DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE.

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(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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National Education Policy (NEP) 2020 for the session 2025-26

For

Second Year B.Tech. Food Technology and Management (Affiliation Institutes)

With effect from the Academic Year 2025-2026

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE.

B. Tech (Food Technology and Management)

A. Program Educational Objectives (PEOs)

Graduates will able to–

1. Learning objectives for Food Technology and Management focus on developing scientific, managerial, and practical skills to ensure food safety, quality, and sustainability throughout the value chain.

2. Understanding food chemistry and processing, implementing quality assurance and management systems, developing new food products, managing food supply chains, adhering to food laws and regulations, and fostering professional skills like critical thinking and entrepreneurship to solve industry problems.

3. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economic and multidisciplinary contexts.

4. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes (POs)

Engineering Graduate will be able to–

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

2. **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.

3. **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.

4. **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.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **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.

7. **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.

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

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

10. **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.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply the setoone "sown work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **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.

C. Program Specific Outcomes (PSO)

Food Technology and management graduates will specifically be able to do in their field.

1. Demonstrate the ability to apply fundamental knowledge of mathematics, science and engineering to identify, formulate, analyze, investigate, and design complex problems in the field of electrical engineering.

2. Demonstrate ability to apply the appropriate techniques and modern engineering tools to manage and solve complex electrical engineering projects, adapt in multi- disciplinary environments, and engage in lifelong learning.

3. Able to propose & implement engineering solutions in the context of the environment, society, economy, and professional ethics and have good communication skills.

Department of Food Technology and Management

Credit Framework under Four-Years UG Engineering Programme with Multiple Entry and Multiple Exit options:

- The Four-year Bachelor‟s Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning from different institutions.

- The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG Programme with multi pleentry and multiple exit options are as given below:

Credit Framework

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	One Year UG Certificate in Engg./ Tech.	40	44	2	1
5.0	Two Years UG Diploma in Engg./ Tech.	80	88	4	2
5.5	Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.)	120	132	6	3
	4-Years Bachelor's degree				

- There are multiple exit options at each level. Student will be given a specific Qualification mentioned in the table depending on the level at which he/she decide to have an exit. Ex. If a student decides to exit after completion of two years (level 5.0) of the program, he will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can rejoin the program with the multiple entry option at the level next where he/she chose to exit previously. (Student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit).
- Minimum credit requirements of each level are mentioned in the credit framework table.
- There are 4distinct options available at level 6.0.
- First one is basic level 6.0 option where minimum 160-maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.

  Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech in Food Technology and Management Engineering with Computer Engineering**" (160-176 credits) enables

students to take up five-six or required additional courses of 14 credits in thediscipline other than Food Technology and Management Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Food Technology and Management Engineering with Computer Engineering**" (160-176 credits) student is supposed to take up 50% or more courses to complete the 50% or more credits (from assigned 14 credits) from **Computer Engineering minor bucket**. The remaining courses to complete the assigned 14 credits can be covered from other discipline's minor buckets.

- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18-20 extra credits). These three options are given below:

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	(B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor	160	176	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors with Research and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors)	180	194	8	4

- Level 6.0: The **Bachelor's Engineering Degree with Honours**in chosen Major Engg./ Tech. Discipline i.e. in Food Technology and Management with Honours with Multidisciplinary Minor (180-194 credits) enables students of Food Technology and management Engineering to take up five-six additional courses of 18 to 20 credits in the Food Technology and Management discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18- 20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for the duration off Four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e. in Food Technology and Management Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Food Technology and management Engineering to take up a research project of 18 to 20 credits in the Food Technology and Management Engineering discipline distributed over semesters VII to VIII. **Student must have CGPA equal to or greater than 7.5 at the end of sixth semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B. Tech in Food Technology and Management Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Food Technology and Management Engineering (for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Computer Engineering discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Computer Engineering**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Computer Engineering** discipline distributed over semesters III to VIII, which are over and above the min.160-max.176 Credits. The decision regarding the mechanism of distribution of these 18-20creditsoversemesters III to VIII, prescribed for the duration of four years will be taken by Academic Authoritiesof University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Students need to follow the Semester-wise Credit distribution structure for Four Year UG Engineering Program as prescribed in the table given above.
- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.
- Multidisciplinary courses (MDM) and Open Elective (OE) courses can be chosen from the MDM and OE Buckets depending on students choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- Students can complete 40% of the courses through online platforms like NPTEL/SWAYAM. The NPTEL SWAYAM course content should be at least 80% similar to the course content in the syllabus.

Semester-wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

General Rules and Regulations

1. The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session

may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

Registration:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full- Time Student of a UG/PG Programme:

   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATIONINABSENTIAwillbeallowedonlyinexceptionalcaseswiththeapproval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:
   i) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
   ii) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   iii) Paid all required advance payments of the Institute and hostel for the current semester;
   iv) Not been debarred from register in gon any specific ground by the Institute.

Evaluation System:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2023-24,from I year B. Tech.

Percentage of marks	Letter Grade	Grade Point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awarded based on CGPA of all eighth semester of B. Tech Program.

CGPA for pass is minimum 5.0	
CGPA up to <5.50	Pass class
CGPA≥ 5.50&<6.00	Second Class
CGPA≥ 6.00&<7.5	First Class
CGPA >7.50	Distinction
[Percentage of Marks=CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

Mid Semester Exam (MSE)Marks	20
Continuous Assessment Marks	20
End Semester Examination (ESE)Marks	60

4. A total of 100 Marks for each practical course are distributed as follows

1.	Continuous Assessment Marks	40

2.	End Semester Examination (ESE) Marks	60

- It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, M. Tech to score a minimum of 45 marks out of 100 with a minimum of 20marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech starting from Academic Year 2023-24

5. Description of Grades

EX Grade: An EX grade stands for outstanding achievement.
EE Grade: The EE grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the

current semester of admission only and his/her performance will be awarded with EE grade only.

If any of the students remain absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

FF Grade: The FF grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded „FF" grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance

a. Semester Grade Point Average(SGPA)

The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} ci\ gi]}{[\sum_{i=1}^{n} ci]}$$

Where

"n" is the number of subjects for the semester,

"c_i" is the number of credits allotted to a particular subject, and

"g_i"is the grade-points awarded to the student for the subject based on his performance as per the above table.

SGPA will be rounded off to the second place of decimal and recorded as such.

b. Cumulative Grade Point Average (CGPA):

An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} ci\ gi]}{[\sum_{i=1}^{m} ci]}$$

Where,

"m" is the total number of subjects from the first semester onwards up to and including the semester S,

"ci" is the number of credits allotted to a particular subject, and

"gi" is the grade-points awarded to the student for the subject based on his/ her performance as per the above table.

CGPA will be rounded off to the second place of decimal and recorded as such.

7. Attendance Requirements:

a. All students must attend every lecture, tutorial and practical classes.

b. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

c. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

d. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

8. Transfer of Credits:

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a. 20% of the total credit will be considered for respective calculations.

b. Credits transferred will be considered for overall credits requirements of the programme.

c. Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d. A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e. A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f. Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g. In exceptional cases, the students may opt for higher credits than the prescribed.

B. Tech Second Year Food Technology and management

(Affiliation Institutes)

SEMESTER III											
Sr. No.	**Course Code**	**Course Title**	**Teaching Scheme**			**Marking Scheme**			**Total Marks**	**CR**	**ategory**
			L	**T**	**P**	**CA**	**ISE**	**ESE**			
1	25AF1000BS301	Engineering Mathematics-III	3	0	0	20	20	60	100	**3**	**BSC**
2	25AF1504PC302	Food Chemistry	3	0	0	20	20	60	100	**3**	**PC**
3	25AF1504PC303	Food Microbiology	3	0	0	20	20	60	100	**3**	**PC**
4	25AF1504PCL304	Food Chemistry and Food Microbiology Lab	0	0	4	60	0	40	100	**2**	**PC**
5	25AF1OTHOEM05D 25AF1OTHOEM05E 25AF1SCIOEM05M	**Open Elective-I** A- Fluid Mechanics B- IOT **C-** Renewable Energy Sources	3	0	0	20	20	60	100	**3**	**OE**
6	25AF1504MD306	**MDM Bucket** **(**Unit Operations in Food Processing)	2	0	0	20	20	60	100	**2**	**MDM**
7	25AF1000HM307B	Innovation and Entrepreneurship	2	0	0	20	20	60	100	**2**	**HSSM**
8	25AF1504CP308	Community engineering Project/Field Project	0	0	4	60	0	40	100	**2**	**CEP**
9	25AF1UHVVE310	Universal Human Values	3	0	0	20	20	60	100	**3**	**VEC**
Total			**19**	**0**	**8**				**900**	**23**	

NOTE:*Refer to Multidisciplinary Minor Bucket (MDM)

L - Lecture,**T-** Tutorial,**P / PR** - Practical, **CA** - Continuous Assessment, **TH** - Theory, **MSE -** Mid Semester Examination, **ESE** - End Semester Examination, **CR** - Credit

BSC/ESC: *Basic Science Course/ Engineering Science Course,* ***PC:*** *Programme Core Course,****OE:*** *Open Elective Other than particular programme,* ***MDM:*** *Multidisciplinary Minor Bucket,* ***HSSM:*** *Humanities Social Science and Management,* ***CEP-*** Community engineering Project, ***VEC:*** *Value Education Course*

SEMESTER IV											
Sr. No.	**Course Code**	**Course Title**	**Teaching Scheme**			**Marking Scheme**			**Total Marks**	**CR**	**Category**
			L	**T**	**P**	**CA**	**MSE**	**ESE**			
1	25AF1504PC401	Principles of Food Processing	3	0	0	20	20	60	100	**3**	**PCC**
2	25AF1504PC402	Food Engineering-I	3	0	0	20	20	60	100	**3**	**PCC**
3	25AF1504PC403	Food Biochemistry and Nutrition	3	0	0	20	20	60	100	**3**	**PCC**
4	25AF1504PCL404	Food Processing and Food Engineering (Lab)	0	0	4	60	0	40	100	**2**	**PCC**
5	25AF1OTHOEM05G 25AF1OTHOEM05H 25AF1OTHOEM05I	**Open Elective II** ***A-*** *Heat and mass transfer,* ***B-*** *Information and Communication Technology,* **C-** *Chemical Reaction engineering*	3	0	0	20	20	60	100	**3**	**OE**
6	25AF1504MD406	**MDM Bucket* (**Technology of Spices and Plantation crops)	3	0	0	20	20	60	100	**3**	**MDM**
7	25AF1COIVE407	Constitution of India	2	0	0	50	0	0	50	**AU**	**VEC**
8	25AF1000VE408A	Life of Chatrapati Shivaji Maharaj	1	0	0	50	0	00	50	**1**	**VEC**
9	25AF1000HM409	Patents and IPR	2	0	0	20	20	60	100	**2**	**Ent**
10	25AF1000AE410A 25AF1000AE410B 25AF1000AE410C	A)Modern Indian Language(Marathi) B)Modern Indian Language(Hindi) C)Modern Indian Language (Sanskrit)	2	0	0	50	00	50	100	**2**	**HSSM**
11	25AF1504PC411	Development of laboratory skills	2	0	0	20	20	60	100	**2**	**VSEC**
		Total	**23**	**0**	**4**				**1000**	**24**	

NOTE:*Refer to Multidisciplinary Minor Bucket (MDM)

L - Lecture, **T-** Tutorial, **P / PR** - Practical, **CA** - Continuous Assessment, **TH** - Theory, **MSE -** Mid Semester Examination, **ESE** - End Semester Examination, **CR** - Credit

BSC/ESC: *Basic Science Course/ Engineering Science Course,* ***PC:*** *Programme Core Course,****OE:*** *Open Elective Other than particular programme,* ***MDM:*** *Multidisciplinary Minor Bucket,* ***HSSM:*** *Humanities Social Science and Management,* ***CEP-*** Community engineering Project, ***VEC:*** *Value Education Course*

SEMESTER V												
Sr. No.	**Course Code**	**Course Title**	**Teaching Scheme**			**Marking Scheme**			**Total Marks**	**CR**	**Category**
			L	**T**	**P**	**CA**	**MSE**	**ESE**			
1	26AF1504PC501	Food Business Management	3	0	0	20	20	60	100	**3**	**PCC**
2	26AF1504PC502	Dairy technology	3	0	0	20	20	60	100	**3**	**PCC**
3	26AF1504PC503	Cereals, Legumes and Oil seed Technology	3	0	0	20	20	60	100	**3**	**PCC**
4	26AF1504PCL504	Dairy technology(lab)	0	0	4	60	0	40	100	**2**	**PCC**
5	26AF1504PCL505	Cereals, Legumes and Oil seed technology (Lab)	0	0	4	60	0	40	100	**2**	**PCC**
6	26AF1504MD506	**MDM Bucket*** (Food Supply chain Management)	3	0	0	20	20	60	100	**3**	**MDM**
7	26AF1504PC507A 26AF1504PC507B 26AF1504PC507C	**Elective I** A- Food plant design and layout B- Cold Chain Management C- Beverage Technology	3	0	0	20	20	60	100	**3**	**Elective**
8	26AF1504PC508A 26AF1504PC508B 26AF1504PC508C	**Program elective-I** A- Spices and plantation crop Technology B- Digital Technology in food Processing C- Extrusion Technology	3	0	0	20	20	60	100	**3**	**Program Elective**
		Total							**800**	**22**	

List of Multidisciplinary Minor (MDM) Courses offered by Department of Food Technology and Management

Sem	CourseTitle	Teaching Scheme			EvaluationScheme				
		L	T	P	CA	MSE	ESE	Total	No.of Credits
III	Unit Operations in Food Processing	2	-	-	20	20	60	100	2
IV	Technology of Spices and Plantation crops	3	-	-	20	20	60	100	3
V	Food Supply chain Management	3	-	-	20	20	60	100	3
VI	Food By-products and waste utilization	3	-	-	20	20	60	100	3
VII	Applied Statistics	3	-	-	20	20	60	100	3
	Total	**14**	**-**	**-**	**100**	**100**	**300**	**500**	**14**

Semester III

25AF1000BSC301Engineering Mathematics-III

Teaching Scheme	Examination Scheme
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.
2. To understand and study the Physics principles behind the developments of engineering materials.

Course Outcome:

After completion of this course, students will be able to:

CO1. Solve higher order linear differential equations using appropriate techniques for modeling and analyzing electrical circuits.

CO2. Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.

CO3. Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO4. Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.

CO5. Analyze conform al mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit	Contents	Hrs.
1	**Laplace Transform:** Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms -Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n , scale change property, transforms of functions divided byt, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions-periodic function, Heaviside-unit step function, Dirac delta ,function.	9
2	**Inverse Laplace Transform:** Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.	9
3	**Fourier Transform:** Definitions–integral transforms; Fourier integral theorem (with out proof); Fourier sine and cosine integrals; Complex form of Fourier integrals ; Fourier sine and cosine trans forms; Properties of Fourier trans forms; Par seval ‟sidentity for Fourier Transforms.	9

4	**Partial Differential Equations and Their Applications:** Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange‟s linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation and one dimensional wave equation.	**9**
5	**Functions of Complex Variables:** Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form ;Cauchy‟s integral theorem; Cauchy‟s integral formula; Residues; Cauchy‟s residue theorem (All theorems without proofs).	**9**
	Total	**45**

TEXT BOOKS:

1. Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H.K. DasandEr. RajnishVerma,S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B.B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw-Hill Publications, New Delhi.

REFERENCE BOOKS*:*

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O ‟Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C.R. Wylie & L.C. Barrett, Tata Mcgraw- Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr.B.B.Singh, Synergy Knowledge ware, Mumbai.Integral Transforms by I.N. Sneddon, Tata McGraw-Hill, New York.

25AF1504PC302 FOOD CHEMISTRY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. Food chemistry course objectives include understanding the chemical composition and properties of food constituents (carbohydrates, proteins, lipids, vitamins, etc.), their physio-chemical changes during processing and storage, and how these affect food quality, safety, and nutrition.
2. Students also learn to apply analytical techniques to identify and quantify these components, understand food additives and contaminants, and relate chemical principles to food industry applications and problem-solving.

Course Outcomes

After completion of this course, students will be able to

1. Students will be able to describe and characterize the chemical, structural, and functional properties of key food components like proteins, lipids, and carbohydrates.
2. They will learn about the chemical composition and properties of major food groups, such as

meat, dairy, eggs, and plant products.

3. Course outcomes include discussing the structure, function, and stability of vitamins, minerals, and bio-active compounds.
4. Students identify and explain the chemical reactions responsible for food deterioration and spoilage.

Units	TOPICS	Hrs,
1	**Introduction:** Nature Scope and development of food chemistry, role of food chemist. **Moisture in foods**: Role and type of water in foods; Functional properties of water; role of water in food spoilage; Types of water, Water activity and sorption isotherm; Molecular mobility and foods stability	**7**
2	**Carbohydrates:** Definition, classification and nomenclature. General properties(physical and chemical) of sugar. Reducing and non-reducing sugars. Common monosaccharides, di-saccharides and poly-saccharides. Chemistry of starch, cellulose, gums and mucilage. Crude fibre. Changes of carbohydrates on cooking, modification of carbohydrates,	**8**
3	**Protein:** Classification. Amino acid sequence in proteins, pleated sheet and helix structure of proteins. Molecular weight of proteins and ultra-centrifuge separation and purification of proteins. Physical and chemical properties of amino acids. Food proteins and their characteristics. Protein denaturation, modification of protein	**8**
4	**Lipids:** Classification. Physical and chemical properties. Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types,	**7**
5	**Vitamins and minerals:**Occurrence and chemistry, Losses during processing and storage. **Flavors and colorants:** Chemical compounds responsible for food flavors, odors, and colors, including natural and synthetic sources.	**8**
6	**Food Additives:** Classification, Functions and chemical properties of various food additives. **Contaminants and Toxins:** Identification and analysis of undesirable substances in food.	**7**
	Total	**45**

TEXT BOOKS:

1. Food Chemistry, L.H. Meyer, C.B.S. Publishers, Delhi, 1987
2. Food chemistry by Fenamma : 3rd Ed. Marcel Dekker, Inc., New York, USA. 1996
3. Principles of Food Chemistry by DeMan JM, AVI Publishing Co Inc., 1976
4. Essentials of Food and Nutrition By Swaminathan M., Vol. II, Ganesh & Co., 1974

REFERENCE BOOKS:

1. Food Chemistry by H.-D. Belitz, W. Grosch and P. Schieberle, 4th Ed. Springer-Verlag Berlin Heidelberg. 2009
2. Food Chemistry by David Newton, Facts on File, Inc. New York, ISBN: 0816052778
3. Introductory Food Chemistry. Comstock Publishing Associates by John W. Brady,Cornell University Press, Ithaca, USA. 2013

25AF1504PC303	FOOD MICROBIOLOGY	
Teaching Scheme Lectures Theory:03Hr/Week Credit:03		**Examination Scheme** Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. Food microbiology course objectives include developing a deep understanding of microbial roles in food spoilage and safety, identifying foodborne pathogens and contaminants, applying food preservation techniques to extend shelf life.
2. Use of microbiological methods to ensure food safety and quality control.
3. Students also learn to analyze the factors influencing microbial growth, control undesirable microorganisms, and integrate knowledge of food safety regulations and management systems into their practice.

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

1. Students learn to identify and analyze various foodborne microorganisms and spoilage microbes using different methods, including isolation and detection techniques.
2. Courses focus on understanding the types of food spoilage, the effect of factors like temperature on spoilage, and the various methods and techniques used to preserve food.
3. Students gain knowledge about foodborne illnesses, including infections and intoxications, and the procedures for investigating and preventing them.
4. Outcomes include learning microbiological quality control schemes and management systems, such as Food Safety Management Systems (FSMS).

Unit	Topic	Hrs.
1	Introduction to Biology and its branches. Relevance of Microbiology in preservation of foods. Composition of microbial world. Branches of Microbiology. Water Microbiology. Management of toxic industrial wastes. - Physical and chemical methods of control of microorganisms. Microbial integrations. Food industry waste as fermentation substrate.	**8**
2	Morphology and physiology of virus, bacteria, yeast, molds and algae. Growth, nutrition and reproduction. Isolation and identification of microorganisms. Pure cultures and their characteristics. Sterilization. Maintenance of cultures. Culturing techniques: Batch culturing, Continuous culturing, Fed-batch culturing. Factors affecting growth.	**8**
3	Mutations: types of mutations, mutagenesis, mutation rate, repair of mutations, phenotypes of bacterial mutants and designation of bacterial Mutation	**7**
4	Destruction of microorganisms: physical agents and chemical agents, chemotherapeutic agents and chemotherapy, characteristics of antibiotics and mode of action of antibiotics	**8**
5	Contamination of foods by microorganisms from natural sources, spoilage of different foods – general principles, causes and spoilage and growth of microorganisms in foods. Food intoxicants, mycotoxins. Cood poisoning and food infections-investigation of a food borne disease outbreak. Methods of food Preservation.	**7**
6	General principles of food hygiene in food handling, personnels, food processing plants. Impurities in water and its treatment. Sanitation facities and procedures in food processing plants.	**7**
	Total	**45**

TEXT BOOKS:

1. Food Microbiology, by Frazier, 4th Ed. Tata McGraw-Hill Education, New Delhi. 1987

2. Modern Food Microbiology, by James M. Jay, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA. 2002
3. Prescott, Herley, Klein : Microbiology, 2nd Edition, Tata McGraw Hill
4. Microbiology: Pelczar, Chan and Krieg, 5 th Ed. Tata McGraw-Hill New Delhi
5. Fundamentals of Microbiology: Jeffrey C.P., Elsevier Publication, London 2017

REFERENCE BOOKS:

1. Food Microbiology By Martin R. Adams and Maurice O. Moss, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK. 2008
2. Basic Food Microbiology By George J. Banwart, 2nd Ed. Chapman & Hall, New York, USA. 1989

25AF1504PCL304 FOOD CHEMISTRY AND FOOD MICROBIOLOGY (Lab)

Teaching Scheme	**Examination Scheme**
Practical :04Hr/Week, Credit: 02	Internal Assessment:60 Marks Mid-Sem Exam: 00 Marks End Sem Exam: 40 Marks

	Experiments	**Hrs**
S. No	**Experiments (Food Chemistry)**	**4**
1	Laboratory sample preparation	**4**
2	Determination of moisture content of food samples	**4**
3	Determination of ash content of food samples	**4**
4	Determination of Oil/fat content of food samples	**4**
5	Determination of carbohydrate/starch content of food samples	**4**
6	Determination of Protein content of food samples	**4**
7	Determination of crude fiber content of food samples	**4**
	Experiments (Food Microbiology)	**4**
8	Introduction to equipments commonly used in microbiology laboratory	**4**
9	Use of microscopic techniques for identification, viable count and size measurement of microorganisms	**4**
10	Sterilization of glass wares used in microbiology laboratory	**4**
11	Preparation of culture media	**4**
12	Isolation of microorganisms (Streak plate, pour plate techniques)	**4**
13	Different staining techniques (Gram's staining, spore staining)	**4**
14	Microbial examination of water, air and food utensils	**4**
15	Microbial examination of food (Bread, dairy products)	**4**
	Total	**60**

TEXT BOOKS/ REFERENCE BOOKS:

1. Food Chemistry, L.H. Meyer, C.B.S. Publishers, Delhi, 1987
2. Food chemistry by Fenamma : 3rd Ed. Marcel Dekker, Inc., New York, USA. 1996
3. Principles of Food Chemistry by DeMan JM, AVI Publishing Co Inc., 1976
4. Essentials of Food and Nutrition By Swaminathan M., Vol. II, Ganesh & Co., 1974
6. Food Microbiology, by Frazier, 4th Ed. Tata McGraw-Hill Education, New Delhi. 1987
7. Prescott, Herley, Klein : Microbiology, 2nd Edition, Tata McGraw Hill
8. Microbiology: Pelczar, Chan and Krieg, 5 th Ed. Tata McGraw-Hill New Delhi
9. Fundamentals of Microbiology: Jeffrey C.P., Elsevier Publication, London 2017

AF1OTHOEM05D	FLUID MECHANICS	
Teaching Scheme Lectures Theory:3Hr/ Week Credit:03		**Examination Scheme** Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To understanding of basic physics of fluids.
2. To gain knowledge to calculate and design engineering applications involving fluid.
3. To understanding of analyzing flow systems in terms of mass, momentum, and energy balance.

Course Outcomes:

After completion of this course,

CO1: Students will be able to understand and apply fundamental principles of fluid properties, pressure, and flow; analyze and solve problems involving fluid statics, dynamics, and conservation laws (mass, momentum, energy)

CO-2: Explain and apply theories of laminar and turbulent flow in pipes and boundary layers;

CO-3: Design or evaluate engineering applications such as pipe flow systems and pumps.

	Course Content	Hrs
Unit 1:	Fluid Properties and Fluid Statics: Fluid Properties: Definition of fluid, Fluid as a continuum, Properties of fluid, Viscosity, Types of fluid, Compressibility, Surface tension, Capillarity and vapor pressure. Fluid Statics: Pascal's law, Hydrostatic law of pressure, Total Pressure, Centre of Pressure, Buoyancy, Meta center, Condition of Equilibrium of floating and submerged bodies	**10**
Unit 2:	Fluid Kinematics, Eulerian and Langragian approach of fluid flow, Types of flow, Definition of steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Compressible, incompressible, rotational, ir-rotational, flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream, function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Uniform, non-uniform, Compressible, incompressible.	**10**
Unit 3:	Fluid Dynamics, Euler's equation, Bernoulli's equation along a streamline for incompressible flow, Practical, applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.	**7**
Unit 4:	Forces on Immersed Bodies and Boundary Layer Theory, Forces on Immersed Bodies: Lift and Drag, Drag on a flat plate and on aerofoil. Types of drags, Development of lift. (Magnus effect) stalling condition of aerofoil.	**9**
Unit 5:	Dimensional analysis, Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers.	**9**
	Total	**45**

Text Books:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition, 1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5th edition.

3. Fluid Mechanics and Hydraulic Machines, Dr. R. K. Bansal, Laxmi Publication, Delhi, 2005

Reference Books:

1. V. L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9th edition, 1998.
2. S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2nd edition, 2003.

25AF1OTHOEM05E INTERNET OF THINGS

Teaching Scheme	**Examination Scheme**
Lectures Theory:3Hr/ Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To develope practical skills to design, build, and manage connected systems, including understanding basic electronics, programming microcontrollers (like Arduino) and microprocessors (like Raspberry Pi),
2. To Implement wireless communication protocols, using cloud platforms for data management, and developing solutions for real-world problems such as home automation and smart infrastructure

Course Outcomes:

After completion of this course, students will be able to learn,

1. Identify and troubleshoot electronic components, assemble circuits on breadboards, use measurement devices, and program microcontrollers like Arduino using embedded C to interface with sensors and actuators.
2. Build low-cost embedded systems and design basic networks for IoT solutions.
3. Develop proficiency in embedded C for microcontrollers and Python for Raspberry Pi-based IoT applications.
4. Understand and utilize wireless IoT technologies like Node MCU and concepts like TCP/IP modeling.
5. Grasp the fundamentals of cloud platforms for deploying and managing IoT applications.

Course Content

Unit 1:	IoT and Cloud Computing: Introduction, Physical design of IoT, Logical design of IoT, IoT enabling technologies, Domain specific IoTs, IoT design methodology, logical design, IoT physical devices (such as Raspberry Pi, pcDuino, Beaglebone black, Cubieboard), Introduction to cloud computing: cloud models, cloud service examples,cloud-based services & applications, Cloud service and platform	**9**
Unit 2:	Applied Machine to Machine Communication, Introduction to M2M, Description of M2M Market, Segments/Applications – Automotive, Smart Telemetry, Surveillance and Security, M2M Industrial Automation, M2M Terminals and module.	**9**

Unit 3:	Information Systems in Manufacturing, Manufacturing organizations, management, and the networked enterprises, Globalization challenges and opportunities, Dimensions of Information systems, Approaches to study information system, Technical and Behavioral approach, Information Technology Infrastructure.	**9**
Unit 4:	Introduction to Smart Manufacturing, Introduction; Demand-Driven and Integrated Supply Chains; Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations); Real Time, Sustainable Resource Management (intelligent energy demandmanagement, production energy optimization and reduction of GHG), Online Predictive, Modelling, Monitoring, and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes.	**9**
Unit 5:	Privacy, Security and Governance for Internet of Things, Introduction, Overview of Governance, Privacy and Security Issues, Security, Privacy and Trust in IoT- Data-Platforms for Smart manufacturing, First Steps Towards a Secure Platform, Data Aggregation forthe IoT in Smart manufacturing.	**9**
	Total	**45**

TEXT BOOKS:

Internet of Things, A Hands-on Approach, Bahga and V. Madisetti, Create Space Independent PublishingPlatform, 1st edition, 2014, ISBN: 978-0996025515.

REFERENCE BOOKS:

1. Cloud Computing, A hands-on approach, Bahga and V. Madisetti, Create Space Independent PublishingPlatform, 1st edition, 2013, ISBN: 978-1494435141
2. M2M communications: A systems approach, D. Boswarthick, O. Elloumi, and O. Hersent,Wiley, 1st edition, 2012, ISBN: 978-1119994756
3. Introduction to Mechatronic Design, J. Edward Carryer, et al.,Prentice Hall, 1st edition,2010, ISBN: 978-8131788257.
4. Management Information Systems, K. Laudon and J. Laudon,14th edition, Pearson Higher Education,2016, ISBN: 9780136093688.

25AF1SCIOEM05M RENEWABLE ENERGY SOURCES

Teaching Scheme Lectures Theory:3Hr/ Week Credit:03	**Examination Scheme** Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To understandenergy systems, analyzing various renewable sources like solar, wind, and biomass, evaluating their environmental and economic aspects,
2. To assess resource potential, and developing solutions for energy challenges to promote sustainable development and grid integration

Course Outcomes:

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

CO1 Explain the difference between renewable and non-renewable energy
CO2 Describe working of solar collectors
CO3 Explain various applications of solar energy
CO4 Describe working of other renewable energies such as wind, biomass, nuclear

Unit	Course Content	Hrs

Unit 1:	Solar Energy Energy resources, Estimation of energy reserves in India, Current status of energy conversion Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.	**10**
Unit 2:	Solar Collectors Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC. Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.	**11**
Unit 3:	Solar Energy Applications Air/Water heating, Space heating/cooling, solar drying, and solar still, Photo-voltaic conversion.	**6**
Unit 4:	Wind Energy and Biomass Introduction to wind energy, Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and Introduction to biomass resources, Location of plants, Biomass conversion process.	**10**
Unit 5:	Other Renewable Energy Sources Tidal, Geo-thermal, OTEC, hydro-electric, Nuclear energy	**8**
Total		**45**

TEXT BOOKS:

1. Chetan Singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, 2008.

REFERENCE BOOKS:

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw-Hill Publications, New Delhi,1992.
2. G. D. Rai, "Solar Energy Utilization", Khanna Publisher, Delhi,1992.

25AF1504MD306 UNIT OPERATIONS IN FOOD PROCESSING (MDM)

Teaching Scheme: **Lecture: 2hrs/week** **Credits: 02**	**Examination Scheme:** Continuous Assessment: 20 Marks MidSemesterExam:20Marks EndSemesterExam:60Marks

Course Objectives:

1. To enable students to apply engineering principles to food processing,
2. To understand and use various food processing equipment, analyze and select appropriate method for different food materials,
3. To design and modify processing lines to improve product quality and efficiency.

Course Outcomes:

After completion of this course, Students will understand

1. The physical, mechanical, and textural properties of various food materials.
2. They will be able to describe the chemical composition of food and relate it to its functional properties.
3. Students will be able to apply the principles of sieving, filtration, and centrifugal separation to separate solids, liquids, and gases in food processing.
4. They will understand the concepts and equipment for particle size reduction in food products.
5. Students will learn about agitation, mixing, and conveying of food materials, including liquids and solids.
6. Students will understand the principles and applications of various mechanical operations such as drying, heating, and freezing of food.

Unit	Course content	Hrs
UNIT- 1	**Size reduction:** Benefits, classification, sieve/screen analysis, principle and mechanisms of comminution of food Size reduction equipment: Principal types, hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, colloid mill, cutting machines (slicing, dicing, shredding, pulping)	**8**
UNIT- 2	**Mixing:** Theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers),	**6**
UNIT- 3	**Motion of particle through a fluid:** Stoke's Newton's law. Free and hindered setting. Setting tank and double cone classifiers, Batch and continuous thickeners, Settling chamber, cyclone, filter bag and electrostatic precipitators.	**6**
Unit -4	**Mechanical Separation**: Theory, Screening: Stationery screens, Grizzlies, Trommel and Vibrating screens. Mechanical Separations liquids by centrifugation, clarifiers, desludging machines Filtration: theory of filtration, rate of filtration, pressure drop during filtration, applications. Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids	**8**
Unit -5	**Centrifugation:** Tubular bowl centrifuge, disk centrifuge and batch basket centrifuge. **Fluidization:** Conditions for fluidization: Aggregate and particulate fluidization. Ergun's and Carman-Kozeny equations **Distillation:** Principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation, fractional distillation, steam distillation, distillation of wines and spirits	**10**
Unit -6	**Thermal Processing of foods:** (blanching, Pasteurization, Aseptic processing, Sterilization, baking, Cooking, evaporation, crystallization, etc). and non-thermal Processing of foods (Freezing,Freeze drying, vacuum drying, irradiation, etc)	**7**
	Total	**45**

TEXT BOOKS/ REFERENCE BOOKS:

1. Mc Cabe, Warren L., Smith, Juluain C. and Harroit, Peter ; Unit Operations of Chemical Engineering, 5th Edition, Mc Graw Hill Int. ed (Chemical Engineering Series) Mc Graw Hill Book Company, New York, 1993.
2. Foust, Alan S., Wenseli, Leonard A., Clump, Curtis W., mans, Louis and Anersen, L.Bryce ; : Principles of Unit Operations, Wiley International Edition, John Wiley & Sons Inc., New York.
3. Coulson, J.M. and Richardson, J.F. ; Unit Operations (Volume 2 of Chemical Engineering) New York: Mc Graw – Hill Book Co;, Inc.
4. Gupta, Santosh K. ; Momentum Transfer Operations, Tata McGraw-Hill, New Delhi.
5. Badger, Walter L. and Banchero, Julius T. : Introduction to Chemical Engineering, Mc Graw-Hill, Kogakusha Ltd., New Delhi.
6. Brown, C.G.: Unit Operations, John Wiley & Sons, Inc., New York.
7. Chattopadhyay, P. : Unit Operations of Chemical Engineering, Vol. I, Khanna Publishers, New Delhi.

25AF1000HM307B	INNOVATION AND ENTREPRENEURSHIP
Teaching Scheme Lectures Theory:02Hr/ Week Credit:02	**Examination Scheme** Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To cultivate an entrepreneurial mindset and leadership qualities through real-world simulations, role-play, and industry case studies.
2. To develop skills in problem and customer identification using design thinking principles, market analysis, and trend assessment.
3. To gain proficiency in solution design, prototyping, and iteration to create a strong value proposition and align solutions with customer needs.
4. To understand and apply foundational business models, financial planning, and go-to-market strategies, including lean canvas and startup funding options.

Course Outcome:

After completion of this course, students will be able to:

CO1.Developent repreneurial mind-set and attributes

CO2.Apply process of problem-opportunity identification and feasibility assessment through developing a macro perspective of the real market, industries, domains and customers

CO3. Analyse Customer and Market segmentation, estimate Market size.

CO4.Initiate Solutionde sign, Prototype for Proof of Concept. Understand MVP development and validation techniques to determine Product-Market fit.

CO5.Craft initial Business and Revenue models, financial planning and pricing strategy for profitability and financial feasibility of a venture.

Unit	Contents	Hrs.
1	**Entrepreneurship Fundamentals &Context:** Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. Gamified role play based exploration aligned to one‟s short term career aspiration and ambition. An understanding of how to build entrepreneurial mindset, skillsets, attributes and networks while on campus. Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity	6
2	**Problem & Customer Identification:** Understanding and analysing the macro Problem and Industry perspective, technological, socio-economic and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problem using Design thinking principles. Analysing problem and validating with the potential customer. Iterating problem-customer fit. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity. Core Teaching Tool: Several types of activities including: Class, game, Gen AI, Get out of the Building ‟and Venture Activity.	6
3	**Solution design & Prototyping:** Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Developing Problem-solution fitinaniterative manner. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating value, features and benefits. Initial testing for proof-of- concept and iterate on the prototype. Core Teaching Tool: Venture Activity,no code Innovation	6

	tools, Class activity	
4	**Opportunity Assessment and Sizing:** Assess relative market position via competition analysis, sizing the market and assess scope and potential scale of the opportunity. Core Teaching Tool: Class and Venture Activity	**6**
5	**Business & Financial Model, Go-to-Market Plan:** Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build -Measure – Lean approach Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analysing financial performance. Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options. Core Teaching Tool: Founder Case Studies–Samaand, Securely Share; Class activity and discussions; Venture Activities	**6**
	Total	**30**

TEXT/ REFERENCE BOOKS:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGraw Hill, 11th Edition.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
3. Osterwalder, A., &Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons
4. Chowdhry Ajay, (2023) Just Aspire: Notes on Technology, Entrepreneurship and the Future.
5. Simon Sinek (2011) Start With Why, Penguin Books limited
6. Brown Tim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business
7. NamitaThapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
8. Collins Jim, Porras Jerry, (2004) Built to Last: Successful Habits of Visionary Companies
9. Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big
10. 10.Saras D. Sarasvathy,(2008) Effectuation: Elements of EntrepreneurialExpertise, Elgar Publishing Ltd

25AF1504CP308 COMMUNITY ENGINEERING PROJECT/ FIELD PROJECT	
TeachingScheme LecturesTheory:04Hr/Week Credit:02	**Examination Scheme** Internal Assessment:60Marks Mid-Sem Exam: 00 Marks End Sem Exam: 40 Marks

Course Objectives:

This course provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work. The main objectives of EL are:

- To promote professional skills and knowledge through meaningful hands on experience
- To build confidence and to work in project mode
- To acquire enterprise management capabilities

Course Outcomes:

- Students will be boosted with hands-on training and entrepreneurship skills among outgoing UG students interested in the field of Agriculture & allied branches.
- Students will undergo special training in frontier areas of Agriculture for undergraduate degree students for establishing an enterprise and its management.
- Students will explore the possibility of expanding scope/ federating students into business group and for industrial sectors.

	Content	Hrs
	Students may select one of the following ELP Modules 1. Drying and Dehydrations of fruits and vegetables 2. Fruits and Vegetable Products 3. Beverages and other Innovative Products 4. Spice Products 5. Postharvest management and marketing of Fresh Fruits and Vegetables 6. Egg, Poultry and Meat Processing 7. Bakery Products 8. Grain based Products (Cereal, Legumes/pulses and oilseeds) 9. Chocolate, Confectionary and Snack Products 10. Traditional, Heritage Food Products 11. Milk and Milk products 12. Processing of Fish and Fish Products 13. Functional Foods and Nutraceuticals	**60**
	Total	**60**

25AF1UHVVE310 UNIVERSAL HUMAN VALUES	
Teaching Scheme LecturesTheory:03Hr/Week Credit:03	**Examination Scheme:** Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To understand the concept to value education and explore self-awareness as a foundation for continuous happiness and prosperity.
2. To promote harmony within one self and between these lf and the body, fostering self-regulation and holistic well-being.
3. To develop an understanding of harmonious relationships in the family and society, based on trust, respect, and universal values.
4. To gain insight into the inter connectedness and mutual fulfillment in nature, fostering a holistic perception of existence and ethical professional practices.

Course Outcome:

After completion of this course, students will be able to:

CO1.Students will demonstrate an understanding of value education and its role in achieving happiness, prosperity, and self-exploration.

CO2.Students will be able to differentiate between the needs of these lf and the body and develop strategies for achieving harmony and self-regulation.

CO3.Students will understand the importance of trust, respect, and values in human relationships, fostering harmony within the family and society.

CO4.Students will recognize the inter connectedness of nature, society, and existence, promoting a holistic approach to life and mutual fulfillment.

CO5.Students will apply ethical principles in professional settings, utilizing humanistic education and strategies for transitioning to a value-based life and profession.

Unit	Contents	Hrs.
1	**Introduction to Value Education** - Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity–the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility - Happiness and Prosperity–Current Scenario - Method to Fulfil the Basic Human Aspirations	8
2	**Harmony in the Human Being** - Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to Ensure self-regulation and Health	8
3	**Harmony in the Family and Society** - Harmony in the Family– the Basic Unit of Human Interaction - Values in Human-to-Human Relationship - „Trust'–the Foundational Value in Relationship - 'Respect'–as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order	9

4	**Harmony in the Nature (Existence)** - Understanding Harmony in the Nature - Inter connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence	10
5	**Implications of the Holistic Understanding–a Look at Professional Ethics** - Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - AB as is for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models- Typical Case Studies - Strategies for Transition towards Value-based Life and Profession	10
	Total	**45**

TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi,2019. ISBN978- 93-87034-53-2

REFERENCE BOOKS

1. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N.Tripathi, New Age Intl. Publishers, New Delhi,2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas K. Gandhi
5. Small is Beautiful- E.F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence -JC Kumarappa
8. Bharat Mein Angreji Raj- PanditSunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj or Indian Home Rule-by Mohandas K. Gandhi
11. India Wins Freedom- Maulana Abdul KalamAzad

Vivekananda- Romain Roll and(English) Gandhi - Romain Rolland (English)

SEMESTER IV

25AF1504PC401 PRINCIPLES OF FOOD PROCESSING

Teaching Scheme	Examination Scheme:
LecturesTheory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objective:

1. To understand Food Fundamentals
2. To understand Safety & Quality principles of food processing
3. To learn methods to prevent spoilage, reduce waste
4. To develop skills in designing processes, operating equipment
5. To understand the science behind preservation (heat, cold, drying, chemicals)

Course Outcome:After completion of this course, students will be able to:

CO1. Students will be able to understand Core Principles & Properties of food processing
CO2. Students will learn about methods like drying, microwave heating, and irradiation.
CO3. Students will know food quality, safety laws, regulations, and quality control measures.
CO4. Students will be able to develop new food products (e.g., functional, probiotic).
CO5. Students will be able to analyze and solve problems related to food processing

Unit	Contents	Hrs.
1	**Introduction:** Defining food; classification of food; constituents of foods; food processing; food preservation; food spoilage – introduction, causes of food spoilage, food poisoning, food-borne intoxication, food-borne infection Food preservation and processing: Introduction; necessary; methodology; principles and methods of food preservation	8
2	**High Temperature Preservation:** Introduction; blanching; pasteurization; sterilization; canning **Low temperature preservation:** Introduction; methods of low temperature preservation; chilling; refrigeration and cold storage; factors affecting refrigerated & frozen storage of foods; effect of freezing on constituents of foods	8
3	**Drying, dehydration and concentration:** Introduction; purpose; water activity and relative humidity; factors affecting rate of drying and dehydration; drying methods; changes during drying and dehydration; different driers; concentration- methods of concentration, changes; effect of drying, dehydration and concentration on quality of foods. **Food irradiation:** Introduction; radiation sources; measurement of radiation dose; mechanism of action; type of irradiation; factors affecting food irradiation; effect of irradiation	8
4	**Preservation using sugar, salt and acids:** Sugar – Introduction, factors affecting osmotic pressure of sugar solution, foods preserved using sugar; salt: introduction, antimicrobial activity of salt, estimation of salt, food products preserved using salt; acid – Introduction, mechanism, common foods preserved using acids	9

5	**Preservation by use of chemicals**: Introduction; objectives; factors affecting antimicrobial activity of preservatives; type of chemical preservatives; sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc. Food fermentation: Introduction, methods, common fermented foods.	**10**
6	**Recent methods in processing**: Introduction; PEF, HPP, ultrasound, dielectric heating; microwave heating, ohmic heating; infrared heating; UV light, X-rays, membrane processing, ozonization; high intensity electric field in pulses; new hybrid drying technologies; monitoring by NMR and MRI Technology, etc Effect of processing on nutritional value of food: Introduction; consuming raw foods; changes during meat grilling; effect of processing on vitamins; effect of processing on minerals; effect of processing on carbohydrates; effect of processing on lipids	**10**
	Total	**45**

TEXT BOOKS:

1. Preservation of Fruits & Vegetables, Girdhari Lal, G. S. Siddappa, G. L. Tandon, Indian Council of Agricultural Research, Publications 1986
2. Food Processing Technology: Principles and Practice, P. Fellows, CRC Press, 2000, ISBN: 9780849308871
3. Handbook of Analysis and Quality Control for Fruit and Vegetable Product, Ranganna S, 2nd Ed. Tata-McGraw-Hill. 2001
4. Introduction to Food Processing, Jelen P., Prentice Hall , 1985
5. Emerging Technologies for Food Processing, Da-Wen Sun, Academic Press, 2005 , ISBN: 9780080455648

REFERENCE BOOKS:

1. Food Science, Potter NN and Hotchkiss JH, Springer Science & Business Media, 2013ISBN: 9401572623
2. Food Processing and Preservation, B. Sivasankar, PHI Learning Pvt. Ltd., 2002, ISBN: 9788120320864
3. Introduction to Food Science and Technology, Stewart GP and Amerine MA, Elsevier, 2012 ISBN: 0323156649
4. Technology of Food Preservation, Desroiser N.W., AVI Pub. Co., 1997

25AF1504PC402 FOOD ENGINEERING-I

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1) To provide fundamental knowledge of engineering principles.
2) To develop the ability to analyze and solve basic food engineering problems.
3) To familiarize students with food processing equipment and systems.
4) To enable students to apply mathematical and scientific tools.
5) To prepare students for higher studies and professional careers.

Course Outcome:

After completion of this course, students will be able to:

CO-1 Analyze crushing and screening principles and equipment's used for them.

CO-2 Awareness of different screening equipment and sieve analysis

CO-3 Understand basic principles of filtration and centrifugation and design of related equipment's.

CO-4 Understand construction of psychometric chart and basic principles of drying

CO-5 Understand principles of evaporation and design of evaporators based on Industrial requirements

Unit	Contents	Hrs.
1	**Engineering properties of food materials**: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.	6
2	**Mechanical Operations- Size reduction**: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)	9
3	**Drying and dehydration:** Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foam-mat dryers, construction and use. **Freezing and Thawing:** Freezing and Thawing calculations; Application of Plank's equation to specific food system; Refrigeration system and thermodynamic aspects; Concept of cold storage design; Refrigeration load for chilling and freezing process, Psychometric chart for food unit operations.	9
4	**Mixing:** theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder- liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids	6
5	**Mechanical Separations:** Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine **Filtration:** Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids	9
6	**Membrane separation:** General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration	6

	Total	45

TEXT BOOKS :

1) ZekiBerk.(2018).Food Process Engineering and Technology.3rd Edition. Academic Press.
2) Earle,R.L," Unit Operations in Food Processing", Pergamon Press,Oxford,U.K,1985.
3) Geankoplis, C. J. (2002). Transport processes and unit operations.3rdEdition. Prentice Hall of India.
4) Oulsonand Richardsons.(1998).Chemical Engineering, Vol. II, Asiali Books Pvt. Ltd.
5)McCabe and Smith, "Unit Operations,"McGraw-Hill,New York
6) Rao,D.G.(2012).Fundamentals of Food Engineering.PHIL earning Private Limited, New Delhi.
7) Albert I barzand Gustavo V.Barbosa-Cánovas.2003.Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
8) J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering,Vol.2, Particle Technology and Separation Processes, 5th Ed. Butterworth–Heinemann, Oxford, UK

REFERENCE BOOKS :

1) Treybal,R.E.(1981).Mass Transfer Operations, 3 rd edition.McGraw-Hill.
2) Dennis,R.H.(1981)."Food Process Engineering.Academic Publishing and Press,King Saud University.
3) Rao, M.A.Syed S.H.Rizvi, and Ashim K.Datta.(2008).Engineering properties of foods.
4) Sahay, K.M.and Singh,K.K.(2003).UNIT Operations in Agricultural Processing.

25AF1504PC403 FOOD BIOCHEMISTRY AND NUTRITION

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1) To Build a foundational understanding of biomolecules, their structure, and their functional roles in sustaining life processes.
2) To develop ability to explain metabolic pathways and their regulation in livingorganisms.
3) To cultivate skills to relate biochemical principles to physiological functions and clinical conditions.
4) To equip learners with the competence to apply biochemical knowledge in Food analysis, pharmacy, nutrition, medicine, and biotechnology contexts.
5) To promote scientific thinking, problem solving, and analytical reasoning in biochemical investigations in Food analysis.

Course Outcome:

After completion of this course, students will be able to:

CO-1 Explain the structure and functional behaviour of biomolecules in foods, including carbohydrates, proteins, lipids, vitamins, and minerals.

CO-2 Illustrate the biochemical pathways involved in food metabolism.

CO-3 Apply biochemical principles to evaluate nutritional quality, bioavailability, and functional properties of food components.

CO-4 Use laboratory techniques such as chromatography, electrophoresis, and spectrophotometry to analyze biochemical constituents in food.

Unit	Contents	Hrs.

1	**Introduction:** Biochemistry & it's scope; Cellular Biochemistry-structure of plant and animal cell, tissues, Photosynthesis of Plants, Digestion of foods in Humans. DNA as genetic material	**6**
2	**Carbohydrates**: Metabolism of carbohydrates – glycolysis and TCA cycle, production of ATP, oxidative and substrate phosphorylation, dietary fiber, non-digestible oligosaccharides, resistant starch, prebiotics, Lactose intolerance, Glycemic index, keto diet **Proteins:** Metabolism of proteins - Breakdown of proteins, transamination, deamination, decarboxylation, Urea cycle, Protein indigestion/ deficiency disorders.In-born error of metabolism,	**8**
3	**Lipids:**Metabolism of lipids; biosynthesis of fatty acids, β-oxidation of Saturated fatty acids, formation and utilization of ketone bodies,blood lipids (LDL, HDL, VLDL etc), trans fats, Cholesterol, fatreplacers and mimetics, **Vitamins and minerals:** Sources and classification, Metabolic functions, deficiency disorders.	**8**
4	**Nutrition:** Terminologies used in nutrition, Metabolic function of nutrients, digestion, absorption, assimilation and transport of nutrients in human beings.Water intake and losses.Food pyramid, energy value of foods from proximate composition.B.M.I., Basal Metabolic Energy, factors affecting, and calorieneeds for B. M. E. Nutrition agencies; Nutrition of community; Nutritional policies and their implementation	**9**
5	**Diets and RDA**: Preparation of balanced diet and RDA for various groups (According to age groups, physiological status; Athletic and sports man), **Malnutrition**: Type of Malnutrition(under nutrition and over nutrition); Nutrition education	**8**
6	**Nutritional Assessment**: Diet surveys; Anthropometry; Clinical examination; Food fad and faddism, Introduction to Nutraceuticals and functional foods, Anti-nutritional factors present in foods and their remedies,Nutritional labelling of foods;	**6**
	Total	**45**

TEXT BOOKS:

1. Fundamentals of Biochemistry, Jain JL, Jain S and Jain N, S. Chand Publication, India 2016
2. Biochemistry, Satyanarayana, Elsevier, 2013
3. Outlines of Biochemistry, Conn EE and Stumpf PK, 4th Edition Wiley Eastern Ltd, Pune
4. Advanced Text Book on Food & Nutrition (Volume I and II), Swaminathan M, The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
5. ABC of Nutrition (4th edition), Stewart Truswell, BMJ Publishing Group 2003 ISBN 0727916645
6. Principles of Human Nutrition, Martin Eastwood, Blackwell Publishing, Boca Rotan

REFERENCE BOOKS:

1. Biochemistry & Molecular Biology of Plants, Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones, John Wiley and Sons, Inc., NY, USA. 2002
2. Biochemistry, Donald Voet and Judith G. Voet, 4th Ed. John Wiley and Sons, Inc., NY, USA. 2011
3. Nutrition and Health, Gerald W, Taylor and Francis, London 2002, ISBN 0415278740
4. Essentials of Human Nutrition, Jim M. and Stewart T., Oxford University Press, 2002
5. Introduction to Human Nutrition, Micheal J. G., Susan A.L. Aedin C. and Hester H.V, Wiley-Blackwell Publication, UK 2009, ISBN 9781405168076

25AF1504PCL404 FOOD PROCESSING AND FOOD ENGINEERING (Lab)		
	Teaching Scheme Practical :04Hr/Week, Credit: 02	**Examination Scheme** Internal Assessment:60 Marks Mid-Sem Exam: 00 Marks End Sem Exam: 40 Marks

	Experiments	**Hrs**
S. No	**Experiments (Food Processing)**	**4**
1	Demonstration of various machineries used in processing	**4**
2	Demonstration of effect of blanching on quality characteristics of leafy vegetables	**4**
3	Preservation of fruits and vegetables by drying and dehydration	**4**
4	Preservation by high/low temperature (pasteurization, sterilization and freezing)	**4**
5	Preservation of food by using chemicals (RTS, Nector, Cordial)	**4**
6	Preservation by high concentration of sugar(Jam/Jelly/Marmalade /syrup /squash)	**4**
7	Preparation of fermented food products (pickling)	**4**
	Experiments (Food Engineering)	**4**
8	Determination physical properties of food - shape and size, particle density /true density and porosity of solid grains and powdery materials	**4**
9	Operation of size reduction of grain using Rittinger's law, Kick's law and Bond's law	**4**
10	Operation of tray dryer and drying process calculations	**4**
11	Study of spray dryer and drying process calculations	**4**
12	Study of osmosis in fruit and Determination of solid gain and moisture loss during osmosis	**4**
13	Study of centrifugal separator, and reverse osmosis process	**4**
14	Determination of mixing index of a feed mixer	**4**
15	Study of ultra-filtration/membrane separation process	**4**
	Total	**60**

TEXT BOOKS:

1. Preservation of Fruits & Vegetables, Girdhari Lal, G. S. Siddappa, G. L. Tandon, Indian Council of Agricultural Research, Publications 1986
2. Food Processing Technology: Principles and Practice, P. Fellows, CRC Press, 2000, ISBN: 9780849308871
3. Handbook of Analysis and Quality Control for Fruit and Vegetable Product, Ranganna S, 2nd Ed. Tata-McGraw-Hill. 2001
4. McCabe and Smith, "Unit Operations,"McGraw-Hill,New York
5. Rao,D.G.(2012).Fundamentals of Food Engineering.PHIL earning Private Limited, New Delhi.
6. Sahay, K.M.and Singh,K.K.(2003).UNIT Operations in Agricultural Processing.

25AF1OTHOEM05G HEAT AND MASS TRANSFER

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To understand Fundamental laws and mechanisms of heat (conduction, convection, radiation) and mass transfer (diffusion, convection).
2. To develop skills to analyze heat and mass transfer in simple and complex systems, including phase changes (boiling, condensation).
3. To solve Problems for various geometries and conditions (steady, unsteady, 1D, 2D).
4. To design Equipments like heat exchangers, condensers, evaporators, and distillation columns.

Course Outcome:

After completion of this course, students will be able to:

1. Students will be able to distinguish between steady/unsteady heat transfer and their applications.
2. Students will be able to analyze radiation heat transfer, including shields.
3. Students will understand vapor-liquid equilibrium and mass transfer theories (HTU, NTU).
4. Students will able to calculate heat/mass transfer coefficients and overall coefficients.
5. Students will be able to estimate heat loss/gain and determine insulation requirements.

Unit	Contents	Hrs.
1	Basic heat transfer processes, Heat transfer coefficients, properties related to heat transfer; One-dimensional steady state conduction, Theory of heat conduction, Fourier's law and its derivation	**7**
2	Heat transfer through composite walls one-dimensional steady state heat conduction with heat generation, Heat flow through slab, hollow sphere and cylinder with linear heat transfer, Convection: Forced and free convection	**7**
3	Use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient	**8**
4	Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces	**7**
5	Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchanger, heat exchanger design Application of different types of heat exchangers in dairy and food industry	**8**
6	Mass transfer: Mass transfer operations, Selection of mass transfer operation, Diffusion, Mass transfer coefficient, Theories of mass transfer, Fick's law of diffusion, steady state diffusion of gases and liquids throughsolids, application in food industry. Construction working and design of mass transfer equipments: Distillation column and Absorption column.	**8**
	Total	**45**

TEXT BOOKS:

1. Heat and Mass Transfer , Nag P , McGraw Hill, 2011
2. Heat and Mass Transfer – Fundamentals and Applications, Yunus AC and Afshin JG, McGraw Hill, 2015
3. Heat Transfer, Gupta CP, Prentice Hall of Media, New Delhi 1994
4. Heat Transfer , J.P. Holman, 10th Ed. McGraw-Hill Book Co., Boston, USA. 2010

REFERENCE BOOKS:

1. Heat Transfer in Process Engineering. Eduardo Cao, The McGraw-Hill Companies, Inc., New York, USA. 2010
2. A Heat Transfer Textbook, John HL and John HL, Phlogiston Press, Cambrige, MA, USA. 2008
3. Unit Operations of Chemical Engineering, Warren LM, Julian S. and Peter H., 7th Ed. McGraw-Hill, Inc., NY, USA. 2004
4. Transport Processes and Separation Process Principles (Includes Unit Operations), Christie John Geankoplis, 4th Ed. Prentice-Hall, NY, USA. 2003

25AF1OTHOEM05H INFORMATION AND COMMUNICATION TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To understand core ICT concepts, terminology, hardware, software, and network components.
2. To gain hands-on experience with programming, databases, networking, cybersecurity and common software (spreadsheets, documentation).
3. To learn how ICT impacts business, communication, and data management, and how to use tools for information retrieval and problem-solving.
4. To develop communication (listening, writing, presenting), critical thinking, collaboration, and entrepreneurial skills.
5. To understand ethical considerations, security protocols, and the social responsibility of using technology.

Course Outcome:

After completion of this course, students will be able to:

CO1: Students will be able to analyze problems, design algorithms, and plan ICT implementations.
CO2: Students will be able to understand codes, databases, etc
CO3: Students will communicate effectively in digital environments, present ideas, and work in teams.
CO4: Students will use various ICT tools for data analysis, digital documentation, multimedia creation, and efficient information retrieval.
CO5: Students will apply knowledge of data transmission, storage, network performance, and cybersecurity principles.

Unit	Contents	Hrs.

1	Introduction to Computers, Definition: Hardware, Software & firmware. Types of software. Data Representation, Number systems (Binary, Hexadecimal). Difference between ASCII & UNICODE (Different Encoding Schemes)	**7**
2	Primary , Secondary Memory , Units used for measurement of memory , Input Output devices, Operating Systems, definition and types	**7**
3	File Management. Applications used for document creation & Editing, Data presentation using slides	**7**
4	Use of Spreadsheets for statistical analysis, evaluating mathematical & logical expressions. Use of Spreadsheets for Interpretation and graph creation.	**8**
5	Database, concepts and types, uses of DBMS/RDBMS in Agriculture Database design, creation, Preparation of presentation. Import export operations, using numerical tabular data/text/graph /slides within different applications using cut-paste. Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc;	**8**
6	Geospatial technology for generating valuable agri-information, Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions. Communication process, Berlo' s model, feedback and barriers to communication.	**8**
	Total	**45**

TEXT BOOKS :

1. Computer Fundamentals, Pradeep K. Sinha and Priti Sinha, III edition, BPB Publications, B-14, Connaught Place, New Delhi – 110 001
2. Computer Fundamentals, P.K. Sinha, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.

REFERENCE BOOKS:

1. Mastering Office Professional for window 95, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
2. Statistical Methods for Agricultural workers by V.G. Panse and P.V. Sukhatma, ICAR, New Delhi.
3. http://www.tutorialsforopenoffice.org/category_index/base.html
4. http://mkisan.gov.in/downloadmobileapps.aspx
5. http://www.nrsc.gov.in/Agriculture
6. http://iasri.res.in/
7. http://communicationtheory.org/berlos-smcr-model-of-communication/

25AF1OTHOEM05I CHEMICAL REACTION ENGINEERING

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To grasp concepts like reaction order, molecularity, and experimental determination of rate expressions from batch data.
2. To apply mass/energy balances, calculus, and thermodynamics to derive design equations for

ideal reactors
3. To choose suitable reactor types for specific processes and optimize operating conditions (temperature, pressure) for maximum yield/selectivity, especially in complex reactions.
4. To analyze non-ideal reactors (using RTD, dispersion models) and design reactors for multiple reactions (series, parallel) and heterogeneous systems (catalytic reactors, fixed beds).

Course Outcome:
After completion of this course, students will be able to:
CO1: Develop rate expressions for reactions, analyze experimental data, and understand reaction mechanisms.
CO2**:** Design and size ideal (Batch, CSTR, PFR) and non-ideal reactors, considering single and multiple reactions, and heat effects (non-isothermal).
CO3**:** Use residence time distribution (RTD) to evaluate non-ideal reactors (dispersion, tanks-in-series models) and compare reactor performance.
CO4**:** Understand catalyst function, effectiveness factors, and design reactors for catalytic and multiphase reactions (e.g., fixed-bed reactors).
CO5**:** Apply fundamental balances to solve reactor design problems, incorporating heat exchange equipment.

Unit	Contents	Hrs.
1	Introduction and a brief review of the kinetics of homogeneous reactions, Interpretation of batch reactor rate and data, from constant volume and constant pressure systems. Single Ideal reactors including design aspects	**7**
2	Design for single reactions, Multiple reactions, Thermal characteristics of reactors: temperature and pressure effects. Non-ideality in reactors and its effects on chemical conversion. One parameter models to represent the behaviour of chemical reactors	**10**
3	Introduction to Non-ideal flow, RTD measurements, Models to predict conversions	**8**
4	Homogeneous and Heterogeneous Catalysis, Kinetics of Solid Catalyzed Reactions. Design of gas – solid catalytic reactors	**8**
5	Introduction to multiphase reactors	**6**
6	Mass Transfer with Chemical Reactions: Regimes of operation and Model contactors	**6**
	Total	**45**

TEXT BOOKS :

1. Chemical Reaction Engineering, Levenspiel, O. 3rd Edition, John Wiley and Sons, 2004.
2. Chemical Engineering, Kinetics, Smith, J.M. , Kinetics, 3rd Edition, and McGraw Hill, 1981.
3. Dinbigh, K. & Turner, K.G. Chemical Reactor Theory – An Introduction, Cambridge Univ. Press.Hall, 2007.
4. Scott Fogler, H. : Elements of Chemical Reaction Engineering, 4th Edition, Prentice

REFERENCE BOOKS:

1. The Engineering of Chemical Reactions by L. D. Schmidt.
2. Introduction to Chemical Kinetics and Reactor Design by Charles Hill.
3. "The Engineering of Chemical Reactions" by L.D. Schmidt
4. "Perry's Chemical Engineers' Handbook" (Green & Perry)

25AF1504MD406 TECHNOLOGY OF SPICES AND PLANTATION CROPS (MDM)

Teaching Scheme	Examination Scheme
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1.Impart knowledge about the importance, scope, and specific characteristics (composition, chemistry, etc.) of various plantation crops.

2. Develop an understanding of the principles and practices of post-harvest management, including harvesting techniques, pre-cooling, grading, and storage, to minimize losses.

3. Acquaint students with the specific processing technologies for converting raw plantation produce into finished products (e.g., manufacture of tea, coffee powder, cocoa, spice oils/oleoresins).

Course Outcome:

After completion of this course, students will be able to:

CO1: Understand the unique composition and properties of different plantation crops and how these influence processing methods.

CO 2: Apply appropriate post-harvest handling and preservation techniques to maintain the quality and safety of plantation crops.

CO3: Operate and manage equipment and processes used in the industrial processing of tea, coffee, cocoa, and spices.

CO-4: Evaluate the quality of raw materials and finished products using relevant analytical techniques and quality standards.

CO-5: Develop new value-added products (e.g., chocolate, essential oils, various spice products) from plantation crops and their by-products.

Unit	Contents	Hrs.
1	**Introduction:**Introduction, definition, importance, historical significance,Production and processing scenario of spices and plantation crops. Commercial value of Spices, Condiments, plantation crops and theirproducts in globalmarket.	6
2	**Processing Techniques for spices:**Cultivation practices, Harvesting and transportation, cleaning, destoning, sorting-grading, winnowing, drying, storage, Curing, grinding and milling operations and Processing methods for spices like–ginger, chilli, turmeric, onion, garlic, pepper, cardamom,	7
3	**Minor spices, herbs and leafy vegetables:** processing and utilization of All spice, annie seed, sweet basil, caraway seed, cassia, cinnamon, clove, coriander, cumin, dill seed, Fern seed nutmeg, mint, marjoram, Rose merry, saffron, sage, savory, thyme, ajowan, curry leaves, asafetida , etc.	8
4	**Processing Technologies for Plantation Crops:** Processing technologies and quality control forTea, Coffee, Cocoa, kokum, chicory, cashew nut, jackfruit, coconut, Vanilla and annatto-processing. By productsof plantation crops processing and its utilization.	10
5	**Spice and flavorings:** Flavoring compounds in Spice asspice-oils, spice powders, oleoresins, concentrates,etc.Separation and purification of natural and Synthetic	8

	flavoring agents. Quality Standards and Specifications	
6	**Quality Assurance and Marketing of Spices and Plantation Crop Products**: Quality evaluation and control of process, Food safety and hygiene practices,Marketing strategies and channels, Packaging technologies,labelling requirements, regulations and certifications.	**6**
	Total	**45**

TEXT BOOKS :

1. Spices and Plantation Crops by K.G. Shanmugavelu, Agrotech Publication, Delhi
2. Spice and Condiments by Pruthi J.S., National Book Trus, 1996
3. Handbook on Spices and Condiments (cultivation, processing and extraction), Panda H., Asia Pacific Business Press Inc. 2010
4. The Complete Book on Spices &Condiments (with cultivation, processing & uses) by NIIR BOARD, Asia Pacific Business Press Inc. 2010
5. Spices and Seasonings: A Food Technology Handbook by Tainter DR and Grenis AT, John Wiley and Sons, 2001

REFERENCE BOOKS:

1. Handbook of Herbs and spices by Peter VK, Woodhead Publishing 2012
2. The Book of Spices by Rosengarten F., Pyramid Books, 1973
3. Spices and Herbs for the Food Industry by Lewis YS, Food Trade Press, 1984
4. Food Flavourings by P.R. Ashust, Springer, 2012

25AF1COIVE407 CONSTITUTION OF INDIA

Teaching Scheme	**Examination Scheme**
Lectures Theory:02Hr/Week Credit: Audit	Internal Assessment:50Marks Marks End Sem Exam: 00 marks

Course Objectives:

1.Explain the historical background, sources, features, and keyprovisions of the Indian Constitution, including citizenship,fundamental rights, duties, and directive principles.
2. Describe the structure, roles, and functions of the Union andState governments, and analyze the relationship between theCentre and States.
3. Interpret the organization and functioning of local self-government institutions and evaluate their role instrengthening grassroots democracy.
4. Analyze the functions of the Election Commission and otherconstitutional bodies related to the welfare of marginalizedcommunities and women

Course Outcome:

After completion of this course, students will be able to:

CO-1: Describe the making of the Indian Constitution, its evolution, and salient features (e.g., written, rigid, parliamentary democracy).

CO-2: Explain and apply fundamental rights (e.g., Equality, Freedom) and duties, recognizing their importance for nation-building.

CO-3: Understand the functioning, powers, and roles of the Union (President, Parliament, Judiciary) and State governments.

CO-4:Identify the functions and responsibilities of constitutional bodies like the Election Commission, UPSC, and CAG

Unit	Contents	Hrs.
1	Introduction: Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy.	6
2	Union Government and its Administration: Structure of the Indian Union: Federalism, Centre- State, relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, RajyaSabha.	6
3	State Government and its AdministrationGovernor: Role and Position, CM and Council of Ministers, State Secretariat:Organisation, Structure and Functions.	6
4	Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	6
5	Election Commission: Election Commission: Role and Functioning, ChiefElection Commissioner and Election Commissioners, State ElectionCommission: Role and Functioning, Institute and Bodies for the welfare ofSC/ST/OBC and women.	6
	Total	**30**

SUGGESTED READINGS :

1. Sastry, T. S. N., (2005). India and Human Rights: Reflections, Concept Publishing Company India (P Ltd.).
2. Nirmal, C.J., (1999). Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

25AF1000VE408 A LIFE OF CHATRAPATI SHIVAJI MAHARAJ

Teaching Scheme	Examination Scheme
Lectures Theory:01Hr/Week Credit: 1	Internal Assessment:50Marks End Sem Exam: 00 marks

Course Objectives:

1. Analyze Chhatrapati Shivaji Maharaj's leadership qualities, strategic thinking, and management skills.
2. Develop critical thinking and problem-solving skills through case studies and discussions
3. Recognize the relevance of the Chhatrapati's principles and values in modern times

Course Outcome:

After completion of this course, students will be able to:

CO-1 Explain Chhatrapati Shivaji Maharaj's military strategies, conquests, and establishment of the Maratha Empire.
CO2 Evaluate the Chhatrapati's leadership qualities, such as courage, vision, human values and adaptability.
CO3 Apply the Chhatrapati's principles, such as decentralization and social welfare, to modern engineering challenges.

Unit	Contents	Hrs.
1	**Shivaji Maharaj as a Great Conqueror:** Master Strategist and innovator in Military Tactics, Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.	**5**
2	**Shivaji Maharaj's Management and leadership strategies**: Architecture and metallurgy of Raigad Fort, Use of Light Cavalry , Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains ,Fortifications and Military Architecture.	**5**
3	**Shivaji Maharaj's views on Democracy and Nationalism**: Shivaji Maharaj's views about Women's rights, their dignity and religious views, His views on Democracy & Nationalism	**5**
	Total	**15**

TEXT/REFERENCE BOOKS:

1 Desai, Ranjit. Shriman Yogi. Mehta Publishing House. 2018.
2 Kurundkar, Narhar. Chatrapati Shivaji Maharaj Jeevan Rahasya. Deshamukh and Company. 2024
3 Keluskar, Krushnaji Arjun. Chhatrapati Shivaji Maharaj. Sudhir Prakashan. 2020.
4 Bedekar, Ninad. Kalatil Vyavsthapan Tatve. 2015.
5 Sarkar, Jadunath. Shivaji and His Times by Jadunath Sarkar, Classic Book on the Life and History.

25AF1000HM409 PATENTS AND IPR

Teaching Scheme	Examination Scheme
Lectures Theory:02Hr/Week Credit: 2	Internal Assessment:20Marks Mid Sem Exam: 20 Marks End Sem Exam: 60 marks

Course Objectives:

1. To understand the fundamentals of patents, designs, and copyrights and the patent classification system in India.
2. To analyze the scope of patent rights, including licensing, technology transfer, and the use of patent databases.
3. To explore the evolution, significance, and administration of intellectual property rights (IPR) in India and internationally.
4. To examine recent developments in IPR across biological systems, software, and traditional knowledge through case studies.

Course Outcome:

After completion of this course, students will be able to:

CO1. Demonstrate proficiency in patent categorization and practical patent procedures.
CO2. Utilize patent databases effectively. CO3. Grasp the significance of IPR and its historical context.
CO4. Stay updated on the latest IPR developments, especially in biological systems and computer software
CO5. Apply acquired knowledge and problem-solving skills to real-world cases related to patents and IPR

Unit	Contents	Hrs.
1	Patents Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the	**3**

	international patent system, Utility models	
2	Patent Rights Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	**3**
3	Overview of Intellectual Property Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad.	**3**
4	New Developments in IPR Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies	**3**
5	Case studies: Case studies related to patents and IPR	**3**
	Total	**15**

TEXT/REFERENCE BOOKS:

1. Feroz Ali, The Law of Patents, LexisNexis
2. Ronald D. Slusky, Invention Analysis and Claiming – A Patent Lawyer‟s Guide, Second Edition, American Bar Association, 2012.
3. Feroz Ali, The Touchstone Effect – The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.

25AF1000AE410A A) MODERN INDIAN LANGUAGE(MARATHI)

Teaching Scheme	**Examination Scheme**
Lectures Theory:02Hr/Week Credit:2	Internal Assessment:50Marks End Sem Exam: 50 marks

Course Objectives:

1. मराठी भाषेचा ऐतिहासिक प्रवास, संस्कृत, प्राकृत आणि अपभ्रंश भाषांचा प्रभाव समजून घेणे.
2. मराठी लेखनाचे नियम, व्याकरण व शुद्धलेखन यांची अचकूता आत्मसात करणे.
3. समजनशील आणि औपचारिक लेखन कौशल्ये विकसीत करणे.
4. भाषांतर तत्त्वे, प्रमेयता आणि सांस्कृत संदर्भांचा विचार करून मराठीतून इग्रंजी आणि इग्रंजीतून मराठी भाषांतर करण्याचे कौशल्य प्राप्त करणे.

Course Outcome:

After completion of this course, students will be able to:

CO1. विद्याथी मराठी भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.

CO2. शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.

CO3. विविध प्रकारच्या लेखन शैली आत्मसात करून सजृनशील, विश्लेषणात्मक आणि औपचारिक लेखन करू शकतील.

CO4. अचकू, स्पष्ट आणि भाषिक -सांस्कृतीक दृष्टीकोनातून योग्य भाषांतर करू शकतील.

CO5. व्यावसायिक आणि साहित्यीक भाषांतरात प्रावीण्य मिळवू शकतील.

Unit	Contents	Hrs.
1	मराठीचा उगम आणि विकास: मराठीचा उगम आणि विकास, मराठी भाषेवर संतपरंपरेचा प्रभाव - ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास,मराठीत बखरी लेखन व इतिहास दर्शन, आधुनिक मराठी आणि सुधारणा चळवळी-टिळक, फुले, आणि आगरकर यांचे योगदान.	**3**
2	स्वातंत्र्यानंतरची मराठी भाषा: महाराष्ट्र राज्य निर्मिती व मराठीचा अधिकृत दर्जा,डिजीटल युगातील मराठी भाषा : ब्लॉग , सोशल मीडया आणि ई-साहित्य , मराठी भाषासंरक्षणासाठी उपाययोजना, शिक्षण व्यवस्थेतील मराठीचा वापर, जागतिक स्तरावरमराठी भाषेचा प्रभाव	**3**
3	मराठी लेखनाचे नियम आणि व्याकरण : संधी, वाक्यप्रकार (विधानार्थी वाक्य , प्रश्नार्थी वाक्य , आज्ञार्थी वाक्य इ.), विरामचन्हे आणि त्यांचे उपयोग, शुद्धलेखन, समानार्थी शब्द (पर्यायवाची शब्द), विरुद्धार्थी शब्द .	**3**
4	लेखन कौशल्य : लेखन कौशल्याचा परिचय, लेखन कौशल्याचे महत्त्व आणि आवश्यकता, पत्रलेखन, निबंध लेखन,	**3**

	वृत्तलेखन (वृत्तपत्रीय लेखन), इतिवृत्त लेखन, सारांश लेखन	
5	भाषांतर (मराठीतून इंग्रजी आणि इंग्रजीतून मराठी): भाषांतराचा मूलभूत परिचय-भाषांतराची व्याख्या आणि स्वरूप , महत्त्व आणि उपयोग, भाषांतराचे प्रकार इ. पारिभातषक शब्दावली , मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर	**3**
	Total	**15**

SUGGESTED READINGS:

1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन, मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
3. "अनुवाद तसद्धांत आणि प्रयोग " – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृहप्रकाशन)
4. मराठी भाषा आणि साहित्याचा इतिहास – वि. का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

25AF1000AE410B B) MODERN INDIAN LANGUAGE(HINDI)

Teaching Scheme	**Examination Scheme**
Lectures Theory:02Hr/Week Credit: 2	Internal Assessment:50Marks End Sem Exam: 50 marks

Course Objectives:

1.हिंदी भाषा के उद्भव , विकास और ऐतिहासिक प्रवृत्तीयों को समझाना।
2. हिंदी व्याकरण और लेखन कौशल्य में दक्षता प्रदान करना।
3. प्रशाशन , शिक्षा और संचार में हिंदी के व्यावहारिक उपयोग को स्पष्ट करना।
4. अनुवाद कौशल्य विकसीत करना,जिससे तकनीक एवं व्यावसायिक संचार सुगम हो

Course Outcome:

After completion of this course, students will be able to:

CO1. वि द्याथी हिंदी भाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
CO2. हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
CO3. व्यावसायिक प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
CO4. अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदी के बीच प्रभावी अनुवाद कर सकेंगे

Unit	Contents	Hrs.
1	हिंदी भाषा का उद्भी और स्रोत : ▪ हिंदी भाषा की उत्पत्ती और स्वरूप ▪ संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास ▪ हिंदी की प्रमुख बोलियाँ (ब्रज , अवधी, खडी बोली, भोजपुरी, राजस्थानी आदी) ▪ हिंदी पर फारसी, अरबी और अंग्रेजी भाषा का प्रभाव.	**3**
2	स्वातंत्र्योत्तर काल में हिंदी भाषा ▪ प्रशासन . शिक्षा और संचार माध्यमों में हिंदी की भमिका ▪ राजभाषा के रूप में हिंदी – संवैधानिक स्थिती और व्यावहारिक उपयोग ▪ हिंदी का वैश्विक विस्तार और डिजटल माध्यमों में हिंदी की उपस्थिती ▪ प्रशासन और संचार माध्यमों में हिंदी	**3**
3	हिंदी भाषा लेखन के नियम और व्याकरण ▪ वर्णमाला ▪ शब्द -भेद ▪ संधी ▪ वाक्य रचना ▪ वर्तनी ▪ उपसग, प्रत्यय और शब्द निर्माण की प्रक्रिया ▪ विराम चिन्हों का प्रयोग ▪ पर्यायवाची शब्द ▪ विलोम शब्द	**3**
4	लेखन कौशल ▪ पत्र लेखन ▪ प्रतिवेदन (रपोट) लेखन ▪ विज्ञप्ती , नोटिस और परिपत्र लेखन निबंध लेखन ▪ सार लेखन.	**3**
5	अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी) अनुवाद : सिद्धांत और परंपरा, अनुवाद : क्षेत्र , प्र कार , पारिभाषीक शब्दावली , अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद	**3**
	Total	**15**

Suggested readings :

1. हिंदी भाषा का उद्भव और विकास" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
2. "हिंदी भाषा का इतिहास" – डॉ. रामवलास शर्मा (राजकमल प्रकाशन)
3. "भारत में राजभाषा हिंदी" – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा परिषद)
4. "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
5. "हिंदी लेखन कौशल" – डॉ. रमेश गुप्ता (सातहत्य भवन)
6. "अनुवाद विज्ञान और सद्धांत " – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

25AF1000AE410C C) MODERN INDIAN LANGUAGE(SANSKRIT)

Teaching Scheme	**Examination Scheme**
Lectures Theory:02Hr/Week Credit: 2	Internal Assessment:50Marks End Sem Exam: 50 marks

Course Objectives:

1. संस्कृत भाषेचा ऐतिहासिक प्रवास
2. संस्कृत लेखनाचे नियम, व्याकरण आत्मसात करणे .
3. दैनंदिन संवादासाठी लागणारे काही शब्द यांचा अभ्यास करणे.

Course Outcome:

After completion of this course, students will be able to:

CO1.विद्यार्थी संस्कृत भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील

CO2.शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.

CO3.विविध प्रकारच्या लेखन शैली आत्मसात करून लेखन करू शकतील

CO4.अचूक, स्पष्ट आणि भाषिक -सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील

Unit	Contents	Hrs.
1	Introduction to Sanskrit: Importance and history of Sanskrit, Sanskritalphabets (Varnamala), Swaras (Vowels), Vyanjanas (Consonants),Pronunciation and script (Devanagari).	3
2	Basic Grammar: Nouns, pronouns, Grammatical numbers, Grammaticalgenders, Grammatical person, Verbs, Tenses, Sandhi (Combination of letters),Karaka (Case system) – Nominative, Accusative, Instrumental, etc., Vibhakti(Declensions of nouns and pronouns), Linga (Gender: Masculine, Feminine,Neuter), Vakya Rachana (Sentence construction).	3
3	Simple Vocabulary and Sentence Formation: Basic words and their meanings (nature, family, animals, objects, etc.), Greetings and basic conversational phrases, Formation of simple sentences	3
4	Selected Sanskrit Shlokas and Subhashitas: Recitation and meaning of simpleverses from Bhagavad Gita, Hitopadesha, or Panchatantra, Common proverbs(Subhashitas)	3
5	Reading and Writing Practice: Reading simple Sanskrit texts, Writing smallparagraphs in Sanskrit	3
	Total	15

25AF1504PC411 DEVELOPMENT OF LABORATORY SKILLS

Teaching Scheme	**Examination Scheme**
Lectures Theory:02Hr/Week Credit:02	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1) To understand the Good Laboratory Practices of the various laboratories
2) To understand and learn the self-behavioral pattern while working in the laboratories
3) To acclimatize with the working environment of the various laboratories

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

CO-1 Understand the Good Laboratory Practices of various laboratories

CO-2 Learn the self-behavioral pattern while working in the laboratories

CO-3 Acclimatize with the working environment of the various laboratories

Unit	Contents	Hrs.
1	**Introduction to laboratories:** Food Technology Laboratories, Basic Engineering Laboratories and Basic Science Laboratories	5
2	**Lab safety:** Safety norms and "Dos and Don'ts" in various laboratories. Study of principle features of "Good Laboratory Practices" (Hygiene, waste disposal, preventing contamination and cross-contamination)	5
3	**Equipment Management:** Different types of Equipments, Chemicals, Glassware and Plastic-ware used in the Laboratories. Instruments used in the laboratories, their Standard Operating Procedures (SOP), calibration and maintenance of balances, pH meters, ovens, mixers, refractometers, etc	5
4	**Sampling Techniques:** Various Methods of collecting representative food samples (Solid and liquid) for analysis.	5
5	**Food Testing:** Study of various food testing methods like Physical, chemical, microbial and sensory analysis. Identification of food Packaging material.	5
6	**Food Laws & Standards:** Regulatory compliances like FSSAI standards and ISO 17025. Analytical grade standards used in the Laboratories.	5
	Total	30

SUGGESTED READINGS :

1. "OECD Principles of Good Laboratory Practice (as revised in 1997). OECD Environmental Health and Safety Publications. 1. OECD. 1998. Archived from the original on 20 April 2010. Retrieved 15 October 2006.
2. OECD Principles of Good Laboratory Practice (GLP) and GLP Compliance Monitoring" Organisation for Economic Co-operation and Development. Retrieved April 28, 2024.
3. Kevin Robinson for BioPharm International, 1 Aug 2003. GLPs and the Importance of Standard Operating Procedures Archived 21 March 2005 at the Wayback Machine

REFERENCE BOOKS :

1. Espahangizi, Kijan (2015). From Topos to Oikos: The Standardization of Glass Containers as Epistemic Boundaries in Modern Laboratory Research
2. (1850–1900); (PDF). Science in Context. 28 (3): 397–25.
3. Jump up to: abc Jackson, Catherine M. (2015-03-01). The Wonderful Properties of Glass LiebigKaliapparatand the Practice of Chemistry in Glass. Isis. 106(1):43– 69.
4. Chemical manipulation; being instructions to students in chemistry, on the methods of performing experiments of demonstration or of research, with accuracy and success / By Michael Faraday Wellcome Collection. Retrieved 2022-03-25.

Semester V

26AF1504PC501 FOOD BUSINESS MANAGEMENT

Teaching Scheme	Examination Scheme
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To track the food supply chain from raw farm inputs and procurement through manufacturing, packaging, and distribution.
2. To apply financial planning, market intelligence, and investment analysis to increase the profitability of food enterprises

Course Outcome:

After completion of this course, students will be able to:

- CO-1: Apply scientific and engineering principles to scale up food production, standardize recipes and manage inventory.
- CO-2: Implement total quality management (TQM) and ensure compliance with food safety and hygiene regulations (such as FSSAI guidelines).
- CO-3: Understand how to layout food plants, kitchens, and food service units to maximize workflow and sanitation.

Unit	Contents	Hrs.
1	**Introduction to Food Business Management:** Definitions, management principles, Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid; Maslow's Hierarchy of needs theory; Overview of the food industry, Structure and growth of the Indian food processing sector, Business environment and food value chain, Types of food enterprises (micro, small, medium, and large), Functions of management, Business ethics and corporate social responsibility (CSR)	9
2	**Food Entrepreneurship and Business Planning:** Entrepreneurship in the food sector, Identification of business opportunities, Business model development, Preparation of business plans, Feasibility analysis, Project appraisal and risk assessment, Government schemes and startup support for food businesses	9
3	**Marketing and Consumer Behaviour:** Principles of food marketing, Markets: Types of markets and their characteristics, Market research and demand forecasting, Consumer behaviour and buying decisions, Product positioning and branding, Packaging and labelling as marketing tools, Digital marketing and e-commerce for food products, Export marketing basics Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity	9
4	**Financial and Operations Management:** Sources of finance, Types of costs, Cost estimation and budgeting, Pricing strategies, Break-even analysis, Inventory management, Procurement and operations management, Working capital management, Performance measurement. National income: GDP, GNP, NNP, personal income, per capita income, inflation; Finance management: Definition, scope, objective; Different systems of accounting, Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection	6

5	**Food Business Regulations and Supply Chain:** Food business licensing and registration, Food safety regulations and compliance, Intellectual Property Rights (IPR), Supply chain and logistics management, Procurement strategies, Vendor management, Sustainability and traceability in food businesses	**6**
6	**Innovation, Sustainability and Emerging Trends:** Innovation in food business, New product development and commercialization, Functional and specialty food markets, Digital transformation in food businesses, Artificial Intelligence and data analytics in food enterprises, Circular economy and sustainable business practices, Case studies of successful food startups and multinational food companies	**6**
	Total	**45**

TEXT BOOKS :

1. Agriculture, Finance and Management By Reddy and Raghuram, Oxford & IBH Pub Co, 1996
2. Marketing Management By Kotler and Keller, Burton, Pearson Education Australia, 2008
3. Management: Principles and Guidelines By Duening and Ivacevinch, Dreamtech Press, 2003

REFERENCE BOOKS :

1. Principles and Practices of Management By L.M. Prasad, 2001
2. Principles of Management, By Koontz Harold Tata McGraw-Hill Education Private Limited, New Delhi.
3. Managerial Economics By P.C. Thomas, 9th Ed. Kalyani Publishers
4. Modern Economic Theory By K.K Dewett and M.H. Navalur, S Chand & Sons, New Delhi.

26AF1504PC502 DAIRY TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. Understand the composition, properties, and quality evaluation of milk.
2. Learn the principles and operations involved in milk processing and preservation.
3. Study the manufacturing processes of major dairy products.
4. Understand dairy plant sanitation, quality assurance, and food safety practices.
5. Gain knowledge of packaging, storage, and recent advances in dairy technology.

Course Outcomes

After completion of this course, students will be able to

CO-1: Explain the composition, properties, and quality assessment of milk.
CO-2: Apply appropriate processing techniques for market milk production.
CO-3: Describe the manufacturing processes of various dairy products.
CO-4: Evaluate quality control, sanitation, and food safety requirements in dairy processing.

Unit	TOPICS	Hrs,
1	**Milk Composition and Quality:** Importance of dairy industry, Present status of milk & milk products in India and Abroad, Composition and physicochemical properties of various species, Factors affecting milk composition, Nutritive value of milk, Milk quality standards, Platform tests and quality evaluation, Adulteration and detection methods, Procurement and reception of milk	**5**
2	**Milk Processing Technology:** Receiving of milk, quality evaluation and testing of milk, procurement, processing of market milk By Filtration, clarification, pasteurization (LTLT, HTST, UHT), standardization, homogenization, sterilization, storage, transport and distribution	**6**

3	**Manufacture of Dairy Products:** Special milks such as flavoured, sterilized, recombined & reconstituted, toned & double toned milk, humanized, fortified, condensed milk, evaporated milk, Cream separation & standardization of milk (Pearson's square method); and butter, Ghee, Khoa, Paneer and chhana, Cheese (Cheddar and Mozzarella) and cheese spreads, Fermented/Probiotic milk products (Curd, Yogurt, Lassi, shrikhand), Indigenous milk products like burfi, kalakand, gulabjamun and rosogolla, whole and skimmed milk powder, Ice cream manufacture, Instantization of milk	**12**
4	**Quality Assurance and Dairy Plant Hygiene:** Microbiology of milk, Sources of contamination, Cleaning and sanitation (CIP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), HACCP in dairy industry, FSSAI standards for milk and dairy products	**7**
5	**Packaging, Storage and Dairy By-products:** Packaging materials for dairy products, Shelf-life and storage conditions, Cold chain management, Utilization of whey and buttermilk, Dairy waste management, Environmental considerations, Value-added dairy products	**8**
6	**Emerging Trends in Dairy Technology:** Functional dairy foods, Probiotic and prebiotic dairy products, Lactose-free milk, Fortified dairy products, Automation and digital technologies in dairy processing, Sustainable dairy processing, Recent innovations in the dairy industry	**7**
	Total	**45**

TEXT BOOKS:

1. Sukumar De – Outlines of Dairy Technology
2. P. F. Fox & P. L. H. McSweeney – Dairy Chemistry and Biochemistry
3. R. C. Chandan – Dairy Processing and Quality Assurance
4. Tufail Ahmed – Dairy Plant Engineering and Management

REFERENCE BOOKS:

1. Walstra, Wouters & Geurts – Dairy Science and Technology
2. Y. H. Hui – Handbook of Food and Beverage Fermentation Technology
3. Early, R. – The Technology of Dairy Products
4. Bylund, G. – Dairy Processing Handbook
5. FSSAI – Manual of Methods of Analysis of Milk and Milk Products

26AF1504PC503 CEREALS, LEGUMES AND OIL SEED TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. To study crop structures, enhance milling and processing efficiency, improve nutritional value, and develop value-added food products while reducing post-harvest losses
2. To study the physical, chemical, and structural characteristics of coarse grains, pulses, and oilseeds.
3. To optimize dehusking, splitting, and size-reduction techniques for legumes and coarse cereals.
4. To maximize oil yield and quality through efficient mechanical pressing and solvent extraction methods.

5. To use deoiled cakes and milling by-products for nutritious human foods and animal feeds.

Course Outcomes

After completion of this course, students will be able to

CO-1: Students will gain specialized knowledge in food grain structures, industrial processing, milling operations, and value-added product development.

CO-2: Students will understand the structural parts, chemical composition, and nutrient distribution of cereal grains, pulses, and oilseeds.

CO-3: Students will be able to **e**valuate physical attributes (like bulk density and angle of repose) and biochemical characteristics essential for storage and processing.

Unit	TOPICS	Hrs,
1	**Introduction to Cereals, Legumes and Oilseeds:** Classification and production status in India and globally, Grain structure and morphology, Chemical composition and nutritional significance, Functional properties of starches and proteins, Post-harvest handling and storage, Quality standards and grading	**7**
2	**Cereal Processing Technology:** Milling of rice, wheat, maize, millets (major and minor), barley, and oats, Flour milling and grading, Parboiling of rice, Malting and pearling, Breakfast cereals, Bakery flour requirements, Value-added cereal products like flakes, puffing, canning and instant rice.	**8**
3	**Legume Processing Technology:** Structure and composition of legumes, Cleaning, grading, dehulling, and splitting, Milling of pulses, milling quality, efficiency and factors affecting milling; problems in dhal milling, Soaking, germination, cooking, and fermentation, Processing of soybean and other legumes,	**8**
4	**Oilseed Processing Technology:** Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds, Preparation of oilseeds for extraction, Mechanical oil expression, Solvent extraction, Oil refining: degumming, neutralization, bleaching, deodorization, Processing of edible oils, By-products and their utilization Anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti nutritional compounds	**7**
5	**Products and Byproduct of cereal and millets:** Infant foods from cereals and millets, cereal based fermented products, breakfast cereal foods – flaked, puffed, expanded, extruded and shredded products, etc., Byproduct of pulses and oil milling and their value addition, Utilization of oil seed meals for food uses i.e. high protein products like **protein concentrates and isolates, Novel pulse-based products**	**8**
6	**Emerging Technologies and Value Addition:** Extrusion technology, Instant cereal and pulse products, Ready-to-cook and ready-to-eat products, Fortification and biofortification, Functional foods and nutraceuticals, Gluten-free cereal products, Sustainable processing and waste utilization, Recent innovations in cereal, pulse, and oilseed industries	**7**
	Total	**45**

TEXT BOOKS:

1. Technology of Cereals, By Kent NL, Woodhead Publishing1983, ISBN: 9780080408347
2. Post Harvest Technology of Cereals, Pulses and Oil seeds By A. Chakravarthy, Oxford and IBH Publishing Company, 2014
3. Modern Cereal Science & Technology By Y. Pomeranz, VCH Publishing, 1987, ISBN: 9780895733269
4. Pulses By Harbhajan Singh, Agrotech Pub. Academy, 2005 ISBN: 9788183210140
5. Legumes Chemistry, Technology and Human Nutrition By Mathews RH, Marcel Dekker, 1989
6. Post harvest technology of cereals: pulses and oilseeds By Chakraverty A., Oxford & ibh

publishing company, 1988, ISBN: 9788120402898
7. Bailey's Industrial Oil & Fat Products By Bailey A.E. and Shahidi F, Wiley Publciation, 2005 ISBN: 9780471385462

REFERENCE BOOKS:

1. Rice – Utilization By Luh b.s, Springer, 1991 ISBN: 9780442004859
2. Post Harvest Biotechnology of Cereals By Salunkhe D.K., CRC Press, 1985, ISBN: 9780849362880
3. Handbook of Post Harvest and Technology; Cereals, Fruit and Vegetables tea and spices By Chakraverty A., Mujumdar A.S. Hosahalli S.R., CRC Press 1990, ISBN: 9780203911310
4. Food and Feed from Legumes and Oilseeds By Smartt J and Nwokolo E., Springer, 2012, ISBN: 9781461304333
5. Legumes and Oilseed Crops By Bajaj YPS, Springer, 2012, ISBN: 9783642744488
6. Handbook of Seed Science and Technology By Basra A., CRC Press, 2006,ISBN: 9781560223153

26AF1504PCL504 DAIRY TECHNOLOGY (Lab)

Teaching Scheme	**Examination Scheme**
Practical: 04Hr/Week	Internal Assessment:60 Marks
Credit:2	End Sem Exam: 40 Marks

Course Objectives

Course Objectives

1. Understand the composition, properties, and quality evaluation of milk.
2. Learn the principles and operations involved in milk processing and preservation.
3. Study the manufacturing processes of major dairy products.
4. Understand dairy plant sanitation, quality assurance, and food safety practices.
5. Gain knowledge of packaging, storage, and recent advances in dairy technology

Course Outcomes

After completion of this course, students will be able to

CO-1: Explain the composition, properties, and quality assessment of milk.
CO-2: Apply appropriate processing techniques for market milk production.
CO-3: Describe the manufacturing processes of various dairy products.
CO-4: Evaluate quality control, sanitation, and food safety requirements in dairy processing.

Units	TOPICS	Hrs
1	Sampling and testing of milk	**6**
2	Determination of fat content of milk by Gerber's centrifuge method	**8**
3	Detection of adulterants in milk and milk products	**6**
4	Standardization of milk	**8**
5	Heat processing of milk – Pasteurization	**6**
6	Centrifugal cream separation, Preparation of butter, ghee	**6**
7	Preparation of ice-creams	**6**
8	Preparation of indigenous fermented and coagulated milk products (dahi, Shrikhand, paneer, channa, rasogulla, etc)	**6**
9	Preparation of khoa, Peda and barfi	**4**
10	Visit to dairy Processing plant	**4**
	Total	**60**

TEXT BOOKS:

1. Sukumar De – Outlines of Dairy Technology
2. P. F. Fox & P. L. H. McSweeney – Dairy Chemistry and Biochemistry
3. R. C. Chandan – Dairy Processing and Quality Assurance
4. Tufail Ahmed – Dairy Plant Engineering and Management

REFERENCE BOOKS:

1. Walstra, Wouters & Geurts – Dairy Science and Technology
2. Y. H. Hui – Handbook of Food and Beverage Fermentation Technology
3. Early, R. – The Technology of Dairy Products
4. Bylund, G. – Dairy Processing Handbook
5. FSSAI – Manual of Methods of Analysis of Milk and Milk Products

26AF1504PCL505 CEREALS, LEGUMES AND OIL SEED TECHNOLOGY (Lab)

Teaching Scheme	**Examination Scheme**
Practicals:04Hr/Week	Internal Assessment:60 Marks
Credit:2	End Sem Exam: 40 Marks

Course Objectives

1. To study crop structures, enhance milling and processing efficiency, improve nutritional value, and develop value-added food products and edible oils while reducing post-harvest losses
2. To study the physical, chemical, and structural characteristics of coarse grains, pulses, and oilseeds.
3. To optimize dehusking, splitting, and size-reduction techniques for legumes and coarse cereals.
4. To maximize oil yield and quality through efficient mechanical pressing and solvent extraction methods.
5. To use deoiled cakes and milling by-products for nutritious human foods and animal feeds.

Course Outcomes

After completion of this course, students will be able to

CO-1: Students will gain specialized knowledge in food grain structures, industrial processing, milling operations, and value-added product development.

CO-2: Students will understand the structural parts, chemical composition, and nutrient distribution of cereal grains, pulses, and oilseeds.

CO-3: Students will be able to **e**valuate physical attributes (like bulk density and angle of repose) and biochemical characteristics essential for storage and processing.

Units	TOPICS	Hrs
1	Determination of physical, chemical and Functional properties of cereal grains	**6**
2	Milling of cereal grains (Wheat, rice, Sorghum)	**6**
3	Studies on Germination and cooking quality of cereals	**6**
4	Determination of starch content, gelatinization of starch and sedimentation value	**6**
5	Determination of physical properties of legumes/oilseeds	**6**
6	Milling of legumes	**6**
7	Cooking quality of dhal, Preparation of quick cooking dhal	**6**
8	Value addition of Legumes by Preparation of composite flour, soy milk and soy paneer, Puffed products and Preparation of protein isolate	**8**
9	Measurement of physico-chemical properties of oils, Hydrogenation of oil, Measurement of melting point of fats,Preparation of peanut butter	**6**

10	Visit to cereal milling/dhal mill and oil mill industry,	**4**
	Total	**60**

TEXT BOOKS:

1. Technology of Cereals, By Kent NL, Woodhead Publishing1983, ISBN: 9780080408347
2. Post Harvest Technology of Cereals, Pulses and Oil seeds By A. Chakravarthy, Oxford and IBH Publishing Company, 2014
3. Modern Cereal Science & Technology By Y. Pomeranz, VCH Publishing, 1987, ISBN: 9780895733269
4. Pulses By Harbhajan Singh, Agrotech Pub. Academy, 2005 ISBN: 9788183210140
5. Legumes Chemistry, Technology and Human Nutrition By Mathews RH, Marcel Dekker, 1989
6. Post harvest technology of cereals: pulses and oilseeds By Chakraverty A., Oxford & ibh publishing company, 1988, ISBN: 9788120402898
7. Bailey's Industrial Oil & Fat Products By Bailey A.E. and Shahidi F, Wiley Publciation, 2005 ISBN: 9780471385462

REFERENCE BOOKS:

1. Rice – Utilization By Luh b.s, Springer, 1991 ISBN: 9780442004859
2. Post Harvest Biotechnology of Cereals By Salunkhe D.K., CRC Press, 1985, ISBN: 9780849362880
3. Handbook of Post Harvest and Technology; Cereals, Fruit and Vegetables tea and spices By Chakraverty A., Mujumdar A.S. Hosahalli S.R., CRC Press 1990, ISBN: 9780203911310
4. Food and Feed from Legumes and Oilseeds By Smartt J and Nwokolo E., Springer, 2012, ISBN: 9781461304333
5. Legumes and Oilseed Crops By Bajaj YPS, Springer, 2012, ISBN: 9783642744488
6. Handbook of Seed Science and Technology By Basra A., CRC Press, 2006,ISBN: 9781560223153

26AF1504MD506 FOOD SUPPLY CHAIN MANAGEMENT (MDM)

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. To understand the principles, components, and importance of food supply chain and logistics management in ensuring food quality, safety, and efficient distribution.
2. To apply inventory management, warehousing, transportation, cold chain, and distribution strategies for efficient movement of food products from farm to consumer.
3. To analyse the impact of procurement, demand forecasting, risk management, and digital technologies on food supply chain performance.
4. To evaluate food supply chain systems based on food safety standards, regulatory requirements, sustainability, and operational efficiency.
5. To develop integrated food supply chain solutions incorporating modern logistics, traceability, and digital technologies for improved productivity and customer satisfaction.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the concepts, structure, and functions of food supply chains and logistics systems in the food industry.
CO2: Apply inventory control, warehousing, transportation, cold chain, and distribution techniques for efficient food supply chain management.
CO3: Analyse procurement, demand forecasting, risk factors, and logistics operations affecting food quality, safety, and supply chain performance.
CO4: Evaluate food supply chain systems with respect to food safety regulations, quality assurance, sustainability, and cost effectiveness.
CO5: Design an integrated food supply chain model incorporating traceability, digital technologies, and emerging logistics solutions for efficient food distribution.

Units	TOPICS	Hrs,
1	**Introduction to Supply Chain Management:** Definition; Scope & Importance of Supply Chain Management; Key drivers Of the SCM; Features of Supply Chain Management; Supply Chain Network – 1st Tier , 2nd Tier; Network decisions in SCM; Suppliers and Customers; Customer Service Dimension (Seven "R" Principles, Service after sale, Customer delight)	**7**
2	**Procurement, Post-Harvest Handling and Logistics:** Agricultural procurement systems, Contract farming and farmer-producer organizations (FPOs), Post-harvest losses and reduction strategies, Food storage systems (ambient, refrigerated and frozen), Transportation modes for perishable and non-perishable foods, Warehouse management, Packaging for transportation	**8**
3	**Inventory Management and Distribution:** Inventory concepts and classification, Inventory control techniques (ABC, EOQ, JIT), Demand forecasting methods, Distribution channels for food products, Retail supply chains, E-commerce and food delivery supply chains, Third-party logistics (3PL)	**8**
4	**Food Quality, Safety and Traceability:** Food safety in supply chains, HACCP and GMP in logistics, Traceability systems, Product recall procedures, Food fraud and adulteration prevention, Regulatory framework (FSSAI, Codex, ISO 22000), Documentation and record keeping	**7**
5	**Cold Chain, Sustainability and Risk Management:** Principles of cold chain management, Refrigerated storage and transportation, Cold chain for fruits, vegetables, dairy, meat and seafood, Sustainable food supply chains, Circular economy in food logistics, Supply chain risks and resilience, Climate change and food supply chains	**8**
6	**Digital Technologies and Emerging Trends:** Digital transformation in food supply chains, Internet of Things (IoT), Artificial Intelligence (AI) and Machine Learning applications, Blockchain for food traceability, RFID, GPS and sensor technologies, Big Data analytics, Case studies on modern food supply chains, Future trends in global food logistics	**7**
	Total	**45**

TEXT BOOKS:

1. Bourlakis, M. A. & Weightman, P. W. H. (2004). Food Supply Chain Management. Blackwell Publishing.
2. Chopra, S. & Meindl, P. (2021). Supply Chain Management: Strategy, Planning, and Operation (8th ed.). Pearson.
3. Rushton, A., Croucher, P. & Baker, P. (2022). The Handbook of Logistics and Distribution Management (7th ed.). Kogan Page.
4. Harald Dyckhoff et al, Ed.: Supply Chain Management and Reverse Logistics, Springer (India).
5. Jayashree Dubey and M.L. Saikumar Ed.: Supply Chain Management, IIPE Hyderabad and New Century Publication.

6. Sarika Kulkarni, Ashok Sharma: Supply Chain Management-Creating Linkages for Faster Business Turnaround, McGraw Hill.
7. RP Mohanty: Supply Chain Management-Theories and Practice, Biztantra.

REFERENCE BOOKS:

1. Christopher, M. (2016). Logistics and Supply Chain Management (5th ed.). Pearson.
2. A leading reference on logistics strategy, supply chain integration, customer service, and supply chain resilience.
3. Monczka, R. M., Handfield, R. B., Giunipero, L. C. & Patterson, J. L. (2020). Purchasing and Supply Chain Management (7th ed.). Cengage Learning.
4. Covers procurement, sourcing strategies, supplier relationship management, and supply chain operations.
5. Wisner, J. D., Tan, K. C. & Leong, G. K. (2021). Principles of Supply Chain Management: A Balanced Approach (6th ed.). Cengage Learning.
6. Robert B. Handfield, Ernest L. Nicholas, Jr.: Introduction to Supply Chain Management,Pearson Education.
7. Ronald H. Ballou, Samir K. Srivastava: Business Logistics/Supply Chain Management, Pearson Education.
8. John Mentzer: Supply Chain Management, Response Books.
9. Janat Shah: Supply Chain Management, Pearson Publications.
10. N. Chandrasekaran: Supply Chain Management - Process, System and Practice, Oxford Press.

26AF1504PC507A FOOD PLANT DESIGN AND LAYOUT

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. To understand the principles of food plant design, layout planning, and the factors influencing plant location.
2. To apply engineering concepts for designing process flow, material handling systems, and equipment arrangement in food processing plants.
3. To develop efficient plant layouts by considering hygiene, food safety, sanitation, utilities, and regulatory requirements.
4. To evaluate economic, environmental, and sustainability aspects involved in food plant design and operation.
5. To design a food processing plant layout for a specific food industry considering productivity, worker safety, and quality assurance.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the fundamental principles of food plant design, plant location, and factors affecting plant layout.

CO2: Select appropriate process flow diagrams, equipment, and material handling systems for different food processing industries.

CO3: Design hygienic and efficient plant layouts by integrating production, storage, utilities, waste management, and personnel movement.

CO4: Analyse food plant designs with respect to GMP, HACCP, FSSAI standards, worker safety, and environmental sustainability.

CO5: Prepare a complete conceptual design and layout of a food processing plant considering technical, economic, and operational requirements.

Unit	TOPICS	Hrs,
1	**Introduction to Food Plant Design:** Importance and objectives of food plant design, Plant design procedure and project planning, Types of food processing plants, Principles of food plant layout, Types of layouts: Product layout, Process layout, Fixed-position layout, Combination layout, Factors affecting layout selection, Characteristics of an efficient plant layout	**7**
2	**Plant Location and Site Selection:** Plant location theories, Factors affecting plant location, Site selection criteria, Selection of land and building requirements, Industrial zoning and environmental considerations, Economic plant size, Future expansion planning, Green food processing plants and sustainable infrastructure	**8**
3	**Equipment Layout and Plant Utilities:** Equipment selection criteria, Equipment sizing and capacity determination, Process flow diagrams (PFD), Piping and Instrumentation Diagram (P&ID) (Introduction), Material handling systems, Utilities: Steam, Water, Refrigeration, Compressed air, Electricity, Lighting, ventilation, drainage, and fire safety	**8**
4	**Hygienic Plant Design and Food Safety:** Hygienic design principles, Zoning in food industries, Personnel and material movement, Cross-contamination prevention, GMP and GHP requirements, HACCP-based plant design, FSSAI regulations, ISO 22000 requirements, Waste management and sanitation planning	**7**
5	**Design of Food Processing Plants:** Layout considerations for: Dairy processing plant, Fruit and vegetable processing plant, Beverage processing plant, Bakery and confectionery plant, Grain milling plant, Spice processing plant, Ready-to-eat food processing plant, Cold storage and warehouse layout, Sitting (Zoning) of Process sections	**8**
6	**Plant Economics and Project Engineering:** Project formulation, Techno-economic feasibility study, Capital investment, Fixed and operating costs, Break-even analysis, Depreciation, Project scheduling (PERT & CPM), Preparation of Detailed Project Report (DPR), Case studies of modern food processing plants,	**7**
	Total	**45**

TEXTBOOKS:

1. López-Gómez, A. & Barbosa-Cánovas, G. V. (2005). *Food Plant Design*. CRC Press.
2. Moore, J. M. (1976). *Plant Layout and Design*. Macmillan Publishing Company, New York.
3. Hall, H. S. & Rosen, Y. S. (1963). *Milk Plant Layout*. FAO, Rome.

REFERENCE BOOKS:

1. Singh, R. P., Heldman, D. R. & Erdogdu, F. (2024). Introduction to Food Engineering (6th ed.). Academic Press/Elsevier.
2. Maroulis, Z. B. & Saravacos, G. D. (2008). Food Plant Economics. CRC Press/Taylor & Francis.
3. Robberts, T. C. (2013). Food Plant Engineering Systems (2nd ed.). CRC Press.
4. Holah, J. & Lelieveld, H. (2011). Hygienic Design of Food Factories. Woodhead Publishing.
5. Berk, Z. (2018). Food Process Engineering and Technology (3rd ed.). Academic Press.
6. Heldman, D. R., Lund, D. B. & Sabliov, C. D. (2018). Handbook of Food Engineering (3rd ed.). CRC Press.

26AF1504PC507B COLD CHAIN MANAGEMENT

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. To understand the principles, components, and significance of cold chain management in maintaining the quality and safety of perishable food products.
2. To apply refrigeration, storage, packaging, and transportation technologies for designing efficient cold chain systems.
3. To analyse factors affecting temperature-controlled logistics, product shelf life, and quality throughout the cold supply chain.
4. To evaluate cold chain operations based on food safety regulations, quality assurance standards, energy efficiency, and sustainability.
5. To develop integrated cold chain solutions using modern monitoring and traceability technologies for food processing and distribution.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the principles, components, and importance of cold chain management in the preservation and distribution of perishable foods.

CO2: Apply refrigeration, cold storage, packaging, and transportation techniques to maintain product quality and safety throughout the supply chain.

CO3: Analyse the influence of temperature, humidity, and logistics on shelf life, food quality, and operational efficiency.

CO4: Evaluate cold chain systems with respect to food safety standards, regulatory requirements, energy efficiency, and sustainability.

CO5: Design a basic cold chain system incorporating monitoring, traceability, and digital technologies for efficient management of temperature-sensitive food products.

Units	TOPICS	Hrs,
1	**Introduction to Cold Chain Management:** Concept and importance of cold chain, Components of cold chain systems, Cold chain requirements for perishable foods, Cold chain in fruits, vegetables, dairy, meat, seafood, and frozen foods, Temperature-sensitive food products, Food losses due to poor cold chain management, Cold chain infrastructure in India, Government initiatives and policies for cold chain development	7
2	**Refrigeration and Cold Storage Systems:** Fundamentals of refrigeration, Classification, desirable properties of refrigerants, Types of refrigeration systems, Cold storage design and classification, Chilling, freezing, and deep freezing, Controlled Atmosphere (CA) storage, Modified Atmosphere (MA) storage, Ripening chambers, Warehouse design and insulation materials Azeotropes; Components of vapour compression refrigeration system, Ice manufacturing: Principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice	8
3	**Cold Chain Logistics and Transportation:** Refrigerated transportation systems, Reefer trucks, refrigerated containers, and rail transport, Packaging requirements for cold chain, Loading and unloading practices, Distribution network planning, Last-mile delivery of perishable foods, Route optimization, Inventory management in cold chain	8
4	**Quality, Safety, and Monitoring:** Temperature monitoring and control, Data loggers and wireless sensors, Internet of Things (IoT) in cold chain monitoring, HACCP in cold chain operations, GMP and GHP in cold storage, Food quality	7

	deterioration during storage, Shelf-life evaluation, Traceability systems, Risk assessment in cold chain	
5	**Cold Chain Design and Management: P**lanning and design of integrated cold chain systems, Capacity estimation, Equipment selection, Utility requirements, Energy-efficient cold storage design, Renewable energy applications in cold chain, Maintenance of refrigeration equipment, Cold chain economics and cost analysis, Sustainability in cold chain operations Air-conditioning: factors affecting comfort air-conditioning, classification, industrial air-conditioning, round air-conditioning, unitary air-conditioning systems, central air-conditioning, humidifiers and dehumidifiers,	**8**
6	**Emerging Trends:** Digital technologies in cold chain, Artificial Intelligence (AI) and automation, RFID and blockchain applications, Smart warehouses, Pharmaceutical and vaccine cold chains, Export cold chain management, National Centre for Cold-chain Development (NCCD) guidelines, Case studies on successful cold chain systems in India and abroad	**7**
	Total	**45**

TEXT BOOKS:

1. *Cold Chain Management,* Aung, M. M. & Chang, Y. S. Springer, Cham. (2023).
2. *Handbook of Frozen Food Processing and Packaging* (2nd ed.),By Sun, D.-W. (Ed.) (2012) CRC Press.
3. *Advances in Food Refrigeration* By Sun, D.-W. (Ed.) (2001) Woodhead Publishing.
4. Refrigeration and Air Conditioning By C.P. Arora, 2nd Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2000
5. Textbook of Refrigeration and Air Conditioning By R. S. Khurmi & J. K. Gupta, Eurasia Publishing House Pvt. Ltd., New Delhi 1999
6. Basic Refrigeration and Air Conditioning By Ananthanarayan PN, 4th Edition, McGraw Hill, Delhi 2013

REFERENCE BOOKS:

1. Refrigeration and Air Conditioning By W.F. Stoecker and J.W. Jones, 2nd Ed. McGraw-Hill Book Co., New York, USA. 1982
2. Refrigeration & Air Conditioning Technology By William C. Whitman, William, 6th Ed. Delmar, Cengage Learning, NY, USA. 2017
3. Refrigeration and Air Conditioning By Arora RC, PHI Learning, New Delhi 2010
4. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing/Elsevier.
5. James, S. J. & James, C. (2002). *Meat Refrigeration*. CRC Press/Woodhead Publishing.
6. Stringer, M. & Dennis, C. (2002). *Chilled Foods: A Comprehensive Guide* (2nd ed.). Woodhead Publishing.

26AF1504PC507C BEVERAGE TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. To understand the principles of beverage processing, formulation, preservation, and quality evaluation for alcoholic and non-alcoholic beverages.

2. To apply processing technologies and unit operations involved in the production of fruit beverages, carbonated drinks, fermented beverages, dairy beverages, tea, coffee, and functional beverages.
3. To analyse the effects of ingredients, processing conditions, packaging, and storage on beverage quality, stability, and shelf life.
4. To evaluate beverage manufacturing processes with respect to food safety, quality standards, regulations, and sustainability.
5. To develop value-added and innovative beverages using emerging technologies and novel ingredients to meet consumer and industry requirements.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the principles, classification, ingredients, and processing methods of various alcoholic and non-alcoholic beverages.

CO2: Apply appropriate processing, preservation, packaging, and storage techniques for the production of safe and high-quality beverages.

CO3: Analyse the influence of raw materials, formulation, processing parameters, and storage conditions on beverage quality, stability, and shelf life.

CO4: Evaluate beverage production systems based on food safety standards, quality assurance, regulatory requirements, and sustainability practices.

CO5: Design and formulate value-added beverages incorporating novel ingredients, functional components, and emerging processing technologies.

Units	TOPICS	Hrs,
1	**Introduction to Beverage Technology:** Classification of beverages, Beverage industry in India and global scenario, Composition and nutritional aspects, Water quality requirements, Beverage ingredients (sweeteners, acids, flavours, colours, preservatives), Beverage processing flow charts	**7**
2	**Fruit and Vegetable Beverages:** Fruit juices and nectars, Squashes, cordials, crushes, Ready-to-Serve (RTS) beverages, Fruit concentrates, Vegetable juices, Clarification and filtration, Preservation techniques	**8**
3	**Carbonated and Non-Carbonated Beverages:** Soft drinks, Carbonation principles, Carbon dioxide handling, Sports drinks, Energy drinks, Functional beverages, Low-calorie beverages, Isotonic beverages	**8**
4	**Tea, Coffee, Cocoa and Dairy Beverages:** Tea processing and beverage preparation, Coffee processing, Cocoa and chocolate beverages, Milk-based beverages, Flavoured milk, Fermented dairy beverages, Plant-based beverages Miscellaneous beverages: coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups, low-calorie and dry beverages, spices and plant extracts	**7**
5	**Fermented and Alcoholic Beverages:** Fermentation principles, Wine production, Beer manufacturing, Cider, Kombucha, Probiotic beverages, Quality control during fermentation, Common distilled sprits like Vodka, rum, Gin, Brandy, Whiskey, etc.	**8**
6	**Ingredients, manufacturing, packaging, Quality Control and Emerging Trends**: processes and equipment for different beverages; Water treatment and quality of water, Sweeteners, colorants, acidulants, clouding, clarifying and flavoring agents for beverages, Carbon dioxide and carbonation. Beverage packaging materials, Filling and sealing systems, Beverage spoilage, Quality assurance, HACCP and FSSAI regulations, Sensory evaluation, Novel beverages, Functional beverages, Ready-to-drink products, Sustainable processing technologies	**7**
	Total	**45**

TEXT BOOKS:

1. Ashurst, P. R. (2016). Chemistry and Technology of Soft Drinks and Fruit Juices (3rd ed.). Wiley-Blackwell.
2. Woodroof, J. G. & Phillips, G. F. (1981). Beverages: Carbonated and Non-carbonated. AVI Publishing Company.
3. Priyadarshini, S. & De, S. (2018). Technology of Non-Alcoholic Beverages. Oxford Book Company.
4. Fruit and Vegetable Juices By Tressler D.K., Joslyn M.A. and Marsh G.C., AVI publishing company New York 1971
5. Food and Beverage Technology International USA By Bernard and Alan, Sterling Publication, 1989
6. Beverages: Technology, Chemistry and Microbiology By Varnam and Sutherland, Springer, 1994

REFERENCE BOOKS:

1. Hui, Y. H. (Ed.) (2006). Handbook of Food Science, Technology, and Engineering (Vol. 4: Beverages). CRC Press.
2. Steen, D. P. & Ashurst, P. R. (2008). Carbonated Soft Drinks: Formulation and Manufacture (2nd ed.). Blackwell Publishing
3. Tucker, G. S. (Ed.) (2016). Food Beverage Stability and Shelf Life. Woodhead Publishing.
4. Bamforth, C. W. (2005). Food, Fermentation and Micro-organisms. Blackwell Publishing.
5. Joshi, V. K. (Ed.) (2016). Indigenous Fermented Foods of South Asia. CRC Press.
6. Fellows, P. J. (2017). Food Processing Technology: Principles and Practice (4th ed.). Woodhead Publishing/Elsevier.
7. Handbook of Alcoholic Beverages By Alan Buglass, John Wiley and Sons, 2011
8. Beverages By Pare Jean, Company's Coming Publishing Limited, 1997
9. Preservation of Fruit and Vegetable Products By Girdharilal, Siddappa, Tondon, Indian Council of Agricultural Research, Publications 1986

26AF1504PC508A SPICES AND PLANTATION CROPS TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:03	Internal Assessment:20Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. Impart knowledge about the importance, scope, and specific characteristics (composition, chemistry, etc.) of various plantation crops.
2. Develop an understanding of the principles and practices of post-harvest management, including harvesting techniques, pre-cooling, grading, and storage, to minimize losses.
3. Acquaint students with the specific processing technologies for converting raw plantation produce into finished products (e.g., manufacture of tea, coffee powder, cocoa, spice oils/oleoresins).

Course Outcome:

After completion of this course, students will be able to:

CO1: Understand the unique composition and properties of different plantation crops and how these influence processing methods.

CO 2: Apply appropriate post-harvest handling and preservation techniques to maintain the quality and safety of plantation crops.

CO3: Operate and manage equipment and processes used in the industrial processing of tea, coffee, cocoa, and spices.

CO-4: Evaluate the quality of raw materials and finished products using relevant analytical techniques and quality standards.

CO-5: Develop new value-added products (e.g., chocolate, essential oils, various spice products) from plantation crops and their by-products.

Unit	Contents	Hrs.
1	**Introduction:** Introduction, definition, importance, historical significance, Production and processing scenario of spices and plantation crops. Commercial value of Spices, Condiments, plantation crops and their products in global market.	6
2	**Major spices:** Processing technologies and equipments for spices like–ginger, chilli, turmeric, onion, garlic, pepper and cardamom	7
3	**Minor spices, herbs and leafy vegetables:** processing of All spice, annie seed, sweet basil, caraway seed, cassia, cinnamon, clove, coriander, dill seed, Fern seed nutmeg, mint, marjoram, Rose merry, saffron, sage, savory, thyme, ajowan, curry leaves, asafetida , etc.	8
4	**Processing Technologies for Plantation Crops:** Processing technologies, equipments and quality control for Tea, Coffee, Cocoa, kokum, chicory, jackfruit, coconut, Vanilla and annatto-processing. By products of plantation crops processing and its utilization. Processing of arecanut and cashewnut and its quality control	10
5	**Spice and flavorings:** Flavoring compounds in Spice as spice-oils, spice powders, oleoresins, concentrates, etc. Separation and purification of natural and Synthetic flavoring agents. Quality Standards and Specifications	8
6	**Quality Assurance and Marketing of Spices and Plantation Crop Products**: Quality evaluation and control of process, Food safety and hygiene practices, Marketing strategies and channels, Packaging technologies, regulations and certifications. By products from plantation crops and spices	6
	Total	45

TEXT BOOKS :

1. Spices and Plantation Crops by K.G. Shanmugavelu, Agrotech Publication, Delhi
2. Spice and Condiments by Pruthi J.S., National Book Trus, 1996
3. Handbook on Spices and Condiments (cultivation, processing and extraction), Panda H., Asia Pacific Business Press Inc. 2010
4. The Complete Book on Spices &Condiments (with cultivation, processing & uses) by NIIR BOARD, Asia Pacific Business Press Inc. 2010
5. Spices and Seasonings: A Food Technology Handbook by Tainter DR and Grenis AT, John Wiley and Sons, 2001

REFERENCE BOOKS:

1. Handbook of Herbs and spices by Peter VK, Woodhead Publishing 2012
2. The Book of Spices by Rosengarten F., Pyramid Books, 1973
3. Spices and Herbs for the Food Industry by Lewis YS, Food Trade Press, 1984
4. Food Flavourings by P.R. Ashust, Springer, 2012

26AF1504PC508B DIGITAL TECHNOLOGY IN FOOD PROCESSING

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives:

1. To introduces students to digital technologies transforming the food processing industry.
2. To covers Industry 4.0, Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), Robotics, Big Data Analytics, Blockchain, Digital Twins, Cloud Computing, Smart Manufacturing, and Digital Quality Management systems.
3. To learn how these technologies improve productivity, food safety, traceability, sustainability, and decision-making in modern food industries.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the role of digital technologies and Industry 4.0 in food processing.
CO2: Apply IoT and sensor technologies for process monitoring and quality control.
CO3: Analyse applications of AI, Machine Learning, and Big Data in food manufacturing.
CO4: Evaluate digital traceability, blockchain, and cybersecurity solutions in food supply chains.
CO5: Design smart food processing systems integrating automation and digital technologies.

Units	TOPICS	Hrs,
1	**Introduction to Digital Technologies in Food Processing:** Digital transformation in food industries, Industry 4.0 concepts, Smart manufacturing, Cyber-Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Edge Computing, Industrial communication networks, Benefits and challenges of digitalization	**7**
2	**IoT and Smart Sensors in Food Processing:** Smart sensors and actuators, Wireless Sensor Networks, RFID technology, GPS applications, Real-time monitoring, SCADA systems, PLC-based automation, Smart packaging, Predictive maintenance, Environmental monitoring in food plants Applications: Cold chain monitoring, Dairy processing, Meat processing, Beverage industry	**8**
3	**Artificial Intelligence and Data Analytics:** Introduction to Artificial Intelligence, Machine Learning concepts, Deep Learning overview, Computer Vision, Image processing for quality inspection, Predictive analytics, Big Data in food industries, Decision support systems, **AI applications:** Sorting and grading, Shelf-life prediction, Process optimization, Demand forecasting, Defect detection	**8**
4	**Digital Supply Chain and Traceability:** Block chain technology, Digital traceability, Food authentication, Food fraud detection, Supply chain digitalization, Warehouse automation, ERP systems, Digital logistics, Cyber security in food industries, Regulatory aspects **Case studies**: Farm-to-fork traceability, Export food chains	**7**
5	**Advanced Digital Technologies:** Robotics in food processing, Collaborative robots (Cobots), Autonomous Guided Vehicles (AGVs), Digital Twin technology, Augmented Reality (AR), Virtual Reality (VR), 3D Food Printing, Sustainable smart manufacturing, Future trends in digital food industries, Industrial case studies	**8**
6	**Digital Quality Management and Food Safety:** Digital Food Safety Management Systems (FSMS), HACCP in digital food processing, Process Analytical Technology (PAT), Statistical Process Control (SPC), AI and Computer Vision for quality inspection, Digital documentation and regulatory	**7**

	compliance, Industrial applications and case studies	
	Total	**45**

TEXT BOOKS:

1. Digital Transformation in the Food Industry – Galanakis, C. M.
2. Food Industry 4.0 – Galanakis, C. M.
3. Internet of Things: Principles and Paradigms – Rajkumar Buyya
4. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig
5. Machine Learning – Tom M. Mitchell

REFERENCE BOOKS:

1. Automation in Food Processing – Da-Wen Sun
2. Computer Vision in Food Quality Evaluation – Da-Wen Sun
3. Blockchain in Agriculture and Food Supply Chain
4. Big Data Analytics – Seema Acharya

26AF1504PC508C EXTRUSION TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Lectures Theory:03Hr/Week Credit:3	Internal Assessment:20 Marks Mid-Sem Exam: 20 Marks End Sem Exam: 60 Marks

Course Objectives

1. Understand the principles, equipment, and processing parameters involved in food extrusion technology for the manufacture of diverse food products.
2. Apply extrusion processing techniques to produce cereal-, pulse-, protein-, and snack-based food products with desired quality attributes.
3. Analyse the effects of raw material characteristics and extrusion variables on product quality, nutritional properties, and process efficiency.
4. Evaluate extrusion systems with respect to product quality, energy efficiency, food safety, and industrial applications.
5. Develop innovative extruded food products by integrating novel ingredients, process optimization, and emerging extrusion technologies.

Course Outcomes

After completion of this course, students will be able to

CO1: Explain the principles, types, components, and applications of extrusion technology in food processing.

CO2: Apply suitable extrusion process parameters for the production of cereal, pulse, protein, and functional food products.

CO3: Analyse the influence of raw material properties and extrusion variables on product quality, nutritional characteristics, and process performance.

CO4: Evaluate extrusion processes based on food safety, product quality, process efficiency, and sustainability.

CO5: Design and optimize extrusion processes for the development of value-added and innovative food products

Units	TOPICS	Hrs,
1	**Fundamentals of Food Extrusion:** Introduction to food extrusion technology, History and evolution of extrusion processing, Principles of extrusion cooking, Classification of extruders: Single-screw and twin-screw extruders, Components	7

	of extrusion systems: Feed hopper, barrel, screw configuration, die, cutter and drive system, Advantages, limitations and industrial applications of extrusion technology	
2	**Raw Materials and Process Variables:** Raw materials used in extrusion: cereals, millets, pulses, legumes, starches, proteins and dietary fibres, Functional properties of extrusion ingredients, Role of moisture content, particle size and ingredient composition, Process variables: barrel temperature, screw speed, feed rate, die configuration and residence time, Rheological behaviour of food materials during extrusion, Effect of extrusion parameters on product characteristics	**8**
3	**Extrusion Processing and Product Development:** Extrusion cooking mechanism, Expansion and texturization phenomena, Manufacture of: Ready-to-eat snack foods, Breakfast cereals, Pasta and noodles, Baby foods, Instant food mixes, Pet and aquaculture feeds, Texturized vegetable proteins (TVP), Product formulation and optimization	**8**
4	**Quality Evaluation and Nutritional Aspects:** Physical properties: expansion ratio, bulk density, water absorption index (WAI), water solubility index (WSI), texture and colour, Nutritional changes during extrusion, Effect on carbohydrates, proteins, lipids, vitamins and minerals, Functional properties of extruded foods, Shelf-life studies and quality evaluation, Packaging and storage of extruded products	**7**
5	**Process Optimization and Industrial Applications:** Process optimization techniques, Experimental design and Response Surface Methodology (RSM), Process control and automation in extrusion, Energy efficiency and sustainability in extrusion processing, Industrial applications in cereal, snack, confectionery and protein-based food industries, Food safety and quality assurance in extrusion processing	**8**
6	**Emerging Trends in Food Extrusion Technology:** High-moisture extrusion technology, Extrusion for plant-based meat analogues, Functional and fortified extruded foods, Gluten-free extruded products, Extrusion of novel ingredients (millets, pulses, underutilized grains), 3D food printing using extruded materials, Digitalization, Industry 4.0 and AI applications in extrusion processing, Sustainable extrusion and future prospects	**7**
	Total	**45**

TEXT BOOKS:

1. Guy, R. C. E. (Ed.) (2001). Extrusion Cooking: Technologies and Applications. Woodhead Publishing.
2. Riaz, M. N. (2000). Extruders in Food Applications. Technomic Publishing Company.
3. Harper, J. M. (1981). Extrusion of Foods. CRC Press.
4. Extruded foods By Matza S., Springer, 2000
5. Technology of Extrusion Cooking By N.D. Frame, Springer, 2012
6. Extruders in Food Application By Riaz M.N., CRC Press, 2000

REFERENCE BOOKS:

1. Fellows, P. J. (2017). Food Processing Technology: Principles and Practice (4th ed.). Woodhead Publishing/Elsevier.
2. Frame, N. D. (Ed.) (1994). The Technology of Extrusion Cooking. Springer.
3. Singh, R. P., Heldman, D. R. & Erdogdu, F. (2024). Introduction to Food Engineering (6th ed.). Academic Press/Elsevier.
4. Brennan, J. G. (Ed.) (2006). Food Processing Handbook. Wiley-VCH.
5. Advances in Food Extrusion Technology By Maskan and Altan, CRC Press, 2000

6. Extrusion of Foods By Harper JM, CRC Press, 1981
7. New Protein Foods, vol. I, and II By A.L. Altschuls, Academic Press, 1985