive Engineering | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | |
| 5 | 18ECO01 | PCB Design and Fabrication | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | | | |
| 5 | 18ECO02 | Neural Networks and Fuzzy Logic for Engineering Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | | | |
| 5 | 18EE001 | Electrical Wiring and Lighting | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 5 | 18EE002 | Solar and Wind Energy Systems | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 5 | 18EIO01 | Neural Networks and Deep Learning | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | 18CSO01 | Data Structures and its Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | 18CSO02 | Formal Languages and Automata Theory | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 5 | 18CSO03 | Computational Science for Engineers | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | 18ITO01 | Python Programming | | | ✓ | | ✓ | | | | | | | | | |
| 5 | 18ITO02 | Advanced Java Programming | | | ✓ | | ✓ | | | | | | | | | |
| 5 | 18CHO01 | Polymer Technology | ✓ | ✓ | | | | | | | | | | | | |



| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 5 | 18CHO02 | Introduction to Drugs and Pharmaceuticals Technology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | 18MAO02 | Graph Theory and its Applications | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 6 | 18MAO03 | Number Theory and Cryptography | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | |
| 6 | 18CYO02 | Instrumental Methods of Analysis | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 6 | 18CEO02 | Disaster Management | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | | | ✓ | | |
| 6 | 18MEO02 | Design of Experiments | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | | |
| 6 | 18MTO02 | Factory Automation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | |
| 6 | 18MTO03 | Data Acquisition and Virtual Instrumentation | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | | |
| 6 | 18AUO02 | Autonomous Vehicles | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 6 | 18ECO03 | Principles of Quantum Computing | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | 18EEO03 | Energy Conservation and Management | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | |
| 6 | 18EIO02 | Digital Image Processing and Its Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | 18EIO03 | Industrial Automation | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | 18CSO04 | Web Engineering | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 6 | 18CSO05 | Foundations of Data Analytics | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 6 | 18CSO06 | Nature inspired optimization techniques | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 6 | 18CSO07 | Introducing Data Science | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 6 | 18ITO03 | Java Programming | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | | |
| 6 | 18ITO04 | Next Generation Databases | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 6 | 18CHO03 | Bio Energy Resources | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | 18CHO04 | Fundamentals of Nanoscience and Nanotechnology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18MAO04 | Advanced Linear Algebra | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 7 | 18MAO05 | Optimization Techniques | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 7 | 18PHO02 | Structural and Optical Characterization of Materials | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 7 | 18CYO03 | Waste and Hazardous Waste Management | ✓ | ✓ | ✓ | ✓ | | | ✓ | | | | | | | |



| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 7 | 18CEO03 | Introduction to Smart Cities | ✓ | ✓ | ✓ | | | | ✓ | | | | | | | |
| 7 | 18CEO04 | Environmental Health and Safety | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 7 | 18MEO03 | Fundamentals of Ergonomics | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ | | ✓ | | |
| 7 | 18MEO04 | Principles of Management and Industrial Psychology | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| 7 | 18MTO04 | 3D Printing and Design | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | | |
| 7 | 18MTO05 | Drone System Technology | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | |
| 7 | 18AU003 | Alternate Fuels for Automobile | ✓ | ✓ | | | | | | | | | | | | |
| 7 | 18ECO04 | Electronic Hardware and Troubleshooting | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 7 | 18ECO05 | Principles of Communication Techniques | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18EE004 | Micro Grid and Smart Grid | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18EE005 | Electrical Safety | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 7 | 18EIO04 | Biomedical Instrumentation and Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18EIO05 | PLC Programming and Its Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18CSO08 | Artificial Intelligence and its Applications | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 7 | 18ITO05 | Business Continuity Planning | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 7 | 18ITO06 | Mobile Application Development | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 7 | 18CHO05 | Enzyme Engineering | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 7 | 18CHO06 | Nuclear Engineering | ✓ | ✓ | | | | | | | | | | | | |
| 7 | 18CEO05 | Infrastructure Planning and Management | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 8 | 18CEO06 | Environmental Laws and Policy | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 8 | 18MEO05 | Safety Measures for Engineers | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | |
| 8 | 18MEO06 | Energy Conservation in Thermal Equipments | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | ✓ | ✓ | ✓ | | |
| 8 | 18MTO06 | Robotics | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | |
| 8 | 18MTO07 | Virtual and Augment Reality in Industry 4.0 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | | |
| 8 | 18AU004 | Automotive Electronics | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 8 | 18AU005 | Vehicle Maintenance | ✓ | | ✓ | | | ✓ | | | | | | | | |
| 8 | 18ECO06 | Bioinspired Computing Technologies | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |



| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---------|-------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 8 | 18EEO06 | Electric Vehicle | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 8 | 18EIO06 | Measurements and Instrumentation | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 8 | 18EIO07 | Graphical Programming using Virtual Instrumentation | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 8 | 18CSO09 | Applied Machine Learning | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 8 | 18CSO10 | Fundamentals of Blockchain | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 8 | 18CSO11 | Fundamentals of Internet of Things | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 8 | 18ITO07 | Essentials of Information Technology | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 8 | 18ITO08 | Virtual and Augmented Reality Frameworks | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 8 | 18CHO07 | Fertilizer Technology | ✓ | ✓ | | | | | | | | | | | | |
| | | General Open Elective | | | | | | | | | | | | | | |
| 5,6,7,8 | 18GEO01 | German Language Level 1 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO02 | Japanese Language Level 1 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 7 | 18GEO03 | Design Thinking for Engineers | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 8 | 18GEO04 | Innovation and Business Model Development | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5,6,7,8 | 18GEO05 | German Language Level 2 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO06 | German Language Level 3 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO07 | German Language Level 4 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO08 | Japanese Language Level 2 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO09 | Japanese Language Level 3 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6,7,8 | 18GEO10 | Japanese Language Level 4 | | | | | | | | ✓ | ✓ | ✓ | | ✓ | | |
| 5,6 | 18GEO11 | NCC Studies (Army Wing) – I | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| 5,6 | 18GEO12 | NCC Studies (Air Wing) – I | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |

**B.TECH. FOOD TECHNOLOGY CURRICULUM – R2018**

| SEMESTER – I | | | | | | | | | |
|--|----------------------------------|--------------|----|----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18EGT11 | English for Communication I | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 18MAC11 | Mathematics I | 3 | 1* | 2* | 4 | 50 | 50 | 100 | BS |
| 18PHC11 | Applied Physics | 3 | 0 | 2* | 3.5 | 50 | 50 | 100 | BS |
| 18CYC11 | Applied Chemistry | 3 | 0 | 2* | 3.5 | 50 | 50 | 100 | BS |
| 18GET11 | Introduction to Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 | ES |
| 18MEC11 | Engineering Drawing | 2 | 0 | 2 | 3 | 50 | 50 | 100 | ES |
| Practical / Employability Enhancement | | | | | | | | | |
| 18MEL11 | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | ES |
| Total Credits to be earned | | | | | 21 | | | | |

*Alternate Weeks

| SEMESTER – II | | | | | | | | | |
|--|--|--------------|----|----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18EGT21 | English for Communication II | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 18MAC21 | Mathematics II | 3 | 1* | 2* | 4 | 50 | 50 | 100 | BS |
| 18PHC27 | Physics of Materials | 3 | 0 | 2* | 3.5 | 50 | 50 | 100 | BS |
| 18CYC27 | Environmental Chemistry and Sustainability | 3 | 0 | 2* | 3.5 | 50 | 50 | 100 | BS |
| 18CSC11 | Problem Solving and Programming | 2 | 0 | 2 | 3 | 50 | 50 | 100 | ES |
| 18FTT21 | Fundamentals of Biochemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| Practical / Employability Enhancement | | | | | | | | | |
| 18VEC11 | Value Education | 2 | 0 | 1 | 1 | 100 | 0 | 100 | HS |
| Total Credits to be earned | | | | | 21 | | | | |

*Alternate Weeks

**B.TECH. FOOD TECHNOLOGY CURRICULUM – R2018**

| SEMESTER – III | | | | | | | | | |
|--|---|--------------|---|---|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18MAC31 | Mathematics III | 3 | 1 | 0 | 4 | 50 | 50 | 100 | BS |
| 18FTT31 | Food Process Calculations | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 18FTT32 | Fluid Mechanics in Food Processing Operations | 3 | 1 | 0 | 4 | 50 | 50 | 100 | ES |
| 18FTT33 | Process Engineering Thermodynamics | 3 | 1 | 0 | 4 | 50 | 50 | 100 | ES |
| 18FTT34 | Food Chemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT35 | Food Microbiology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| Practical / Employability Enhancement | | | | | | | | | |
| 18FTL31 | Fluid Flow Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL32 | Food Chemistry Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL33 | Food Microbiology Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 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 | | | | | | | | | |
| 18MAC41 | Statistics and Numerical Methods | 3 | 1 | 0 | 4 | 50 | 50 | 100 | BS |
| 18FTT41 | Food science and Nutrition | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT42 | Heat Transfer in Food Processing Operations | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 18FTT43 | Mass Transfer in Food Processing Operations | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 18FTT44 | Food Process Engineering I | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 18FTT45 | Engineering Properties of Food Materials | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| Practical / Employability Enhancement | | | | | | | | | |
| 18FTL41 | Heat and Mass Transfer Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL42 | Food Process Engineering I Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18EGL31 | English for Workplace Communication | 0 | 0 | 2 | 1 | 100 | 0 | 100 | HS |
| Total Credits to be earned | | | | | 25 | | | | |

**B.TECH. FOOD TECHNOLOGY CURRICULUM – R2018**

| SEMESTER – V | | | | | | | | | |
|--|---|--------------|-----|-----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18FTT51 | Food Process Engineering II | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT52 | Fruit and Vegetable Processing Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT53 | Process Control and Instrumentation | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 18FTT54 | Food Packaging Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| | Open Elective I | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| Practical / Employability Enhancement | | | | | | | | | |
| 18FTL51 | Food Process Engineering II Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL52 | Fruits and Vegetables Processing Technology Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL53 | Food Process Equipment Design and Drawing Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18GEL51/ 18GEI51 | Professional Skills Training I / Industrial Training I * | -- | -- | -- | 2 | 100 | 0 | 100 | EC |
| 18GET51 | Universal Human Values | 2 | 0 | 0 | 2 | 100 | 0 | 100 | HS |
| Total Credits to be earned | | | | | 25 | | | | |

***80 Hours of Training**

| SEMESTER – VI | | | | | | | | | |
|--|---|--------------|-----|-----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18FTT61 | Baking and Confectionery Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT62 | Dairy Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 18FTT63 | Food Quality and Safety | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| | Professional Elective I | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Open Elective II | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| Practical / Employability Enhancement | | | | | | | | | |
| 18FTL61 | Baking and Confectionery Technology Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL62 | Dairy Technology Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18FTL63 | Food Analysis Laboratory | 0 | 0 | 2 | 1 | 100 | 0 | 100 | PC |
| 18GEL61/ 18GEI61 | Professional Skills Training II / Industrial Training II * | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 18FTP61 | Project Work I Phase I | 0 | 0 | 4 | 2 | 100 | 0 | 100 | EC |
| Total Credits to be earned | | | | | 23 | | | | |

***80 Hours of Training**

**B.TECH. FOOD TECHNOLOGY CURRICULUM – R2018**

| SEMESTER – VII | | | | | | | | | |
|--|--------------------------------------|--------------|-----|-----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| 18MBT71 | Engineering Economics and Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| | 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 |
| | Open Elective III | 3 | 0 | 0 | 3 | 50 | 50 | 100 | OE |
| Practical / Employability Enhancement | | | | | | | | | |
| 18GEP71 | Comprehensive Test / Viva | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 18FTP71 | Project Work I Phase II | 0 | 0 | 8 | 4 | 50 | 50 | 100 | EC |
| Total Credits to be earned | | | | | 21 | | | | |

| SEMESTER – VIII | | | | | | | | | |
|--|-------------------------|--------------|-----|----|-----------|---------------|-----|-------|----------|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| Theory/Theory with Practical | | | | | | | | | |
| | Professional Elective V | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Open Elective IV | 3 | 0 | 0 | 3 | 50 | 50 | 100 | OE |
| Practical / Employability Enhancement | | | | | | | | | |
| 18FTP81 | Project Work II | --- | --- | 12 | 6 | 50 | 50 | 100 | EC |
| Total Credits to be earned | | | | | 12 | | | | |

Total Credits: 172



| LIST OF PROFESSIONAL ELECTIVE COURSES (PE) | | | | | | | |
|--|-------------|--|---|---|---|---|-----|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| Elective – I | | | | | | | |
| 1. | 18FTE01 | Technology of Snack and Extruded Foods | 3 | 0 | 0 | 3 | VI |
| 2. | 18FTE02 | Food Additives and Nutraceuticals | 3 | 0 | 0 | 3 | VI |
| 3. | 18FTE03 | Production of Field and Horticulture Crops | 3 | 0 | 0 | 3 | VI |
| 4. | 18FTE04 | Bioprocess Engineering | 3 | 0 | 0 | 3 | VI |
| 5. | 18FTE05 | Energy Management in Process Industries | 3 | 0 | 0 | 3 | VI |
| 6. | 18FTE06 | Refrigeration and Cold Chain Management | 3 | 0 | 0 | 3 | VI |
| Elective – II | | | | | | | |
| 7. | 18FTE07 | Modern Separation Process | 3 | 0 | 0 | 3 | VII |
| 8. | 18FTE08 | Emerging Technologies in Food Processing | 3 | 0 | 0 | 3 | VII |
| 9. | 18FTE09 | Food Allergens and Toxicology | 3 | 0 | 0 | 3 | VII |
| 10. | 18FTE10 | Food Process Plant Layout and Safety | 3 | 0 | 0 | 3 | VII |
| 11. | 18FTE11 | Fundamentals of Computation Fluid Dynamics | 3 | 0 | 0 | 3 | VII |
| 12. | 18FTE12 | Nanotechnology in Food Processing | 3 | 0 | 0 | 3 | VII |
| Elective - III | | | | | | | |
| 13. | 18FTE13 | Plantation and Spices Products Technology | 3 | 0 | 0 | 3 | VII |
| 14. | 18FTE14 | Reaction Engineering | 3 | 0 | 0 | 3 | VII |
| 15. | 18FTE15 | Fermentation Technology | 3 | 0 | 0 | 3 | VII |
| 16. | 18FTE16 | Dairy Products Technology | 3 | 0 | 0 | 3 | VII |
| 17. | 18FTE17 | Modeling, Simulation and Soft Tools for Food Technologists | 3 | 0 | 0 | 3 | VII |
| 18. | 18FTE18 | Cane Sugar Technology | 3 | 0 | 0 | 3 | VII |
| Elective – IV | | | | | | | |
| 19. | 18FTE19 | Beverage Technology | 3 | 0 | 0 | 3 | VII |
| 20. | 18FTE20 | Food Storage and Infestation Control | 3 | 0 | 0 | 3 | VII |
| 21. | 18FTE21 | Traditional Foods | 3 | 0 | 0 | 3 | VII |
| 22. | 18FTE22 | Technology of Fats and Oils | 3 | 0 | 0 | 3 | VII |
| 23. | 18FTE23 | Agri Business Management and Retail Marketing | 3 | 0 | 0 | 3 | VII |
| 24. | 18FTE24 | Technology of Cereals, Pulses and Oil Seeds | 3 | 0 | 0 | 3 | VII |



| | | | | | | | |
|-----|---------|--|---|---|---|---|------|
| 25. | 18GEE01 | Fundamentals of Research | 3 | 0 | 0 | 3 | VII |
| | | Elective - V | | | | | |
| 26. | 18MBE49 | Entrepreneurship Development | 3 | 0 | 0 | 3 | VIII |
| 27. | 18FTE25 | Analytical Instruments in Food Industries | 3 | 0 | 0 | 3 | VIII |
| 28. | 18FTE26 | Industrial Waste Water Treatment | 3 | 0 | 0 | 3 | VIII |
| 29. | 18FTE27 | Enzymes in Food Processing | 3 | 0 | 0 | 3 | VIII |
| 30. | 18FTE28 | Meat, Fish and Poultry Processing | 3 | 0 | 0 | 3 | VIII |
| 31. | 18FTE29 | Waste Management and By-Product Utilization in Food Industries | 3 | 0 | 0 | 3 | VIII |



| LIST OF OPEN ELECTIVE COURSES (PE) | | | | | | | |
|------------------------------------|-------------|--|---|---|---|---|------|
| S. No. | Course Code | Course Name | L | T | P | C | Sem |
| 1. | 18FTO01 | Food Processing Technology | 3 | 1 | 0 | 4 | V |
| 2. | 18FTO02 | Baking Technology | 3 | 0 | 2 | 4 | V |
| 3. | 18FTO03 | Processing of Milk and Milk Products | 3 | 0 | 2 | 4 | VI |
| 4. | 18FTO04 | Processing of Fruits and Vegetables | 3 | 0 | 2 | 4 | VI |
| 5. | 18FTO05 | Principles of Food Safety | 3 | 0 | 0 | 3 | VII |
| 6. | 18FTO06 | Food and Nutrition | 3 | 0 | 0 | 3 | VII |
| 7. | 18FTO07 | Food Ingredients | 3 | 0 | 0 | 3 | VIII |
| 8. | 18FTO08 | Fundamentals of Food Packaging And Storage | 3 | 0 | 0 | 3 | VIII |



18EGT11 - ENGLISH FOR COMMUNICATION I
(Common to all Engineering and Technology Branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | 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 B1 level in the Common European Framework (CEFR). | | | | | | |
| Unit - I | Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – I: | | | | | | 9 |
| Listening - People talking about their 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. | | | | | | | |
| Unit - II | Listening, Speaking, Reading and Writing. 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. | | | | | | | |
| Unit - III | Listening, Speaking, Reading and Writing. 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. | | | | | | | |
| Unit - IV | Listening, Speaking, Reading and Writing. 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. | | | | | | | |
| Unit - V | Listening, Speaking, Reading and Writing. 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. | | | | | | | |

Total: 45**TEXT BOOK:**

| | |
|----|---|
| 1. | Jack C. Richards, "Interchange, Student's Book 2", 4 th Edition, Cambridge University Press, New York, 2017. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Jack C. Richards & Theodore Rodgers, "Approaches and Methods in Language Teaching", 3rd Edition, Cambridge University Press, New York, 2014. |
| 2. | Penny Ur, "A Course in English Language Teaching", 2 nd Edition, Cambridge University Press, New York, 2012. |



| 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 | | 3 | 47 | 17 | | 33 | 100 |
| CAT2 | | | 37 | 23 | | 40 | 100 |
| CAT3 | | 3 | 47 | 33 | | 17 | 100 |
| ESE | | 2 | 42 | 27 | | 29 | 100 |

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



18MAC11 - MATHEMATICS I
(Common to All Engineering and Technology Branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|-----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | 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, multivariable functions and differential equations.

Unit - I **Matrices:** **9**

Introduction to Matrices in Engineering – 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 – Applications of Eigen values and Eigen vectors: Electric circuit – Mass string problems.

Unit - II **Multivariable Calculus:** **9**

Functions of two 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 - III **First Order Ordinary Differential Equations:** **9**

Solutions of differential equations in variables separable form – Exact differential equations – Linear first order differential equations – Bernoulli's equation – Clairaut's equation.

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

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

Unit - V **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).

List of Exercises / Experiments:

| | |
|----|---|
| 1. | Introduction to MATLAB |
| 2. | Matrix operations : Addition, Multiplication, Transpose and Inverse |
| 3. | Computation of eigen values and eigen vectors |
| 4. | Finding ordinary and partial derivatives |
| 5. | Computing extremes of a single variable function |
| 6. | Plotting and visualizing single variable functions |
| 7. | Solving first and second order ordinary differential equations |
| 8. | Solution of Simultaneous first order ODEs |

***Alternate Weeks**

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

TEXT BOOK:

| | |
|----|---|
| 1. | Grewal B. S., "Higher Engineering Mathematics", 42 nd Edition, Khanna Publications, New Delhi, 2011. |
|----|---|

REFERENCES:

| | |
|----|---|
| 1. | Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2 nd Edition, Pearson India Education, New Delhi, 2018. |
| 2. | Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1 st Edition, CRC Press, London, 2018. |



| 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 | compute extremal values which arise in function of several | Understanding (K2) |
| CO3 | identify the appropriate method for solving first order ordinary differential equations | Applying (K3) |
| CO4 | solve higher order linear differential equations with constant and variable coefficients | Applying (K3) |
| CO5 | apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems | Applying (K3) |
| CO6 | determine eigen values and eigen vectors of a given matrix using MATLAB | Applying (K3), Manipulation (S2) |
| CO7 | compute maxima and minima of a single variable function, plot and visualize single variable function using MATLAB | Applying (K3), Manipulation (S2) |
| CO8 | solve first and second order ordinary differential equations and simultaneous first order ordinary differential equations 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 | 2 | 1 | | | | | | | | | | |
| CO2 | 3 | 2 | | | | | | | | | | | | |
| CO3 | 3 | 3 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 3 | 1 | 1 | | | | | | | | | | |
| CO5 | 3 | 3 | 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 | 20 | 10 | 70 | | | | 100 |
| CAT2 | 20 | 10 | 70 | | | | 100 |
| CAT3 | 20 | 10 | 70 | | | | 100 |
| ESE | 20 | 10 | 70 | | | | 100 |

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



18PHC11 - APPLIED PHYSICS
(Common to All Engineering and Technology Branches)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|----|--------|
| Prerequisites | NIL | 1 | BS | 3 | 0 | 2* | 3.5 |

| | | | | | | | |
|----------|---|--|--|--|--|--|--|
| Preamble | This course aims to impart the essential concepts of properties of matter, acoustics, ultrasonics, quantum physics, laser and fibre optics, 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 | Properties of Matter: | 9 |
|-----------------|------------------------------|----------|

Elasticity: Stress – Strain – Hooke's law – Stress-strain diagram – Poisson's ratio - Modulus of elasticity - Beams – Bending of beams – Expression for bending moment - Cantilever – Depression of the loaded end of a cantilever - Young's modulus by uniform and non-uniform bending methods - I-shaped girders. Viscosity: Viscous force – Viscosity – Co-efficient of viscosity – Importance of viscosity of liquids (qualitative).

| | | |
|------------------|-----------------------------------|----------|
| Unit - II | Acoustics and Ultrasonics: | 9 |
|------------------|-----------------------------------|----------|

Acoustics: Sound - Reverberation and reverberation time – Growth and decay of sound and Sabine's formula (qualitative) - Absorption coefficient - Factors affecting acoustics of buildings and their remedies. Ultrasonics: Properties of ultrasonic waves - Production of ultrasonic waves - Magnetostrictive generator - Piezoelectric generator - Applications of ultrasonic waves in non destructive testing.

| | | |
|-------------------|-------------------------------------|----------|
| Unit - III | Thermal and Quantum Physics: | 9 |
|-------------------|-------------------------------------|----------|

Thermal Physics: Modes of heat transfer - Thermal conductivity - Radial and cylindrical heat flow - Conduction through compound media (series and parallel). Quantum Physics: Matter waves - Schrodinger's time independent and time dependent wave equations – Physical significance of wave function - Particle in a one dimensional box.

| | | |
|------------------|--|----------|
| Unit - IV | Laser, Fibre Optics and Applications: | 9 |
|------------------|--|----------|

Laser and Applications: Spontaneous emission and stimulated emission - Population inversion - Pumping methods - Einstein's coefficients - Nd:YAG laser - Holography. Fiber Optics and Applications: Principle of propagation of light through optical fibers - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optical communication links (block diagram).

| | | |
|-----------------|-------------------------|----------|
| Unit - V | Crystal Physics: | 9 |
|-----------------|-------------------------|----------|

Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures - Crystal imperfections: line and surface imperfections.

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 viscosity of a given liquid using Poiseuille's method. |
| 3. | Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer. |
| 4. | Determination of the wavelength and the angle of divergence of a semiconductor laser. |
| 5. | Determination of the acceptance angle and the numerical aperture of a given optical fiber. |

Alternate Weeks*Lecture:45, Practical:15, Total:60****TEXT BOOK:**

| | |
|----|--|
| 1. | Tamilarasan K. and Prabu K., "Engineering Physics - I", 3 rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Gaur R.K. and Gupta S.L., "Engineering Physics", 8 th Edition, Dhanpat Rai and Sons, New Delhi, 2009. |
| 2. | Mehta and Neeraj, "Applied Physics for Engineers", 1 st Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2011. |
| 3. | Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 3 rd Edition, SCM Publishers, Erode, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | make use of the concepts of elasticity and bending moment of a beam to a simple structure under simple loading to compute the Young's modulus of a material, and to explain the concepts of viscosity of liquids. | Applying (K3) |
| CO2 | apply the concepts of growth and decay of sound energy in a hall to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic waves and non-destructive testing using ultrasonic waves. | Applying (K3) |
| CO3 | use the concepts of heat flow to explain heat conduction through materials, and to describe the behavior of electrons in a metal by means of quantum physics. | Applying (K3) |
| CO4 | apply the concepts of laser 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 fiber optic communication link. | Applying (K3) |
| CO5 | explain seven crystal systems, atomic packing factor of the select crystal systems and the types of crystal defects. | Understanding (K2) |
| CO6 | determine the Young's modulus of a material using the concepts of elasticity and bending moment of a beam, and to determine the viscosity of a liquid using the concepts of viscosity. | Applying (K3), Precision (S3) |
| CO7 | compute the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using the concepts of propagation of sound through a medium. | Applying (K3), Precision (S3) |
| CO8 | determine the wavelength and the angle of divergence of a semiconductor laser beam using the concepts of propagation of light through a medium, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concept of total internal reflection. | 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 | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | |
| CO5 | 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 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 45 | 35 | | | | 100 |
| CAT3 | 20 | 50 | 30 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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



18CYC11 - 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 | 2* | 3.5 |

| | |
|----------|--|
| Preamble | Applied Chemistry course imparts the basic principles and concepts of chemistry in the field of Engineering and Technology. It also imparts knowledge on Water Technology, Electrochemistry, Corrosion and its control, Fuels & Combustion and Polymers. |
|----------|--|

| | | |
|-----------------|--------------------------|----------|
| Unit - I | Water Technology: | 9 |
|-----------------|--------------------------|----------|

Introduction - Sources of water - Impurities in water - Types of water – Water Quality Standards - Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Determination of alkalinity - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process - Carbonate and Calgon conditioning - Desalination by reverse osmosis method.

| | | |
|------------------|--------------------------|----------|
| Unit - II | Electrochemistry: | 9 |
|------------------|--------------------------|----------|

Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications - Conductometric titrations - Mixture of weak and strong acid vs strong base.

| | | |
|-------------------|-----------------------------------|----------|
| Unit - III | Corrosion and its Control: | 9 |
|-------------------|-----------------------------------|----------|

Introduction - Chemical corrosion - Electrochemical corrosion - Galvanic corrosion - Concentration cell corrosion - Galvanic series - Factors influencing rate of corrosion - Corrosion control methods - Sacrificial anodic method - Protective coatings - Pretreatment of metal surface - Metallic coating - Electroplating - Nonmetallic coating - Phosphate coating - Organic coating - Paints - Constituents and their functions - Special paints - water repellent and luminescent paints.

| | | |
|------------------|------------------------------|----------|
| Unit - IV | Fuels and Combustion: | 9 |
|------------------|------------------------------|----------|

Introduction - Classification of fuels - Requirements of a good fuel - Combustion - Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature - Calorific intensity - Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - Refining of petroleum - Manufacture of synthetic petrol - Hydrogenation of coal - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel - LPG.

| | | |
|-----------------|------------------|----------|
| Unit - V | Polymers: | 9 |
|-----------------|------------------|----------|

Introduction - Classification of polymers - Functionality - Polymerization - Plastics - Types - Thermo and thermosetting plastics - Individual polymers - Polypropylene, PVC, PET and epoxy resin - Preparation, properties and uses - Compounding of plastics - Fabrication of plastics - Compression, injection, extrusion and blow moulding methods - Foamed plastics.

List of Exercises / Experiments:

| | |
|----|---|
| 1. | Estimation of total, temporary and permanent hardness of water by EDTA method. |
| 2. | Estimation of Ca ²⁺ and Mg ²⁺ hardness separately by EDTA method. |
| 3. | Estimation of alkalinity of the given water sample. |
| 4. | Conductometric titration - Mixture of acids. |
| 5. | Estimation of hydrochloric acid using pH meter. |

Alternate Weeks*Lecture:45, Practical:15, Total:60****TEXT BOOK:**

| | |
|----|--|
| 1. | Palanisamy P.N., Manikandan P., Geetha A. & Manjula Rani K., "Applied Chemistry", 5 th Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2018. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Jain & Jain, "Engineering Chemistry", 16 th Edition, Dhanpat Rai Publishing Company, New Delhi, 2016. |
| 2. | Sharma B.K., "Industrial Chemistry", Krishna Prakasan Media Pvt. Ltd, Meerut, 2014. |
| 3. | Palanisamy P.N., Manikandan P., Geetha A. & Manjula Rani K., "Chemistry Laboratory Manual", Rajaganapathy Publishers, Erode, 2018. |



| 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 to construct cells and measure the electrode potential | Applying (K3) |
| CO3 | adopt the suitable corrosion control methods for the given practical 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) |
| CO6 | estimate the amount of hardness for the given water sample by EDTA method | Applying (K3), Precision (S3) |
| CO7 | estimate the amount of alkalinity for the given water sample | Applying (K3), Precision (S3) |
| CO8 | 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 | 2 | 1 | 1 | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 2 | | | | | | | | | | | | |
| CO5 | 3 | 2 | | | | | | | | | | | | |
| CO6 | 3 | 2 | 1 | 3 | | | | | | | | | | |
| CO7 | 3 | 2 | 1 | 3 | | | | | | | | | | |
| CO8 | 3 | 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 | 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)



18GET11 - INTRODUCTION TO ENGINEERING
(Common to All Engineering and Technology Branches)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | NIL | 1 | ES | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|--|--|--|--|--|----------|
| Preamble | The objective of this course is to realize the importance of engineering, measurements and the fundamental concepts of common engineering disciplines like Civil, Mechanical, Electrical and Electronics Engineering. | | | | | | |
| Unit - I | Engineering and Measurements: | | | | | | 9 |
| Engineering and Measurements: Engineering - Engineer and Engineering Graduate - Graduate attributes - Role of engineer - Professional bodies and their role. Physical Quantities - Dimensions - SI Units, Symbols and Conversions - Mechanical Measuring Instruments - Electrical Measuring Instruments - Accuracy and Precision - Data Acquisition System. | | | | | | | |
| Unit - II | Mechanical Engineering: | | | | | | 9 |
| Mechanical Engineering: IC Engines - Power Plants - Boilers and Furnaces - Pumps - Refrigeration and Air Conditioner - CAD/CAM - Additive Manufacturing. Hybrid Electric Vehicles, Industry 4.0. | | | | | | | |
| Unit - III | Civil Engineering: | | | | | | 9 |
| Civil Engineering: Selection of the site for Building - Building approval process - Contract and tenders - Building Materials - Components of Building - Sequence of works for building construction - Prefabricated Structures - Water Management - Rainwater harvesting - Infrastructure - Bridges, Dams and Roads. | | | | | | | |
| Unit - IV | Electrical Engineering: | | | | | | 9 |
| Electrical Engineering: Terminologies - Current, voltage, potential difference, power, energy - Supply: DC, AC - single phase and three phase - Energy conversion - Utility structure - Single line diagram of power system - Apparatus - Tariff - House wiring. Alternator - Induction motor - Solar and wind energy. | | | | | | | |
| Unit - V | Electronics Engineering: | | | | | | 9 |
| Electronics Engineering: Resistor, Inductor, capacitor - Diode - LEDs - Rectifier - Power Supply - Transistor - Transistor as an amplifier - MOSFET - Logic Gates - Microprocessor - Micro controller - Radio communication - Internet of Things. | | | | | | | |

Total:45**TEXT BOOK:**

| | |
|----|---|
| 1. | Faculty of Mechanical Engineering, "Introduction to Engineering", McGraw Hill Education India Pvt. Ltd., Chennai. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Arvid R. Eide, Roland D. Jenison, Steven K. Mickelson and Larry L. Northup , "Engineering Fundamentals and Problem Solving", 7 th Edition, McGraw Hill Education, New York, 2018. |
| 2. | Navaneethakrishnan P., Selvakumar P., Rajeshkumar G. and Sangeetha R.K., "Basic Civil and Mechanical Engineering", McGraw Hill Education, New Delhi, 2016. |
| 3. | Senthilnathan N., Logeswaran T. and Suresh M., "Basic Electrical and Electronics Engineering", McGraw Hill, New Delhi, 2016. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | recognize the roles of engineer, measurement quantities and systems in Engineering | Understanding (K2) |
| CO2 | infer the components and principles of mechanical engineering applications | Understanding (K2) |
| CO3 | summarize the process involved in building construction, infrastructure and water conservation | Understanding (K2) |
| CO4 | recognize the fundamental terms involved in electrical engineering | Understanding (K2) |
| CO5 | explain the working of basic electronic components and its applications | 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 | | |
| CO2 | 3 | 2 | 1 | 1 | | 2 | 1 | | | | | 3 | | |
| CO3 | 3 | 2 | 1 | 1 | | 2 | 1 | | | | | 3 | | |
| CO4 | 3 | 1 | | | | | | | | | | 3 | | |
| CO5 | 3 | 2 | 1 | 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 | 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)



18MEEC11 - ENGINEERING DRAWING
(Common to all Engineering and Technology Branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | 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 |
|-----------------|---|----------|

General Principles of Orthographic Projection: 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 Solid: 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: 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 Surfaces: 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 |
|-----------------|--|----------|

Isometric Projection and Introduction to AutoCAD: 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.

Total:45

TEXT BOOK:

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

REFERENCES:

- | | |
|----|---|
| 1. | Basant Agrawal, Agrawal C.M. "Engineering Drawing", 2 nd 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", 1 st 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 | 20 | 40 | 40 | | | | 100 |

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



18MEL11 - ENGINEERING PRACTICES LABORATORY
(Common to all Engineering and Technology Branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | I | ES | 0 | 0 | 2 | 1 |

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. | To prepare a leak proof sheet metal tray/box/funnel using modern power tools. |
| 6. | Welding practice using welding simulator. |
| 7. | Project: Preparing innovative articles using wood/sheet metal. |
| PART B – ELECTRICAL AND ELECTRONICS ENGINEERING | |
| 8. | Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection |
| 9. | Wiring circuit for fluorescent lamp and stair case wiring |
| 10. | Measurement of earth resistance |
| 11. | Soldering of simple circuits and trouble shooting |
| 12. | Implementation of half wave and full wave rectifier using diodes |

Total:30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|--|
| 1. | Engineering Practices Laboratory Manual. |
|----|--|

| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|--|---------------------------------------|
| On completion of the course, the students will be able to | | |
| 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 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 3 | | |
| CO2 | 3 | 2 | 1 | 1 | | | | | 3 | 2 | 2 | 3 | | |
| CO3 | 2 | 1 | | | | | | | 3 | 2 | 2 | 3 | | |
| CO4 | 3 | 2 | 1 | 1 | | | | | 3 | 3 | 2 | 3 | | |
| CO5 | 3 | 2 | 1 | 1 | | | | | 3 | 2 | 2 | 3 | | |

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



18EGT21 - ENGLISH FOR COMMUNICATION II
(Common to All Engineering and Technology Branches)

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

| | |
|-----------------|---|
| Preamble | This course is designed to impart required levels of fluency in using the English Language at B1 level in the 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, "Interchange, Student's Book 3", 4 th Edition, Cambridge University Press, New York, 2017. |
|--|

REFERENCES:

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|---|
| 1. Jane Willis, "A Framework for Task Based Learning", Longman, Harlow, 1996. |
|---|

| |
|---|
| 2. Rod Ellis, "Task Based Language Learning and Teaching", Oxford University Press, London, 2003. |
|---|



| 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 | 3 | 3 | 30 | 40 | | 24 | 100 |
| CAT2 | 3 | 3 | 33 | 43 | | 18 | 100 |
| CAT3 | 3 | 3 | 33 | 43 | | 18 | 100 |
| ESE | 3 | 3 | 31 | 45 | | 18 | 100 |

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



18MAC21 - MATHEMATICS II
(Common to All Engineering and Technology Branches)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|----|---|--------|
| Prerequisites | Nil | 2 | BS | 3 | 1* | 2 | 4 |

Preamble To impart the knowledge of 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 **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 - II **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 and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.

Unit - III **Beta and Gamma Functions:** **9**

Definition of beta and gamma Functions – Properties – Relation between beta and gamma functions – Transformations of gamma function – Applications of beta and gamma functions: Evaluation of definite integrals in terms of beta and gamma functions.

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 – 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. | Evaluating indefinite and definite integrals |
| 2. | Evaluating double and triple integrals |
| 3. | Finding the area between two curves |
| 4. | Computing gradient, divergence and curl |
| 5. | Computation of beta and gamma 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 Weeks**

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

TEXT BOOK:

| | |
|----|--|
| 1. | Grewal B.S., "Higher Engineering Mathematics", 43 rd Edition, Khanna Publications, New Delhi, 2014. |
|----|--|

REFERENCES:

| | |
|----|---|
| 1. | Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - II", 2 nd Edition, Pearson India Education, New Delhi, 2018. |
| 2. | Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1 st Edition, CRC Press, London, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | solve problems involving double and triple integrals | Understanding (K2) |
| CO2 | apply the concept of vectors in engineering problems | Applying (K3) |
| CO3 | use Beta and Gamma functions to improper evaluate integrals | Applying (K3) |
| CO4 | identify, construct and apply analytic functions in electrostatics and fluid flow problems | Applying (K3) |
| CO5 | evaluate complex integrals which is extensively applied in engineering | Applying (K3) |
| CO6 | evaluate line, double and triple integrals and determine area between two curves using MATLAB | Applying (K3), Manipulation (S2) |
| CO7 | compute gradient, curl and divergence of a vector function 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 | 2 | 2 | | | | | | | | | | | |
| CO2 | 3 | 2 | | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 1 | | | | | | | | | | | | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | | |
| CO6 | | | | | 3 | | | | | | | | | |
| CO7 | | | | | 2 | | | | | | | | | |
| CO8 | | | | | 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 | 10 | 70 | | | | 100 |
| CAT2 | 20 | 10 | 70 | | | | 100 |
| CAT3 | 20 | 10 | 70 | | | | 100 |
| ESE | 20 | 10 | 70 | | | | 100 |

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



18PHC27- PHYSICS OF MATERIALS

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|-----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Applied Physics | 2 | BS | 3 | 0 | 2* | 3.5 |

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 **9**

Conducting and Dielectric Materials: Conducting materials: Introduction - Classical free electron theory – Electrical and thermal conductivities –Wiedemann- Franz law –Lorentz number –Merits and demerits of classical free electron theory – Quantum free electron theory. 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 capacitor.

UNIT – II **9**

Magnetic Materials and Microwaves: Origin of magnetism - Types of magnetic materials – Domain theory of ferromagnetism – Soft and hard magnetic materials – Application: Metal detector and magnetic inductive flow meter – Microwaves: Introduction - Conversion of microwaves into heat- Penetration depth and applications.

UNIT –III **9**

Nano Materials: Low dimensional structures: quantum dot, quantum wire and quantum well – Properties of nanomaterials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Sol gel method – Carbon nanotubes: structures and properties – Industrial applications of nanotechnology in food processing and packaging.

UNIT – IV **9**

Crystal Growth: Introduction – Nucleation: Classical theory of nucleation – Critical radius – homogeneous and heterogeneous nucleation – Free energy formation of critical nucleus – Crystal growth techniques – Melt growth methods: Czochralski and Bridgman – Low temperature solution growth method.

UNIT – V **9**

Materials Characterization: Importance of materials characterization – Raman spectroscopy - X-ray diffraction – Scanning electron microscope: principle, construction and working – Transmission electron microscope: principle, construction and working - Thermal analysis: Thermo gravimetric analysis (TGA).

List of 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 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.

Alternate Weeks*Lecture:45, Practical: 15, Total: 60****TEXT BOOK:**

1. Tamarasani K. and Prabu K., "Engineering Physics-II", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

REFERENCES / MANUAL:

1. Raghavan V., "Materials Science and Engineering: A first course", 5th Edition, Prentice-Hall of India, New Delhi, 2009.
2. Li, Lin, Ashok Kumar, "Materials Characterization Techniques", Sam Zhang; CRC Press, 2008.
3. Tamarasani K. and Prabu K., "Physics Laboratory Manual", SCM Publishers, Erode, 2018.



| 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 describe the select characteristics and applications of dielectrics | Applying (K3) |
| CO2: | apply the concepts of magnetism to make clear the working of metal detector, magnetic inductive flow meter and the uses of microwaves in food processing | Applying (K3) |
| CO3: | explain the features and the select preparation techniques of nano-materials and carbon nano tube | Understanding (K2) |
| CO4: | describe the phenomena related to crystal growth and the select crystal growth techniques | Understanding (K2) |
| CO5: | apply the concepts of Raman effect, X-ray diffraction, matter waves and thermograph to illustrate the working of Raman spectroscopy, X- ray diffraction technique, electron microscopes and thermo gravimetric analysis | Applying (K3) |
| CO6: | determine the specific resistance of metals using the concept of electrical conductivity | Applying (K3), Precision (S3) |
| CO7: | determine the thermal conductivity of dielectric materials using the concept of heat flow through the materials | Applying (K3), Precision (S3) |
| CO8: | 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 | 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 | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | | |
| CO3 | 3 | 2 | | | | | | | | | | | | |
| CO4 | 3 | 2 | | | | | | | | | | | | |
| CO5 | 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 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 30 | 40 | 30 | | | | 100 |
| CAT3 | 25 | 45 | 30 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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



18CYC27 - ENVIRONMENTAL CHEMISTRY AND SUSTAINABILITY

| | | | | | | | |
|-------------------------------|--------------------------------|-------------|-----------------|----------|----------|-----------|---------------|
| Programme & Branch | B.Tech. Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Applied Chemistry | 2 | BS | 3 | 0 | 2* | 3.5 |

Preamble: Environmental Chemistry aims to realize the interdisciplinary and holistic nature of the environment for food technology students and stimulate them to quest for environment, ecosystem, biodiversity and sustainability in food processing.

UNIT - I **9**

Environment and Natural Resources: Components and sub components of environment–natural resources: forest resources, water resources, mineral resources, food resources, energy resources, land resources – role of an individual in conserving natural resources.

UNIT - II **9**

Ecosystems and Biodiversity: Ecosystem - Components of an ecosystem - structural and functional features – energy flow in the ecosystem - functional attributes (food chain and food web only) – introduction, types, characteristic features, structure and functions of the (a) forest ecosystem (b) aquatic ecosystems (ponds, rivers and oceans) - Biodiversity - Introduction – classification – values of biodiversity – India as a mega diversity nation - biodiversity at global, national and local level - hotspots of biodiversity – threats to biodiversity – endangered and endemic species of India – in-situ and ex-situ conservation of biodiversity.

UNIT - III **9**

Environmental Pollution: Definition – causes, effects, control measures and case studies of: (a) air pollution - climate change, global warming, acid rain, ozone layer depletion (b) water pollution - environmental significance of dissolved oxygen, BOD and COD (c) soil pollution - solid waste management (d) noise pollution.

UNIT - IV **9**

Environmental Legislation and Laws: Environment and Development: Population explosion – industrialization – urbanization – environmental impact - Environmental Legislation and Laws: Pollution control boards - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – community and NGOs participation.

UNIT - V **9**

Sustainable Food Processing: 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.

List of Experiments:

1. Estimation of chloride ion in the given water sample using Argentometric method.
2. Determination of Dissolved Oxygen in the given wastewater sample.
3. Determination of COD in the given wastewater sample.
4. Kinetics of reactions – Acid catalyzed hydrolysis of an ester.
5. Determination of physical characterization of wastewater (pH, color, turbidity and dissolved solids)

Lecture:45, Practical:15, Total: 60

TEXT BOOK:

1. Palanisamy P.N., Manikandan P., Geetha A., ManjulaRani K., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2019.

REFERENCES/ MANUAL:

1. Anubha Kaushik and Kaushik C.P., “Environmental Science and Engineering”, 6th Multicolor Edition, New Age International (P) Ltd., New Delhi, 2018.
2. Stephanie Clark, Stephanie Jung and Buddi Lamsal, “Food Processing: Principles and Applications”, 2nd Edition, John Wiley and Sons, 2014.
3. Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., “Chemistry Laboratory Manual”, Rajaganapathy Publishers, Erode, 2018.

* Alternate Weeks



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1: | illustrate various natural resources and the role of individual for its conservation | Understanding (K2) |
| CO2: | elaborate the features of ecosystems 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 environmental legislation laws to solve various social issues | Applying (K3) |
| CO5: | apply the green engineering principle for sustainable food processing | Applying (K3) |
| CO6: | estimate the amount of chloride and DO in the given water sample | Applying (K3), Precision (S3) |
| CO7: | determine the rate constant of hydrolysis of an ester | Applying (K3), Precision (S3) |
| CO8: | determine the pH, colour, turbidity, dissolved solids and COD in the given wastewater | 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 | 2 | 1 | | | | | 3 | | | | | | | |
| CO2 | 2 | 1 | | | | | 3 | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | 3 | | | | | | | |
| CO4 | 3 | 2 | 1 | 1 | | | 3 | | | | | | | |
| CO5 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO6 | 3 | 2 | 1 | 3 | | | | | | | | | | |
| CO7 | 3 | 2 | 1 | 3 | | | | | | | | | | |
| CO8 | 3 | 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 | 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)



18CSC11 - PROBLEM SOLVING AND PROGRAMMING
(Common to All Engineering and Technology Branches)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 1 | ES | 2 | 0 | 2 | 3 |

| | | | | | | | |
|--|--|--|--|--|--|--|----------|
| Preamble | This course mainly focuses on the basic concepts of computing, the methodology of problem solving and developing skills in programming using C language. | | | | | | |
| Unit - I | Introduction to Computer and Problem Solving: | | | | | | 6 |
| Overview of computers - Applications of computers - Characteristics of computer - Basic computer Organization - Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudocodes - Structuring the logic. | | | | | | | |
| Unit - II | Case Study on Problem Solving: | | | | | | 6 |
| Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables - Finding the biggest number - Counting - Summation of numbers - Factorial computation - Generation of Fibonacci Sequence - Summation of series - Base Conversion - Reversing the digits of an Integer. | | | | | | | |
| Unit - III | Introduction to C and Control Statements: | | | | | | 6 |
| Overview of C - Basic structure of a C Program - Executing a C Program - C Character set - Tokens - Keywords and Identifiers - Constants - Variables - Data types - Storage classes - Managing Input and Output operations - Operators and Expressions - Decision making and Branching - Looping - Break and continue statements. | | | | | | | |
| Unit - IV | Arrays, Strings and Structures: | | | | | | 6 |
| Arrays - One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables - Performing simple string operations - Introduction to structures: Structure definition - Structure declaration - Accessing a structure member - Structure initialization - Unions. | | | | | | | |
| Unit - V | Functions: | | | | | | 6 |
| User defined functions: Elements of user defined functions - String handling functions - Library functions (strings and characters manipulation) - Passing arguments to functions – Recursion. Introduction to Pointers: Understanding pointers - Accessing address of a variable - Declaring pointer variables - Initialization of pointer variables - Accessing a variable through its pointer - Parameter passing mechanisms. | | | | | | | |

List of Exercises / Experiments :

| | |
|----|---|
| 1. | Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, selective and repetitive structures |
| 2. | Programs for demonstration of working of different types of operators like arithmetic, logical, relational and ternary operators involving sequential structures |
| 3. | Demonstration of programs using decision making statements namely 'if', 'else if', 'switch', conditional and unconditional 'goto' (selective structures) |
| 4. | Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (iterative structures) |
| 5. | Demonstration of programs for declaration, initialization and performing operations on one-dimensional and two-dimensional numeric arrays |
| 6. | Demonstration of programs for implementing various string operations like 'copy', 'finding length', 'compare', 'concatenate' with and without built-in library functions. |
| 7. | Demonstration of programs for making use of user-defined data types namely structures and unions |
| 8. | Demonstration of modular programming concepts using functions – developing programs using built-in and user-defined functions and parameter passing mechanisms |

Lecture:30, Practical:30, Total:60

TEXT BOOK:

| | |
|----|--|
| 1. | "Problem Solving and Programming", compiled by Department of CSE, Kongu Engineering College, Internal circulation, 2017. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Dromey R.G., "How to Solve it by Computer", Pearson Education, 2009. |
| 2. | Balagurusamy E., "Fundamentals of Computing and Programming", Tata McGrawHill Education Pvt. Ltd., 2017. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | outline the characteristics, organisation, working principles and applications of computers | Understanding (K2) |
| CO2 | express the solution for the given real world problems in terms of algorithm, flowchart and pseudocode | Applying (K3) |
| CO3 | identify the appropriate looping and control statements in C for providing the solution to the given problems | Understanding (K2) |
| CO4 | demonstrate the usage of arrays, strings and structures to solve the given problems | Understanding (K2) |
| CO5 | apply fundamental modular programming knowledge to solve the given problems and recall the basic concepts of pointers | Understanding (K2) |
| CO6 | demonstrate the execution of flowchart for the given problem using Raptor | Applying (K3), Precision (S3) |
| CO7 | demonstrate the application of control statements using simple C programs | Applying (K3), Precision (S3) |
| CO8 | implement solutions to the given problem using user defined functions and data types | 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 | 2 | | | | | | | | | | | | | |
| CO2 | 2 | 2 | 2 | | 2 | | | | | | | | | |
| CO3 | | 2 | 1 | | | | | | | | | | | |
| CO4 | | 2 | 1 | | | | | | | | | | | |
| CO5 | | 2 | 1 | | | | | | | | | | | |
| CO6 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | | | | |
| CO7 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | | | | |
| CO8 | 3 | 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)

**18FTT21 - FUNDAMENTALS OF BIOCHEMISTRY**

| Programme & Branch | B.Tech. – Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 2 | PC | 3 | 0 | 0 | 3 |

Preamble: This course will deal about the structure and properties of biomolecules, actions of enzymes and metabolism.

| | | |
|-----------------|--|----------|
| UNIT – I | | 9 |
|-----------------|--|----------|

Carbohydrates: Classification; Simple Sugars: mono and disaccharides, Hygroscopicity and solubility, optical rotation, mutarotation; 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 and uses in foods.

| | | |
|------------------|--|----------|
| UNIT – II | | 9 |
|------------------|--|----------|

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

| | | |
|-------------------|--|----------|
| UNIT – III | | 9 |
|-------------------|--|----------|

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

| | | |
|------------------|--|----------|
| UNIT – IV | | 9 |
|------------------|--|----------|

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

| | | |
|-----------------|--|----------|
| UNIT – V | | 9 |
|-----------------|--|----------|

Nucleic Acids: Composition and structure of DNA and RNA. **Metabolism:** Metabolism - Glycolysis; TCA cycle; substrate level phosphorylation. Protein metabolism – urea cycle. Cellular respiration - electron transport chain. Lipid metabolism – lipases and phospholipases. Fatty acid metabolism – beta oxidation and fatty acid synthesis. Inter relationship of metabolic pathways.

Total: 45

TEXT BOOK:

1. Belitz H. D., Grosch W., and Schieberle P., "Food Chemistry", 3rd Edition, Springer Verley, Berlin, 2008.

REFERENCES:

1. Jain J.L., Sunjay Jain and Nitin Jain, "Fundamentals of Biochemistry", S. Chand & Co., New Delhi, 2008.
2. 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 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | | 1 | | | | | | 1 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | | 1 | | | | | | 1 | 2 | 2 |
| CO4 | 3 | 2 | 1 | 2 | | | | | | | | 1 | 2 | 2 |
| CO5 | 3 | 1 | 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 | 40 | 60 | | | | | 100 |
| CAT2 | 40 | 60 | | | | | 100 |
| CAT3 | 40 | 60 | | | | | 100 |
| ESE | 40 | 60 | | | | | 100 |

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



18VEC11 - VALUE EDUCATION
(Common to All Engineering and Technology Branches)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | NIL | 2 | HS | 2 | 0 | 1 | 1 |

| | | | | | | | |
|----------|---|--|--|--|--|--|--|
| Preamble | The aim of the course is to make the students to understand the purpose and value of life and to exhibit positive human values. | | | | | | |
|----------|---|--|--|--|--|--|--|

| | | | | | | | |
|-----------------|------------------------------------|----------|--|--|--|--|--|
| Unit - I | Philosophy of Life Science: | 4 | | | | | |
|-----------------|------------------------------------|----------|--|--|--|--|--|

Life - Purpose of life (four stages of life) - Philosophy of life (who am I') – Law of nature (cause of the life and body) - Content of the Life (five sheaths) - Goal of life. Five duties in life. Methodology: Life and messages of spiritual and national leaders - The forgotten hero, etc. Project report: Complementing with happiness - Every soul is potentially divine.

| | | | | | | | |
|------------------|---|----------|--|--|--|--|--|
| Unit - II | Human Values - Moral Foundation: | 4 | | | | | |
|------------------|---|----------|--|--|--|--|--|

Truth, forgiveness, compassion, endurance, humility, non violence, moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith - Good habits - Attitude forming for Individual peace. Practical Methods: Personal experience with above characters, Puranic Stories - Self resolve diary maintenance.

| | | | | | | | |
|-------------------|-----------------------|----------|--|--|--|--|--|
| Unit - III | Social Values: | 4 | | | | | |
|-------------------|-----------------------|----------|--|--|--|--|--|

Family - Family System - Greatness of women - World brotherhood (vasudeiva kudumbagam) - Glorious Bharath - Bharathian systems - Past-Present-Future - Team spirit - Goal setting - Economics - Education - Politics - Responsibilities of people - Preserving natural resources. Methodology: Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games. Team Spirit - Yogic Games.

| | | | | | | | |
|------------------|--|----------|--|--|--|--|--|
| Unit - IV | Development of Mental Prosperity: | 4 | | | | | |
|------------------|--|----------|--|--|--|--|--|

Prosperity of mind - Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga - Types - Uses - Precaution - Contradiction - Kriyas - Asanas - Pranayamas - Meditative techniques. Methodology: Asana - Pranayama - Cyclic meditation - Nada anu sandhana - Meditation - Yogic games for memory. Album on asanas, pranayama and mantra.

| | | | | | | | |
|-----------------|--|----------|--|--|--|--|--|
| Unit - V | Maintenance of Physical Health: | 4 | | | | | |
|-----------------|--|----------|--|--|--|--|--|

Human body - Structure - Ten Systems of the body as per modern science. Five elements - Harmonious relationship - Life force - Conserving vitality and health through natural life - Pranic food and its importance - Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease - Acute and chronic - Disease - Life and death. Methodology: Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.

List of Exercises / Experiments:

| | |
|----|---|
| 1. | List of Loosening Exercises: Neck Movements, Shoulder Joint Movements, Elbow Joint Movement, Wrist Joint Movements, Finger Joint Movements, Rip Joint Movement, Hip Joint Movements, Spinal Cord Movement, Knee Joint Movements, Ankle Joint Movements, Toe Joint Movements. |
| 2. | List of Asanas: Surya Namaskara, Shavasana, Makarasana, Uttanpadasana, Pawanmuktasana, Sedubandasana, Naukasana, Vipareetakarani, Bhujangasana, Sarpasana, Shalabasana, Dhanurasana, Padmasana, Parvatasana, Vakrasana, Janu Sirshasana, Ustrasana, Yoga Mudra, Meru Tandanasana, Tadasana, Katichakrasana, Paadahastanasana, Parivarta Trikonasana, Ardha Chakrasana, Viruksasana. |
| 3. | List of Pranayamas: Naadi Sodhana Pranayama, Bhastrika Pranayama, Bhramari Pranayama, Sheetali Pranayama. |

Lecture:20, Practical:10, Total:30

TEXT BOOK:

| | |
|----|--|
| 1. | Value Education, "Compiled by Vethathiri Maharishi Institute for Spiritual and Intuition Education", Aliyar, Pollachi, 2018. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Value Education - Yoga Practical Guide, "Compiled by Padmasoorya Naturopathy and Yoga Foundation", Coimbatore, 2018. |
|----|--|



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | understand the purpose and value of life. | Understanding (K2) |
| CO2 | exhibit positive human values. | Understanding (K2) |
| CO3 | understand social values. | Understanding (K2) |
| CO4 | take steps to develop mental and physical health | Applying (K3), Imitation (S1) |

| 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 | | |
| CO2 | | | | | | 3 | | 3 | | | | 3 | | |
| CO3 | | | | | | 3 | | 3 | | | | 3 | | |
| CO4 | | | | | | 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 | | | | | | | 0 |
| CAT2 | | | | | | | 0 |
| CAT3 | | | | | | | 0 |
| ESE | 25 | 75 | | | | | 100 |

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

**18MAC31 - MATHEMATICS III**

(Common to Civil Engineering, Mechanical Engineering, Mechatronics Engineering, Automobile Engineering, Electronics And Communication Engineering, Electrical And Electronics Engineering, Electronics And Instrumentation Engineering, Chemical Engineering & Food Technology Branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|-----------|-----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 3 | BS | 3 | 1* | 2* | 4 |

Preamble To provide the skills for solving the real time engineering problems involving partial differential equations and impart knowledge in Fourier transform and Z-Transform.

Unit - I **Fourier Series:** **9**

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

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

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 - III **Applications of Partial Differential Equations:** **9**

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).

Unit - IV **Fourier Transform:** **9**

Fourier Integral theorem (without proof) – Fourier transform pair – Properties (without proof) – Transforms of simple functions – Fourier Sine and Cosine transforms – Properties (without proof) – Convolution theorem and Parseval's identity (Statement and applications only).

Unit - V **Z – Transform:** **9**

Definition – Z-transform of some basic functions – Elementary properties – Inverse Z- transform: Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms: Solution of difference equations.

List of Exercises / Experiments :

| | |
|----|--|
| 1. | Expressing given function in terms of Fourier series. |
| 2. | Harmonic Analysis of given data. |
| 3. | Solving second order partial differential equations. |
| 4. | Solution of One dimensional wave equation. |
| 5. | Solution of Two dimensional heat equation. |
| 6. | Determining Fourier and inverse Fourier transform of a given function. |
| 7. | Computing Z- transform of a discrete sequence. |
| 8. | Apply Z- transforms to obtain the solution of difference equations. |

Alternate Weeks*Lecture:45, Tutorial and Practical:15, Total:60****TEXT BOOK:**

1. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

REFERENCES:

| | |
|----|--|
| 1. | Erwin Kreyszig, "Advanced Engineering Mathematics", 10 th Edition, John Wiley & Sons Ltd., USA, 2019. |
| 2. | Duraisamy C., Vengataasalam S., Arun Prakash K. & Suresh M., "Engineering Mathematics – III", 2 nd Edition, Pearson India Education, New Delhi, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | express given function or data in terms of Fourier series | Applying (K3) |
| CO2 | solve the given standard partial differential equations | Applying (K3) |
| CO3 | apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations | Applying (K3) |
| CO4 | use the mathematical principles of Fourier transforms which will provide the ability to formulate and solve some of the physical problems of engineering | Applying (K3) |
| CO5 | apply Z transform techniques for analyzing linear time invariant systems | Applying (K3) |
| CO6 | express the given data in Fourier series using MATLAB | Applying (K3), Manipulation (S2) |
| CO7 | solve partial differential equations using PDE Modeler | Applying (K3), Manipulation (S2) |
| CO8 | find Fourier and Z-Transforms using MATLAB built in functions | 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 | 1 | 1 | | | | | | | | | | |
| CO2 | 3 | 3 | 1 | 1 | | | | | | | | | | |
| CO3 | 3 | 3 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 3 | 1 | 2 | | | | | | | | | | |
| CO5 | 3 | 3 | 1 | 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 | 20 | 10 | 70 | | | | 100 |
| CAT2 | 20 | 10 | 70 | | | | 100 |
| CAT3 | 20 | 10 | 70 | | | | 100 |
| ESE | 20 | 10 | 70 | | | | 100 |

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



18FTT31 - FOOD PROCESS CALCULATION

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| 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 | | | | | | | 9 +3 |
| Units and Dimensions, Fundamental Calculations: 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 gas law, use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation. | | | | | | | |
| UNIT – II | | | | | | | 9 +3 |
| Material Balance Calculation: 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 | | | | | | | 9+3 |
| Recycle Operations: Recycle stream, 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 | | | | | | | 9+3 |
| Energy Balance Calculation: 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 | | | | | | | 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”, 8 th Edition, Prentice Hall of India, New Delhi, 2013. | | | | | | |
| REFERENCES: | | | | | | | |
| 1. | Yanniotis S., “Solving Problems in Food Engineering”, Springer, New York, 2008. | | | | | | |
| 2. | Toledo Romeo T., “Fundamentals of Food Process Engineering”, 4 th 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 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 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 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 | 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 | 20 | 60 | | | | 100 |
| CAT2 | 20 | 20 | 60 | | | | 100 |
| CAT3 | 20 | 20 | 40 | 20 | | | 100 |
| ESE | 15 | 25 | 40 | 20 | | | 100 |

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



18FTT32 - FLUID MECHANICS IN FOOD PROCESSING OPERATIONS

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| 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 | | | | | | | 9 +3 |
| Fluid Statics and Dimensional Analysis: Nature of fluids, Physical properties of fluids. Types of fluids: Compressible and incompressible fluids, Newtonian and Non-Newtonian fluids. Fluid statics: Hydrostatic equilibrium. Application of fluid statics: manometers, continuous gravity decanter. Basics of dimensional analysis: Rayleigh's method and Buckingham's II method. | | | | | | | |
| UNIT – II | | | | | | | 9+3 |
| Basic Equations of Fluid Flow: Continuity equation. 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, contraction. Friction loss in fittings, valves and coils. | | | | | | | |
| UNIT – III | | | | | | | 9+3 |
| Flow Past Immersed Bodies: 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: Types of impellers, Flow pattern in agitated vessel. Estimation of Power consumption in agitated vessels. | | | | | | | |
| UNIT – IV | | | | | | | 9+3 |
| Transportation of Fluids: Classification of Pumps. Positive displacement pumps: operation, capacity and characteristics. Centrifugal pump: Performance, losses and characteristics. Calculation of power and discharge. Gear pumps, Lobe pumps, Screw pumps, diaphragm pumps, progressive cavity pump, vacuum pump, metering pump, peristaltic pump –working principle and application. Pump selection in food processing. Fans, blowers and compressors – Selection, types and applications. Pipelines for the transportation of utility fluids, products, semi products and raw materials – sanitary aspects and material of construction. | | | | | | | |
| UNIT – V | | | | | | | 9 +3 |
| Metering of Fluids: Variable head meter: Orifice meter, Venturimeter, Pitot tube. Variable areameter: Rotameter. Calibration of flow meters. Principles and applications of Doppler Effect in flow measurement. Principle of Magnetic flow meters, V-Notch, Turbine flow meters, and Thermal flow meters. 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", 7 th Edition, McGraw Hill, New York, 2005. | | | | | | |
| REFERENCES: | | | | | | | |
| 1. | Romeo T. Toledo, "Fundamentals of Food Process Engineering", 4 th Edition, Springer, New York, 2018. | | | | | | |
| 2. | Paul Singh R., Dennis R. Heldman, "Introduction to Food Engineering", 5 th 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 and dimensional analysis | 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 | 20 | 60 | | | | 100 |
| CAT2 | 10 | 20 | 30 | 40 | | | 100 |
| CAT3 | 10 | 20 | 20 | 40 | | | 100 |
| ESE | 10 | 20 | 40 | 30 | | | 100 |

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



18FTT33 - PROCESS ENGINEERING THERMODYNAMICS

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

| | | | | | | | |
|--|--|--|--|--|--|--|-------------|
| Preamble | To impart knowledge on basic concepts and laws of thermodynamics, behavior of pure fluids, steam properties, steam distributions systems and boilers | | | | | | |
| UNIT – I | | | | | | | 9 +3 |
| Basic Concepts and First Law: Fundamental concepts of thermodynamics: microscopic and macroscopic approach, systems, properties, process, functions, units, energy, heat and work, zeroth law, equilibrium state and phase rule. First law: statement of first law for flow and non-flow process, internal energy, enthalpy, heat capacities (C_V and C_P), Application of first law of thermodynamics: flow through nozzles, throttling process. | | | | | | | |
| UNIT – II | | | | | | | 9 +3 |
| Second Law: Second Law of thermodynamics: Kelvin-Planck, Clausius statements and its equivalence, reversible cycle – Carnot cycle and theorem – thermodynamic temperature scale. Entropy, Clausius theorem, Clausius inequality, estimation of entropy changes during processes, available and unavailable energies. | | | | | | | |
| UNIT – III | | | | | | | 9 +3 |
| PVT Behavior of Pure Fluids: PVT surfaces: P-V, P-T, T-S and H-S Diagrams. Fundamentals of phase equilibria, fugacity. Equation of state and the concept of ideal gas: Process involving ideal gases - constant volume, constant pressure, and constant temperature, adiabatic and polytropic process. Equation of state for real gases: Vander Waals equation, RedlichKwong equation, Virial equation of state. Principle of corresponding states, generalized compressibility charts. | | | | | | | |
| UNIT – IV | | | | | | | 9+3 |
| Steam Properties: Determination of properties of steam using steam tables. Determination of dryness fraction of steam: Calorimeters – Tank or barrel type, throttling, separating, separating and throttling. Steam distribution systems. Types of steam traps and their characteristics. Application of steam in food process industries. | | | | | | | |
| UNIT – V | | | | | | | 9 +3 |
| Boilers: Types of boiler: Fire tube and water tube boiler – working principle, Boiler mountings and Accessories. Performance and energy efficiency of boilers. Simple calculation of Boiler efficiency. Importance of boiler water treatment and blow down. | | | | | | | |
| Lecture: 45, Tutorial: 15, Total: 60 | | | | | | | |
| TEXT BOOK: | | | | | | | |
| 1. | Narayanan K.V., “A Text Book of Chemical Engineering Thermodynamics”, 2 nd Edition, Pentice Hall of India, New Delhi, 2013. | | | | | | |
| REFERENCES: | | | | | | | |
| 1. | Sadhu Singh and Sukumar Pati, “Thermal Engineering”, 1 st Edition, Pearson India Education Services Pvt. Ltd., Noida, 2018. | | | | | | |
| 2. | Romeo T. Toledo, “Fundamentals of Food Process Engineering”, 4 th Edition, Springer, New York, 2018. | | | | | | |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1: | outline the basic concepts and apply the first law of thermodynamics in processes | Applying (K3) |
| CO2: | understand and apply second law of thermodynamics and Carnot principles | Applying (K3) |
| CO3: | apply the principles and concepts of PVT behavior of pure substances, ideal and real gases | Applying (K3) |
| CO4: | analyze the properties of steam and its quality | Analyzing (K4) |
| CO5: | understand the working principle of boilers and its performance | 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 | 1 | | | | | | | | | 2 | 1 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | | | | | | | | | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | | | | | | | | 1 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 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 | 40 | 30 | 30 | | | | 100 |
| CAT2 | 40 | 30 | 30 | | | | 100 |
| CAT3 | 20 | 30 | 20 | 30 | | | 100 |
| ESE | 20 | 30 | 20 | 30 | 0 | 0 | 100 |

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



18FTT34 - FOOD CHEMISTRY

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Fundamentals of Biochemistry | 3 | PC | 3 | 0 | 0 | 3 |
| Preamble | This course deals about the importance of micronutrients, food additives, modification of biomolecules and interactions of ingredients in food systems. | | | | | | |

| | | |
|---|---|------------------|
| UNIT – I | | 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 | | 9 |
| Changes during Cooking: 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 | | 9 |
| Modification of Biomolecules: 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, biochemical changes in post mortem and tenderization of muscles. | | |
| UNIT – IV | | 9 |
| Interactions of Ingredients in Food Systems: Introduction, Interaction of water with food components - Nature of the Interactions, Functional Properties of Water, Effects on Food Quality; Polysaccharide Interactions in Food systems; Protein-Protein Interactions in Food; Protein-Lipid Interactions in Food Systems | | |
| UNIT – V | | 9 |
| Food Additives: classification and purpose - Role of thickeners, sweeteners, stabilizers, emulsifiers, leaveners, colours, flavoring agents, flour improvers, anticaking agents, sequestrants, humectants, preservatives - examples. Food Colours and Flavors: Natural and synthetic colourants; chlorophyll, carotenoids, betalains, anthocyanins and other phenols. Flavours – sensory perception of flavors, Molecular Mechanisms of Flavor Perception, specific and synthetic flavors, Taste and Other Saporous Substances, Vegetable, Fruit, and Spice Flavors, Flavors from Lactic Acid – Ethanol Fermentations, Flavor Volatiles from Fats and Oils. | | |
| | | Total: 45 |
| TEXT BOOK: | | |
| 1. | Srinivasan Damodaran, Kirk L. Parkin (Eds), “Fennema’s Food Chemistry”, 5 th Edition, CRC Press, 2017. | |
| REFERENCES: | | |
| 1. | Belitz H.D., Grosch W. and Schieberle P., “Food Chemistry”, 3 rd Edition, Springer-Verley, Berlin, 2009. | |
| 2. | Anilkumar G. Gaonkar, Andrew McPherson (Eds), “Ingredient Interactions Effects on Food Quality”, 2 nd Edition, Taylor & Francis, New York, 2006. | |



| 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: | analyze the interaction of ingredients in food systems | Analyzing (K4) |
| CO5: | identify the role of food additive, colours and flavors 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 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | 2 | 1 |
| CO3 | 3 | 3 | 2 | 1 | 1 | | | | | | | | 2 | 1 |
| CO4 | 3 | 3 | 1 | 1 | | | | | | | | | 2 | 1 |
| CO5 | 3 | 3 | 2 | 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 | 40 | 60 | | | | | 100 |
| CAT2 | 10 | 50 | 20 | 20 | | | 100 |
| CAT3 | 10 | 50 | 20 | 20 | | | 100 |
| ESE | 20 | 40 | 20 | 20 | | | 100 |

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



18FTT35 - FOOD MICROBIOLOGY

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 3 | PC | 3 | 0 | 0 | 3 |
| Preamble | This course will help students to gain in depth knowledge in microbiology basics, identification and incidence of microbes in food, spoilage, diseases and its control | | | | | | |

| | | |
|--|---|------------------|
| UNIT – I | | 9 |
| Introduction: Scope of Microbiology – History - Contribution by scientists. Three kingdom concept - Whittaker Five Kingdom concept - Classification of organisms - Prokaryotes and Eukaryotes. Bacteria and Fungi - Structure and Reproduction. Role of Algae and Virus in foods. Bacteriophages – Reproduction. | | |
| UNIT – II | | 9 |
| Classification and Identification: Classification of microorganisms based on nutritional requirements. Introduction to microscopes. Staining techniques: Simple staining, Differential staining and 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 microorganisms in food, Parameters influencing the growth of microorganisms in food - Intrinsic and Extrinsic. Microbial Load assessment: SPC, MPN, DMC, Dye Reduction test, Flow cytometry, ATP measurement, 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: Introduction - Gastroenteritis, Listeriosis, Salmonellosis, Shigellosis, Vibriosis, Campylobacteriosis. Food toxins – Aflatoxin, Ochratoxin, Patulin, Botulin. Indicators of food product quality - Coliform bacteria as indicators. Microbiological criteria for foods. | | |
| | | Total: 45 |
| TEXT BOOK: | | |
| 1. | Pelczar M.J., Chan E.C.S. and Krieg N.R., “Microbiology”, 5 th Edition, Tata McGraw Hill, New York, 2004 for Unit I & II. | |
| 2. | Frazier W.C., Westhoff D.C. and Vanitha N.M., “Food Microbiology”, 5 th Edition, Tata McGraw Hill, New Delhi, 2014 for Unit III, IV & V. | |
| REFERENCES: | | |
| 1. | James M. Jay, Martin J. Loessner, David A. Golden, “Modern Food Microbiology”, 7 th Edition, Springer, Boston, MA, USA, 2005. | |



| 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 them | Remembering (K1) |
| CO2: | outline the appropriate techniques to identify and cultivate microorganisms | Understanding (K2) |
| CO3: | review the importance of microorganisms in foods and its load assessment | 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 | | 2 | | | | | | | | 1 | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| CO3 | 2 | 2 | 3 | | | | | | | | | | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 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 | 48 | 52 | | | | | 100 |
| CAT2 | 48 | 52 | | | | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 40 | 30 | 30 | | | | 100 |

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



18FTL31 - 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 Experiments:

- Determination of discharge coefficient of venturimeter
- Determination of discharge coefficient of orificemeter
- Verifying relationship between friction factor and Reynolds number for flow through square ducts
- Verifying Darcy's equation for flow through circular pipes
- Determination of critical Reynolds number for flow through helical coils
- Determination of discharge coefficient of V- notch
- Verifying relationship between friction factor and Reynolds number for flow through annular pipes
- Determination of loss coefficient of valves and pipe fittings
- Determination of discharge coefficient of orifice in open drum
- Estimation of performance characteristic of centrifugal pumps
- Estimation of performance characteristic of reciprocating pumps
- Verifying Ergun equation for flow through packed beds

Total: 30**REFERENCES / MANUALS / SOFTWARES:**

- Perry Robert, "Perry's Chemical Engineers Handbook", 8th Edition, McGraw Hill, New York, 2007.
- Laboratory Manual

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 | | | | | 2 | 2 | | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | | | | | 2 | 2 | | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | | | | | 2 | 2 | | 3 | 2 |

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



18FTL32 - FOOD CHEMISTRY LABORATORY

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Fundamentals of Biochemistry | 3 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course will deal about analysis and estimation of biomolecules. | | | | | | |

List of 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. Estimation of protein by Kjeldahl method
6. Determination of effect of substrate concentration on amylase activity
7. Determination of dextrose equivalent in modified starches
8. Extraction and estimation of carotenoids and lycopene in fruits/vegetables
9. Estimation of polyphenols in fruits/vegetables
10. Estimation of flavanoids in fruits/vegetables
11. Estimation of Vitamin C in fruits/vegetables
12. Estimation of Iron in food samples

Total: 30**REFERENCES / MANUALS / SOFTWARES:**

1. FSSAI, "Manual of Methods of Analysis of Foods", Ministry of Family and Health Care, Government of India, 2016.
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. Laboratory Manual

COURSE OUTCOMES:

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

BT Mapped (Highest Level)

| | | |
|------|---|---------------------------------|
| CO1: | analyze and estimate macro and micro nutrients in food products | Evaluating (K5), Precision (S3) |
| CO2: | extract oil and determine its properties | Evaluating (K5), Precision (S3) |
| CO3: | determine enzyme activity | 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 | | | | 2 | 2 | | | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | | | | 2 | 2 | | | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | | | | 2 | 2 | | | 3 | 2 |

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

**18FTL33 - FOOD MICROBIOLOGY LABORATORY**

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 3 | PC | 0 | 0 | 2 | 1 |
| Preamble | To identify and characterize microbes associated with foods and to enumerate it. | | | | | | |

List of Experiments:

1. Study experiments on microbiology lab equipments 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 isolation of microorganisms 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 foods
8. Microbial examination of refrigerated / frozen products
9. Assessing the load of coliform bacteria as an indicator microorganism using MPN method
10. Estimation of growth kinetic parameters in batch fermentation
11. Biochemical characteristics of microorganisms using IMViC test
12. Antibiotic sensitivity test for microorganisms

Total: 30**REFERENCES / MANUALS / SOFTWARES:**

1. James G. Cappuccino and Natalie Sherman, "Microbiology A Laboratory Manual", 10th Edition, Pearson Education Inc., 2014.
2. McLandsborough L., "Food Microbiology Laboratory", CRC Press, 2004.
3. Harrigan W.F., "Laboratory methods in food microbiology", Academic Press, 2011.
4. Laboratory Manual

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 | Understanding (K3), Precision (S3) |
| CO2: | isolate the microorganisms from different food stuffs | Applying (K3), Manipulation (S2) |
| CO3: | characterize the microorganisms using different methods | Analyzing (K4), 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 | 3 | 1 | 1 | | | | | | | | 1 | 3 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | | 1 | 3 |
| CO3 | 3 | 3 | 1 | 1 | 1 | | | | | | | | 1 | 3 |

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

**18MAC41 STATISTICS AND NUMERICAL METHODS**

(Common to all Engineering and Technology Branches except ECE,CSE and IT)

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|----|---|--------|
| Prerequisites | NIL | 4 | BS | 3 | 1* | 2 | 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 | | 9 |
| Testing of Hypothesis: Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single mean and difference of means – Small sample tests: Student's t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes | | |
| UNIT – II | | 9 |
| Design of Experiments: Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design. | | |
| UNIT – III | | 9 |
| Solution to Algebraic and Transcendental Equations: 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 | | 9 |
| 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 and backward interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule. | | |
| UNIT – V | | 9 |
| Numerical Solution of First order Ordinary Differential Equations: 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 and Practical:15, Total: 60 |
| List of Exercises: | | |
| 1. Testing significance of means by student's t - test | | |
| 2. Testing the independence of attributes by Chi-square test | | |
| 3. Analyze the difference in means is statistically significant by Completely Randomized Design | | |
| 4. Finding positive root by Regula – Falsi method | | |
| 5. Solving simultaneous linear equations by Gauss – Seidel Method | | |
| 6. Evaluating definite integrals by Trapezoidal and Simpson's rules | | |
| 7. Solution of ODE by Euler and Modified Euler methods | | |
| 8. Solution of ODE by Runge-Kutta method | | |

TEXT BOOK:

| | |
|----|--|
| 1. | Veerarajan T. & Ramachandran T. , "Statistics and Numerical Methods ", 1st Edition, Tata McGraw Hill Education, New Delhi, 2018. |
|----|--|

REFERENCES:

| | |
|----|---|
| 1. | Jay L. Devore. , "Probability and Statistics for Engineering and the Sciences ", 9th Edition, Cengage Learning , USA, 2016. |
| 2. | Steven C. Chapra & Raymond P. Canale. , "Numerical Methods for Engineers ", 7th Edition, McGraw-Hill Education, New York, 2014. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | identify large and small samples and apply suitable tests for solving engineering problems | 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 ordinary differential equations numerically | Applying (K3) |
| CO6 | test whether the given data is significant by hypothesis testing and ANOVA using MATLAB | Applying (K3), Manipulation (S2) |
| CO7 | use MATLAB for determining numerical solutions of algebraic equations and integral values | Applying (K3), Manipulation (S2) |
| CO8 | obtain the numerical solution of ordinary differential equations 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 | 2 | 1 | 2 | | | | | | | | | | |
| CO2 | 3 | 1 | 2 | 2 | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 1 | 1 | 1 | | | | | | | | | | |
| CO5 | 3 | 2 | 1 | 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)



18FTT41 - FOOD SCIENCE AND NUTRITION

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry | 4 | PC | 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 | | 9 |
| Food Groups and Nutrition: 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 | | 9 |
| Carbohydrates - Sugars, Starch and Fiber: 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 | | 9 |
| Lipids and Proteins: 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 | | 9 |
| Energy Value, Energy Balance and Body Composition: 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 | | 9 |
| Nutrition for Different Age Groups: 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. Geriatric 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 | 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)

**18FTT42 - HEAT TRANSFER IN FOOD PROCESSING OPERATIONS**

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 4 | PC | 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 | | 9+3 |
| 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, hollow cylinder. Thermal Conductivity - effect of temperature on thermal conductivity. | | |
| UNIT – II | | 9+3 |
| Convection: 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. | | |
| UNIT – III | | 9+3 |
| Radiation: Black body concept - Radiation properties–Stefan Boltzman's law, emissivity and absorptivity. Concept of grey body – radiation between non-black surfaces –parallel planes, radiation shields. | | |
| UNIT – IV | | 9 +3 |
| Heat Exchangers: 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- Single pass, multi pass heat exchangers, shell and tube heat exchanger, plate heat exchangers – working principles and applications. | | |
| UNIT – V | | 9+3 |
| Evaporators: Types of evaporators –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 – working principle and applications. | | |
| 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.



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1: | infer the fundamental concept of heat conduction | Understanding (K2) |
| CO2: | make use of dimensional analysis for solving convective heat transfer coefficient and relate individual and overall heat transfer coefficient | Applying (K3) |
| CO3: | apply the concepts of radiation in solving heat transfer problems | Applying (K3) |
| CO4: | select a suitable heat exchangers and analyze the performance | Applying (K3) |
| CO5: | summarize the types of evaporators along with its applications | 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 | 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 | 1 | 2 | 2 | | | | | | | 1 | 3 | 2 |
| CO5 | 3 | 2 | 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 | 60 | | | | 100 |
| CAT2 | 20 | 20 | 60 | | | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**18FTT43 - 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 | | 9+3 |
| Mass Transfer Operations: Introduction, Classification and role 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. Interphase Mass Transfer: Individual and over all mass transfer co-efficient. Theories of mass transfer: Two Film, penetration, surface renewal. | | |
| UNIT – II | | 9+3 |
| Analogy between heat, mass and momentum transfer: Reynolds, Chilton- Colburn, Taylor- Prandtl, Von-Karman Analogies. Humidification: Adiabatic saturation process and theory of wet bulb temperature - Measurement of humidity - Cooling towers: Principle and operation. Crystallization: Crystallization Equilibrium–Nucleation–Meta stable region–Seed Crystals. Heat of Crystallization - Rate of crystal growth. Stage equilibrium crystallization. Equipments - Types – Applications. | | |
| UNIT – III | | 9 +3 |
| Distillation: Vapour-liquid equilibria, Raoult's law and deviations from ideality. Methods of distillation: Simple distillation- calculations using Rayleigh equation, Flash vaporization, steam distillation. Design of multistage tray towers for binary systems using McCabe-Thiele method. | | |
| UNIT – IV | | 9+3 |
| Liquid-Liquid Extraction: Equilibrium in ternary systems; Solvent selection criteria; equilibrium stage wise contact –Single stage extraction, Multi stage cross current and counter current operations. Extractors – mixer settlers, packed tower, spray towers, perforated plate, rotating disc contactors, pulse column - working principles and applications. | | |
| UNIT – V | | 9+3 |
| Leaching: Solid-liquid equilibrium, single stage leaching, multi stage cross current and countercurrent leaching operations. Leaching equipments – Bollman extractor, Rotocel extractor, Kennedy Extractor, Pachuca tank, Dorr agitator – working principle and applications. | | |
| Lecture:45, Tutorial:15, Total: 60 | | |

TEXT BOOK:

- Anantharaman N., Meera Sheriffa Begam K.M., “Mass Transfer Theory and Practice”, 1st PHI Publications, New Delhi, 2011.

REFERENCES:

- Treybal R.E., “Mass Transfer Operations”, 3rd Edition, McGraw Hill, New York, 2012.
- 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 (K3) |
| 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 | 60 | | | | 100 |
| CAT2 | 10 | 20 | 20 | 30 | 20 | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 15 | 40 | 15 | 15 | 15 | | 100 |

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

**18FTT44- FOOD PROCESS ENGINEERING I**

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 4 | 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 | | 9+3 |
| Pre-Processing Operations: 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 | | 9+3 |
| Size Reduction: Fibrous foods, Dry foods and Liquid foods – Calculation of Energy Used in Grinding. New Surface Formed by Grinding. Grinding and Cutting equipments - 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 | | 9+3 |
| Mechanical Separation: Sedimentation in liquids - Gravitational sedimentation – Flootation -Sedimentation of particles in gas. Centrifugal separation – Velocity of particles – Radius of neutral zone – Measurement- Equipments. Filtration – Constant rate and Constant pressure filtration – Area calculation- Equipments, Sieving effectiveness and Applications. | | |
| UNIT – IV | | 9+3 |
| Mixing: 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 equipments - Liquid Mixers, Powder and Particle Mixers, Dough and Paste Mixers | | |
| UNIT – V | | 9+3 |
| Extrusion: Theory - Rheological properties and Operating Characteristics. Single and Twin screw extruders - Ancillary Equipments. Applications and Effects on Foods. Material Handling: 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 | 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 | 20 | | | | 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)

**18FTT45 - ENGINEERING PROPERTIES OF FOOD MATERIALS**

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Applied Physics | 4 | PC | 3 | 0 | 0 | 3 |
| Preamble | The course impart knowledge on physical, thermal, optical, electromagnetic, rheological and textural properties of food materials and its measurement methods. | | | | | | |

| | | |
|---|--|------------------|
| UNIT – I | | 9 |
| Physical Properties: 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, Aerodynamic properties – Drag co efficient, Terminal Velocity and its application | | |
| UNIT – II | | 9 |
| Thermal Properties: Definition of specific heat, enthalpy, thermal conductivity, thermal diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity, thermal diffusivity, Calorific value of food, Bomb calorimeter, Boiling point elevation and freezing point depression, Applications of thermal properties. | | |
| UNIT – III | | 9 |
| Optical Properties: Refractive index of food items, Abbe’s refractometer, Sorting of food material using optical properties, Optical activity, Polarimeter, Spectrophotometer, Gloss, color, translucency – Definitions, measurement and applications. Electromagnetic Properties: Electrical properties- electrical conductivity and its measurement, dielectric properties and its measurement methods, microwave heating and other applications | | |
| UNIT – IV | | 9 |
| Rheological Properties: Classification of rheology, Rheological models, 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. Viscosity – Principle, Types- Capillary, Orifice, Falling and Rotational viscometers. | | |
| UNIT – V | | 9 |
| Textural Properties: Types of food textures, Texture measuring instruments- Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA, Properties of food powders. Colour: Interaction of object with light, 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”, 1 st Edition, Springer, New York, 2006. |
| REFERENCES: | |
| 1. | Rao M.A. and Rizvi S.S.H., “Engineering Properties of Foods”, 4 th Edition, CRC Press, New York, 2014. |
| 2. | Sahay K.M. and Singh K.K., “Unit Operations of Agricultural Processing”, 2 nd Edition, Vikas Publishing, New Delhi, 2004. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1: | interpret the physical properties of food materials | Understanding (K2) |
| CO2: | identify the suitable technique for measurement of thermal properties of foods | Applying (K3) |
| CO3: | make use of optical and electromagnetic properties of food materials in food processing | Applying (K3) |
| CO4: | compare the various rheological behavior of food materials | Understanding (K2) |
| CO5: | choose suitable textural and color measurement techniques for food materials | 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 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 1 | | | | | | | 1 | 2 | 2 |
| CO3 | 3 | 3 | 2 | | 1 | | | | | | | 1 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 1 | 1 | | | | | | | 1 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 1 | 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 | 40 | 40 | 20 | | | | 100 |
| CAT2 | 30 | 30 | 40 | | | | 100 |
| CAT3 | 40 | 40 | 20 | | | | 100 |
| ESE | 30 | 35 | 35 | | | | 100 |

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

**18FTL41 - 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 |
| Peramble | To impart practical knowledge on heat and mass transfer that is required for process industry. | | | | | | |

List of Exercises / Experiments :

1. Estimation of individual heat transfer coefficient under Natural/Forced convection heat transfer
2. Determination of Stefan Boltzman constant under 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. Estimation of steam economy and efficiency of an evaporator
7. Verifying the Raleigh's equation for the given system using simple distillation setup
8. Determination of vaporization efficiency (E_v) and thermal efficiency (E_t) of the given system using steam distillation setup
9. Determination of the diffusivity of given liquid to air
10. Studying the theoretical and actual recovery of solvent using leaching
11. Estimation of oil recovery using Expeller
12. Virtual Lab:
 - a. Estimation of thermal Conductivity of a material
 - b. Simple distillation –Demo
 - c. Air diffusion – Demo

Total: 30**REFERENCES / MANUALS / SOFTWARES:**

1. McCabe W.L., Smith J.C., and Harriot P., "Unit Operations of Chemical Engineering", 7th Edition, McGraw-Hill, New York, 2005.
2. Perry Robert, "Perry's Chemical Engineers Hand Book", 8th Edition, McGraw-Hill, New York, 2007.
3. Treybal R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill, New York, 1981.
4. Laboratory Manual
5. <https://vlab.amrita.edu/?sub=1&brch=194>

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 and steam economy for evaporators | Evaluating (K5), Precision (S3) |
| CO2: | determine thermal conductivity, 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 | 1 | | | | 2 | 2 | | | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | | | | 2 | 2 | | | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | | | | 2 | 2 | | | 3 | 2 |

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



18FTL42 - FOOD PROCESS ENGINEERING I LABORATORY

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 4 | PC | 0 | 0 | 2 | 1 |
| Preamble | The course imparts practical knowledge in determination of physical properties of food materials, handling and efficacy of different conveying and agro processing equipments. | | | | | | |

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 of food materials
3. Determination of angle of repose for different grain samples
4. Determination of coefficient of friction for grain samples
5. Experiment on different types of peeling
6. Experiment on sedimentation
7. Determination of mixing index of different food products.
8. Evaluation of conveying efficiency using bucket elevator.
9. Determination of separation efficiency of cyclone separator
10. Experiment on screw conveyor to determine conveying efficiency, power requirement.
11. Performance evaluation of Inclined belt separator

Total: 30**REFERENCES / MANUALS / SOFTWARES:**

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

COURSE OUTCOMES:

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

| | | BT Mapped (Highest Level) |
|------|--|--------------------------------------|
| CO1: | assess the engineering properties of food materials | Evaluating (K5), Precision (S3) |
| CO2: | determine the effectiveness/performance of processing operations | Evaluating (K5), Precision (S3) |
| CO3: | assess the performance of different food conveying /collecting equipments. | 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



18EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION
(Common to all Engineering and Technology branches)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 3 | HS | 0 | 0 | 2 | 1 |
| Preamble | This course is designed to impart required levels of fluency in using the English Language at B2 level in the CEFR through activities, hands-on training and application. | | | | | | |

| | |
|---|----------|
| Language Practice Domains: | |
| 1. Listening | 6 |
| Techniques for effective listening - Listening and note taking - Listening activities using listening texts - Listening to discourse samples of native English speakers – Focussed listening for improving pronunciation - understanding different accents. | |
| 2. Reading | 6 |
| Developing reading skills - Reading aloud - Group reading activities - Reading with correct word stress and intonation. | |
| 3. Soft Skills | 6 |
| Attitude - Goal setting - Time Management - Team Work - Telephonic conversation skills. | |
| 4. Writing | 6 |
| Making preparatory notes, drafts and PPT's for laboratory activities - Word editing features - editing and proof reading. | |
| 5. Speaking | 6 |
| Verbal and non-verbal communication - Introducing oneself - Introducing others – Mock Interviews - Making presentations on chosen topics - Group Discussion. | |
| Total: 30 | |

| | |
|---------------------------|--|
| REFERENCES/MANUAL: | |
| 1. | Kumar, Sanjay and Pushp Lata, "Communication Skills", 2 nd Edition, Oxford University Press, New Delhi, 2017. |
| 2. | Laboratory Manual. |

| | | |
|---|---|---------------------------------------|
| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
| On completion of the course, the students will be able to | | |
| 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 | | 3 | | |
| CO2 | | | | | | | | | 2 | 2 | | 2 | | |
| CO3 | | | | | | | | | 2 | 2 | | 2 | | |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy | | | | | | | | | | | | | | |

**18FTT51 - FOOD PROCESS ENGINEERING II**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | Heat Transfer in Food Processing Operations, Engineering Properties of Food Materials | 5 | PC | 3 | 0 | 0 | 3 |

| | |
|----------|--|
| Preamble | To impart knowledge about different processes like drying, heating, cooling and preservation techniques involved 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 equipments.

| | | |
|------------------|-------------------------|----------|
| 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, Heat Pump drying, Dielectric 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.

| | | |
|------------------|---------------------------------|----------|
| 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.

Total:45**TEXT BOOK:**

| | |
|----|---|
| 1. | Fellows P.J., "Food Processing Technology: Principles and Practice", 3rd Edition, Wood head 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 | 16 | 26 | 20 | 28 | 10 | | 100 |

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



18FTT52 - FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry | 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, syrupeing, 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, Production of Speciality 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. | Thompson A.K., "Fruit and Vegetables: Harvest, Handling and Storage", 2nd Edition, Blackwell Publishing Ltd., Oxford, UK, 2003. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | |
|----|--|



| 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 | 3 | 1 | | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO5 | 3 | 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 | 16 | 40 | 44 | | | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 25 | 40 | 35 | | 5 | | 100 |

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

**18FTT53 - PROCESS CONTROL AND INSTRUMENTATION**

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

| | |
|-----------------|--|
| 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+3 |
|-----------------|--|------------|

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in 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+3 |
|------------------|-----------------------------|------------|

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+3 |
|-------------------|---|------------|

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, Bode stability criterion.

| | | |
|------------------|--------------------|------------|
| Unit - IV | Automation: | 9+3 |
|------------------|--------------------|------------|

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+3 |
|-----------------|-----------------------------|------------|

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. – Mcleod gauge, Piraniguage. Level measurement – sight glass level indicator, float and tape liquid level gauge.

Lecture:45, Tutorial:15, Total:60**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", 1 st Edition, Prentice Hall of India, New Delhi, 2011. |
| 2. | Donald R. Coughanowr, Steven E. LeBlanc, "Process Systems Analysis and Control", 3 rd 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 | 3 | 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 | 40 | 40 | | | | 100 |
| ESE | 10 | 20 | 40 | 20 | 10 | | 100 |

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

**18FTT54 - FOOD PACKAGING TECHNOLOGY**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 5 | 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 Pty 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)

**18FTL51 - FOOD PROCESS ENGINEERING II LABORATORY**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Process Engineering I | 5 | PC | 0 | 0 | 2 | 1 |
| Preamble | | | | | | | |

List of Exercises / Experiments :

| | |
|-----|--|
| 1. | Experiment on analysis of particle size distribution using hammer mill. |
| 2. | Determination of fineness modulus for ground material using ball mill. |
| 3. | Determination of energy requirement in size reduction using burr mill. |
| 4. | Experiment on paddy dehusker to determine the shelling efficiency. |
| 5. | Experiment on Oil Expeller to determine the expeller efficiency. |
| 6. | Experiment on drying characteristics of food material using infrared radiation and vacuum drier. |
| 7. | Experiment on drying characteristics of food material using tray dryer. |
| 8. | Experiment on drying characteristics of food material using fluidized bed dryer. |
| 9. | Experiment on drying characteristics of food materials using microwave dryer. |
| 10. | Determination of terminal velocity of food materials. |
| 11. | Experiment on Freezing characteristics of foods. |
| 12. | Virtual Lab experiments a) Lethality in Canning Foods – Demo. b) Food Freezing – Demo. |

Total: 30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|--|
| 1. | Margarida Vieira and Peter Ho, "Experiments in Unit Operations and Processing of Foods", 1st Edition, Springer Science & Business Media, New York, 2008. |
| 2. | Rao M.A. and Rizvi S.S.H., "Engineering Properties of Foods", 4th Edition, CRC Press, New York, 2014. |
| 3. | Xiao Dong Chen and Majumdar A.S., "Drying Technologies in Food Processing", 1st Edition, WileyBlackwell, U.K., 2008. |

COURSE OUTCOMES:

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

| | | BT Mapped (Highest Level) |
|-----|---|--------------------------------------|
| CO1 | determine the effectiveness of size reduction equipment | Evaluating (K5), Precision (S3) |
| CO2 | assess the performance of agro processing 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 | | | | | 3 | 2 | | 1 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | | | | | 3 | 2 | | 1 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 1 | | | | | 3 | 2 | | 1 | 2 | 2 |

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

**18FTL52 - 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 |
| Preamble | | | | | | | |

List of Exercises / Experiments :

| | |
|-----|---|
| 1. | Study the effect of blanching treatment on the fruits and vegetables. |
| 2. | Study the efficiency of the screw press extractor and pulper. |
| 3. | Preparation of squash and study on its characteristics. |
| 4. | Preparation and study on characteristics of sauce. |
| 5. | Preparation of fruit bar and fruit toffee and study on its shelf life characteristics. |
| 6. | Preparation and analysis of fruit powder and study its characteristics upon vacuum packaging. |
| 7. | Formulation of jams and comparison with commercial product. |
| 8. | Formulation of jellies / marmalade and comparison with commercial product. |
| 9. | Preparation and study on characteristics of osmotic dehydrated fruit product. |
| 10. | Preparation and study on characteristics of dried onion, garlic and ginger. |
| 11. | Preparation of pickles and chutneys. |
| 12. | Development of new fruit /vegetable based product and study its shelf life upon storage conditions. |
| 13. | Virtual Laboratory Experiments a. Osmotic Drying of foods – Experimentation. |

Total:30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|--------------------|
| 1. | Laboratory Manual. |
|----|--------------------|

COURSE OUTCOMES:

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

| | | BT Mapped (Highest Level) |
|-----|---|--------------------------------------|
| CO1 | interpret the changes of fruits and vegetables upon blanching | Analyzing (K4), Manipulation (S2) |
| CO2 | assess the performance of fruit processing equipments | Evaluating (K5), Precision (S3) |
| CO3 | prepare and characterize 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 | 2 | 1 | 1 | | | | 3 | 2 | | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 2 | | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 2 | | 2 | 3 | 2 |

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

**18FTL53 - FOOD PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY**

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Heat Transfer in Food Processing Operations | 5 | PC | 0 | 0 | 2 | 1 |
| Preamble | | | | | | | |

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. |
| 11. | Design and drawing of mixing tanks. |
| 12. | Design and drawing of spray drier. |

Total:30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|---|
| 1. | Dawande S.D., "Process Equipment Design Volume 1 and 2", 5th Edition, Denett and Company, India, 2015. |
| 2. | Joshi M.V. and Mahajan V.V., "Process Equipment Design", 4th Edition, MacMillan India, New Delhi, 2009. |
| 3. | 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 separators, dryers and mixing equipments | 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 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 1 | | | | 3 | 2 | | 1 | 2 | 2 |

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



18GEL51 - 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 | 80 | 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”, 6 th 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”, 3 rd 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)



18GET51 - UNIVERSAL HUMAN VALUES
(Common to all BE/BTech branches)

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 5 | MC | 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: | 9 |
| 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: | 9 |
| Human Begin 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: | 9 |
| 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: | 9 |
| 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: | 9 |
| 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: 45**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 | understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society. | Understanding (K2) |
| CO2 | distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body. | Understanding (K2) |
| CO3 | understand 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. | Understanding (K2) |
| CO4 | understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature. | Understanding (K2) |
| CO5 | distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. | 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 | | | | | | 1 | | 3 | | | | | | |
| CO2 | | | | | | | | 2 | | | | | | |
| CO3 | | | | | | 1 | | 3 | | | | | | |
| CO4 | | | | | | | | 2 | | | | | | |
| CO5 | | | | | | | | 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, 3 – 50 marks & ESE – 100 marks)

**18FTT61 - BAKING AND CONFECTIONERY TECHNOLOGY**

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Fundamentals of Biochemistry, 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. 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. Wafers, puff pastry, chemically leavened bakery products. Classification of confectionery Products – Ingredients - Basic Technical considerations-crystallization, stickiness, TSS, TS, pH.

| | | |
|-----------------|--------------------------------|----------|
| Unit - V | Confectionery Products: | 9 |
|-----------------|--------------------------------|----------|

Composition and manufacturing process - Sugar boiled products - Candy, lollipop, lozenges. 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 Ashokkumar, "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012. |
|---|

REFERENCES:

- | |
|---|
| 1. Weibiao Zhou and Hui Y. H., "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)

**18FTT62 - 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.

| | | |
|------------------|---|----------|
| 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 |
|-----------------|--|----------|

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", Volume 3, 1st Edition, Wiley, New Delhi, 2014. |
|--|

| |
|--|
| 2. 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 scenario | Applying (K3) |
| CO3 | Infer the technical aspects of unit processing operations of milk | Understanding (K2) |
| CO4 | Identify the 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 | | | | 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 | 20 | 60 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**18FTT63 - FOOD QUALITY AND SAFETY**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Microbiology | 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", 2 nd 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 Jersey, 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)

**18FTL61 - 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 |
| Preamble | To provide insight practical knowledge about the different raw materials and products of bakery and confectionery sectors. | | | | | | |

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 confectionery. |
| 10. | Preparation of toffee and fudge. |
| 11. | Preparation of cocoa based confectionery. |
| 12. | Virtual Lab: Demonstration on Yeast Fermentation. |

Total:30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|---|
| 1. | Duncan Manley, "Biscuit, Cracker and Cookie Recipes for the Food Industry", 1st Edition, Wood head Publishing, England, 2001. |
| 2. | Yogambal Ashokkumar, "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012. |

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



18FTL62 - 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 |
| Preamble | To provide exposure to variety of technical operations in milk and milk product processing industry. | | | | | | |

List of Exercises / Experiments :

| | |
|-----|---|
| 1. | Studies on titratable acidity and specific gravity of milk. |
| 2. | Determination of fat and solids-not-fat contents of milk. |
| 3. | Detection of adulterants in milk. |
| 4. | Analysis on thermal stability of milk. |
| 5. | Studies on standardization process of milk. |
| 6. | Studies on homogenization process of milk. |
| 7. | Development of market milk. |
| 8. | Development of flavored and fortified milk. |
| 9. | Development of paneer. |
| 10. | Determination of churning efficiency of butter churner. |
| 11. | Determination of efficiency of spray dryer. |
| 12. | Studies on Cream Separation from milk. |
| 13. | Heating milk in a tubular heat exchanger. |

Total:30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|---|
| 1. | Sukumar De, "Outlines of Dairy Technology", 1st Edition, Royal Oxford University Press, New Delhi, 2001. |
| 2. | Hui Y.H., "Dairy Science and Technology Handbook: Applications Science, Technology and Engineering", 1st Edition, volume 1 Edition, Wiley, New Delhi, 2014. |
| 3. | Bylund G., "Dairy Processing Handbook", 1st Edition, Tetra Pak Processing Systems AB, UK, 2003. |

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), Precision (S3) |
| CO2 | infer the technical aspects of raw milk processing | Applying (K3), Manipulation (S2) |
| CO3 | appraise the factors affecting various dairy processes | 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 | 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



18FTL63 - FOOD ANALYSIS LABORATORY

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry | 6 | PC | 0 | 0 | 2 | 1 |
| Preamble | To analyse the quality of different food products | | | | | | |

List of Exercises / Experiments :

| | |
|-----|---|
| 1. | Analysis of vegetable oils / Fats. |
| 2. | Analysis of spices (Turmeric / Chilly). |
| 3. | Analysis of Vinegar. |
| 4. | Analysis of Tea/ Coffee. |
| 5. | Analysis of Jam/Jelly/ Marmalade / Juices. |
| 6. | Analysis of milk and milk products. |
| 7. | Analysis of dehydrated vegetables and Fruits. |
| 8. | Analysis of water. |
| 9. | Analysis of salt/ sugar/ Jaggery. |
| 10. | Detection of food Adulteration. |
| 11. | Textural and Colour profile analysis of food material. |
| 12. | Determination of energy value of foods. |
| 13. | Virtual laboratory experiments a. Estimation of minerals by flame photometry – Demo. b. Determining water rehydration in pasta – Experimentation. |

Total: 30**REFERENCES/MANUAL/SOFTWARE:**

| | |
|----|--|
| 1. | Ministry of Health and Family Welfare, "Manual of Methods for the Analysis of Foods", 9 th Edition, Government of India, New Delhi, 2016. |
| 2. | 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



18FTP61 - PROJECT WORK I PHASE I

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 6 | EC | 0 | 0 | 4 | 2 |

Total : 60

| 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

**18MBT71 – 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), Product Life 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 and Control - Inventory - EOQ Determination. | | | | | | | |
| Unit - V | Financial Management: | | | | | | 9 |
| Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – 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", 1st Edition, 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, New York, 2019. |



| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|----------------------------------|
| On completion of the course, the students will be able to | | |
| 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)



18GEP71 – COMPREHENSIVE TEST AND VIVA
(Common to all BE/BTech branches)

| | | | | | | | |
|-------------------------------|------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 7 | EC | 0 | 0 | 0 | 2 |

| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|----------------------------------|
| On completion of the course, the students will be able to | | |
| CO1 | demonstrate knowledge in their respective programme domain. | Applying (K3) |
| CO2 | defend any type of interviews, viva-voce, and aptitude tests conducted for career progression | Applying (K3) |
| CO3 | exhibit professional etiquette and solve related engineering problems | 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 | 2 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | | | | | 1 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | | | | | 1 | 2 | 2 | 3 | 3 | 2 |

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



18FTP71 - PROJECT WORK I PHASE II

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 7 | EC | 0 | 0 | 8 | 4 |

Total: 120

| 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



18FTP81 - PROJECT WORK II

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|-----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 8 | EC | 0 | 0 | 12 | 6 |

Total:180

| 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

**18FTE01 - TECHNOLOGY OF SNACK AND EXTRUDED FOODS**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 6 | 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 others. Types and Functions of ingredients – structure forming materials, dispersed phase/filling materials, plasticizers/lubricants, soluble solids, nucleating substances, coloring and flavoring 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 | 3 | 1 | 1 | | | | | | | | | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | 1 | | | | | | | | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 1 | | | | | | | | 2 | 3 | 1 |
| CO4 | 3 | 2 | 2 | 1 | | | | | | | | 2 | 3 | 1 |
| CO5 | 3 | 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)



18FTE02 - FOOD ADDITIVES AND NUTRACEUTICALS

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry | 6 | PE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|----------|--|--|--|--|--|--|--|
| Preamble | To provide deeper insight to students on role of food additives and nutraceutical 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.

| | | |
|------------------|---|----------|
| Unit - IV | Functional Foods and Nutraceuticals: | 9 |
|------------------|---|----------|

Introduction, definition. Difference between functional foods and nutraceuticals. Examples for fortified functional foods. Plant and animal based nutraceutical. Health benefits of Polyphenols, flavonoids, omega-3 fatty Acids, carotenoids. Technologies to recover nutraceuticals compounds - Distillation, ultra hydrostatic 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, Probiotic, 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 | 40 | 30 | 30 | | | | 100 |
| CAT2 | 40 | 30 | 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)

**18FTE03 - PRODUCTION OF FIELD AND HORTICULTURE CROPS**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 6 | 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., Annadurai K. and Somasundaram E., "A Text book of Agronomy", 1st Edition, Scientific Publishers, Jodhpur, 2005. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Yellamanda Reddy T. and Sankara Reddi G.H., "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 | 40 | 40 | 20 | | | | 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)

**18FTE04 - BIOPROCESS ENGINEERING**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | Food Microbiology, Food Process Calculation , Food Process Engineering II | 6 | 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 bioprocessing operations.

| | | |
|-----------------|--|----------|
| Unit - V | Bio Product Recovery Methods and Applications in Food Industry: | 9 |
|-----------------|--|----------|

Filtration, sedimentation, centrifugation, precipitation, cell disruption, chromatography, crystallization, lyophilisation, drying. Lactic Acid Production, Citric Acid Production, HFCS Production, Baker Yeast Production.

Total:45**TEXT BOOK:**

| | |
|----|--|
| 1. | Michael L.S. huler, FikretKargi, 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 and 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 stoichiometric 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)

**18FTE05 - ENERGY MANAGEMENT IN PROCESS INDUSTRIES**

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Heat Transfer in Food Processing | 6 | 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 (UNFCCC), 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 preparing Process 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 | 16 | 24 | 20 | 20 | 20 | | 100 |
| ESE | 10 | 16 | 24 | 28 | 22 | | 100 |

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

**18FTE06 - REFRIGERATION AND COLD CHAIN MANAGEMENT**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 6 | PE | 3 | 0 | 0 | 3 |

| | |
|-----------------|--|
| Preamble | To impart the basic concepts of refrigeration systems, low temperature storage systems and theoretical knowledge on cold chain management. |
|-----------------|--|

| | | |
|-----------------|----------------------|----------|
| Unit - I | Introduction: | 9 |
|-----------------|----------------------|----------|

Introduction to refrigeration, unit of refrigeration capacity. Review of Second law of thermodynamics and interpretation. Production of low temperatures - principles and process. Refrigerants - classification and thermodynamic properties, Ozone depletion potential, Reversed Carnot cycle, Limitations of reversed Carnot systems.

| | | |
|------------------|--|----------|
| Unit - II | Components of Refrigeration System: | 9 |
|------------------|--|----------|

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 |
|-------------------|-------------------------------|----------|

Refrigeration cycle – simple vapor 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 |
|------------------|---|----------|

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 |
|-----------------|--------------------|----------|

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, fishery products, fruit /vegetables and dairy products.

Total:45**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. Arora C.P., "Refrigeration and Air Conditioning", 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., Delhi, 2008. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | outline the basic concepts of refrigeration principles and refrigerants | 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 |
| CO2 | 3 | 3 | 2 | | | | | | | | | 1 | 1 | 1 |
| CO3 | 3 | 3 | 3 | 2 | | | | | | | | 1 | 1 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 1 | | | | | | | 2 | 1 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 2 | | | | | | | 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 | 40 | 60 | | | | | 100 |
| CAT2 | 20 | 30 | 20 | 30 | | | 100 |
| CAT3 | 10 | 10 | 15 | 15 | 10 | | 100 |
| ESE | 20 | 30 | 20 | 15 | 15 | | 100 |

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



18FTE07 - 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, ultra filtration, microfiltration, electro dialysis 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, Trouble shooting.

Unit - IV Ionic Separation and Permeation: **9**

Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electro dialysis. 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, Industrial effluent treatment by modern techniques.

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., 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 | 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 | 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)

**18FTE08 - 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, Engineering Properties Of Food Materials | 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 - 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:

- Han Jung H., "Packaging for Non-thermal Processing of Food", 1st Edition, Wiley-Blackwell, Oxford, 2007.
- Mujumdar A.S., "Handbook of Industrial drying", 4th Edition, CRC Press, UK, 2014.
- 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)



18FTE09 - FOOD ALLERGENS AND TOXICOLOGY

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry , Food Microbiology | 7 | 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.PEF. | | | | | | |
| 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. Anti-toxicants 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 colors .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 behavioral effect, immune-toxicity. | | | | | | |
| 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 | analyze 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)

**18FTE10 - FOOD PROCESS PLANT LAYOUT AND SAFETY**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 7 | 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.

| | | |
|------------------|---|----------|
| 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.

| | | |
|-------------------|--|----------|
| 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.

Total:45**TEXT BOOK:**

| |
|--|
| 1. Sean Mora, "Process plant layout ", 2nd Edition, Butterworth-Heinemann, 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)

**18FTE11 - FUNDAMENTALS OF COMPUTATION FLUID DYNAMICS**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | Heat Transfer in Food Processing Operations, Mass Transfer In Food Processing Operations, Mathematics I, Mathematics II | 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", 2nd Edition, Springer Science and Business Media, Germany, 2013. |
|----|--|

REFERENCES:

| | |
|----|---|
| 1. | Da Wen Sun, "Computational Fluid Dynamics in Food Processing", 1st Edition, CRC Press, New York, 2007. |
| 2. | Versteeg H.K. and Malalasekara W., "An Introduction to Computational Fluid Dynamics", 2nd Edition, Pearson Education Ltd., England, 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 | 3 | 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 | 20 | 30 | 20 | 20 | | 100 |
| ESE | 20 | 25 | 25 | 15 | 15 | | 100 |

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

**18FTE12 - NANOTECHNOLOGY IN FOOD PROCESSING**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 7 | 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. | Qasim Chaudhry, 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)

**18FTE13 - PLANTATION AND SPICES 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 spices and their health benefits. Importance in culinary preparations.

| | | |
|-------------------|------------------------------|----------|
| Unit - III | Processing of Spices: | 9 |
|-------------------|------------------------------|----------|

Processing of spices: Processing of spices – Pepper, Chilli, Turmeric, Cardamom, Cinnamon, Clove, Vanilla and Ginger. Spices Products – Liquid products and Solid Products. Importance of Cryogenic grinding of spices. Spice Oils – Concept and importance. Extraction methods - Solvent extraction, Steam distillation.

| | | |
|------------------|--|----------|
| Unit - IV | Herbs and 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, Distillation, Extraction. Distillation of volatile oils, Application of spice essential oils. Oleoresins - Extraction, Quality and Application of oleoresins. Biosynthesis of flavours – Microorganisms, Enzymes, Plant suspension cultures.

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 technologies for essential oil and oleoresin extraction | 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)



18FTE14 - 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 reactor, 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 reactor 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:

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|----|---|
| 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)



18FTE15 - FERMENTATION TECHNOLOGY

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | Fundamentals of Biochemistry, Food Microbiology | 7 | PE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|----------|---|--|--|--|--|--|--|
| Preamble | To provide an idea about the concepts of fermentation process and products. | | | | | | |
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|-----------------|--|----------|
| 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.

| | | |
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| 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., "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, Jytte Josephsen, 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)

**18FTE16 - 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 | | | | | | |
|----------|--|--|--|--|--|--|--|

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|-----------------|--|----------|
| Unit - I | Coagulated and Fermented Milk Products: | 9 |
|-----------------|--|----------|

Coagulated Milk Products: Definitions, Classification, Paneer: Types of paneer, Basic operations in Paneer Production; Cheese: Types of cheese, Basic operations in Cheese Production. Fermented milk products: Definitions; Classification; Yoghurt: Types, Yoghurt Production- significance of each processing steps; Dahi: Types of dahi, dahi Production; Preparation of Cultured Butter Milk.

| | | |
|------------------|--|----------|
| Unit - II | Frozen Dairy Products and Dried Milk: | 9 |
|------------------|--|----------|

Frozen dairy products: Definition, Classification, Composition of Ice cream, Other frozen desserts, Technological aspects of ice cream manufacture, Dried ice cream mix: Composition, Technology, Uses Dairy By-products: Definition, Types. Caseinates: Composition, Process of manufacture, Whey Protein products: Classification, Process of manufacture

| | | |
|-------------------|----------------------------------|----------|
| Unit - III | Condensed and Dried Milk: | 9 |
|-------------------|----------------------------------|----------|

Condensed Milk: Definition, Classification, Legal Standards for Evaporated and Condensed Milks, Manufacture of Sweetened Condensed Milk, Manufacture of Evaporated Milk. Dried 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 |
|------------------|---------------------------------|----------|

Fat Rich Dairy Products: 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 | Traditional dairy products: | 9 |
|-----------------|------------------------------------|----------|

Traditional dairy products: Classification of traditional dairy products, Khoa: Definition, varieties and standards, Methods of preparation of khoa, Gulabjamun: 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.

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. | Walstra P., 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 | 2 | 2 | | | | | | | | | 1 | 3 | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 1 |
| CO3 | 3 | 2 | 2 | | | | | | | | | 2 | 3 | 2 |
| CO4 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 1 |
| CO5 | 3 | 2 | 2 | | | | | 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 | 40 | 60 | | | | | 100 |
| CAT2 | 40 | 20 | 40 | | | | 100 |
| CAT3 | 40 | 60 | | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**18FTE17 - 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, Simcad Pro simulation software, COMSOL, gPROMS.

Total:45**TEXT BOOK:**

| |
|---|
| 1. Tijsskens 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)



18FTE18 - CANE SUGAR TECHNOLOGY

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | Heat transfer in Food Processing Operation, 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: Brief account 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)

**18FTE19 - BEVERAGE TECHNOLOGY**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 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 |
| Introduction: 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 | Alcoholic Beverages: | | | | | | 9 |
| Alcoholic Beverages: Types of alcoholic beverages. Wine – types – production and defects. Beer – Types – Production and defects. Distilled beverages – Brandy, Whiskey, Rum, Gin – Production and defects. | | | | | | | |
| Unit - III | Non Alcoholic Beverages: | | | | | | 9 |
| Non Alcoholic Beverages: 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. | | | | | | | |
| Unit - IV | Specialty and Malt Beverages: | | | | | | 9 |
| Specialty Beverages: Coffee & Instant coffee, Tea – black and green tea, Spices, Plant extracts. Malt beverages– Branded malt beverages in market. Coco Based Beverages. Traditional Beverages. Sport beverages – Physiological needs and formulation. | | | | | | | |
| Unit - V | Quality Control: | | | | | | 9 |
| Quality Control: 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. Requirements of Soluble solids and titratable acidity in beverages. | | | | | | | |

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 | explain the production of alcoholic beverages and identify the defects | Applying (K3) |
| CO3 | make use of suitable techniques for development of non-alcoholic beverages | 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 | 40 | 20 | 40 | | | | 100 |
| CAT2 | 40 | 24 | 36 | | | | 100 |
| CAT3 | 24 | 24 | 52 | | | | 100 |
| ESE | 40 | 30 | 30 | | | | 100 |

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

**18FTE20 - FOOD STORAGE AND INFESTATION CONTROL**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 7 | 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 |
|-----------------|---|----------|

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 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, 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 |
|------------------|-------------------------------|----------|

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 |
|-----------------|-----------------------------------|----------|

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 storage 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)

**18FTE21 - 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 |
|-----------------|--|----------|

Traditional Foods: 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 |
|------------------|---------------------------------------|----------|

Grain Based Traditional Foods: 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 and Dairy based Traditional Foods: | 9 |
|-------------------|--|----------|

Fruits and Vegetable based Traditional Foods: 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.

| | | |
|------------------|---|----------|
| Unit - IV | Traditional Fermented Food Products: | 9 |
|------------------|---|----------|

Traditional Fermented Food Products: Idli, Tempe, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing procedures to reduce loses of nutrients.

| | | |
|-----------------|--|----------|
| Unit - V | 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.

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. | Stanbury P.F., Whitaker A & Hall S.J., "Principles of Fermentation Technology", 3rd Edition, Elsevier, USA, 2016. |
| 2. | Mohammed Al-Khusaibi, Nasser Al-Habsi & Mohammad Shafiur Rahman, "Traditional Foods: History, Preparation, Processing and Safety", 1st Edition, Springer, UK, 2019. |



| 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 knowledge to retain the nutritional quality and minimize the nutrient losses | Applying (K3) |
| CO5 | analyze the role of traditional foods on curing diseases | 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 | 2 |
| CO2 | 3 | 2 | 2 | | 1 | 2 | | | | | | 1 | 2 | 1 |
| CO3 | 3 | 2 | 2 | | 1 | 2 | | | | | | 1 | 2 | 1 |
| CO4 | 3 | 2 | 2 | | 1 | 2 | | 1 | | | | 1 | 2 | 1 |
| CO5 | 3 | 1 | 2 | | 2 | 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 | 40 | 60 | | | | | 100 |
| CAT2 | 40 | 60 | | | | | 100 |
| CAT3 | 30 | 20 | 40 | 10 | | | 100 |
| ESE | 35 | 20 | 40 | 5 | | | 100 |

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



18FTE22 - 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. | | | | | | | |
| 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. |



| 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)

**18FTE23 - 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 aspect of agriculture business and retail operations. | | | | | | |
|----------|--|--|--|--|--|--|--|

| | | |
|-----------------|--|----------|
| Unit - I | Introduction on Agribusiness and Marketing: | 9 |
|-----------------|--|----------|

Introduction: Definition, Structure, Features of agribusiness, Importance of agribusiness, Scope for 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 |
|------------------|--|----------|

Export in Agribusiness: 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 Agribusiness: 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 and Planning: 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 |
|-----------------|---|----------|

Retail Organization and Directing: 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 | 3 | 2 | | | | | | | | 1 | 1 | 2 | | 2 |
| CO2 | 3 | 2 | | | | | | | | 2 | 1 | 2 | | 2 |
| CO3 | 3 | 2 | 1 | | | | | | | 1 | 1 | 2 | | 2 |
| CO4 | 3 | 2 | 1 | | | | | | | 2 | 2 | 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 | 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)

**18FTE24 - TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|--|------|----------|---|---|---|--------|
| Prerequisites | Engineering Properties of Food Materials | 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 rolls 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, dehulling – 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)



| Programme & Branch | All BE/BTech branches | 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 Limited, 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)



18MBE49 - ENTREPRENEURSHIP DEVELOPMENT
(Common to All BE/BTech Engineering and Technology Branches)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | Engineering Economics and Management | 8 | EC | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|--|--|--|--|--|--|----------|
| Preamble | The purpose of this course to create entrepreneurial awareness among engineering students. | | | | | | |
| Unit - I | Entrepreneurship Concepts: | | | | | | 9 |
| Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs -Entrepreneurship Development in India | | | | | | | |
| Unit - II | Entrepreneurial Ventures and Opportunity Assessment: | | | | | | 9 |
| New venture creation – Bootstrapping, Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs. | | | | | | | |
| Unit - III | Business Plan: | | | | | | 9 |
| Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch'- case studies | | | | | | | |
| Unit - IV | Financing and Accounting: | | | | | | 9 |
| Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy. | | | | | | | |
| Unit - V | Small Business Management: | | | | | | 9 |
| Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies- Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting | | | | | | | |

Total:45**TEXT BOOK:**

| | |
|----|---|
| 1. | Donald F. Kuratko, "Entrepreneurship: Theory, Process, Practice", 11 th Edition, Cengage Learning, Boston, 2020. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha, "Entrepreneurship", 11 th Edition, McGraw Hill, Noida, 2020. |
| 2. | Charantimath Poornima M., "Entrepreneurship Development and Small Business Enterprises", 3 rd Edition, Pearson Education, Noida, 2018. |
| 3. | Gordon E. & Natarajan K., "Entrepreneurship Development", 6 th Edition, Himalaya Publishing House, Mumbai, 2017. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur | Applying (K3) |
| CO2 | identify suitable entrepreneurial ventures and business opportunity | Applying (K3) |
| CO3 | assess the components of business plan | Analyzing (K4) |
| CO4 | appraise the sources of finance and interpret accounting statements | Applying (K3) |
| CO5 | interpret the causes of sickness of small scale enterprises and its remedies | 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 | 2 | 1 | 1 | | 3 | 2 | | 1 |
| CO2 | 1 | 2 | 2 | 2 | | 2 | 2 | 1 | 1 | | 3 | 2 | | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 |
| CO4 | 1 | 1 | 2 | 1 | | 2 | 1 | 1 | 1 | 2 | 3 | 2 | | 1 |
| CO5 | 1 | 1 | 2 | 1 | | 2 | 1 | 1 | 1 | 2 | 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 | 30 | 30 | 20 | | | 100 |
| CAT3 | 30 | 30 | 40 | | | | 100 |
| ESE | 20 | 30 | 40 | 10 | | | 100 |

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

**18FTE25 - ANALYTICAL INSTRUMENTS IN FOOD INDUSTRIES**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Fundamentals of Biochemistry | 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 photometry and Thermal methods: | 9 |
|------------------|--|----------|

NMR spectroscopy & Flame photometry: 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", 5th Edition, 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 photometry 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)

**18FTE26 - 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 – electro dialysis.

| | | | | | | | |
|------------------|--------------------------|--|--|--|--|--|----------|
| 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. Shammass., "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)

**18FTE27 - ENZYMES IN FOOD PROCESSING**

| | | | | | | | |
|-------------------------------|--------------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Food Chemistry | 8 | 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 Menten Equation, Linear Plots / Km and V_{max} . Production of industrial enzymes: Sources of enzymes, microbial fermentation and downstream processing, Enzyme formulation. | | | | | | | |
| Unit - II | Enzymes in milk processing and brewing industry: | | | | | | 9 |
| Enzymes in milk processing and brewing industry: Milk Processing: Milk clotting enzymes, Lacto peroxidase, Cheese-ripening enzymes, Lysozyme, Lactase, Lipase, Transglutaminase Brewing : Malting, Brew house 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)

**18FTE28 - 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 | 8 | 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 abattoirs, slaughterhouse and its features. Handling and maintenance of tools and core equipment. Cleaning and sanitation in meat plants. Food safety measures – GMP and GHP.

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 | 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 | 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)

**18FTE29 - WASTE MANAGEMENT AND BY-PRODUCT UTILIZATION IN FOOD INDUSTRIES**

| Programme & Branch | B.Tech. & Food Technology | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 8 | 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 from 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:

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|----|---|
| 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 | 3 | 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 | 30 | 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)



18FT001 - FOOD PROCESSING TECHNOLOGY
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 5 | OE | 3 | 1 | 0 | 4 |

| | | | | | | | |
|--|---|--|--|--|--|--|------------|
| Preamble | To provide insight about the processing and preservation methods used for various food materials. | | | | | | |
| Unit - I | Introduction about Food: | | | | | | 9+3 |
| Introduction: Scope of food science and technology, Food - Definitions and functions, Sources of food, scope and benefit of industrial food preservation, Constituents of foods, perishable, non-perishable food commodities, Food as source of energy. | | | | | | | |
| Unit - II | Ambient Temperature processing: | | | | | | 9+3 |
| Ambient Temperature processing: Size reduction, mixing, forming, separation and concentration - centrifugation, filtration, extraction, concentration - theory and equipments. | | | | | | | |
| Unit - III | High temperature preservation: | | | | | | 9+3 |
| High temperature preservation: Introduction, Principles and methods - Canning and retorting – flowsheet, retorting, 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 |
| Low temperature preservation: 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 |
| Food Fermentation: Theory of fermentation, Types of Fermentation, equipments, effect on foods, fermented food products - soy sauce, curd, sauerkraut, vinegar - role in human health. Irradiation - 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 & Dennis R. Heldman, "Introduction to Food Process Engineering", 5th Edition, Academic Press, USA, 2014. |
| 2. | Sivasankar B., "Food Processing and Preservation", 1st Edition, 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 | 40 | | 20 | | | 100 |
| CAT2 | 40 | 20 | 40 | | | | 100 |
| CAT3 | 12 | 20 | 40 | 28 | | | 100 |
| ESE | 20 | 20 | 30 | 30 | | | 100 |

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



18FTO02 - BAKING TECHNOLOGY
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 5 | 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. Problems during processing.

List of Exercises / Experiments :

| | |
|----|--|
| 1. | Estimation of quality parameters of bakery ingredients |
| 2. | Determination of gluten content and sedimentation value of flour |
| 3. | Determination of diastatic activity of flour |
| 4. | Estimation of dough raising capacity of leaveners |
| 5. | Preparation and analysis of bread |
| 6. | Preparation and analysis of biscuit and cookies |
| 7. | Preparation and analysis of cake |

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. | CauvainStanley P & Young Linda S., "Technology of Bread Making", 3rd Edition, Springer, US, 2015. |
| 2. | Servet GulumSumnu& 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 conduct sensory analysis | 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)



18FTO03 - PROCESSING OF MILK AND MILK PRODUCTS
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 6 | 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 |
| Processing of market milk: 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. | | | | | | | |
| Unit - II | Manufacture of special milks: | | | | | | 9 |
| Manufacture of special milks: 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 Paneer: | | | | | | 9 |
| Manufacture of 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. | | | | | | | |
| Unit - IV | Technology of butter manufacture: | | | | | | 9 |
| Technology of butter manufacture: Packaging and storage, over-run in butter, control of fat loss, defects in butter, rheology of butter. Methods of ghee making, innovations in ghee manufacturing process, packaging of ghee. | | | | | | | |
| Unit - V | Manufacture of Cheese: | | | | | | 9 |
| Manufacture of Cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage, Pizza cheese etc. 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 paneer |
| 5. | Preparation of butter |
| 6. | Preparation of ghee |
| 7. | Preparation of cheddar 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. | Birendra Kumar Mishra, "Dairy and Food Processing Industry: Recent Trends", 2nd Edition, Astral International, New Delhi, 2014. |
| 2. | Hui Y.H., "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), Manipulation (S2) |
| CO7 | utilize the technical knowledge in preparation of pannier | Applying (K3), Manipulation (S2) |
| CO8 | utilize the technical knowledge in preparation of butter | 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 | 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 | 20 | 20 | | | | 100 |
| CAT2 | 40 | 20 | 20 | | | | 100 |
| CAT3 | 40 | 20 | 20 | | | | 100 |
| ESE | 40 | 40 | 20 | | | | 100 |

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



18FT004 - PROCESSING OF FRUITS AND VEGETABLES
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 6 | 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**

Physiology and post harvest changes of fruits and vegetables: 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**

Preprocessing operations: 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**

Preservation of Fruits and Vegetables products: Chilling, Freezing, Pasteurization, Sterilization, Irradiation, Waxing, Edible coating, Controlled Atmospheric Storage (CAS), Modified Atmospheric Storage (MAS).

Unit - IV **Fruit beverages:** **9**

Fruit beverages: Classification of fruit beverages, Juice, Squash, cordial, concentrated juice, nectar, Ready to Serve (RTS). Fermented fruit beverages - Wine and vinegar production. Juice making equipment.

Unit - V **Processing of fruits and vegetables products:** **9**

Processing of fruits and vegetables products: 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 |

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 characterize 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 | 1 | 1 | | | 1 | | | | | | 2 | 2 | 1 |
| CO2 | 3 | 2 | 2 | | 2 | 1 | | | | | | 1 | 3 | 2 |
| CO3 | 3 | 2 | 2 | | 2 | 2 | | 1 | | | | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | | | 2 | | 1 | | | | 1 | 3 | 2 |
| CO5 | 3 | 2 | 2 | | | 2 | | 1 | | | | 1 | 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 | 60 | 20 | | | | 100 |
| CAT3 | 20 | 60 | 20 | | | | 100 |
| ESE | 30 | 40 | 30 | | | | 100 |

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



18FTO05 - PRINCIPLES OF FOOD SAFETY
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology) | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 7 | 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 Jersey, 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)



18FTO06 - FOOD AND NUTRITION
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 7 | 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: | 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 |
|------------------|-----------------------------------|----------|

Idea of 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. Infancy - nutritional requirements, breast feeding, infant formula. Introduction of supplementary foods. Nutritional needs of toddlers, preschool, school going children- and adolescents - Dietary management. Geriatric 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 | 1 | | | | | | | | | 3 | 1 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | 1 | 1 | 3 |
| CO3 | 3 | 3 | 2 | 1 | | | | | | | | 1 | 1 | 3 |
| CO4 | 3 | 3 | 2 | 1 | | | | | | | | 1 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 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 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 40 | 60 | | | | | 100 |
| ESE | 35 | 40 | 25 | | | | 100 |

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



18FTO07 - FOOD INGREDIENTS
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech 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 |
|-----------------|-------------------------|----------|

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 |
|------------------|---------------------------|----------|

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 |
|-------------------|---------------------------|----------|

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 |
|------------------|-------------------------------------|----------|

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/ potentator; Importance of taste and flavours; Role of flavoring agents in food processing.

| | | |
|-----------------|---|----------|
| Unit - V | Nutraceuticals and phytochemicals: | 9 |
|-----------------|---|----------|

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. | ShakuntalaManay, 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., "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 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 50 | 30 | | | | 100 |
| ESE | 25 | 35 | 40 | | | | 100 |

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



18FTO08 - FUNDAMENTALS OF FOOD PACKAGING AND STORAGE
(Offered by Department of Food Technology)

| | | | | | | | |
|-------------------------------|---|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech branches except Food Technology | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 8 | 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 Pvt. Ltd., CRC Press, USA, 2011 for Units I, II, III. |
| 2. | Narayanasamy P., Mohan S and Awaknavar J. S., "Pest Management in Store Grains", 1st Edition, Satish Serial Publishing House, New Delhi, 2009 for Units III, IV, V. |

REFERENCES:

| | |
|----|---|
| 1. | Han Jung H., "Innovations in Food Packaging", 2nd Edition, Academic Press, USA 2013. |
| 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 | 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 Branches | Sem. | Category | L | T | P | Credit |
|--------------------|-----------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 5 | OE | 3 | 1 | 0 | 4 |

| | | | | | | | |
|---|--|--|--|--|--|--|------------|
| Preamble | To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning. | | | | | | |
| Unit - I | Vector Spaces: | | | | | | 9+3 |
| Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity | | | | | | | |
| Unit - II | Linear Transformations: | | | | | | 9+3 |
| Introduction – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity. | | | | | | | |
| Unit - III | Inner Product Spaces: | | | | | | 9+3 |
| Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Rotations. | | | | | | | |
| Unit - IV | Matrix Decomposition And Continuous Optimization: | | | | | | 9+3 |
| Cholesky decomposition – Singular Value Decomposition, Continuous Optimization: Introduction – Unconstrained Optimization – Gradient Descent method – Constrained Optimization – Lagrange Multipliers method – Convex Optimization | | | | | | | |
| Unit - V | Linear Regression And Support Vector Machines: | | | | | | 9+3 |
| Parameter Estimation – Maximum Likelihood estimation – Bayesian linear regression – Bayesian parameter estimation of Gaussian distribution, Support Vector Machines: Introduction – Margin and support vectors – Kernels – Primal support vector machine – Dual support vector machine. | | | | | | | |

Lecture:45, Tutorial:15, Total:60**TEXT BOOK:**

| | |
|----|---|
| 1. | Howard Anton and Chris Rorres, "Elementary Linear Algebra", 9 th Edition, John Wiley and Sons, New Delhi, 2011 for Units I, II, III. |
| 2. | Deisenroth M.P., Faisal A.A. and Ong C.S., "Mathematics for Machine Learning", 1 st Edition, Cambridge University Press, 2019 for Units IV, V. |

REFERENCES:

| | |
|----|--|
| 1. | David C. Lay, Steven R. Lay and Judith McDonald, "Linear Algebra and its Applications", 5 th Edition, Pearson Education, New Delhi, 2016. |
| 2. | Ethem Alpaydin, "Introduction to Machine Learning(Adaptive Computation and Machine Learning series)", 4 th Edition, MIT Press, USA, 2020. |
| 3. | Duda R.O., Hart E. and Stork D.G., "Pattern Classification", 2 nd Edition, John Wiley and Sons, New Delhi, 2012. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | understand the concepts of vector spaces. | Understanding (K2) |
| CO2 | apply the concepts of linear mappings in machine learning. | Applying (K3) |
| CO3 | use the concept of inner product space and decompose the given matrix by means of orthonormal vectors. | Applying (K3) |
| CO4 | apply the knowledge of factorisation of matrices and optimization techniques in clustering and classification of data. | Applying (K3) |
| CO5 | describe the concepts of parameter estimation and support vector machine. | 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 | | | | | | | | | | | | |
| CO2 | 3 | 1 | | | | | | | | | | | | |
| CO3 | 3 | 2 | | | | | | | | | | | | |
| CO4 | 3 | 3 | 1 | 1 | 1 | | | | | | | | | |
| CO5 | 3 | 2 | 2 | 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 | 10 | 50 | 40 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 5 | 25 | 70 | | | | 100 |

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



| Programme & Branch | All Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | NIL | 6 | OE | 3 | 1 | 0 | 4 |

| | | | | | | | |
|--|---|--|--|--|--|--|------------|
| Preamble | To develop rigorous logical thinking and analytical skills by graph theoretic concepts which helps for solving real time engineering problems in networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem. | | | | | | |
| Unit - I | Graphs: | | | | | | 9+3 |
| Introduction – Definition – Types of graphs – Degree of vertex – Walk, path and cycle – Isomorphism – Connected graph – Hamiltonian graph – Euler graph – Digraph – Representations of graphs: Adjacency matrix – Incidence matrix. | | | | | | | |
| Unit - II | Trees: | | | | | | 9+3 |
| Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Tree traversal. | | | | | | | |
| Unit - III | Graph Coloring: | | | | | | 9+3 |
| Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications. | | | | | | | |
| Unit - IV | Basic Algorithms: | | | | | | 9+3 |
| Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm – Travelling salesman problem: Two optimal algorithm – Closest Insertion Algorithm. | | | | | | | |
| Unit - V | Network Flows and Applications: | | | | | | 9+3 |
| Flows and cuts in networks - Max-flow Min-cut Theorem – Algorithms: Flow Augmenting Path – Ford-Fulkerson Algorithm for Maximum Flow – Edmonds and Karp algorithm. | | | | | | | |

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

| | |
|----|---|
| 1. | Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, New Delhi, 2010. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Douglas B. West, "Graph Theory", 2 nd Edition, Prentice Hall, New Delhi, 2017. |
| 2. | Jonathan L. Gross & Jay Yellen, "Graph Theory and its Applications", 2 nd Edition, CRC Press, New York, 2006. |



| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|----------------------------------|
| On completion of the course, the students will be able to | | |
| CO1 | explain the types of graphs and illustrate isomorphism on graphs. | Understanding (K2) |
| CO2 | use the concepts and properties of different types of trees in data structures. | Applying (K3) |
| CO3 | estimate the chromatic partition, chromatic polynomial and matching of a given graph. | Applying (K3) |
| CO4 | apply various graph theoretic algorithms to communication and network problems. | Applying (K3) |
| CO5 | identify the maximal flow in network by means of algorithms. | 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 | 1 | | | | | | | | | | | | |
| CO3 | 3 | 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 | 10 | 50 | 40 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 10 | 30 | 60 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

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



| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 6 | OE | 3 | 1 | 0 | 4 |

| | | | | | | | |
|---|---|--|--|--|--|--|------------|
| Preamble | To provide the skills for applying various number theoretic algorithms, congruences, primality tests in cryptography and network security and impart knowledge of basic cryptographic techniques. | | | | | | |
| Unit - I | Divisibility Theory and Canonical Decompositions: | | | | | | 9+3 |
| Division algorithm- Base-b representations – number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM. | | | | | | | |
| Unit - II | Theory of Congruences: | | | | | | 9+3 |
| Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat's Little theorem – Euler's theorem – Chinese remainder theorem. | | | | | | | |
| Unit - III | Number Theoretic Functions: | | | | | | 9+3 |
| Introduction – Functions τ and σ – Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography. | | | | | | | |
| Unit - IV | Primality Testing and Factorization: | | | | | | 9+3 |
| Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method. | | | | | | | |
| Unit - V | Classical Cryptographic Techniques: | | | | | | 9+3 |
| Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography. | | | | | | | |

Lecture:45, Tutorial:15, Total:60**TEXT BOOK:**

| | |
|----|---|
| 1. | Thomas Koshy, "Elementary Number Theory with Applications", 2 nd Edition, Academic Press, Elsevier, USA, 2007 for Units I, II, III. |
| 2. | William Stallings, "Cryptography and Network Security: Principles and Practice", 7 th Edition, Pearson Education, New Delhi, 2019 for Units IV, V. |

REFERENCES:

| | |
|----|---|
| 1. | Ivan Niven, Herbert S. Zuckerman & Hugh L. Montgomery, "An Introduction to the Theory of Numbers", Reprint Edition, John Wiley & Sons, New Delhi, 2008. |
| 2. | Bernard Menezes, "Cryptography and Network Security", 1 st Edition, Cengage Learning India, New Delhi, 2010. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | understand various the concepts of divisibility and canonical decompositions. | Understanding (K2) |
| CO2 | obtain knowledge in theory of congruences and solution of linear congruences. | Applying (K3) |
| CO3 | use different number theoretic function suitably in cryptography. | Applying (K3) |
| CO4 | apply various Primality test and factorisation algorithms to network security problems. | Applying (K3) |
| CO5 | identify the suitable cryptographic techniques to handle real time security issues. | 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 | | | | | | | | | | | | |
| CO2 | 3 | 1 | | | | | | | | | | | | |
| CO3 | 3 | 1 | | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | 2 | | | | | | | | | |
| CO5 | 3 | 2 | 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 | 10 | 30 | 60 | | | | 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)



| | | | | | | | |
|-------------------------------|--|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 7 | OE | 3 | 0 | 0 | 3 |

| | |
|-----------------|--|
| Preamble | To provide the skills for applying linear equations, decomposition of matrices and linear transformations in real time engineering problems and impart knowledge of vector spaces. |
|-----------------|--|

| | | |
|-----------------|--------------------------|----------|
| Unit - I | Linear Equations: | 9 |
|-----------------|--------------------------|----------|

System of linear equations – Row reduction and echelon forms – Vector equations – Matrix equations – Solution sets of linear systems – Applications of Linear systems: Matrix operations – inverse of a matrix, Matrix factorization – Applications to computer graphics.

| | | |
|------------------|-----------------------|----------|
| Unit - II | Vector Spaces: | 9 |
|------------------|-----------------------|----------|

Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.

| | | |
|-------------------|-----------------------------|----------|
| Unit - III | Inner Product Space: | 9 |
|-------------------|-----------------------------|----------|

Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique.

| | | |
|------------------|--------------------------------|----------|
| Unit - IV | Linear Transformations: | 9 |
|------------------|--------------------------------|----------|

General linear transformation – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.

| | | |
|-----------------|--------------------------------------|----------|
| Unit - V | Eigenvalues and Eigenvectors: | 9 |
|-----------------|--------------------------------------|----------|

Definition – Orthogonal Diagonalization – Quadratic forms – Quadratic surfaces – Singular value decomposition – Applications.

Total: 45**TEXT BOOK:**

| | |
|----|---|
| 1. | Howard Anton & Chris Rorres, "Elementary Linear Algebra", 11 th Edition, John Wiley & Sons, USA, 2014. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | David C. Lay, Steven R. Lay & Judith McDonald, "Linear Algebra and its Applications", 5 th Edition, Pearson Education, New Delhi, 2016. |
|----|--|

| | |
|----|--|
| 2. | Gareth Williams, "Linear Algebra with Applications", 8 th Edition, Jones & Barlett Learning, USA, 2014. |
|----|--|



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | use the concepts of matrices and vectors in the solution of a system of linear equations. | Applying (K3) |
| CO2 | understand the concepts of vector spaces. | Understanding (K2) |
| CO3 | understand the concept of inner product space and decompose the given matrix by means of orthonormal vectors. | Understanding (K2) |
| CO4 | transform the system from one dimension to another and represent the pertinent linear transformation in matrix form. | Applying (K3) |
| CO5 | apply the knowledge of quadratic forms and techniques of singular value decomposition for problems arising in power/control system analysis, signals and systems. | 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 | 1 | | | | | | | | | | | | |
| CO3 | 3 | 1 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | |
| CO5 | 3 | 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 | 10 | 20 | 70 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

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



| Programme & Branch | All Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|---|------|----------|---|---|---|--------|
| Prerequisites | NIL | 7 | OE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|--|--|--|--|--|--|----------|
| Preamble | To provide the skills for solving the real time engineering problems involving linear, non-linear, transportation and assignment problems and also impart knowledge in project management and game theoretic concepts. | | | | | | |
| Unit - I | Linear Programming: | | | | | | 9 |
| Introduction – Formulation of Linear Programming Problem – Advantages of Linear Programming methods – Limitations of Linear Programming models – Standard form of LPP – Graphical Method – Simplex Method – Artificial variable techniques – Big M Method. | | | | | | | |
| Unit - II | Transportation Problem: | | | | | | 9 |
| Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Least Cost Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem – Maximization transportation problem. | | | | | | | |
| Unit - III | Assignment Problem and Theory of Games: | | | | | | 9 |
| Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem. Theory of Games: Two-person zero-sum game – Pure strategies - Game with mixed strategies – Rules of Dominance – Solution methods: Algebraic method – Matrix method – Graphical method. | | | | | | | |
| Unit - IV | Project Management: | | | | | | 9 |
| Basic Concept of network Scheduling – Construction of network diagram – Critical path method – Programme evaluation and review technique – Project crashing – Time-cost trade-off procedure. | | | | | | | |
| Unit - V | Non-Linear Programming: | | | | | | 9 |
| Formulation of non-linear programming problem – Constrained optimization with equality constraints – Kuhn-Tucker conditions – Constrained optimization with inequality constraints. | | | | | | | |

Total: 45**TEXT BOOK:**

| | |
|----|---|
| 1. | Kanti Swarup, Gupta P.K. & Man Mohan, "Operation Research", 14 th Edition, Sultan Chand & Sons, New Delhi, 2014. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Sharma J.K., "Operations Research – Theory and Applications", 4 th Edition, Macmillan Publishers India Ltd., New Delhi, 2009. |
| 2. | Gupta P.K. & Hira D.S., "Operations Research: An Introduction", 6 th Edition, S.Chand and Co. Ltd, New Delhi, 2008. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | formulate and solve linear programming problems. | Applying (K3) |
| CO2 | apply transportation algorithms in engineering problems. | Applying (K3) |
| CO3 | use assignment and game theory concepts in practical situations. | Applying (K3) |
| CO4 | handle the problems of Project Management using CPM and PERT. | Applying (K3) |
| CO5 | solve various types of Non-linear Programming problems. | 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 | 1 | 1 | | | | | | | | | | | |
| CO3 | 3 | 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 | 5 | 10 | 85 | | | | 100 |
| CAT2 | 5 | 10 | 85 | | | | 100 |
| CAT3 | 5 | 10 | 85 | | | | 100 |
| ESE | 5 | 10 | 85 | | | | 100 |

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



18PH001 - THIN FILM TECHNOLOGY
(Offered by Department of Physics)

| | | | | | | | |
|-------------------------------|------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 5 | OE | 3 | 1 | 0 | 4 |

| | | | | | | | |
|--|---|--|--|--|--|--|------------|
| Preamble | This course aims to impart the essential knowledge on deposition, characterization and application of thin films in various engineering fields, and also provides motivation towards innovations. | | | | | | |
| Unit - I | Theories and models of thin film growth: | | | | | | 9+3 |
| Introduction - Theories of thin film nucleation: Impingement, Adsorption and Thermal accommodation - The capillarity model - The atomistic models - Structural consequences of thin film nucleation - The four stages of film Growth - The incorporation of defects during growth. | | | | | | | |
| Unit - II | Vacuum technology: | | | | | | 9+3 |
| Principle and working of vacuum pumps: Roots pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cryogenic-pump, Ion pump, Ti-sublimation pump - Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge - Cold cathode and hot cathode ionization gauges - Pressure controlling system (qualitative). | | | | | | | |
| Unit - III | Deposition of thin films - Physical methods: | | | | | | 9+3 |
| Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering - Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering. | | | | | | | |
| Unit - IV | Deposition of thin films – Chemical methods: | | | | | | 9+3 |
| Chemical vapor deposition – Sol-gel method - Chemical bath deposition - Hydro thermal methods – Electroplating deposition - Electroless deposition - Spray Pyrolysis - Spin coating. | | | | | | | |
| Unit - V | Characterization and Applications of thin films: | | | | | | 9+3 |
| Characterization: X-ray diffraction, Energy dispersive X-ray analysis, Atomic probe microscopy, UV-vis spectroscopy, Four probe resistivity – Applications (qualitative): Thin film resistors, Thin film capacitors, Thin film diodes, Thin film transistors, Thin film solar cells, Thin film gas sensors, Thin films for information storage and Optical coatings. | | | | | | | |

Lecture:45, Tutorial:15,Total:60

TEXT BOOK:

| | |
|----|--|
| 1. | Maissel L.I. and Glang R., "Hand book of Thin Film Technology", McGraw Hill Inc., 1970 for Units I,II,III, IV. |
| 2. | Zhang S., Li L. and Kumar A., "Materials Characterization Techniques", CRC Press, 2009 for Unit V. |

REFERENCES:

| | |
|----|--|
| 1. | Ohring M., "Material Science of Thin Films", Academic Press, 1992. |
| 2. | Goswami A., "Thin Film Fundamentals", New Age International Pvt. Ltd., 2003. |
| 3. | Chopra K.L., "Thin Film Phenomena", McGraw Hill Inc., 1969. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | utilize the appropriate theory and models to comprehend the thin film growth process. | Applying (K3) |
| CO2 | apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods. | Applying (K3) |
| CO3 | describe the deposition of thin films by select physical methods using the principle of working of respective methods. | Applying (K3) |
| CO4 | explain the deposition of thin films by select chemical methods using the principle of working of respective methods. | Applying (K3) |
| CO5 | make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films. | 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 | 25 | 35 | 40 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 20 | 35 | 45 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**18PHO02 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS**

(Offered by Department of Physics)

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|--------------------|-----------------------|------|----------|---|---|---|--------|
| Prerequisites | NIL | 7 | OE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|--|--|--|--|--|--|--|----------|
| Preamble | This course aims to impart the essential knowledge on the characterization of materials using X-ray diffraction, Raman spectroscopy, UV-visible spectroscopy, Electron microscopy and Scanning tunneling microscopy and their application in various engineering fields, and also provides motivation towards innovations. | | | | | | |
| Unit - I | Introduction to Characterization Techniques and X-Ray Diffraction: | | | | | | 9 |
| Importance of materials characterization - Classification of characterization techniques - Destructive and non-destructive techniques - Crystalline materials - Reciprocal lattice - Theory of X-ray diffraction - Powder and Single crystal X-ray diffraction: Instrumentation, XRD pattern, Systematic procedure for structure determination, Particle size determination, Strain calculation - Applications of X ray diffraction measurements. | | | | | | | |
| Unit - II | Raman Spectroscopy: | | | | | | 9 |
| Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation – Near-Infra-Red FT Raman Spectroscopy. | | | | | | | |
| Unit - III | Electron Microscopy: | | | | | | 9 |
| Need of Electron Microscopy - Electron Specimen interaction: Emission of secondary electrons, Backscattered electrons, Characteristic X-rays, Transmitted electrons, Specimen interaction volume - Resolution - Scanning electron microscope and Transmission electron microscope: Schematic diagram, Short details of each component and working - Field Emission Gun - Field Emission Scanning electron microscope - Merits of Transmission electron microscope. | | | | | | | |
| Unit - IV | Scanning Tunneling Microscopy: | | | | | | 9 |
| Introduction to quantum mechanical tunneling - Basic principles of scanning tunneling microscopy - Two modes of scanning - Interpreting scanning tunneling microscopic images -Applications of scanning tunneling microscopy. | | | | | | | |
| Unit - V | Ultra Violet and Visible Spectroscopy: | | | | | | 9 |
| Regions of UV-Visible radiation - Colour and light absorption - The chromophore concept - Beer's and Lambert's laws – Theory of electronic transition - Frank Condon principle – Instrumentation and Working of UV vis spectrometer - Applications of UV visible spectroscopy. | | | | | | | |

Total:45**TEXT BOOK:**

| | | |
|----|--|--------------------|
| 1. | Cullity B.D. and Stock S.R., "Elements of X-ray diffraction ", 3rd Edition, Pearson Education, India, 2003 for | Units I,II,III,IV. |
| 2. | Banwell C.N., "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publications, New Delhi, 2007 for Unit V. | |

REFERENCES:

| | |
|----|--|
| 1. | Holt D.B. and Joy D.C., "SEM micro characterization of semiconductors", Academic Press, New Delhi, 1989. |
| 2. | Willard H.H., Merritt L.L., John A. Dean and Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers and Distributors, New Delhi. |
| 3. | Elton N. Kaufman, "Characterization of Materials (Volume1&2)", Wiley-Interscience, 2003. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials. | Applying (K3) |
| CO2 | make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials. | Applying (K3) |
| CO3 | determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy. | Applying (K3) |
| CO4 | utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image at the atomic level recorded using scanning tunneling microscopy. | Applying (K3) |
| CO5 | apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer. | 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 | 40 | 40 | | | | 100 |
| CAT3 | 20 | 35 | 45 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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



| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|--------------------|-----------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 5 | OE | 3 | 1 | 0 | 4 |

| | |
|----------|--|
| Preamble | Corrosion science and engineering aims to equip the students to have wide range knowledge of corrosion and prevention methods in order to meet the industrial needs. |
|----------|--|

| | | |
|-----------------|---------------------------------|------------|
| Unit - I | Corrosion and its units: | 9+3 |
|-----------------|---------------------------------|------------|

Importance of corrosion prevention in various industries: direct and indirect effects of corrosion –free energy and oxidation potential criterion of uniform corrosion –Pilling Bedworth ratio and its consequences –units corrosion rate – mdd (milligrams per square decimeter per day) and mpy (Mils per year) –importance of pitting factor – Pourbaix diagrams of Mg, Al and Fe – and their limitations.

| | | |
|------------------|--------------------------------|------------|
| Unit - II | Mechanism of Corrosion: | 9+3 |
|------------------|--------------------------------|------------|

Localized corrosion: electro chemical mechanism Vs. chemical mechanism – Galvanic corrosion – Area effect in anodic and cathodic metal coatings, Organic coatings of bimetallic systems – prediction using emf Series and Galvanic series – Crevice corrosion – Mechanism of differential oxygenation corrosion – Auto catalytic mechanism of pitting due to crevice or differential oxygenation corrosion – Principles and procedures of cathodic protection: Sacrificial anodes and external cathodic current impression – stray current corrosion.

| | | |
|-------------------|----------------------------|------------|
| Unit - III | Types of Corrosion: | 9+3 |
|-------------------|----------------------------|------------|

Inter-granular corrosion: Stainless steels – cause and mechanism (Cr- Depletion theory) – Weld decay and knife line attack – Stress corrosion and fatigue corrosion – Theory of critical corrosion rate in corrosion fatigue. Cavitation damage – Fretting damage – Atmospheric corrosion – Bacterial corrosion – Marine corrosion –High temperature oxidation of metals – Ionic diffusion through protective oxides.

| | | |
|------------------|-------------------------------|------------|
| Unit - IV | Kinetics of Corrosion: | 9+3 |
|------------------|-------------------------------|------------|

Kinetic aspects of corrosion: Over potential activation and concentration over potentials – Exchange current density – Mixed potential theory – corrosion rates of Fe and Zn in air – free acid – effect of oxidizing agents – Phenomenon of passivation – Theories – effect of oxidizing agents and velocity of flow on passivating metals – effect of galvanic coupling of Fe and Ti respectively with Platinum – Noble metal alloying – anodic protection.

| | | |
|-----------------|---------------------------------|------------|
| Unit - V | Prevention of Corrosion: | 9+3 |
|-----------------|---------------------------------|------------|

Corrosion in inhibition: Inhibitors of corrosion – passivators, adsorbing inhibitors, V.P. inhibitors. Prevention of galvanic crevice, inter granular, Stress and fatigue corrosion at the design stage and in service conditions – control of catastrophic oxidation and Hydrogen disease -control of Bacterial corrosion – Langelier saturation Index and its uses. Corrosion prevention by Coatings – Surface pre-treatment – Hot dip, diffusion and clad coatings – Phosphating and its uses.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

| | |
|----|--|
| 1. | Winston R. & Uhlig H.H., "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, A John Wiley & Sons Inc. Publication, New Jersey, 2008. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | McCafferty E., "Introduction to Corrosion Science", Springer, New York, 2010. |
| 2. | Fontanna, "Corrosion Engineering (Materials Science and Metallurgy Series)", McGraw Hill International Education, Singapore, 2005. |
| 3. | Pietro Pedferri, "Corrosion Science and Engineering", Springer Nature Switzerland AG, Switzerland, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | illustrate the importance of direct and indirect corrosion to familiarize for industrial needs. | Understanding (K2) |
| CO2 | demonstrate the mechanism of different types of corrosion with respect to the environment. | Applying (K3) |
| CO3 | organize the various types and theory of corrosion to understand the corrosion problems. | Applying (K3) |
| CO4 | utilize the theories and kinetics of corrosion to interpret with the real time applications. | Applying (K3) |
| CO5 | summarize the corrosion prevention methods to avoid corrosion related issues. | 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 | | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | 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)



| | | | | | | | |
|-------------------------------|------------------------------|-------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 6 | BS | 3 | 1 | 0 | 4 |

Preamble Instrumental methods of analysis aim to prepare the students to have all-encompassing knowledge of spectral methods in order to identify the molecules and reaction mechanism for the process to enhance application towards the industries.

Unit - I **Absorption and Emission Spectroscopy:** **9+3**

Basic concepts of Absorption and emission spectroscopy – representation of spectra – basic elements of practical spectroscopy – signal to noise ratio - techniques for signal to noise enhancement – resolving power – Fourier transform spectroscopy – evaluation of results – basic principles, instrumentation and applications of atomic absorption, atomic fluorescence and atomic emission spectroscopy.

Unit - II **IR, Raman and NMR Spectroscopy:** **9+3**

Infrared spectroscopy – correlation of IR Spectra with molecular structure, instrumentation, samplings technique and quantitative analysis. Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis. Nuclear magnetic resonance spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – elucidation of NMR spectra and quantitative analysis.

Unit - III **Surface Studies:** **9+3**

Surface study – x-ray emission spectroscopy (XES), electron spectroscopy for chemical analysis (ESCA) - UV photo electron spectroscopy (UPS)- X- ray photo electron spectroscopy (XPS) - Auger emission Spectroscopy (AES) - Transmission Electron microscopy (TEM) - Scanning Electron microscopy (SEM) - Surface tunneling microscopy (STEM) - Atomic force microscopy (AFM).

Unit - IV **Mass Spectroscopy:** **9+3**

Mass spectroscopy – Ionization methods in mass spectroscopy – mass analyzer – ion collection systems - correlation of molecular spectra with molecular structure. Instrumentation design and application of Fourier transform mass spectroscopy (FT-MS)- Inductively coupled plasma mass spectroscopy (ICP-MS) - Secondary Ion Mass Spectroscopy (SIMS) and Ion microprobe mass analyzer (IMMA).

Unit - V **Thermal Analysis:** **9+3**

Thermal analysis: principles and instrumentations and applications of thermogravimetry (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), evolved gas detection, thermo mechanical analysis and Thermometric titrimetry.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

- Willard H.H., Merritt L.L., Dean J.A & Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, New Delhi, 2012.

REFERENCES:

- Chatwal G.R. & Anand Sham K., "Instrumental Methods of Chemical Analysis", 5th Edition, Himalaya Publishing House, Girgaon, Mumbai, 2019.
- Srivastava A.K. & Jain P.C., "Instrumental Approach to Chemical Analysis", 4th Edition, S Chand and Company Ltd, New Delhi, 2012.
- Sharma B.K., "Instrumental Method of Chemical Analysis", Krishna Prakashan Media Pvt. Ltd., Meerut, 2014.



| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|--------------------------------------|
| On completion of the course, the students will be able to | | |
| CO1 | illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques. | Understanding (K2) |
| CO2 | apply the IR, Raman and NMR for quantitative analysis of the sample. | Applying (K3) |
| CO3 | apply the various techniques for the better understanding of surface morphology. | Applying (K3) |
| CO4 | explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample. | Understanding (K2) |
| CO5 | illustrate the thermal analysis for the identification of thermal stability of the compounds. | 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 | | | | | | | | | | | | |
| 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)

**18CYO03 - WASTE AND HAZARDOUS WASTE MANAGEMENT**

(Offered by Department of Chemistry)

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|--------------------|-----------------------|------|----------|---|---|---|--------|
| Prerequisites | Nil | 7 | BS | 3 | 0 | 0 | 3 |

| | | | | | | | |
|----------|--|--|--|--|--|--|--|
| Preamble | Waste and Hazardous waste management aims to equip the students to have a wide-range knowledge on waste management | | | | | | |
|----------|--|--|--|--|--|--|--|

| | | |
|-----------------|--------------------------------|----------|
| Unit – I | Solid Waste Management: | 9 |
|-----------------|--------------------------------|----------|

Solid wastes: Definition, types, sources, classification and composition of solid waste- Solid waste management system – Factors affecting solid waste management system – Solid waste processing technologies – incineration, combustion, stabilization, solidification, chemical fixation, encapsulation, composting, vermicomposting – Energy from waste –Biogasification –Anaerobic digestion, pyrolysis, refuse derived fuels; Landfill leachate and gas management, Landfill bioreactors – Recycling of household and commercial waste, recycling of paper, recycling of tire, recycling of plastics – Health and Environmental effects of Solid Waste – SWM: Indian scenario – Characteristics and quantity of various wastes.

| | | |
|------------------|------------------------------------|----------|
| Unit – II | Hazardous Waste Management: | 9 |
|------------------|------------------------------------|----------|

Hazardous waste Management: Identification and sources – characteristics and categorization – collection, segregation, packaging, labelling, transportation, processing (3R) – risk assessment and waste management treatment and disposal – storage and leak detection – site selection criteria, manifest system and records – Indian scenario – Responsibilities of various authorities. Radioactive Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal.

| | | |
|-------------------|---|----------|
| Unit – III | E-Waste and Biomedical Waste Management: | 9 |
|-------------------|---|----------|

E-Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal. Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste – categories and classification of biomedical waste – hazard of biomedical waste – need for disposal of biomedical waste – waste minimization – waste segregation and labelling – waste handling and collection- Treatment – autoclaving, Incineration, Chemical Disinfection – Disposal – Infection control Practices- status in India.

| | | |
|------------------|--|----------|
| Unit – IV | Pollution from Major Industries and Management: | 9 |
|------------------|--|----------|

Introduction- sources and characteristics – waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts.

| | | |
|-----------------|--|----------|
| Unit – V | Solid Waste Management Legislation: | 9 |
|-----------------|--|----------|

Solid waste management plan – Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments if any – Biomedical Waste (Management and Handling) Rules, 2016; Notification of Ash utilization 1999, 2003, 2009, 2015 and amendments if any – Plastic Waste Management Rules, 2016 – E-Waste Management Rules, 2016 – Bio-Medical Waste Management Rules, 2016 – Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 – Construction and Demolition Waste Management Rules, 2016.

Total:45**TEXT BOOK:**

| | |
|----|--|
| 1. | John Pichtel, "Waste Management Practices: Municipal, Hazardous, and Industrial", 2 nd Edition, CRC Press, Boca Raton, Florida, 2014 for Unit II, III. |
| 2. | Sharma U.C. & Neetu Singh, "Environmental Science and Engineering, Volume 5: Solid Waste Management", 2 nd Edition, Studium Press, United State of America, 2017 for Unit I,IV,V. |

REFERENCES:

| | |
|----|---|
| 1. | VanGuilder & Cliff, "Hazardous Waste Management: An Introduction", Har Cdr Edition, Mercury Learning & Information, Herndon, VA, 2011. |
| 2. | Karen Hardt, "Solid Waste Management", 1st Edition, Callisto Reference, Germany, 2018. |
| 3. | Majeti Narasimha Vara Prasad, Meththika Vithanage & Anwesa Borthakur, "Handbook of Electronic Waste Management: International Best Practices and Case Studies", 1st Edition, Butterworth-Heinemann, United Kingdom, 2019. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | apply the technical points that are required to set up a solid waste management system. | Applying (K3) |
| CO2 | select the various disposal methods of hazardous wastes like radioactive wastes. | Understanding (K2) |
| CO3 | organize the appropriate method for managing e-waste and biomedical wastes. | Applying (K3) |
| CO4 | identify to plan minimization of industrial wastes. | Applying (K3) |
| CO5 | relate the legal legislation to solid waste management. | 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 | | | 3 | | | | | | | |
| CO2 | 2 | 1 | | | | | 3 | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | 3 | | | | | | | |
| CO4 | 3 | 2 | 1 | 1 | | | 3 | | | | | | | |
| CO5 | 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 | 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)

**18GEO01 – GERMAN LANGUAGE LEVEL 1**

(Offered by Department of Electronics and Communication Engineering)

| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | Basics of Language | 5,6,7,8 | HS | 4 | 0 | 0 | 4 |

| | | | | | | | |
|--|--|--|--|--|--|--|-----------|
| Preamble | To acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations. | | | | | | |
| Unit - I | Contacts (Kontakte): | | | | | | 12 |
| Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles. | | | | | | | |
| Unit - II | Accommodation (Die Wohnung): | | | | | | 12 |
| Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with <i>sehr/zu</i> , Adjective with Accusative, prepositions with Dative | | | | | | | |
| Unit - III | Working Environment Communication (Arbeiten/Sie): | | | | | | 12 |
| Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – <i>und, oder, aber</i> . | | | | | | | |
| Unit - IV | Clothes and Style (Kleidung und mode) : | | | | | | 12 |
| Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative. | | | | | | | |
| Unit - V | Health and Vacation (Gesundheit und Urlaub): | | | | | | 12 |
| Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with <i>du/Ihr</i> , Modal verbs – <i>sollen, müssen, nichtdürfen, dürfen</i> . Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: <i>man</i> , Question words – <i>Wer, Wen, Was, Wem</i> , Adverbs – <i>Zuerst, dann, Später, ZumSchl</i> | | | | | | | |

Total:60**TEXT BOOK:**

| | |
|----|--|
| 1. | "Stefanie Dengler, Paul Rusch, Helen Schmitz, TanjaSieber, "Netzwerk Deutsch alsFremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015. |
|----|--|

REFERENCES:

| | |
|----|---|
| 1. | https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware Refer: German 1 for undergraduate students |
| 2. | https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | understanding letters and simple texts | Remembering (K1) |
| CO2 | assimilating vocabulary on accommodation and invitation | Understanding (K2) |
| CO3 | comprehend concept of time, telephonic conversation and job-related information | Understanding (K2) |
| CO4 | understanding how to do shopping in a German store | Understanding (K2) |
| CO5 | understanding body parts and how to plan personal travel | 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 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 1 | 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 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



18GEO02 – JAPANESE LANGUAGE LEVEL 1
(Offered by Department of Electronics and Communication Engineering)

| Programme & Branch | All BE/BTech Engineering & Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | Basics of Language | 5,6,7,8 | HS | 4 | 0 | 0 | 4 |

| | | | | | | | |
|--|---|--|--|--|--|--|-----------|
| Preamble | To understand the basics of Japanese language which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form | | | | | | |
| Unit - I | Introduction to groups of verbs: | | | | | | 12 |
| tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions | | | | | | | |
| Unit - II | Introduction to Casual Form: | | | | | | 12 |
| nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style | | | | | | | |
| Unit - III | Express opinions and thoughts: | | | | | | 12 |
| Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications | | | | | | | |
| Unit - IV | Introduction to If clause and Kanjis: | | | | | | 12 |
| If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-110 Kanjis | | | | | | | |
| Unit - V | Introduction to Counters: | | | | | | 12 |
| How to use numbers-How to use quantifiers-Past form of adjectives and Nouns-Way to say preference-Way of expression degrees of an action-Other necessary particles-How to use numbers-How to use quantifiers-Past form of adjectives | | | | | | | |

Total:60

TEXT BOOK:

| |
|---|
| 1. "MINNA NO NIHONGO–Japanese for Everyone", 2 nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017. |
|---|

REFERENCES:

| |
|---|
| 1. MargheritaPezzopane, "Try N5", 2 nd Edition, Tankobon Softcover, Japan, 2017. |
| 2. Sayaka Kurashina, "Japanese Word Speedmaster", 2 nd Edition, Tankobon Softcover, Japan, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | read and understand typical expression in Hiragana and Katakana | Remembering (K1) |
| CO2 | understand Polite form and Casual form of Japanese | Understanding (K2) |
| CO3 | comprehend personal communication and express greetings | Understanding (K2) |
| CO4 | understand the Kanjis in Japanese Script | Understanding (K2) |
| CO5 | comprehend concept of time, counters and job-related information | 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 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 1 | 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 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|--------------------|---------------------------------|------|----------|---|---|---|--------|
| Prerequisites | Problem Solving and Programming | 7 | OE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|--|--|--|--|--|--|--|----------|
| Preamble | In this course, systematic process of thinking which empowers even the most traditional thinker to develop new, innovative solutions to the problem at hand are studied with an emphasis on bringing ideas to life based on how real users think, feel and behave. | | | | | | |
| Unit - I | Introduction:: | | | | | | 9 |
| Introduction – Need for design thinking – Design and Business – The Design Process – Design Brief – Visualization – Four Questions, Ten Tools – Explore – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing. | | | | | | | |
| Unit - II | Visualization: | | | | | | 9 |
| Introduction – Visualization – Journey Mapping – Value Chain Analysis – Mind Mapping – Empathize – Observations – Need Finding – User Personas. | | | | | | | |
| Unit - III | Brainstorming: | | | | | | 9 |
| Introduction – Brainstorming – Concept Development – Experiment – Ideation – Prototyping – Idea Refinement. | | | | | | | |
| Unit - IV | Assumption Testing: | | | | | | 9 |
| Introduction – Assumption Testing – Rapid Prototyping – Engage – Storyboarding. | | | | | | | |
| Unit - V | Customer Co-Creation Learning Launch: | | | | | | 9 |
| Introduction – Customer Co-Creation Learning Launch – Leading Growth and Innovation – Evolve – Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Quick Wins. | | | | | | | |

Total:45**TEXT BOOK:**

| | |
|----|---|
| 1. | Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011. |
|----|---|

REFERENCES:

| | |
|----|---|
| 1. | Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017. |
| 2. | Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: A Step-by-Step Project Guide", Columbia University Press, 2014. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | outline the basic concepts of design thinking | Understanding (K2) |
| CO2 | make use of the mind mapping process for designing any system | Applying (K3) |
| CO3 | develop many creative ideas through structured brainstorming sessions. | Applying (K3) |
| CO4 | develop rapid prototypes to bring the ideas into reality | Applying (K3) |
| CO5 | plan the implementation of the any system considering the real time feedback | 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 | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| 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 | 10 | 70 | 20 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|------|----------|---|---|---|--------|
| Prerequisites | NIL | 8 | OE | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|--|--|--|--|--|----------|
| Preamble | This course will inspire the students to think innovation concepts and ideas for business model developments. | | | | | | |
| Unit - I | Innovation and Design Thinking: | | | | | | 9 |
| Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping | | | | | | | |
| Unit - II | User Study and Contextual Enquiry: | | | | | | 9 |
| Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications | | | | | | | |
| Unit - III | Product Design: | | | | | | 9 |
| Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction | | | | | | | |
| Unit - IV | Business Model Canvas (BMC): | | | | | | 9 |
| Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies | | | | | | | |
| Unit - V | IPR and Commercialization: | | | | | | 9 |
| Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing | | | | | | | |

Total:45**TEXT BOOK:**

1. Rishiksha T.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1. Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2. Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th Edition, McGraw-Hill Higher Education, 2020.
3. Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st Edition, John Wiley and Sons; 2010.
4. Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017.



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | understand innovation need and design thinking phases | Understanding (K2) |
| CO2 | identify, screen and analyse ideas for new products based on customer needs | Analysing (K4) |
| CO3 | develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product. | Analysing (K4) |
| CO4 | predict a structured business model for MVP | Applying (K3) |
| CO5 | practice the procedures for protection of their ideas' IPR | 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 | | | | | | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO4 | | | | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO5 | | | | 3 | 2 | 2 | | 3 | 2 | 3 | 3 | 3 | 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 | 30 | 40 | 10 | | | 100 |
| CAT2 | 20 | 30 | 40 | 20 | | | 100 |
| CAT3 | 30 | 30 | 40 | | | | 100 |
| ESE | 20 | 30 | 30 | 20 | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | German Language Level 1 | 5/6/7/8 | HS | 4 | 0 | 0 | 4 |

| | | | | | | | |
|----------|---|--|--|--|--|--|--|
| Preamble | This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations. | | | | | | |
|----------|---|--|--|--|--|--|--|

| | | |
|-----------------|----------------------------|-----------|
| Unit - I | Contacts(Kontakte): | 12 |
|-----------------|----------------------------|-----------|

Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.

| | | |
|------------------|------------------------------------|-----------|
| Unit - II | Accommodation(Die Wohnung): | 12 |
|------------------|------------------------------------|-----------|

Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative

| | | |
|-------------------|--|-----------|
| Unit - III | Are you Working?(Arbeiten Sie): | 12 |
|-------------------|--|-----------|

Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.

| | | |
|------------------|--|-----------|
| Unit - IV | Clothes and Style(Kleidung und mode): | 12 |
|------------------|--|-----------|

Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative

| | | |
|-----------------|--|-----------|
| Unit - V | Health and Vacation(Gesundheit und Urlaub): | 12 |
|-----------------|--|-----------|

Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – *sollen, müssen, nicht dürfen, dürfen*. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*

Total: 60**TEXT BOOK:**

| | |
|---|---|
| 1 | Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015. |
|---|---|

REFERENCES:

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|---|--|
| 1 | https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware |
| 2 | https://www.dw.com/en/learn-german - Deutsche Welle , Germany's International Broadcaster |



| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|--------------------------------------|
| On completion of the course, the students will be able to | | |
| CO1 | understand letters and simple texts | Remembering (K1) |
| CO2 | assimilate vocabulary on Accommodation and invitation | Understanding (K2) |
| CO3 | comprehend concept of time, telephonic conversation and job-related information | Understanding (K2) |
| CO4 | understand how to do shopping in a German store | Understanding (K2) |
| CO5 | understand body parts and how to plan personal travel | 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 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 1 | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | German Language Level 2 | 5/6/7/8 | HS | 3 | 0 | 0 | 3 |

| | | | | | | | |
|----------|--|--|--|--|--|--|--|
| Preamble | This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations. | | | | | | |
|----------|--|--|--|--|--|--|--|

| | | |
|-----------------|---|----------|
| Unit - I | All about food (Rund Ums Essen): | 9 |
|-----------------|---|----------|

Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'

| | | |
|------------------|---|----------|
| Unit - II | School days (Nach der Schulzeit): | 9 |
|------------------|---|----------|

Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.

| | | |
|-------------------|---|----------|
| Unit - III | Media in everyday life (Medien in Alltag): | 9 |
|-------------------|---|----------|

To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.

| | | |
|------------------|--|----------|
| Unit - IV | Feelings and expressions (Gefühle): | 9 |
|------------------|--|----------|

Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.

| | | |
|-----------------|---|----------|
| Unit - V | Profession and Travel (Beruf und Reisen): | 9 |
|-----------------|---|----------|

To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.

Total: 45**TEXT BOOK:**

| | |
|----|---|
| 1. | Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1-ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015. |
|----|---|

REFERENCES:

| | |
|----|--|
| 1. | Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011. |
| 2. | https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | understand German food style, restaurant and be able express oneself. | Remembering (K1) |
| CO2 | understand German school system and discuss about habits and provide City-Tipps. | Understanding (K2) |
| CO3 | analyze and compare media in everyday life. | Understanding (K2) |
| CO4 | express feelings, describe a city and write blog entries. | Understanding (K2) |
| CO5 | seek and provide information in a professional setup, give directions to others and talk about travel. | 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 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 1 | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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

**18GEO07 - GERMAN LANGUAGE LEVEL 4**

(Offered by Department of Electronics and Communication Engineering)

| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | German Language Level 3 | 5/6/7/8 | HS | 3 | 0 | 0 | 3 |

| | |
|----------|--|
| Preamble | This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations. |
|----------|--|

| | | |
|-----------------|---------------------------|----------|
| Unit - I | Learning (Lernen): | 9 |
|-----------------|---------------------------|----------|

Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn, weil, Konjunktiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ, ab+dativ

| | | |
|------------------|------------------------------|----------|
| Unit - II | Athletic (Sportlich): | 9 |
|------------------|------------------------------|----------|

Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ

| | | |
|-------------------|--|----------|
| Unit - III | Living Together (Zusammen Leben): | 9 |
|-------------------|--|----------|

To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunktiv II- könnte, Subordinate clauses – als and Wenn.

| | | |
|------------------|--|----------|
| Unit – IV | Good Entertainment (Gute Unterhaltung): | 9 |
|------------------|--|----------|

Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ.

| | | |
|-----------------|---|----------|
| Unit - V | Passage of time and Culture (Zeitablauf & Kultur): | 9 |
|-----------------|---|----------|

Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunktiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um...Zu.

Total: 45**TEXT BOOK:**

| | |
|----|--|
| 1. | Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015. |
|----|--|

REFERENCES:

| | |
|----|---|
| 1. | Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011. |
| 2. | https://www.dw.com/en/learn-german - Deutsche Welle, Germany's International Broadcaster |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|--|--------------------------------------|
| CO1 | leverage learning in Workplace, understanding reports and make presentation. | Remembering (K1) |
| CO2 | reciprocate to different situations, make appointment and understand texts. | Understanding (K2) |
| CO3 | handle relationships and respond appropriately to exchange information | Understanding (K2) |
| CO4 | familiarize to various channels of entertainment | Understanding (K2) |
| CO5 | know about various cultural aspects, usage of proverbs and cliches. | 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 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 1 | 3 | | 3 | | |
| CO5 | | | | | | | | 1 | 1 | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | Japanese Language Level 1 | 5/6/7/8 | HS | 4 | 0 | 0 | 4 |

| | | | | | | | |
|-------------------|---|--|--|--|--|--|-----------|
| Preamble | The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form | | | | | | |
| Unit - I | Introduction to groups of verbs: | | | | | | 12 |
| | tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions | | | | | | |
| Unit - II | Introduction to Casual Form: | | | | | | 12 |
| | nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style | | | | | | |
| Unit - III | Express opinions and thoughts: | | | | | | 12 |
| | Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications | | | | | | |
| Unit - IV | Introduction to If clause and remaining Kanjis: | | | | | | 12 |
| | If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis | | | | | | |
| Unit - V | Introduction to giving and receiving with te form and “when, even if” usages: | | | | | | 12 |
| | Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc. | | | | | | |

Total: 60**TEXT BOOK:**

1. “MINNA NO NIHONGO–Japanese for Everyone”, 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, “Try N5”, 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, “Japanese Word Speedmaster”, 2nd Edition, Tankobon Softcover, Japan, 2018.



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | differentiate groups of verbs and its forms | Remembering (K1) |
| CO2 | understand Polite form and Casual form of Japanese | Understanding (K2) |
| CO3 | comprehend personal communication and express greetings | Understanding (K2) |
| CO4 | understand the Kanjis in Japanese Script and If clause | Understanding (K2) |
| CO5 | comprehend concept of “even if”, “when” and job-related information | 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 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO5 | | | | | | | | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | Japanese Language Level 2 | 5/6/7/8 | HS | 3 | 0 | 0 | 3 |

| | | | | | | | |
|--|--|--|--|--|--|--|----------|
| Preamble | The intermediate level of Japanese which provides understanding of all forms of verbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life | | | | | | |
| Unit - I | Introduction to Potential verbs: | | | | | | 9 |
| Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's. | | | | | | | |
| Unit - II | Introduction to Transitive and Intransitive verbs: | | | | | | 9 |
| Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences- Conjunctions-Basic Questions and kanji's. | | | | | | | |
| Unit - III | Introduction to Volitional forms: | | | | | | 9 |
| Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's. | | | | | | | |
| Unit - IV | Introduction to Imperative and Prohibitive verbs: | | | | | | 9 |
| Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's. | | | | | | | |
| Unit - V | Introduction to Conditional form and Passive verbs: | | | | | | 9 |
| Description of Requirement and Speaker's Judgement, Habitual Actions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's. | | | | | | | |

Total: 45**TEXT BOOK:**

| | |
|----|--|
| 1. | "MINNA NO NIHONGO–Japanese for Everyone", 2 nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017. |
|----|--|

REFERENCES:

| | |
|----|--|
| 1. | Margherita Pezzopane, "Try N5", 2 nd Edition, Tankobon Softcover, Japan, 2017. |
| 2. | Sayaka Kurashina, "Japanese Word Speedmaster", 2 nd Edition, Tankobon Softcover, Japan, 2018. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | read and understand BasicVocabularies. | Remembering (K1) |
| CO2 | understand Conversations used in daily life. | Understanding (K2) |
| CO3 | comprehend personal communication and express greetings. | Understanding (K2) |
| CO4 | understand the Kanji's in Japanese Script. | Understanding (K2) |
| CO5 | comprehend Coherent conversations in everyday situations. | 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 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO5 | | | | | | | | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
|--------------------|--|---------|----------|---|---|---|--------|
| Prerequisites | Japanese Language Level 3 | 5/6/7/8 | HS | 3 | 0 | 0 | 3 |

| | | | | | | | |
|--|--|--|--|--|--|--|----------|
| Preamble | The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people. | | | | | | |
| Unit - I | Introduction to Reasoning: | | | | | | 9 |
| Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's. | | | | | | | |
| Unit - II | Introduction to Exchanging of things: | | | | | | 9 |
| Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's. | | | | | | | |
| Unit - III | Introduction to States of an Action: | | | | | | 9 |
| Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's. | | | | | | | |
| Unit - IV | Introduction to Causative Verbs: | | | | | | 9 |
| Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's. | | | | | | | |
| Unit - V | Introduction to Relationship in Social Status: | | | | | | 9 |
| Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's. | | | | | | | |

Total: 45**TEXT BOOK:**

1. "MINNA NO NIHONGO—Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|--|---|--------------------------------------|
| CO1 | read and Understand Relationship of a Person. | Remembering (K1) |
| CO2 | understand Conversations Used in Everyday Activities. | Understanding (K2) |
| CO3 | comprehend Contents at Near Natural Speed. | Understanding (K2) |
| CO4 | understand the Kanji's in Japanese Script. | Understanding (K2) |
| CO5 | comprehend Orally Presented Materials. | 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 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 3 | | |
| CO5 | | | | | | | | 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 | 75 | 25 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | 25 | 75 | | | | | 100 |
| ESE | 25 | 75 | | | | | 100 |

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



18GEO11 - NCC Studies(Army Wing) – I
(Offered by Department of Electrical and Electronics Engineering)

| | | | | | | | |
|-------------------------------|---|--------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | NIL | 5 / 6 | OE | 3 | 0 | 2 | 4 |

| | |
|-----------------|--|
| Preamble | This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training. |
|-----------------|--|

| | | |
|-----------------|---|----------|
| Unit - I | NCC Organisation and National Integration: | 9 |
|-----------------|---|----------|

NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.

| | | |
|------------------|---|----------|
| Unit - II | Basic physical Training and Drill: | 9 |
|------------------|---|----------|

Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION)

| | | |
|-------------------|-------------------------|----------|
| Unit - III | Weapon Training: | 9 |
|-------------------|-------------------------|----------|

Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.

| | | |
|------------------|--|----------|
| Unit - IV | Social Awareness and Community Development: | 9 |
|------------------|--|----------|

Aims of Social service-Variou Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY- Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility

| | | |
|-----------------|------------------------------------|----------|
| Unit - V | Specialized Subject (ARMY): | 9 |
|-----------------|------------------------------------|----------|

Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.

Lecture :45, Practical:30, Total:75

TEXT BOOK:

| |
|--|
| 1. "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014. |
|--|

REFERENCES:

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|---|
| 1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi. |
| 2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi. |
| 3. "NCC OTA Precise", published by DG NCC, New Delhi. |



| COURSE OUTCOMES: | | BT Mapped (Highest Level) |
|---|---|----------------------------------|
| On completion of the course, the students will be able to | | |
| CO1 | display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion. | Applying (K3) |
| CO2 | demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders.. | Applying (K3) |
| CO3 | basic knowledge of weapons and their use and handling. | Applying (K3) |
| CO4 | understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils | Applying (K3) |
| CO5 | acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles. | 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 | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| 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 | - | - | - | - | - | - | - |
| CAT2 | - | - | - | - | - | - | - |
| CAT3 | - | - | - | - | - | - | - |
| ESE | The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks. | | | | | | |



18GEO12 - NCC STUDIES (AIR WING) – I
(Offered by Department of Information Technology)

| | | | | | | | |
|-------------------------------|---|--------------|-----------------|----------|----------|----------|---------------|
| Programme & Branch | All BE/BTech Engineering and Technology Branches | Sem. | Category | L | T | P | Credit |
| Prerequisites | Nil | 5 / 6 | OE | 3 | 0 | 2 | 4 |

| | | | | | | | |
|-----------------|---|--|--|--|--|--|--|
| Preamble | This course is designed especially for NCC Cadets. This course will help develop character , camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets. | | | | | | |
|-----------------|---|--|--|--|--|--|--|

| | | |
|-----------------|---|----------|
| Unit – I | NCC Organization and National Integration: | 9 |
|-----------------|---|----------|

NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honors’ and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF-Indo-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.

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| Unit – II | Drill and Weapon Training: | 9 |
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Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing (WITH PRACTICE SESSION).

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| Unit – III | Principles of Flight: | 9 |
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Laws of motion-Forces acting on aircraft–Bernoulli’s theorem-Stalling-Primary control surfaces – secondary control surfaces-Aircraft recognition.

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| Unit - IV | Aero Engines: | 9 |
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Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.

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| Unit – V | Aero Modeling: | 9 |
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History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control line models-Radio Control Models-Building and Flying of Aero-models.

Lecture :45, Practical30, Total:75

TEXT BOOK:

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| 1 | “National Cadet Corps- A Concise handbook of NCC Cadets” by Ramesh Publishing House, New Delhi,2014. |
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REFERENCES:

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| 1 | “Cadets Handbook – Common Subjects SD/SW” by DG NCC, New Delhi. |
| 2 | “Cadets Handbook – Specialised Subjects SD/SW” by DG NCC, New Delhi. |
| 3 | “NCC OTA Precise” by DGNCC, New Delhi. |



| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
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| CO1 | display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion. | Applying (K3) |
| CO2 | demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling | Applying (K3) |
| CO3 | illustrate various forces and moments acting on aircraft | Applying (K3) |
| CO4 | outline the concepts of aircraft engine and rocket propulsion | Applying (K3) |
| CO5 | design, build and fly chuck gliders/model airplanes and display static models. | 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 | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| 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 | - | - | - | - | - | - | - |
| CAT2 | - | - | - | - | - | - | - |
| CAT3 | - | - | - | - | - | - | - |
| ESE | The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks. | | | | | | |