SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology
Rules and Regulations for
M.TECH. Courses
Introduced from July 2013-14 onwards

Preamble:

- **What is a credit system?**

A credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**

- Represents a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning, not in teaching.

- Helps to record course work and to document learner workload realistically since all activities are taken into account - not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.

- Segments learning experience into calibrated units, which can be accumulated in order to gain an academic award.

- Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- Affords more flexibility to the learners allowing them to choose inter-disciplinary courses, change majors, programmes, etc.

- Respects 'Learner Autonomy'. Allows learners to choose according to their own learning needs, interests and aptitudes.

- Makes education more broad-based. One can take credits by combining unique combinations. For example, if a learner is studying music, he/she can also simultaneously take a course in Business Management.

- Facilitates Learner Mobility. Offers the opportunity to study at different times and in different places. Credits earned at one institution can be transferred to another.

- Helps in working out twinning programmes.

- Is beneficial for achieving more transparency and compatibility between different educational structures.

- A credit system can facilitate recognition procedures as well as access to higher education for non-traditional learners.

➢ **Some Key Terms**

- **Program:**

A Program is a set of courses that are linked together in an academically meaningful way and generally ends with the award of a Certificate or Diploma or Degree depending on the level of knowledge attained and the total duration of study. For example, Certificate in office Computing, Diploma in Journalism, BA and BSc , etc. would be called 'Programs' at the Certificate, Diploma and Degree level respectively. Over the years, most universities have been using the term 'Course' to indicate what is meant here by 'Program'. In **order to use common nomenclature, therefore, let us refer to BA, B.Sc and B.Com, B.E./M.E, B.Tech/M.Tech as Programs, not Courses.**

- **Course:**

A 'course' in simple terms corresponds to the word 'subject' used in many universities. A course is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, that is, there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program. For instance,

1. 'Compulsory Power Electronics', 'Micocontroller', ' Micro-Electronics', etc. included under the B.Tech/M.Tech Electronics program would be called 'Courses'

2. Mechanical,Civil,Electrical, Electronics,Computer. included under the B.Tech/MTech. Programme would be called 'Courses' for single major Engineering in respective branches.

- **Module and Unit:**

A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. While it is a common practice to treat a single course as an independent module, there are instances where in a single '**Unit**' or a Topic within a course is treated as a Module. For instance,

- One Topic in a course on 'Compulsory English' could be 'Reading Skills'. Such a topic would be called a 'Unit'. If this Unit can operate as a single separate entity, it may be called a 'Module'.

- One Topic in a course on 'Mathematics' could be 'Double integral'. Such a topic would be called a 'Unit'. If this Unit can operate as a single separate entity, it may be called a 'Module'.

- One paper in mathematics will be called one course. Thus in Mathematics at FYBSC level (Semester I and semester II) paper I will be called one module. Every paper in each subject under science faculty will be separate entity and hence it is a course. Structuring the entire curriculum of a program in terms of independent modules helps to provide a lot of flexibility and choice for the learner. He/She can then work out his own combination of courses as per his/her own inclinations.

- **Credit Point:**

This has a reference to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc.. Generally, a system of assigning Credit Points (CP) for a single course is practiced in most countries across the globe. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully. The fallacy of assigning credits to a course purely based on how many lectures (teaching hours) are conducted for a learner at a certain level needs to be avoided. Although there is no hard and fast rule regarding how many credit points a single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein **1 credit is construed as corresponding to approximately 30 to 40 learning hours.**

- **Credit completion and Credit accumulation:**

Each module of an academic program that has been assigned specific credit points also has a certain scheme of learner evaluation as well as certain specific criteria defining successful completion. Credit completion or Credit acquisition may be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. His level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus he 'accumulates' course wise credits.

- **Credit Bank:**

The process of accumulating Credits over a period of time, leads to the idea of a 'Credit Bank'. Conceptually, a Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history. In short, like a regular Bank, this would involve maintaining all the Credit–related transactions of an individual. Credit Banking, when practiced would go a long way in facilitating credit transfers and learner mobility.

- **Credit Transfer:**

Apart from maintaining an account of credits acquired by a learner over a period of time for a wide range of courses, the main idea behind implementing the credit system is to make provision for learner mobility. Credit Transfer means that credits earned at one institution for one or more courses under a given program are accepted under another program either by the same institution or another institution. In practice this means that it is accepted that a certain chunk of learning has already been successfully completed by a learner. This acceptance of earlier acquired credits may be reflected in one of two ways:

(i) Direct Performance Transfer **or** (ii) Course exemption.

- **Performance transfer:**

When a learner who has successfully completed a certain academic program, is allowed to transfer his past performance to another academic program having some common courses,

performance transfer is said to have taken place. In such cases, the grades or marks obtained by the learner in the common courses of the earlier completed program are reflected unchanged in the new program. Thus for example, if two academic programs have 3 common courses, the grades (or marks) in each of them would be reflected in the same way when considering the new academic program. .

- **Course exemption**:

Occasionally, two academic programs offered by a single university or by more than one university may have some common or equivalent course-content. The learner who has already completed one of these academic programs is then allowed to skip these

'equivalent' courses when registering for the new program. He is then 'exempted' from 're-learning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

- **What is Grading?**

The word Grade is derived from the Latin word *gradus*, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learners' performance but it also indicates the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the course by the learners.

- **Encumbrances to Evaluations Reforms**

The issues related to examination and evaluations do not have any state or national boundaries, but are global in nature. It is accepted by all the stakeholders that our educational system is examination ridden. The declaration of examination results with award of marks and class has become of paramount importance for all the stakeholders in the system. In many cases, once the results are out, there is no scope for improvement in marks or performance improvement. This results in a lot of students being deprived from further opportunities. In spite of the repeated regulations and reminders from the UGC and similar continuous follow up from the state government to implement some reforms in the examination system, the fact remains that most universities and higher education institutions have not adopted the same. Some reasons for the delay in implementation of reforms in the academic and examination system are as follows:-

1) Unfortunately, a large section of the society suffers from inertia and is, therefore, reluctant to accept any change.
2) The new system which is planned for implementation has not been clearly explained.
3) Most of the teachers, academic administrators and community at large are inattentive to the intricate technicalities of examinations which affect their reliability, validity & objectivity.
4) There are vested interests that perpetuate the existing practices.
5) Additional time is required to prepare proper guidelines and manuals so as to enable the various stakeholders in understanding the new system.

- **Deficiencies in the Traditional Marking System**

Learners' Evaluation is the process of collecting, analyzing and interpreting the evidences to judge the level of performance performed by the individual learner or a group of learners for the purpose of making the decision of achievement level. The prevailing practice of

evaluation of learners that has been in existence since long involves evaluating the performance of an individual or group of individuals at the end of an academic year within a stipulated time. The learners are often required to express their understanding or mastery over the content included in their curriculum for a complete year within a span of three hours and their efforts over the year are often completely ignored. The present system of evaluation also does not provide for the application of multiple techniques of assessment of the learner's performance in a valid and reliable way. Apart from the several ills that prevail in the examination system through inappropriate testing methods and tools, the current practice of awarding numerical marks for reporting the performance of learners suffers from several

drawbacks and is a source of a variety of errors. Further, the problem gets compounded due to the variations in the marks awarded in different subjects. The 'raw score' obtained by the learner, is, therefore, not a reflection of his true ability.

Our aim to assess the learner's true ability is not being served by the current practice of evaluation. Excellence in quality education can be achieved by evaluating the true ability of the learners with the help of continuous evaluation. **Some deficiencies in the present marking system are listed as follows:-**

1) A difference of one mark is an unrealistic indication of difference in ability. Calibrating students on a 101 point scale (0 to 100) as required in the marking system cannot be objectively achieved.

2) Judgmental bias reflected in the assessment of learners, particularly in the subjective type of answers results in subjectivity in marking.

3) The score of zero which is artificially created for the convenience of the user does not represent zero ability.

4) The score of hundred does not reflect perfection in performance.

5) Marks tend to be unreliable as a consequence of subjectivity due to inter and intra examiner variability.

6) The magnitude of the subjective errors in marking is reported to vary from ten to twenty five (10-25) percentages.

7) Marks obtained in the examinations are considered as the yardstick of the quality of performance which is very sacrosanct for the society.

8) The marks awarded by examiners are often affected by many factors such as unfair means, erratic marking, and subjectivity of the examiners, etc.

9) It is unfair to label a student as 'pass' or 'fail' on the basis of such unreliable evaluation.

10) The 'pass' or 'fail' system often results in promoting corrupt practices besides being discriminatory.

- **Advantages of Grading System**

In view of the deficiencies mentioned above, it is desirable that the marking system used for the declaration of results is replaced by the grading system. According to the grading system, students are placed in ability bands that represent a range of scores. These ability bands may vary according to the number of categories for the classification of the performance of the learners. This ability range may be designated with alphabetical letters called as GRADE. The system of awarding grades would provide a more realistic picture of learner's ability than the prevailing marking system.

However, before we go in for the introduction of grades in place of marks, let us be very clear about one thing. Each method of reporting student performance –marks or grades has its own set of problems and limitations. However, this should not prevent the efforts to use a more scientific and reliable system so as to minimize the shortcoming and difficulties.

Due to the superiority of the grading system over the conventional marking system, several premier institutions and universities of high repute in India as well as abroad have introduced it successfully. **There are several advantages of the grading system; some of them are listed below:**

1) Grading is a far more satisfactory method than the numerical marking system as it reflects an individual learner's performance in the form of a certain level of achievement in relation to the whole group of learners.

2) The Grading system ensures natural classification in qualitative terms rather than quantitative terms since it expresses a range /band of scores to which a student belongs such as O, A, B etc….

3) The award of grades provides a permanent record of the learner's growth and development that might be helpful for institutions of higher education for allocating seats for prospective employers.

4) It may be very helpful for the institutions itself in making a kind of decisions pertaining to placement and promotions.

5) Grading does not require making fine distinctions in performance when no such distinctions

actually exist.

6) It is based on a realistic concept of 'errors of measurement'.

7) Grades are relatively free from extraneous factors like difficulty of the examination, examiner bias, nature of the subject being examined, etc.

8) Grades can be interpreted easily and directly and can be used to prepare an accurate 'profile' of a student'.

9) The system of assigning Grades as opposed to giving Marks will help the creation of healthy competition among students since the rat race for obtaining marks will be eliminated. This will indirectly contribute to relieving the students from undue tension and pressure that may occasionally lead to suicides, trauma, etc.

1. INTRODUCTION

Department of Technology, Shivaji University Kolhapur has been offering 4 post-graduate programs leading to Master's degree in Technology (M.Tech.) since 2006-07 and will offer 5th programme i.e.M. Tech. (Food Technology) from 2013. Admissions to this program are based on primarily on the valid GATE (Graduate Aptitude Test Examination) score. However, if GATE candidates are not available, then the admissions are as per the norms set by the DTE/ Shivaji University, Kolhapur. These norms include the performance of a candidate in a common entrance test conducted by the Department of Technology of Shivaji University, Kolhapur. The intake for the P.G. program of various courses sanctioned by AICTE is as follows.

Sr. No.	Name of the M.Tech Program	Total intake	Open	OBC	SC	ST	Sponsored
1.	**Computer Sc. & Technology**	18	7	3	2	1	5
2.	**Electronics Technology**	18	7	3	2	1	5
3.	**Energy Technology**	18	7	3	2	1	5
4.	**Environmental Sc. & Technology**	18	7	3	2	1	5
5.	**Food Technology**	18	7	3	2	1	5

2. CURRICULUM

2.1. Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes courses to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

2.2. Semesters:

The Department of Technology implements a credit based curriculum and grade based evaluation system. P.G. program is of four semesters. The academic courses are delivered in the first two semesters and during the period of vacation after second semester; the student has to undergo 8 weeks industrial training. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the second week of July and ends by the last week of November while the second semester begins in the first

week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

2.3. Course Credit

Education at the Department of Technology is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programs are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

2.4 Course credits assignment

Each course, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Practical/Laboratory: One laboratory hour per week per semester is assigned half credit.

Example: Course: XYZ Technology: 4 credits (3-0-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

0 hours/week tutorial = 0 credit

2 hours/week practical = 2 × 0.5 = 1 credit

(3-0-2) **4** credit course = (**3** h Lectures + **0** h Tutorial + **2** h Practical) per week

= **5** contact hours per week

2.5 Earning credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

2.6 Evaluation system

1. Semester Grade Point Average (SGPA) =

$$\frac{\sum (\text{course credits in passed courses X earned grade points})}{\sum (\text{Course credits in registered courses})}$$

2. Cumulative Grade Point Average (CGPA) =

$$\frac{\sum (\text{course credits in passed courses X earned grade points) of all Semesters}}{\sum (\text{Course credits in registered courses) of all Semesters}}$$

3. At the end of M. Tech Program, student will be placed in any one of the divisions as detailed below (According to AICTE Handbook 2011-12):

   Ist Division with distinction : CGPA $\geq$ 8.25 and above

   Ist Division : CGPA $\geq$ 6.75 and < 8.25

   IInd Division : CGPA $\geq$ 6.75 and < 6.25

As per AICTE Handbook (2011-12), new gradation suggested as follows.

Table 1

Grade Points	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA≥5.0 can be obtained using equations.

Percentage marks = (CGPA x 10) – 7.5

An example of these calculations is given below:

Typical academic performance calculations - I semester

Table 2

Course no.	Course credits	Grade awarded	Earned credits	Grade points	Points secured

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6 (col4 *col5)
MALXXX	5	CC	5	6	30
CSLXXX	4	CD	4	5	20
PHLXXX	4	AA	4	10	40
PHPXXX	2	BB	2	8	16
MELXXX	4	FF	0	0	00
TTNXXX	2	AB	2	9	18
Total	21		17	38	124

1. Semester Grade Point Average (SGPA) =

$$\frac{(124)}{(21)} = 5.90$$

2. Cumulative Grade Point Average (CGPA) =

Cumulative points earned in all passed courses = 124 (past semesters) + 124 (this sem.) = 248

Cumulative earned credits = 23 (past semesters) + 21 (this sem.) = 44

$$\frac{\sum (124 + 124)}{\sum (23 + 21)} = 5.63$$

System of Evaluation Table

Table 3

Grade	Grade Points	Marks obtained (%)			Description Performance
		Regular Semester	Re-Examination	Summer Semester Examination/ Re-appear	
AA	10	91-100	--	--	Outstanding
AB	09	86-90	91-100	91-100	Excellent
BB	08	76-85	86-90	81-90	Very Good
BC	07	66-75	76-85	71-80	Good
CC	06	56-65	66-75	61-70	Fair
CD	05	46-55	56-65	51-60	Average
DD	04	40-45	40-55	40-50	Poor
FF	00	Below 40	Below 40	Below 40	Fail
EE					Incomplete
WW					Withdrawal
XX	--	--	--	--	Detained
ABSENT	--	--	--	--	Absent
PP	--	--	--	--	Passed (Audit Course)
NP	--	--	--	--	Not Passed (Audit Course)

3. Evaluation Scheme:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous

Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :
   Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
   Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).
4. Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).
5. Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).
6. The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

   i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

   ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

   iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

   iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

9. A student failed in SEE of a laboratory course in a regular semester shall be eligible to appear for examination conducted along with SEE of laboratory courses of the subsequent semester. Such examination shall be fairly comprehensive (generally of 3 hours similar to EPE/EOE i.e. External Practical/Oral Examinations) to properly judge his/her practical skill and theoretical knowledge for that laboratory course. He/She shall suffer a grade penalty as per Table 3.

3.1 Re-examination

If the student misses the continuous internal evaluation of semester due to illness or accident, his application for re-examination must be supported by proper medical certificate duly approved by medical authority. In the event of death of parent or guardian, the application should be supported by adequate evidence of the same.

Any student who fails to apply for re-examination in the prescribed manner will be declared as failed in those courses. The Co-ordinator and Director is empowered to take decisions to handle such issues. **However, after the re-examination, grade awarded will be as per table 3.**

3.2 Summer Term

- About summer term: The student who has failed to clear theory courses/practicals in the regular two semesters of an academic year will be allowed to reappear in the Summer Term which will be held in the summer vacation, by payment of necessary fees on a specified date.

- By paying appropriate fees as per university rules student will be allowed for reappearing in the Summer Term

- Examinations in the Summer Term: The end summer examination of 100 marks will be held for theory courses at the end of summer term.

- The semester end examination of summer practical/laboratory have 100 % weightage (Two hours duration) will be held after theory examination. This shall be evaluated by panel of two examiners for each practical course. In this evaluation, weightages shall be 50:50, for performance of the student in implementation of the practical assigned and oral, respectively.
- However, after the summer term examination the highest grade awarded will be **as per table 3**.

3. 3 Re-appearing

- Student can **re-appear** in the theory and/or practical's in which he/she has secured FF grade, by the payment of necessary fee and he/she can reappear for end-semester examinations of theory and practical's of first and second semester, which will be conducted at the end of first and second semester, respectively.

- The theory courses for which the student is re-appearing shall appear for continuous Internal Evaluation (50% weightage) consist of Internal Test 1st (25% weightage) and Internal Test 2 (25% weightage) and Semester end Examination (50% weightage) of 3hrs. Duration shall be used for the calculation of new grade, which will not exceed BB from regular semester.

- The semester end examination for laboratory of reappearing students shall be conducted with regular student's practical examination. This examination will be of 100 % weightage and the weightages shall be 50:50, for the performance of the student in the implementation of the practical assigned and the oral, respectively. However, in no case the highest grade **awarded will exceed BB from regular semester.**

4 Attendances

- Attendance in classes for all the subjects is compulsory and should be 100%.
- Relaxation of maximum 25% in attendance is permissible to the students on account of medical problems or any genuine reason.
- Student not having 75% attendance in any course/ practical will not be allowed to appear in the end-term examination of that respective course/ practical and given XX grade. He/she has to reregister for all such courses.

5 Student Status

There are various types of student's status:

- Full-time Student on Teaching Assistantship (GATE)
- Full-time Sponsored Student
- Full-time Self-finance Student

5.2 Full-time Student on Teaching Assistantship

A full-time student should complete the Programme within **24 months**. A Full Time student on Teaching Assistantship will receive the Institute Assistantship for the duration of **four** semesters of the M.Tech. Programme, provided he/she has cleared GATE, Such students are awarded **Teaching** Assistantship on the following condition.

i) They should not accept any other scholarships/ employments/financial assistance/salary etc. awarded through any other sources or shall not hold any appointment, paid or otherwise.

ii) They are not sponsored by any organization.

iii) They do not leave the course midway or appear in any competitive examination not related to engineering/technology. They should submit the undertaking in this regard mentioning the refund of scholarship.

The present rate (supported by AICTE (MHRD)) of Teaching Assistantship of **Rs. 8000/-** per month is payable from the date of registration of the first semester till the date of final assessment of dissertation. However in no case the duration of teaching assistantship will exceed 24 months.

(a) Students getting the assistantship will be required to assist in teaching or research, as assigned by the department, to the extent of 6 to 8 hours per week for conduct of practicals/tutorials/lab courses.

(b) The continuation of the assistantship will be subject to satisfactory performance of the duties assigned by the Department as well as satisfactory academic performance.

(c) All M. Tech. students normally will have to complete the programme in 24 months.

(d) For continuation of full assistantship minimum Cumulative Grade Point Average (CGPA) is 6.75. Those who get CGPA less than 6.75 will receive the teaching assistantship of Rs. 2000/- per month till he attains CGPA of 6.75. After he attains the CGPA of 6.75 he will be paid the full teaching assistantship.

5.2 Full-time Sponsored Students

Sponsored candidates who are admitted to the programme should have full financial support from the concerned sponsoring agency, namely, the Govt. Department, organization, Industry, etc., for the entire duration of the programme. They can complete programme on time, depending on the nature of sponsorship.

6. Pattern of Courses

The courses offered for the PG Programmes may be Lecture Courses, Laboratory Courses, Seminars and Projects, and Field Visits.

- The credit for a course is mentioned in the courses of study profile of department.
- Students are required to complete all the credit required for the PG programme as approved by the Departmental Committee from time to time.

❖ Seminar

Seminar shall satisfy the following conditions:

i) Each seminar shall carry two credits and treated as a course for purpose of registration and evaluation.

ii) Seminar examiners, at least two examiners including guide, appointed by the Co-ordinator shall organize the Seminars and forward the grades/marks awarded by the panels of examiners to the Controller of Examination Office by the end of the Semester.

iii) Examiners should be P.G. Teachers

❖ Industrial Training

ii) The period of vacation after second semester, the student has to undergo 8 weeks Industrial training and as a part of evaluation at the end of third semester student should submit the report for the same and give presentation to the concern guide

iii) Industrial Training examiners appointed by the Co-ordinator. Department should organize the Seminars and oral exam and forward the grades/marks awarded by the panels of examiners to the Controller of Examination Office by the end of the Semester.

7. Course Credit Requirements

- The total minimum credit requirement for M. Tech. programme is 80 credits including the dissertation as per AICTE norms

8. Course Assessments and award of grades

8.1 Assessment

For every course taken by the students, he/she is assigned a letter grade on his/her combined performance in all the assessments. These grades are described by the letters and corresponding grade points. The award of grades based on absolute marks out of 100 shall be made as, AA (10 points), AB (9 points), BB (8 points), BC (7 points), CC (6 points), CD (5 points), DD (4 points), FF (0 points - Re-registration), EE-Incomplete, and W – Withdrawal. Minimum passing grade in a course is DD.

If a student does not take or fails in the re-examination, he/she will be awarded the grade **F**. A student getting an **F** grade has to re-appear.

The award of grades based on marks out of 100 weightage shall be made as shown in Table 3. Note that the grade boundaries as indicated in the table may be marginally adjusted and the upper and lower limits are subject to limitations of percentage of marks.

8.2 Seminar Grade

- If a student either does not submit his seminar report by the prescribed date or he/she is absent for presentation on the scheduled date he/she shall be awarded E grade unless he/she is given extension by the coordinator under exceptional circumstances. However in no case the extension shall exceed one month.

- All students who get EE grade in Seminar shall be allowed to complete the evaluation during the period earmarked for re-examination and the grade will be as per table given for re-examination.

8.3 Industrial Training

- If a student either does not submit his/her training report by the prescribed date or he/she is absent for presentation on the scheduled date he/she shall be awarded E grade unless he/she is given extension by the coordinator under exceptional circumstances. However in no case the extension shall exceed one month.

- All students who get EE grade in industrial training shall be allowed to complete the evaluation during the period earmarked for re-examination and the grade will be as per table given for re-examination.

8.4 Dissertation

- The student shall be allowed to submit the dissertation phase I report only after the completion of minimum 50% work of the total project with intermediate /partial results of the dissertation project to the concern guide and the dissertation phase II

report only after the full-fledge demonstration of his /her work to the concerned guide. Assessment of the dissertation shall be based on design & implementation aspects, documentation & presentation skills, utility of the dissertation work & publications based on the same. For the dissertation phase I and phase II concern guide should guide to each student minimum for **2**hrs per week till the final submission of the dissertation of the concern student.

- Students are required to submit final hard bound dissertation report to the respective Department with consent of guide for both dissertation phase I &phase II
  .

- The viva-voce will be conducted by the department.

- Forms for submission of assessed Dissertation, duly completed must be deposited to the Controller of Examination office along with the provisional clearances from Accounts Section.

- Final grade/marks reports are to be sent by the panel of examiners to the Controller of Examination office on completion of viva-voce.

8.6 Late Submission of Dissertation

In any case the student has to complete M. Tech. Programme in four years. The extensions given can exceed till the end of the last academic year. Whenever, any project stage is not submitted before the last date as specified in the academic calendar, the student is required to:

a) Make specific request for extension with justification (without grade restriction) at least 15 days before the last date of submission as specified in the academic calendar.

b) Pay the Institute fees and register for the **fifth/sixth/seventh/eighth** semester for the extension after forth/fifth/sixth/seventh semester, respectively

8.6 Dissertation Evaluation

- The Dissertation phase I assessment and pre-submission assessment of dissertation PART II, if any, will be done by a panel appointed by the controller of examination office in consultation with the Guide. The panel shall consist of the Guide and at least one P.G. teaching faculty members conversant with the field from the university jurisdiction.

- The Dissertation phase II assessment will be done by a Board of Examiners appointed by the Controller of Examination office consisting of the following:

Chairman: Guide.

Guide/co-Guide: Nominated by Department of Technology.

- **Internal Examiner: P.G. teacher** Nominated by COE office, conversant with the field, in consultation with the Guide and He/She should be from the university jurisdiction.

External Examiner: From the panel of examiners approved by the appointment section, COE Office, Shivaji University, Kolhapur.

- The minimum passing grade in each of the dissertation assessment shall be CD.

- In case a student gets a fail grade in any of the project assessment he/she should carry out additional work/modifications etc. as suggested by the panel and appear for assessment within one month from the date of previous assessment. At this assessment, he/she should not be given a grade higher than BB.

- A full-time/GATE student should not take up any other assignment before submitting his/her dissertation.

8.8 Submission of Dissertation

He /She can be allow to submit his/her Dissertation Report by the end of IV Semester, provided that he/she should earn all the credits of Semester I,II & III respectively after earning all the credits of First Year.

8.8 Award of Degree

He /She will be awarded the M.Tech. Degree after acquiring 80 credits.

9.0 Performance Requirements

- The performance of a student in a semester is indicated by a number called the Semester Grade Point Average (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses and projects taken by the student during the semester.

- Example: Suppose in a given semester a student has taken five courses having credits C1, C2, C3, C4, C5 and his/her grade points in those courses are G1, G2, G3, G4, G5 respectively. Then his/ her

$$SGPA = \frac{C1\,G1 + C2\,G2 + C3\,G3 + C4G4 + C5G5}{C1 + C2 + C3 + C4 + C5}$$

- SGPA will be calculated (after re-examination, if any) on the basis of the final grades awarded. The SGPA is calculated up to two decimal places.

- An up-to-date assessment from the time the student entered the Institute is obtained by calculating a number called the Cumulative Grade point Average (CGPA).

- The CGPA is the weighted average of the grade points obtained in all the courses taken by the student since he/she entered the Institute. It is calculated in the same manner as the SGPA. **CGPA for the course credits and the project credits will be separately calculated and shown in the grade card, along with the overall CGPA.**

- In case of a student clearing a failed course, or a course taken in lieu of an earlier course as approved by the Department, the earlier failed grade would be replaced by the new passing grade in calculation of the CGPA.

- For continuation of a student in the Programme the minimum CGPA must be 5.00.

- For CGPA requirement of 5.00 if re-examination is allowed in any of the courses and is taken by the student, CGPA will be calculated using the new grade obtained by the student in the re-exam.

11. Leave Rules

The students getting teaching assistantship are entitled for a leave in an academic year - maximum of 30 days (including medical leave of 10 days) but they are not entitled for any vacation during summer/winter.

11. Departmental Committee

Departmental Committee consists of following: Director- Chairman

Branch Coordinator from respective branch – member

Senior faculty from respective branch – member

Guide/Course Coordinator- member)

SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology

M. TECH. IN FOOD TECHNOLOGY

A) Ordinances and regulations: (as applicable to P.G)

B) Shivaji University, Kolhapur

New Syllabus for Master of Technology in Food Technology

1. **TITLE: Subject**
   M. Tech. in Food Technology under the Faculty of Engineering & Technology

2. **YEAR OF IMPLEMENTATION:**

   New syllabus will be implemented from June 2013 onwards.

3. **PREAMBLE :**

With liberalization of Indian economy, all-round industrial growth has been witnessed in all sectors with improvement in social and economic conditions of our people. This has created demand for more and better quality foods. With advancement in production technology, large amount of marketable surplus of food gains and crop residues, demand appropriate handling, processing, preservation, storage, marketing and utilization. The development of processing industries to preserve the perishable agricultural produce will not only improve economic and nutritional status of our population but it may help in employment generation in rural as well as urban area of the country. This can be achieved by linking production and post harvest technology especially food processing technology in synergistic way.

Currently in the Department of technology, B.Tech. programme is running in five branches, out of these 3 branches have their M.Tech. Programme & Viz. Electronics & communication, Computer science & Tech. and Environmental Science & Tech. It is felt that M.Tech. programme in Food Technology is the urgent need of Western Maharashtra and Konkan region. Every year 1031 students having B.Tech . Food Technology degree are passing out in the whole Maharashtra State and out of these 340 students are from Ratnagiri and Western Maharashtra region. In our Maharashtra state only 4 institutions are offering M.Tech. Food Technology degree with total intake of 56 students and unfortunately there is no institute in Western Maharashtra and konkan region offering this Masters degree. Due to this severe shortage of post graduate degree in Food Technology, students from Maharashtra state are migrating to Northern Universities like

Allahabad University in UP and Longowala University in Punjab or Southern Private University like Karunya University, Coimbattur.

There is a shift in paradigm for higher education of Technology may be due to the higher salary of teachers and funding of Government agencies for research projects which attracts more numbers of students towards post graduate degrees. As Ph.D. in Food Technology is already started from 2010 in the Department of Technology, Shivaji University, Kolhapur and, we have experienced and qualified staff members, hence M. Tech. in Food Technology can be started from the coming academic year, 2013-14.

4. GENERAL OBJECTIVES OF THE COURSE/PAPER:

Followings are the objectives of this course

a) To cater competent Food Technologist to take leading roles in Industries, Research and Academic institutions at National and International levels.

b) To address the problems of farmers and entrepreneurs with respect to design and development of process and products, and come out with economically feasible solutions.

c) To enable the students to gain an insight into basic and advance Technologies in Food processing and preservation methods.

d) To provide a thorough knowledge on Food Analysis Techniques to manipulate the food quality and safety parameters.

e) To educate students about health and nutritional importance of food components so that they can pass on the health value of food to the society.

5. **DURATION**

The course will be a full time course.

The duration of the course will be of 2 years i.e with 4 semesters.

6. **PATTERN:**

Pattern of the examination will be semester based with choice based credit system.

7. **FEE STRUCTURE:**

- As per Shivaji University and Govt. of Maharashtra.
- Other fees will be applicable as Shivaji University norms/rules.

8. **ELIGIBILITY FOR ADMISSION:**

Any student having B. Tech. / B. E. Degree in Food Technology /Food Engineering and Technology /Food Engineering /Food Science /Food Process Technology /Food Process Engineering/Chemical Technology/Chemical Engineering /Biotechnology/ M.Sc. (Food Science and Technology) and qualified in the entrance examination of Shivaji University, Kolhapur or GATE exam.

9. **MEDIUM OF INSTRUCTION:**

The medium of instruction will be English (as applicable to the course/ programme concerned).

10. **INTAKE CAPACITY:**

18 students per year

11. **STRUCTURE OF THE COURSE:**

M. Tech. (Food Technology)
Course Structure
Semester I

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	FT 10	Research Methodology (Audit)	2	-	-	-
2	FT 11	Advances in Food Engg. and Technology	4	-		4
3	FT 12	Advances in Food Science and Nutrition	4	-		4
4	FT 13	Novel Techniques in Food Packaging	4	-		4
5	FTE 1	Elective-I	3	-		3
6	FTE 2	Elective-II	3	-		3
7	FTS 1	Seminar –I	-	-	2	2
8	FT 14	Laboratory- I Advances in Food Engg. And Technology	-	-	2	1
9	FT 15	Laboratory-II Advances Food Science and Nutrition	-	-	2	1
10	FT 16	Laboratory-III Novel Techniques in Food Packaging	-	-	2	1
		Total	20	-	8	23
Total Contact hours per week = 28						

Elective I	**Elective II**
FTE-11 : Advances in meat, fish and poultry processing	FTE-21: Advances in processing of dairy technology
FTE-12: Modern techniques in fruits and vegetable processing	FTE-22: Food rheology and texture
FTE-13 : Waste utilization of food processing industries	FTE-23: Advances in cereals and pulses processing technology

Semester II

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	FT 20	Advances in Food Biotechnology	4	-	-	4
2	FT 21	Chemical and instrumental analysis of food components	4	-	-	4
3	FT 22	Food Quality, Safety and Toxicology	4	-	-	4
4	FTE 3	Elective-III	3	-	-	3
5	FTE 4	Elective-IV	3	-	-	3
6	FTS 2	Seminar –II	-	-	2	2
7	FT 23	Laboratory- I Advances in Food Biotechnology	-	-	2	1
8	FT 24	Laboratory-II Chemical and instrumental analysis of food components	-	-	2	1
9	FT 25	Laboratory-III Food Quality, Safety and Toxicology	-	-	2	1
		Total	18	-	8	23
Total Contact hours per week = 26						

Elective III	**Elective IV**
FTE-31 : Newer developments in bakery and confectionery	FTE-41: Recent developments in processing of plantation crops
FTE-32: Nutraceutical and functional foods	FTE-42: Simulation and modeling in food processing
FTE-33 : Food color and flavor technology	FTE-43: Project management for food processing industries

Semester III

Course Code	Course	Teaching Scheme			
		L	T	P	Credits
T 31	* Industrial Training	-	-	**2	4
S 32	Dissertation Phase-I	-	-	**5	10
	Total	**-**	**-**	**7**	**14**
	**Total Contact hours per week/students = 2 &5 respectively for T31 & S32				

* 8 Weeks at the end of First Year (Summer)
** Average contact hours/week/student

Semester IV

Course Code	Course	Teaching Scheme			
		L	T	P	Credits
D 42	Dissertation Phase-II	-	-	5	20
	Total	**-**	**-**	**5**	**20**
	Total Contact hours per week = 5				

SYLLABUS OF M. TECH (FOOD TECHNOLOGY)

SEMESTER-I

(FT-10) Research Methodology (Audit Course)

Teaching Scheme: L: 2 **T:** - **Credits:** -

Unit I :
Research Methodology: An Introduction **Hrs**
Objectives of Research, Types of Research, Research Methods and

Methodology, Defining a Research Problem, Techniques involved in Defining a Problem **4**

Unit II :
Research Design
Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps In Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling **6**

Unit III :
Measurement and Scaling Techniques
Measurement in Research, Measurement Scales, Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques **4**

Unit IV :
Methods of Data Collection and Analysis
Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation **4**

Unit V :
Techniques of Hypotheses, Parametric or Standard Tests
Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, as a non-parametric Test, Conversion of Chi to Phi, Caution in Using Chi- square test **4**

Unit VI :
Analysis of Variance and Co-variance
ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type Factor Analysis, Path Analysis **4**

Interpretation and Report **1**

(FT-11) Advances in Food Engg. and Technology

Teaching Scheme: L: 4 **T: --** **Credits: 4**

Unit I :
Material and energy balance, Transport Phenomena for food systems, Flow behaviour of non Newtonian fluids, Rheology of dough, Unsteady state Heat Transfer with phase change, Heat transfer during drying and freezing. (8 Hrs)

Unit II:
Equipment design aspect of evaporators, dryers, freezers. Form Fill Seal, Vacuum and other packaging machines. Materials used for food processing equipment and corrosion control. (6 Hrs)

Unit III :
Newer techniques in thermal food processing - Retort processing, UHT, Extrusion - hot and cold. (6 Hrs)

Unit IV :
Radio-frequency heating Microwave for food cooking and dehydration, Ohmic heating. Advances in Freezing and refrigeration techniques. (6 Hrs)

Unit V :
Pulsed electric field, high-intensity light pulses, irradiation technique , thermo-sonication, High hydrostatic processing of foods, super critical CO_2 technique. (8 Hrs)

Unit VI :
Modified atmosphere, enzymatic processing and hurdle technology. Advanced Membrane Technology for water and liquid foods and effluent treatment. (6 Hrs)

Books Recommended

1. Food Engineering Operations by Brennan J.G, 1976
2. Fundamentals of food process engineering by Romeo Toledo, 1999
3. Engineering Properties of Foods by Rao MA and Rizvi SSH, 1986
4. Elements of Food Engineering by Watson EL and Harper JC, 1989,
5. Food Process Engineering by Heldman DR and Singh RP, 1984,
6. Food Engg. Fundamentals by J. Clair Batty, 1983
7. Handbook of food and bioprocess modeling by Sablani S., Rahman M, 2007
8. Advances in food processing and technology by Peter Fellows
9. Food processing and technology: Principle and practice by P Fellows 2009

(FT 12) Advances in Food Science and Nutrition

Teaching Scheme: L: 4 **T: --** **Credits: 4**

Unit I :
Chemistry of Carbohydrates: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars. Chemistry, properties and preparation of Pectic substances, gums & polysaccharides, Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins (7Hrs)

Unit II :

Chemistry of Proteins: Importance of Proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides & Proteins. Sources and distribution of Proteins. Isolation, identification & purity of Proteins. Denaturation. Physical & chemical characteristics of Proteins. (6Hrs)

Unit III :

Chemistry of Lipids: Definition & classification of lipids. Basic Structures, Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospolipids, and unsaponifiables, Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, hydrogenated fats, shortening agents, confectionary fats etc. Rancidity of fats & oils, and its prevention, antioxidants. (7Hrs)

Unit IV :

Chemistry water, vitamins and minerals : Importance of water in foods. Structure of water & ice. Concept of bound & free water & their implications. Sorption Phenomena and Sorption isotherms. Vitamin stability,Toxicity and sources of vitamins, Bioavailability of vitamins, Reasons for the loss of vitamins in foods. Classification, functional properties and uses of minerals. (6Hrs)

Unit V :

Physiological importance of nutrients : Recent advances in biochemistry of food metabolism and nutritional aspects of foods; Nutritional requirements of special group of people such as aged, infants, pregnant & lactating mothers, patients etc. Therapeutic nutrition & formulation of special dietary foods; Relation of food and diseases; Deficiencies of essential nutrients; Assessment of nutritional status & RDA; Effect of processing on nutrients; (8Hrs)

Unit VI :

Nutraceutical aspects of food : Functional foods and nutraceuticals with attributes to control cardiovascular diseases, cancer, obesity, ageing etc. Food components and nutrients affecting immune systems, behaviour and performance; Functional aspects of dietary fibre, amino acids & peptides, lactic acid bacteria, antioxidants, vitamins, fatty acids etc. (6Hrs)

Books Recommended

1. "Food Chemistry" Marcel Dekker, Inc., New York, O.R.Fennema
2. "Food Chemistry" Springer Berlin, Heidelberg, New York. Belitz, H.D.. Grosch
3. Introductory foods, Bennion M. and Hughes, D. (1975),Macmillan publishing Co., New York.
4. Advances in food and nutrition research by Steve L. Taylor
5. Human nutrition by Burton, BT, 1976,
6. Food, Nutrition and Diet Therapy by Krause and Mahan 1996,

(FT 13) Novel Techniques in Food Packaging

Teaching Scheme: L: 4 **T: --** **Credits: 4**

Unit – I

Active and intelligent packaging: Active Packaging Techniques and intelligent Packaging Techniques, current use of novel Packaging Techniques, consumers and novel Packaging

Oxygen, ethylene and other scavengers: Oxygen scavenging technology, selecting right types of oxygen scavenger, ethylene scavenging technology, corbon dioxide and other scavengers. (7Hrs)

Unit II :

Antimicrobial food packaging: Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging.

Shelf life study of packaged foods.

Non-migratory bioactive polymers (NMBP) in food packaging: Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications. (7Hrs)

Unit III :

Packaging-flavour interaction: Factors affecting flavour absorpstion, role of food matrix, role of differing packaging materials,flavour modification and sensory quality.

Developments in modified atmosphere packaging (MAP): Novel MAP gas, testing novel MAP applications, applying high oxygen MAP (07 Hrs)

Unit IV :

Recyling of packaging materials: Recyclability of packaging plastics, improving the recyclability of plastics packaging, testing safety and quality of recycled materials, using recycled plastics in packaging .Biodegradable packaging materials. (7Hrs)

Unit V :

Packaging materials for newer techniques like radiation processing, microwave and radiowave processing, high pressure processing, thermal processing as retortable pouches and special purpose foods like space food, defence food etc. Role of packaging in the supply chain of perishable and frozen foods. (7Hrs)

Unit VI :

Safety and legislative aspects of packaging: Regulatory considerations, plastic, metal, paper and glass packaging, bar coding and labeling. (5Hrs)

Books Recommended

1. Modern food packaging, Indian Institute of Packaging, 1998
2. Novel Food Packaging Techniques, Ahvenainen .
3. Food packaging and preservation by M.Malthlouthi, 1994
4. Food and Packaging Interactions by Risch.S.H. 1991
5. Handbook of Food Packaging by F.A. Paine and H.Y. Paine 1983
6. Food Packaging Technology (Vol.1 & 2) by G. Bureau and J.L.Multon, 1996
7. Handbook of Package Engineering by Hanlon, Kelsey & Forcinio

FTE 1 : Elective- I

FTE - 11 Advances in Meat, Fish and Poultry Processing

Teaching Scheme: L: 3 T: - Credits: 3

Unit – I

Meat Industry: Meat and meat products in India-an Industrial profile, Meat production and trade practices, Prospects and problems in production of fresh meat in India, Research and Development activities on meat, fish and poultry products (06 Hrs)

Unit – II

Gross and microstructure of muscle, Mechanism of muscle contraction and relaxation: Organization of skeletal muscle from gross structure to molecular level, Muscle Communication (sarcolemma, sarcoplasmic reticulum, Innervation), Muscle metabolism, Different types of connective tissues and their relevance to properties of meat, Myofilament proteins and their major functions, Nervous tissue, nerves and the nature of stimuli, membrane potential in nerve and muscle, Events that occur during relaxation and contraction (06 Hrs)

Unit – III

Cattle and beef, sheep and mutton, pig and pork and their fabrication: Breeds, Pre slaughter care, ante and post mortem, slaughter, handling of offal (edible and inedible).Cuts of beef, pork and mutton (03 Hrs)

Meat inspection and grading: Application and Enforcement of inspection laws, elements of inspection (sanitation, antemortem inspection, postmortem inspection, condemnation, product inspection, laboratory inspection, labeling). Identification of inspected products, product inspection, types of grades, factors used to establish quality grades, conformation, fleshing and finish (06 Hrs)

Unit – IV

Properties of fresh meat: Perception of tenderness, Factors effecting tenderness, connective tissue, collagen, sarcomere contractile state, Myofibrillar tenderness, marbling, Methods to improve tenderness (Electrical stimulation, aging, Meat color, Pigments associated with color, Chemical state of pigments, methods to improve meat color. Water holding capacity (Net charge effect and stearic effect) (06 Hrs)

Unit – V

Poultry meat: Kind of poultry, processing of poultry. Special poultry products, Breaded poultry, Smoked turkey, Packaged pre cooked chicken, Freeze dried poultry meat (03 Hrs)

Unit – VI

Meat analogues and restructured meat products: Textured plant proteins, processes for preparation of meat analogues and restructured meat products

Fish processing and fish products: Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates (06 Hrs)

Recommended Books: Title	**Author**
Meat poultry and Sea Food Technology	Henricksons
Fish Technology	R.J. Robert
Poultry product Technology	G.J. Mountney
Meat Processing	Joseph Kerry, John Kerry and David Ledwood
Meat Hand Book	Albert Levie
Poultry Processing	G.H.Weiss:
Processing of Aquatic Food Products	F.W. Wheaton and T. B. Lawson
Poultry meat processing and quality	G Mead

FTE – 12 Modern techniques in fruits and vegetable processing

Teaching Scheme: L: 3 T:0 - **Credits:** 3

Unit – I

Introduction: Importance of fruits and vegetable processing, impact on Indian economy, processing concept

Processing characteristics: Advances in fruits and vegetable selection, grading, sorting, blanching and other pre processing steps in automation of processing line, kinetics of quality changes: physical, chemical, sensory and nutritional changes during processing (06Hrs)

Unit – II

Thermal processing: Influence of elevated temperature on microbial population, product quality, process time calculation, blanching techniques and purpose of blanching, determination of blanching processes, concept of commercial sterilization, heating and cooling of food in container, influence of commercial sterilization on product quality (06 Hrs)

Unit – III

Juice and pulp extraction – various extractors used including Hydraulic Press -Hot and Cold Break process - Clarification - Clarification centrifuges – Decanters and desludgers. Preparation and packaging of pulps, Jams, Jellies, Marmalades, Squashes. Pickles, Puree, Ketchup, Sauce - Different types Glass and Plastic Containers, Large capacity storage containers in plastic, in plastic and SS containers. Different filling, closing and sterilization operations. Different preservatives used for long and short-term storage (08 Hrs)

Unit – IV

Aseptic processing: Aseptic processing and Bulk packing of Fruit juice concentrates, Pulps and Puree – Brief information on Asepticity and how it is strictly maintained in the plant - Aseptic heat exchangers for sterilizing and concentrating the product - Aseptic fillers. Different system of filling practiced. Tetra pack for small quantities - Dole system and Scholle system for bulk storage in Bag & Boxes and Bag & Drums. - Storage of Aseptically packed products. (06Hrs)

Unit – V

Drying and Dehydration: Concept of drying and drying curves, state of water in fruits and vegetables, drying effect on product quality and nutritive value, Advances in drying of fruits and vegetables

Specialty products - Fruit Bars , Fruit juice concentrates – methods of concentration -evaporators used for concentration of fruit juices and pulp - Tubular, Plate and scraped surface evaporators and Fruit Powders - Preparation of Fruit material for powder production - Working of Spray Dryer and Drum Dryer - Fruit juice aroma Recovery and its importance. (06 Hrs)

Unit –VI

Minimally processed fruits and vegetables: Concept of hurdle technology,thermal heating approach to minimal processing, high frequency heating, microwave heating and ohmic heating (4 Hrs)

Recommended Books Title	Author
Commercial Fruit Processing	Woodruf and Luh
Commercial Fruits and Vegetable Products	W.V. Cruess
Thermobacterology in Food Process	Stumbo C.R.
Handbook of Fruit science and Technology: Production, Composition, storage and processing	D.K. salunkhe and S.S. Kadam
Freezing Effects on Food Quality	Lester E. Jeremiah
Handbook of Food Analysis	Leo M.L. Nollet
Postharvest Physiology of Vegetables	J. Weichmann

FTE – 13 Waste utilization of food processing industries

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit I

Basic considerations: Standards for emission or discharge of environmental pollutants from food processing Industries as per the updated provision of Environment (Protection) Act, 1986. (6Hrs)

Unit II :

Characterization and utilization of by-products from Cereal Pulses, Oilseeds, Fruits and vegetables, Plantation products, Fermented foods, Milk, Fish, Meat, Egg and poultry processing industries. (6 Hrs)

Unit III :

Characterization of food Industry effluents, Physical and chemical parameters, Oxygen demands and their interrelationships, Residues (solids), Fats, Oils and grease, Forms of Nitrogen, Sulphur and Phosphorus, Anions and cations, Surfactants, Colour, Odour, Taste, Toxicity. (6 Hrs)

Unit IV :

Unit concept of treatment of food industry effluent, Screening, Sedimentation Floatation as pre – and primary reactants.

Biological oxidations: Objects, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological contracters and their Variations and advanced modifications. (8 Hrs)

Unit V :

Advanced wastewater treatment systems. Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis. Physico-chemical separations: activated carbon adsorption, Ion-exchange electrodialysis and magnetic separation. Chemical oxidations and treatment Coagulation and flocculation. Disinfection. Handling disposal of sludge (6 Hrs)

Unit VI :

Solid Waste Treatment : Biological composting, drying and incineration; Design of Solid Waste Management. System: Landfill Digester, Vermi composting Pit. (4 Hrs)

REFERENCES :

1. A. Chakravarthy & De, "Agricultural Waste and By Product Utilisation".
2. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
3. V. Oreopoulou, W. Russ, (ed) “Utilisation of by-products and treatment of waste in the food industry” Vol, 3., Springer, 2007.
4. K. Waldron “Handbook of waste management and co-product recovery in food processing”. CRC, 2007.
5. R. Smith, J. Klemes, J-K Kim “Handbook of water and energy management in food processing.”, CRC, 2008.
6. Waste treatment in the food processing industry. –C. Yapijakis , L.Wang, Yung Tse- Hung, H. LO, CRC,2005

FTE 2 :Elective -II

FTE – 21 Advances in processing of dairy technology

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit I :
Operation Flood and Dairy Development programmes in India. Physico-chemical properties and structure of milk and milk constituents. (4 Hrs)

Unit II
Chemical and microbial spoilage of milk and milk products. Methods and procedures for sampling and testing of milk and milk products. Laws and standards for milk and milk products. Milk adulteration. (8 Hrs)

Unit III :
Fluid milk processing, packaging and distribution products. Traditional milk based Indian sweets (6 Hrs)

Unit IV:
Common dairy processes- cream separation (standardization), pasteurization, sterilization and homogenization. (6 Hrs)

Unit V :
Manufacture of milk products- butter, cream, cheese, ice-cream, evaporated milk, condensed milk, dried milk, butter oil, dried milk products. (6 Hrs)

Unit VI :
Waste utilization from dairy processing industries. Hygiene and sanitation practices in dairy industry. (6 Hrs)

References :

1. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
2. Herrington BL “Milk & Milk Processing”, McGraw-Hill Book Company. 1948
3. Lampert LH; “Modern Dairy Products”, Chemical Publishing Company1970.
4. Fox PF “Developments in Dairy Chemistry – Vol 1 & 2”, Applied Science Pub Ltd.
5. De Sukumar “Outlines of Dairy Technology” Oxford University Press 6
6. Lampert I.M. “Modern dairy products”, Eurasia publishing House Ramnagar New Delhi, 1970.
7. Webb B.H. & Whittier E.O “Byproducts from milk” , AVI publishing Co., Connecticut, 1970.
8. James N.Warner “Principles of Dairy Processing “, Wiley Eastern Ltd.
9. Eckles,Combs and Macy “Milk and Milk Products”,Tata McGraw Hill.
10. Aneja et al “Technology of Indian Milk Products”. A Dairy India Publication

FTE – 22 Food Rheology and Texture

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit – I

Food rheology and structure: stress and strain tensors, viscometric properties, shear stress-shear rate relationships, units in rheological measurements, types of fluid flow behaviour, apparent viscosity, intrinsic viscosity, stress-strain behaviour of solid foods, linear viscoelasticity, phase transitions in foods.

Flow and functional models for rheological properties of fluid foods: Time independent flow behaviour, Apparent viscosity- shear rate relationships of shear- thinning foods, models for time-dependent flow behaviour, role of solids fraction in rheology of dispersions, affect of temperature on viscosity, treatment of rheological data using models. (06 Hrs)

Unit - II

Tube viscometry : introduction, Rabinowitsch Mooney equation, laminar flow velocity profiles, laminar flow criteria, yield stress evaluation, jet expansion, slit viscometry, glass capillary viscometers, pipeline design calculations, velocity profiles in turbulent flow.

Rotational viscometry : introduction, concentric cylinder viscometry, cone and plate viscometry, parallel plate viscometry, mixer viscometry. (06 Hrs)

Unit - III

Extensional flow: introduction: uniaxial extension, biaxial extension, flow through a converging die, opposing jets, spinning, tubeless siphon, steady sheer properties from squeezing flow data.

Viscoelasticity : introduction, transient tests for viscoelasticity, oscillatory testing, Deborah number, experimental difficulties in oscillatory testing of food, viscometric and linear viscoelastic functions.

Rheology of food gum and starch dispersions: effect of heating, effect of sugar and protein, rheological behaviour of starch, rheology of starch- gum dispersions. (07 Hrs)

Unit - IV

Rheological behaviour of processed fluid and semisolid foods: fruit juice, milk and milk concentrates, chocolate, mayonnaise, margarine, structural analyses of food dispersions, structural components of yield stress.

Rheological behaviour of food gels: rheological tests to evaluate properties of gel systems, gel point and sol-gel transition by rheological measurements.

Application of rheology to fluid food handling and processing: Velocity profiles in tubes, energy requirements for pumping, pump selection and pipe sizing, power consumption in agitation, heat transfer to fluid foods, and role of rheology in thermal processing of canned foods. (08 Hrs)

Unit – V

History of Food Microstructure Studies, Light Microscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Other Instrumentation and Techniques. Food Structure in the Mouth and Beyond. Water and Ice, Proteins, Lipids, Carbohydrates. (06 Hrs)

Unit - VI

Measurement of Texture, Structural Aspects of Food Texture, Quality and Structure of various food products. (03 Hrs)

Recommended Books: Title	**Author**
Microstructural Principles of Food Processing Engineering	José Miguel Aguilera
Food Texture	Moskowitz
Principles of Food Processing	Richard W. Hartel
Phase Transitions in Foods	Yrjö H. Roos
New Frontiers in Food Microstructure	Donald B. Bechtel
Mass transfer	Thomas Kilgore Sherwood
Image Analysis for the Biological Sciences	C. A. Glasbey
An Introduction to Rheology	H.A. Barnes
Fat Crystal Networks	Alejandro G. Marangoni
Multidimensional Microscopy	Philip C. Cheng
Food Emulsions	Stig Friberg
Dehydration of Foods	Gustavo V. Barbosa-Cánovas
Food Processing (Industry at Work)	Melvin Berger
Polymer Gels	D. DeRossi
hermal Processing of Packaged Foods	S.D. Holdsworth
Chemical Engineering for the Food Industry	D. Leo Pyle
Rheological Methods in Food Process Engineering	Steff, J. F

FTE – 23 Advances in cereals and pulses processing technology

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit - I

Present status and future prospects of cereals and Pulses - Current trends in area, production and yield **(02 Hrs)**

Unit - II Wheat

Wheat production, varieties and their quality. Types of wheat grading system. Structure and composition, environmental effect in relation to processing quality, Enzyme in wheat and their implications in wheat technology, conditioning and milling of wheat. Principles and machine operations, Air fractionation of flours. Flour and its treatment. Technology of bakery product such as bread, biscuits, cake, crackers, pretzel, etc. Production, equipment and ingredient. Role of ingredients in bakery products. **(06 Hrs)**

Unit - III Rice

Paddy Processing: Paddy varieties, their composition and quality characteristics. Curing of paddy. Parboiling processes, cold water soaking and hot water soaking processes, paddy dryer-LSU dryer. by products of paddy processing - paddy husk and its uses - as boiler fuel, husk ash, activated carbon, furfural and other by products, Production of flattened rice and puffed rice from paddy

Rice Milling: Paddy dehusking processes: rice mill flow chart, Engelberg huller mills, modern rice mills. Components of modern rice mill, pre cleaners, shellers, under runner shellers and centrifugal shellers, paddy separators – Satake and Schule designs, Polishers-cone polishers and other types, bran and brokens separators, Rice mill yields and loss due to brokens at different stages of milling, Rice mill machinery handling. Methods of rice bran oil extraction **(6 Hrs)**

Unit - IV

Milling of Pulses: Major Pulses grown in the country and their application, Status of Pulse milling industry in India, need for modernization, Traditional milling process, merits and demerits, Drying of legumes, Sun drying, Traditional Processing steps – Pre-cleaning, Pitting, Oil application, conditioning, Dehusking and splitting, Machinery and equipment employed, mass balance, losses during milling; Modern milling process, Mechanical hot air drying and conditioning, merits and demerits, Dehusking in Pulse Pearler, Water conditioning, splitting of pulses in Pulse splitter, process flow chart, Merits and demerits, Mini dal mill, working principle, advantages and disadvantages, Grinding of split pulses, pulse flour products, their applications, equipment used **(6 Hrs)**

Unit - V

Milling and Processing of Maize : Dry milling of maize: Storage and drying, Pre-cleaning, cleaning equipment, Degermination and Dehusking, Roller milling, Sifting, Purifying, Aspiration, Pneumatics in a maize mill, Products of milling-Flour, Semolina, Brewers' grits etc and their applications

Wet milling of Maize and corn: Modern methods of processing, Cleaning, Steeping, Degermination, Bran and Fibre separation, Gluten and Starch Separation, extraction process; Equipment needed for Degermination, Debranning and starch separation, Starch conversion into other value added products, Acid Hydrolysis, Enzyme Hydrolysis, Isomerization processes, Processing for Dextrose, Malto Dextrin and other products. Extraction and refining of Corn oil in brief. **(10 Hrs)**

Unit - VI

Storage and Handling: Bag Storage, Bag Storage structure design, Parameters of good storage structure, Cover Plinth Storage Structures, CAP storage (Ceiling and Plinth Storage), Plans for Bag storage, lay outs, Dunnage, Materials for Dunnage, Pallets, Protection against Rodents, Fungi, Pests and Mites, Fumigation Processes for bag storage piles, Bulk Storage in silos and large Bins; Problems of Silo storage, Construction of Silos, Physical load and mechanical strength of Silos, concrete and Metal Silos, Silo flow problems, Relative merits and demerits of Silo storage to Bag Storage, Relative Costs of Silo and Bag Storage, Conveyors and Elevators for feeding and discharging into Silos. In silo Aeration and Drying, Problems of Dust Explosion in Grain Storages, Quality Changes of Grains during storages and remedial measures to prevent unwanted quality changes **(06 Hrs)**

Text Books

Title	**Author**
Post Harvest Technology of Cereals, Pulses and Oilseeds	Chakraverty, A
The Chemistry and Technology of Cereals as Food and Feed	Samuel Matz
Technology of Cereals	N. L. Kent and A. D. Evans
Maize-Recent Progress in Chemistry and Technology	George E Inglett
Pulses – Chemistry, Technology and Nutrition	Ruth H. Matthews
Modern Cereal Science and Technology	Y. Pomeranz
Storage of Cereal Grains and their Products	Cryde M. Christensen
Hand Book Of Cereal Science and Technology	Karel Kulp and Joseph P Pante

(FTS-1) Seminar-I

Teaching Scheme: P: 2 **Credits: 2**
Contact hrs : 2 Hrs./Week/student

The topic of seminar shall be based on area of Food Technology; preferably considering new ideas, concepts, technologies & developments in the field of Food Technology. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the present context, report documentation and presentation skills. Guide should spare for 2hrs /week/student for seminar

(FT-14) Laboratory- I

Advances in Food Engg. and Technology

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report.

(FT-15) Laboratory- II

Advances in Food Science and Nutrition

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report

(FT-16) Laboratory- III

Novel Techniques in Food Packaging

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report.

SEMESTER-II

(FT 20) Advances in Food Biotechnology

Teaching Scheme: L: 4 **T: --** **Credits: 4**

Unit I :

Microbiology and Biochemistry of fermented foods, Production of baker's yeast, starter cultures, algae, mushrooms and single cell proteins from differents substrates. Fermented cereal /legume products, including bread, Traditional fermented foods. Soya based Oriental fermented foods. (8Hrs)

Unit II :

Production of Wine, Beer, and other alcoholic beverages. Production of lactic acid, citric acid, vinegar. Fermented dairy products such as cheese, yoghurt, sweet curd, paneer, shreekhand, Fermented pickles. (6Hrs)

Unit III :

Production of amino acids, fatty acids, vitamins, polysaccharides, flavours and colours. (6Hrs)

Unit IV :

Enzyme applications in industry. Advantages and constraints of immobilized enzymes and microbial cells. Types of enzyme reactors. Aerobic and anaerobic treatment of effluents from food processing industry. Activated sludge process, biomethanation. (6Hrs)

Unit V :

Concept and problems of plant and animal tissue culture. Technology for cultivation of callus and suspension cultures from explant. Synthesis of natural products by plant tissue culture. Microcarrier cultivation of animal cells. Production of monoclonal antibodies. (6Hrs)

Unit VI :

Chemical structure of nucleic acid proteins; introduction to Genetics, DNA replication, transcription and translation.; cell division, cell cycle, DNA repair mechanism, modifying enzymes, recombinant DNA technology, mutation and polymorphism and their detection. PCR, RT-PCR, electrophoresis, electro blotting and capillary blotting. Application to produce genetically modified foods. (8Hrs)

Books Recommended

1. Fundamentals of food biotechnology by Byong H.Lee, 1996
2. Food biotechnology by Kalidas Shetty, 2006
3. Brock Biology of microorganisms, 12th ed., by M.Madigan, J.Martinko, J.Parkar,2009
4. Principles of genetics by R. H. Tamarin, 2004
5. Fundamental bacterial genetics by Nancy Trun and Janine Trempy, 2004
6. Basic molecular and Cell Biology 3rd edition Ed. by David Latchman. 2006.

(FT 21) Chemical and instrumental analysis of food components

Teaching Scheme: L: 4 **T: --** **Credits: 4**

Unit I :

Preparation & Standardization of solutions, sample preparation and sampling, Buffer Methods & principle for determinations of Proximate composition: Moisture, Fat, Protein, Fiber, Carbohydrate, Ash. (6Hrs)

Unit II :

Analysis of Starch, Reducing and Non reducing sugars in foods. Determination of Minerals: Iron, Calcium, Phosphorus, Vitamin-A,Vitamin- B, Vitamin- C. Plant pigments (carotene, lycopene, chlorophyll, anthocyanins). (6Hrs)

Unit III :

Blanching adequacy, non enzymatic browning. Analysis of fats and oil (FFA, PV, RM value) Sensory evaluation – different scales, training, skills and importance for consumer acceptance. Quantification of sensory attributes - Artificial Tongue, Artificial Nose. Texture analysis. (8Hrs)

Unit IV :

Enzymes in food analysis; Supercritical fluid extraction in food analysis; Rapid methods for detection of food pathogens, biosensors, automation and use of computers in food analysis. (6Hrs)

Unit V :

Application of modern techniques including spectroscopy (atomic absorption. Measurement),flame photometry. X-ray analysis of foods and its applications, electrophoresis-applications, principle and different types. Mass spectroscopy, IR, Nuclear magnetic resonance (NMR). (8Hrs)

Unit VI :

Chromatography :GC, GC –MS, HPLC, HPTLC, gel permeation, ion-exchange, etc., their principles and applications. Refractometry – its applications and methods. Rheology measurements. DSC, SEM, rapid methods of thermal analysis. (6Hrs)

ReferenceBooks :

1. Food Analysis Theory and Practice Y.Pomeranz
2. The Chemical Analysis of Foods and Food Products Morris B.Jacobs
3. Food Analysis: Separation Techniques W.Graenwedel
4. Handbook of Analysis and Quality Control for Fruits and Vegetables S.Ranganna
5. Food Analysis Nielson
6. Handbook of Food Analysis Nollel

(FT 22) Food Quality, Safety and Toxicology

Teaching Scheme: L: 4 **T:** -- **Credits: 4**

Unit I :
Objectives, importance and functions of quality control. Quality of raw materials and finished products, statistical quality control. Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), ISO 9001 (Quality Management System). Food regulations, grades and standards, Licensing and registration. (6Hrs)

Unit II :
Types of food hazards: biological, chemical and physical; Risk assessment; Existing and emerging pathogens due to globalisation of food trade; Newer systems of safety evaluation such as HACCP. Salient features of Food Safety & Standards Act, 2006,Structure of FSSAI, ISO 22000 (Food Safety Management System), Traceability, Food Recall. (6Hrs)

Unit III :
Testing of food ingredients & additives; Animal studies including LD50; Ames test for teratogenicity; Natural toxic constituents in plant foods; Shellfish poisoning; Chemicals from processing such as fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, pesticides and herbicides. (6Hrs)

Unit IV :
Intentional and unintentional additives; Toxicity due to microbial toxins including botulinum and staphylococcal toxins, mycotoxin and due to other food pathogens; Food allergy and intolerance; Detoxication strategy. (6Hrs)

Unit V :
Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labelling (Packaging types, understanding labelling rules & Regulations, Nutritional labelling, labelling requirements for pre-packaged food as per CODEX). (6Hrs)

Unit VI :
Organic food, Identifying Organic foods, Advantages, The Organic Certification Process, Organic Food labeling, GM food,Why are GM food produced, Main issues of concern for Human Health, How are GM Food regulated Internationally, Regulation in India. (6Hrs)

Books Recommended

1. Environmental regulation and food safety by Veena Jha.
2. Microbiological safety of food by Hobbs, 1973
3. Emerging technologies; food process by Da-wen, 2005
4. Food safety by Laura K Egendorf, 2000
5. International standards of food safety by Naomi Rees, David Watson, 2000
6. Codex alimentarius by FAO & WHO, 2007

FTE 3 :Elective – III

FTE – 31 Newer developments in bakery and confectionary

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit I
Current status, growth rate, and economic importance of Bakery and Confectionary Industry in India. Product types, nutritional and safety of products, pertinent standards & regulations. **(04 Hrs)**

Unit II
Introduction to baking; Bakery ingredients and their functions; Machines & equipment for batch and continuous processing of bakery products. Bakery and confectionary industry ; raw materials and quality parameters; dough development; methods of dough mixing; dough chemistry; rheological testing of dough- Farinograph, Mixograph, Extensograph, Amylograph/ Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data. **(08 Hrs)**

Unit- III
Technology for the manufacture of bakery products – bread, biscuits, cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking. **(06 Hrs)**

Unit- IV
Chocolate Processing Technology, Compound coatings & Candy Bars, Tempering technology, Chocolate hollow figures, Chocolate shells, Enrobing technology, Manufacture of candy bars, Presentation and application of vegetable fats. Production of chocolate mass. **(04 Hrs)**

Unit- V
Sugar confectionery manufacture, General technical aspects of industrial sugar confectionary manufacture, Manufacture of high boiled sweets- Ingredients,Methods of manufacture- Types- Center- filled, lollipops, coextruded products. Manufacture of gums and jellies- Manufacture of Miscellaneous Products, caramel, Toffee and fudge- Liquorices paste and aerated confectionery, Lozenges,sugar panning & Chewing gum, fruit confections Quality aspects. **(08 Hrs)**

Unit- VI
Quality characteristics of confectionery ingredients; technology for manufacture of flour ,fruit, milk, sugar, chocolate and special confectionery products; colour, flavor and texture of confectionery; standards and regulations ; machineries used in confectionery industry. **(06 Hrs)**

Text Books

1. E.B. Jackson: Sugar Confectionery Manufacture, Second edition, Aspen publishers Inc., 1999. Great Britain
2. Guilford L Spencer and George P. Made: Cane Sugar Hand Book (1993) John Wiley and sons Inc. London
3. P. Manohara Rao: Industrial Utilization of Sugar Cane and its co-products P.J.International Consultants, New Delhi
4. Maurice Shachman, Soft Drinks Companion: A Technical Handbook for the Beverage Industry, CRC press, Florida, USA (2005)
5. W.Ray, Junk & Harry M. Pancost: Hand Book of Sugars – for Processors, Chemists and Technologists: AVI Puvblishing, West port (1973)
6. Oliver Lyle: Technology of Sugar for Refinery Workers Chapman and Hall Ltd., (1950)
7. 4E.Hugott: Hand Book of Cane Sugar Engineering Elsevier Publishing /company, London (1986)
8. Matz, S. A. *Bakery Technology and Engineering*, (CBS Publications, 2003)
9. Matz, S. A. *Cereals as Food and Feed*, (CBS Publications, 2001)
10. Pyler, E. J. *Baking Science and Technology*, (Sosland Publishing Company, 2009)

FTE - 32 Nutraceuticals and functional Foods

Teaching Scheme: L: 3 T : 0 **Credits : 3**

Unit – I

Defining nutraceuticals and functional foods, Nature, type and scope of nutraceutical and functional foods. Nutraceutical and functional food applications and their health benefits, Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions (08 Hrs)

Unit – II

Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc. Antioxidants and other phytochemicals, (isoflavones, lycopenes), their role as nutraceuticals and functional foods, Dietary fibers and complex carbohydrates as functional food ingredients (08 Hrs)

Unit – III

Protein as a functional food ingredient, Probiotic foods and their functional role, Herbs as functional, health promoting activity of common herbs. Cereal products as functional foods – oats, wheat bran, rice bran etc. (08 Hrs)

Unit – IV

Functional vegetables products, oil seeds and sea foods.
Coffee, tea and other beverages as functional foods/drinks and their protective effects (04 Hrs)

Unit – V

Effects of processing, storage and interactions of various environmental factors on the potentials of such foods (04 Hrs)

Unit – VI

Marketing and regulatory issues for functional foods and nutraceuticals
Recent development and advances in the areas of nutraceutical and functional foods (04 Hrs)

Recommended Books: Title	Author
Functional Foods	R. Chadwick,S. Henson,B. Moseley,G.
Methods of Analysis for Functional Foods and Nutraceuticals	W. Jeffrey Hurst
Handbook of Functional Dairy Products	
Functional Foods	Mazza
Handbook of Nutraceuticals and Functional Foods	Robert E.C. Wildman

FTE-33 Food Color and Flavor Technology

Teaching Scheme : L : 3 T : 0 **Credits : 3**

UNIT - I

Food Colors: Food colours - Types and properties, regulatory aspects, safety issues - natural food colours - heme pigments,chlorophylls, carotenoids, anthocyanins and flavonoids, tannins,caramel and others Artificial food colours. (6 Hrs)

UNIT - II

Colour encapsulation and stabilization**:** Principles and techniques of color extraction and encapsulation, types of encapsulation, factors affecting stabilization of encapsulated color &their applications in food industry, Packaging and color compounds interaction, Effect of storage, processing, transportation and environmental conditions on color components / constituents. (8 Hrs)

UNIT - III

Flavoring materials of natural origin: Natural flavors, sources of natural flavoring materials – Herbs and spices, standards of purity and sensory assessment of herbs and spices, classification of herbs and spices, Distillation of volatile oils, Spice essential oils, Application of spice essential oils, Essential oil content of spices. Oleoresins-Extraction, Quality and, Application of oleoresins. (8 Hrs)

UNIT - IV

Flavoring materials made by processing: Natural products made by roasting (cocoa/chocolate) Reaction flavors. Enzymatically derived flavorings (Butter and cheese).Flavors made by fermentation.Biotechnological production of aroma chemicals,Flavors made by pyrolysis. (4 Hrs)

UNIT - V

Flavor potentiators: Chemical properties, sensory properties, flavour potentiation in foods – toxicity. Flavor Production: Liquid flavorings, emulsions, dry flavorings. Application of flavorings in food processing:, Achieving flavor balance, and criteria for application of flavorings, Available flavorings, processing parameters, specific flavoring applications. (6 Hrs)

UNIT – VI

Flavour encapsulation and stabilization**:** Principles and techniques of flavour encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavour &their applications in food industry, Packaging and flavor compounds interaction, Effect of storage, processing, transportation and environmental conditions on flavour components / constituents. (4 Hrs)

Reference Books :

Title	Author
Source Book of Flavors	Reineccius, G.
Flavour chemistry and technology	Heath, H. B.
Understanding Natural Flavors.	Piggott, J. R., Paterson, A.
Food Flavor:	Morton, I. D., Macleod A. J.
Recent advances in flavour researches	Yamanishi, T.
Bioprocess Production of Flavor, Fragrance, and Color Ingredients	Gabelman, A.
Food Flavorings.	Ashurst P. R.
Encyclopedia of food and color additives, Vol III,	George, A. B.
Food Additive s, 2nd Edition,	Branen, A. F.

FTE 4 :Elective - IV

FTE – 41 Recent developments in processing of plantation crops

Teaching Scheme : L : 3 T : 0 **Credits : 3**

Unit -I

Plantation Crops - Description of various types of Plantation crops, viz., coconut, arecanut, coffee, tea, cocoa etc. Processing and preservation methods. Value-added products shelf-stable products viz., coconut water bottling, desiccated coconut powder, coffee concentrate, instant coffee powder, instant tea powder, cocoa processing. (06 Hrs)

Unit -II

Spices & Condiments - Description of various types of spices and condiments, their composition, functional properties, flavouring agents. Nutritive value of spices and their health benefits. In termediate Moisture Products – In termediate Moisture Products viz., ginger paste,ginger – garlic paste, tamarind paste, tamarind concentrate. Their importance in culinary preparations. Flavour retention and packaging methods. (06 Hrs)

Unit -III

Spice Powders & Curry Powders : Their importance in culinary preparations, their preparation methods, grinding and packaging methods for spice powders like chilli powder, turmeric powder, ginger powder, garlic powder; and Masala Powders for chicken masala, meat masala, biryani masala, chat masala etc. Importance of Cryogenic grinding of spices. (06 Hrs)

Unit IV

Spice Oils – Concept and importance of spice oils from spices like and condiments like clove, cardamom, cinnamum etc. Their application in food processing, and extraction methods of spice oils by various techniques, viz., solvent extraction, steam distillation etc. (06 Hrs)

Unit V

Extraction of Oleoresins – Concept and importance of oleoresins in food processing, processing of spices like chilli, turmeric, pepper, ginger etc. for solvent extraction of oleoresins. Oleoresins technology, desolventization methods, regulatory and statutory requirements for oleoresin processing. (06 Hrs)

Unit VI

Herbs – Description of various types of herbs, viz., Basil, Chives, Cilantro, Dill,
Coriander, Mint, Oregano, Parsely, Chives, Borage and Avocada leaves, Rose marry, Saga, Tarragon, Thyme, Winter savory and bolbo leaves, Papalo, Pipicha and Safflower.Their nutritive value & health benefits, their processing and Post harvest handling. Packaging methods for processed products. (06 Hrs)

TEXTBOOKS :

1. Spices & Condiments, J S Pruthi, National Book Trust, New Delhi (2001).
2. Spices : Morphology, History , Chemistry., J W Parry, Chemical Publishing Co.,
3. New York (1969).
4. Leafy Spices, V Prakash, CRC Press, Florida (1990).
5. Salunkhe, D.K. and Kadam S.S. Ed. 1998. Hand book of Vegetable Science and Technology, Marcel Dekker, New York, USA.
6. Chocolate, Cocoa and Confectionery Technology, Minifie Bernard W., III Edition, Aspen Publication, 1999.
7. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004.

FTE - 42 Simulations and Modeling In Food Processing

Teaching Scheme : L : 3 T : 0 **Credits : 3**

Unit – I

Fundamentals of modeling and simulation; Definition of basic terms like system, entity attribute, activity, state of system, system environment; categories of system, stochastic activities; Different steps for modulation and simulation, Types of models; Advantages of modulation and simulation, disadvantages of modulation; Monte Carlo Method or random simulation, Application areas of simulation (8 Hrs)

Unit – II

Numerical methods for solving of transcedental model equations; Iterative convergence method, derivation and algorithm of bisectional method or intermediate value theorem; False position or Regula Falsi method; Newton Raphson method, Convergence of Newton Raphson method, Generalized Newton's method for multiple roots, Secant Method, Convergence of secant method; Iterative or method of successive approximation. (8 Hrs)

Unit – III

Introduction to numerical integration, trapezoidal rule, Simpson's 1/3 rd rule, Truncation error in Trapezodial rule, Simpson's 1/3 rd rule. Solution of Ordinary Differential Equation Model: Picard Method, Taylor's Series method, Euler's method, Modified Euler's method, First order, third and fourth order, Runga Kutta method. Solution of partial differential equations models: Differential Laplace, Poisson, parabolic and hyperbolic equation, Finite difference method, graphical method, Bender - Schmidt method (8 Hrs)

Unit – IV

Optimization: Introduction, optimization theory, optimization methods, Graphical and numerical methods of optimization, Unconstrained optimization, Constrained optimization, Programming optimization, experimental optimization, Response surface methodology (RSM) (4 Hrs)

Unit – V

Modelling and simulation of Thermal processing, convection dehydration, osmotic dehydration, spray drying. (4 Hrs)

Unit - VI

Modelling and simulation of Freeze Drying, Freezing process; deep fat frying; extrusion process; filtration processes; membrane separation process; distillation and Extraction processes. (4 Hrs)

Recommended Books: Title	**Author**
Computerized Control Systems in the Food Industry	Gauri S. Mittal
Response surface methodology	R. H. Myers
Computer aided techniques in Food Technology	Israel Saguy
Response surfaces design and analysis	A. I. Khuri & J. A. Cornell
Design of Experiments	Montgomery

FTE-43 Project management for food processing industries

Teaching Scheme : L : 3 T : 0 **Credits : 3**

UNIT - I

Concept of entrepreneurship: entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, Budgeting monitoring, evaluation and follow up.

Types of business ownership such as Proprietorship, Partnership, Limited Company and Joint stock companies. (6 Hrs)

UNIT - II

Management: Definition, Functions, Principles, Planning, Organizing ,Coordinating, Directing, Controlling. Objectives & Polices of Corporate Management. Organization Structures types-advantages and disadvantages of each type. (6 Hrs)

UNIT - III

Brief description of Functional Management systems such as Financial Management, Personnel Management, Production Management and Marketing Management (6 Hrs)

UNIT - IV

Principles of Accountancy - Ledger and journal postings. Brief discussion of Balance sheet – trial balance, Profit and Loss accounts. Introduction to different types of accounts. Cost accounting – types. Methods of preparing cost sheet for the product manufactured. (6 Hrs)

UNIT - V

Labor welfare and safety measures – Forecasting the demand for the product and demand analysis – Supply and demand relationships. Inventory Management – EOQ model – ABC, JIT, FIFO, FILO, VED and FSN analysis . (6 Hrs)

UNIT - VI

Quality Control : Quality aspects of food, Quality control theory –Control of variables and attributes , Control charts. Sampling Theory –Problems related to quality control of food products –ISO 9000. (6 Hrs)

References:

1. Industrial Engineering and Management by O.P. Khanna
2. Operations Research by V .K .Kapoor
3. Entrepreneurship - Thomas W Zimmer and Norman M Scarborough 1996. Prentice Hall, New Jersey, USA.
4. Entrepreneurship Strategies and Resources - Mark J Dollinger 1999. Prentice hall, Upper Saddal River, New Jersey, USA.
5. Entrepreneurial Development - Khanks SS 1999. S. Chand and company New Delhi.
6. Principles of Agri Business Management - D. David and S Erickson 1987. Mc Graw Hill Book Co., New Delhi.

(FTS-2) Seminar II

Teaching Scheme: P: 2 **Credits: 2**
Contact hrs : 2 Hrs./Week/student

The topic of seminar shall be based on area of Food Technology; preferably considering new ideas, concepts, technologies & developments in the field of Food Technology. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the present context, report documentation and presentation skills. Guide should spare for 2hrs /week/student for seminar

(FT-23) Laboratory- I

Advances in Food Biotechnology

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report.

(FT-24) Laboratory- II

Chemical and instrument analysis of food components

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report.

(FT-25) Laboratory- III

Food Quality, Safety and Toxicology

Teaching Scheme: P: 2 **Credits: 1**

A performance based on Experiments, or assignment or Visit report.

SEMESTER-III

T 31 Industrial Training:

Teaching Scheme Examination Scheme

Contact hrs : 2 Hrs./Week/student **Credit: 4**

8 Weeks at the end of First Year and as a part of evaluation at the end of third semester student should submit the report for the 8 week industrial training and give presentation to the concern guide; concern guide should spare 1hrs/week/student

Semester-III & IV

S 32 and D 42 Dissertation Project Phase I & II

The student shall be allowed to submit the dissertation phase I report only after the completion of minimum 50% work of the total project with intermediate /partial results of the dissertation project to the concern guide and the dissertation phase II report only after the full-fledge demonstration of his /her work to the concerned guide. Assessment of the dissertation shall be based on design & implementation aspects, documentation & presentation skills, utility of the dissertation work & publications based on the same.

For the dissertation phase I and phase II concern guide should guide to each student minimum for **2** hrs per week till the final submission of the dissertation of the concern student.