सत्यमेव जयते

NIFTEM
KNOWLEDGE • INNOVATION • OUTREACH

National Institute of Food Technology Entrepreneurship and Management
Ministry of Food Processing Industries, Government of India

NIFTEM/S/K/36/12

Date: 10.01.2013

Sub: Minutes of the 2nd meeting of the Academic Council of NIFTEM held on 26.12.2012 at 3:30pm at NIFTEM Campus

The undersigned is directed to forward herewith the Minutes of the 2nd meeting of the Academic Council of NIFTEM held on 26.12.2012 at 3:30pm at NIFTEM Campus, Kundli Distt. Sonipat, Haryana under the chairmanship of Hon'ble Vice Chancellor, NIFTEM.

(SUSHIL KUMAR)
Registrar & Member Secy.
Phone No: 0130-2219773
Fax No: 0130-2219772

To,

1. Dr. A. K. Dhawan, Professor & Dean of Academics, NIFTEM
2. Dr. A. K. Singh Suryavanshi, Professor & HoD (FBM&E), NIFTEM
3. Dr. P. K. Nema, Associate Prof./HoD (Eng.), NIFTEM: Member
4. Dr. Ashutosh Upadhyay, Associate Prof./HoD (FST), NIFTEM
5. Dr. V. Mishra, Associate Prof./Head of Department (B&AS), NIFTEM
6. Dr. Santanu Basu, Associate Professor, NIFTEM
7. Dr. MD Irfan Ahmad Ansari, Associate Professor, NIFTEM
8. Dr. Neeraj, Assistant Professor, NIFTEM
9. Dr. Rupesh Chavan, Assistant Professor, NIFTEM
10. Dr. Ambika Badh, Assistant Professor, NIFTEM
11. Prof. H. N. Mishra, IIT Kharagpur
12. Prof. Subhash Chand, IIT Delhi
13. Shri Sanjay Khajuria, Vice President, Nestle India
14. Shri Hiren Bhatt, CEO, Amul Dairy,
15. Shri A.D. Padam Singh Issac, Chairman Aachi Masala Foods P. Ltd.

Copy to

1. Sr. PS to Vice Chancellor, NIFTEM
2. Sh. Rohit Mathur, Director, MoFPI, Panchsheel Bhawan, August Kranti Marg, New Delhi -110 065
3. Registrar's Personal Sections.
4. Advisor to Hon'ble VC
5. Library.

Minutes of the 2nd meeting of Academic Council of National Institute of Food Technology Entrpreneurship and Management (NIFTEM), held on 26. 12. 2012 at 3: 00 PM in Hon'ble VC Meeting Room, NIFTEM Campus, Kundli, Sonepat.

The following were present:

1. Shri Ajit Kumar, Vice- Chancelleor, NIFTEM : Chairman
2. Shri Sushil Kumar, Registrar, NIFTEM : Secretary
3. Prof Ashok Dhawan, Dean (Academic), NIFTEM : Member
4. Prof S. K. S. Suryavanshi, Dean (Students Welfare) : Member
5. Dr. Ashutosh Upadhyay, HoD (FST), NIFTEM : Member
6. Dr. P. K. Nema, HoD (Engg), NIFTEM : Member
7. Dr. Santanu Basu, Associate Professor, NIFTEM : Member
8. Dr Irfan Ansari, Associate Professor, NIFTEM : Member
9. Dr. Neeraj, Assistant Professor, NIFTEM : Member
10. Dr. Rupesh Chavan, Assistant Professor, NIFTEM : Member
11. Shri Hiren Bhatt, CEO, Amul, Anand Gujrat : Member

Leave of absence granted to Dr. H. N. Mishra, Dr. Vijendra Mishra, HoD (BAS, Dr Ambika Badh, Assistant Professor, NIFTEM.

The following decisions were taken:

Agenda Item No.1

Confirmation of the minutes of 1st meeting of Academic Council held on 23. 08. 2012.

Minutes of the last meeting were confirmed.

Agenda Item No. 2

Consideration of action taken report in respect of the minutes of the first meeting of Academic Council held on 23. 08. 2012.

Action taken report was accepted

Agenda Item No.3

Revised Procedure and educational qualification for admission in B. Tech (Food Technology and Management) programme of NIFTEM during 2013-14.

The item was approved

Agenda Item No. 4

Introducing Ph. D Programme at NIFTEM

The item was approved with the following changes

Point 1 (f): "Any other discipline approved by the Academic Council" be deleted

Point 2 (a): "M. Tech./ M. Sc." be replaced with a "Master's degree"

Point 4: The maximum number of seats in a department will be on the basis of Faculty strength as per UGC guidelines, however for the current year the department may decide the number of seats as per the available facilities.

Point 6 (b) Student shall also study a course on Communication skills, technical and scientific writing etc.

Point 6 (h) The number of examiners shall be as per UGC guidelines, if any.

The following points be added:

(i) Total requirement of course work for Ph.D. degree will be between 12 to16 credits

(ii) A student must complete his degree within 5 years of registration; thereafter the registration shall stand cancelled. However, in exceptional circumstances this period may be extended upto further two years by the Vice-chancellor, NIFTEM.

(iii) Provisions be made for employed personnel to complete their Ph.D., at NIFTEM in a part time manner by making arrangements for the course work during evening and week ends. However, their admission will be only through the prescribed procedure.

Agenda Item No. 5

M. Tech./Ph. D. in Food Biotechnology

For the time being only an M. Tech. programme on "Food Biotechnology and Management" may be started from academic session 2013-14 by creating a virtual department of Food Biotechnology.

Agenda Item No. 6

Creation of a virtual department of undergraduate studies and a Faculty for Post graduate studies.

- Approved; The question of nominating a faculty for P. G. Studies is an internal matter of NIFTEM and it may be got approved on file.

Agenda Item No. 7

Addition of elective courses for B. Tech.

Should be put up to the next meeting of Academic Council.

Agenda Item No. 8

B. Tech./M. Tech. With a core concentration (= specialization)

Should be put up to the next meeting of Academic Council.

Agenda Item No. 9

Deficiency Courses for students with non-related background.

Three decisions were taken:

(a) Biology course for B. Tech. students with non-biology background be added as a preparatory course as proposed

(b) Qualifications for admission to M. Tech programmes be modified so as to ensure admission of students from related subjects only

(c) Ph. D. students from non-related backgrounds will be required to clear M. Tech. level courses as "preparatory courses", as determined by HoD concerned.

Agenda Item No.10

Credits for Village Adoption Programme

Approved

Agenda Item No.11

International Exchange of students

It was approved with a condition that NIFTEM shall meet airfare only.

Agenda Item No. 12

Courses for ground level personnel: Evening and weekend classes

Approved

Agenda Item No. 13

Minimum requirement of attendance at NIFTEM for each course.

Approved. However, leave granted by the prescribed process shall count towards making 90%

Agenda Item No. 14.

Periodicity of BoS and Academic Council meetings

Approved as proposed

Agenda Item No. 15

Academic Monitoring and auditing Unit

Approved, except part (c), which provided 15% of answer sheets being reserved for external examiner.

Agenda Item No. 16

Revision in Academic Calendar for semester- II (Even Semester) 2012-13

Approved. However, Village Adoption Programme shall begin from 18.06.2013 instead of 16.06.2013 and the rest of the calendar shall be revised accordingly.

Agenda Item No. 17

Approval of Board of Studies (BOS) minutes of different programmers

Approved, except the minutes of Board of studies of BAS. The recommendations of this Board be brought in detail in a Tabular form comparing the existing and the proposed changes.

Towards the end, Dr. Hiren Bhatt, member Academic Council pointed out that:

1. NIFTEM should develop a mechanism to interact with the parents of students directly. This will increase the social awareness about NIFTEM. The event should be inbuilt in academic calendar. The possibility of online interactive sessions with parents must also be explored.
2. Quality of NIFTEM programmes and courses rather than the number of courses is important.
3. Placement of students will be the most important issue and NIFTEM should review as to how much input can be made in this regard.
4. Management lectures should be arranged from reputed organizations.

Meeting ended with the thanks to the Chair.

Annexure 1

Subject: Revised procedure and educational qualification for admission to B Tech (Food Technology and Management) programme at NIFTEM during 2013-14

NIFTEM admission guidelines 2013-14

Year of Passing Qualifying Examination (QE):
Only those candidates who have passed their Class 12th Exam or any other qualifying examination in 2011 or 2012; or those who are appearing in their Class 12th Exam or any other qualifying examination in 2013. Candidates who passed Class 12th/Qualifying examination in 2010 or before as well as those who will appear in such examination in 2014 or later are not eligible.

Candidates who appeared in class 12th/other Qualifying Examinations in 2010, did not pass in 2010, but passed in 2011 are also not eligible to appear in JEE (Main) 2013.

Subject combinations required in the qualifying examination:
Subjects in Qualifying Examination: Physics, Mathematics and one of the subjects from (Chemistry, Bio-technology, Computer Science, Biology) along with 50% marks in total including all subjects

Date of Birth
Only those candidates whose date of birth falls on or after October 01, 1988 are eligible. However, in the case of Scheduled Caste (SC), Scheduled Tribe (ST) and Persons with Disabilities (PwD) candidates, upper age limit is relaxed by 5 years, i.e. SC, ST and PwD candidates who were born on or after October 01, 1983 are eligible. Date of birth as recorded in the Secondary Education Board/University certificate will only be considered.

Intake
180 Seats

Other Eligibility Conditions
For admission to the B. Tech. courses, candidate must
(a) be an Indian national (Admission to foreign national will be provided as per GOI norms and it would be over and above prescribed intake)
(b) bear a good moral character and should not have been debarred from any institution/university,
(c) submit a physical fitness certificate from a registered medical practitioner.

Selection Procedure for B.Tech. Programme
The admission to the First Semester of the B. Tech. (FTM) programme will be offered to the candidates based on their All India Rank in JEE-2013. Counseling for admission will be done by NIFTEM.

Annexure 2

Subject: Introducing Ph. D. Programme at NIFTEM

Proposed guidelines for admission to Ph. D. Programme and regulations for award of Ph. D. degree at NIFTEM are as below

1. NIFTEM shall have Ph.D. programmes in the following Departments:
(a) Agriculture and Environment Sciences
(b) Basic and Applied Sciences
(c) Engineering
(d) Food Business Management and Entrepreneurship
(e) Food Science and Technology

The details of the areas of specialization shall be put up on the web-site of NIFTEM and admission notification shall indicate this.

2. Minimum qualifications for admission to Ph.D. programme shall be:

(a) Masterôs degree in a relevant discipline with at least 60% marks at Masters, Bachelors and Senior Secondary School (10 + 2) level. Preference will be given to NET/ GATE qualified candidate.

(b) Candidates appearing in qualifying examination may apply, but will be considered provisionally subject to meeting the above requirements.

(c) Reservation shall apply as per Govt of India norms

3. Applications for Ph.D. programme shall be invited in the month of April each year. The selection procedure for admission to Ph.D. programme shall be as below:

(a) Candidates fulfilling minimum requirements will be called for a written test at their own expense at the designated examination centers during May/ June.

(b) The test shall assess the Bachelor level knowledge of the subject in addition to examination of ability to comprehend, analyze and reason.

(c) The result of the written test along with the schedule of interviews shall be put up on NIFTEM web-site. No individual communication shall be made.

(d) The number of candidates to be called for interview or a cut off percentage may be fixed by the competent authority.

(d) Interviews shall be held at NIFTEM Campus during the month of June/ July. The candidates called for interview from a distance more than 200 Km from NIFTEM, shall be paid second class train/ bus fare for their travel.

4. The maximum number of seats in a department will be on the basis of Faculty strength as per UGC guidelines, however for the current year the department may decide the number of seats as per the available facilities. However, as per UGC guidelines, the number has to be decided well in time and included in the advertisement.

5. The NET/GATE qualified candidates selected through the above process shall be allowed to enroll for Ph.D. degree program at NIFTEM and NIFTEM shall provide a NIFTEM Ph.D. Fellowship (Rs 16000, 18000 and 20000 per month in the first, second and third year). Those without NET/GATE shall be provided with NIFTEM Ph.D. scholarship (Rs 12000 per month).

6. Regulations for Award of Ph.D. degree shall be as below:

(a) Qualifications to become an ñeligible Ph.D. guideò shall be as below: An Assistant Professor of the Department with three years of post Ph.D. experience can act as a research guide of Ph.D. students of the department. All Associate Professors and Professor shall be ñeligible guidesò. The maximum number of students that a faculty member can enroll will be as per UGC guidelines.

(b) Students admitted to Ph.D. programme at NIFTEM shall undertake course work for at least one semester, which will include a course on Research methodologies which may include quantitative methods and computer applications, as per UGC guidelines. Student shall also study a course on Communication skills, technical and scientific writing etc. Total requirement of course work for Ph.D. degree will be between 12 to16 credits.

Students with Masterôs degree in allied branches, if admitted, shall undergo one more semester of course work to complete the areas of deficiency as determined by HOD/ Research guide of the student.

(c) Minimum qualifying requirements of marks for the course work shall be determined by NIFTEM and students meeting those requirements will be allowed to proceed for research work after the course work is complete. Students not able to meet minimum qualifying requirement of marks in the course work shall be put on ñAcademic Probationò.

(d) Each student shall plan his research work with the guide and deliver a ñpre-Ph.D. researchò seminar, which will then be approved by the Ph.D. committee consisting of Research guide of the student, HOD of the department and a representative of Dean (Academic).

(e) Each student shall make one presentation to report the progress of work and then another presentation prior to submission of the thesis. The ñPh.D. committeeò shall evaluate these seminars and the progress of the student. In the event of unsatisfactory progress, the committee may recommend the student to be put on ñAcademic probationò.

(f) The fellowship/ stipend of a student on ñAcademic probationò shall not be paid for the period of probation. If probation continues for more than two semesters, the Ph.D. enrollment of the student shall stand cancelled.

(g) A student shall publish at least two research paper in a refereed journal of impact factor not less than 1 prior to submission of the thesis. A reprint or acceptance letter shall be submitted along with the thesis.

(h) The thesis submitted by the student shall be sent for examination to at least two examiners, one of whom shall be out of state, preferably out of India.

(i) Upon receipt of satisfactory reports the student shall make a public defense of his thesis, in which one of the examiners shall conduct vivo voce.

7. A student must complete his degree within 5 years of registration; thereafter the registration shall stand cancelled. However, in exceptional circumstances this period may be extended upto further two years by the Vice-chancellor, NIFTEM.

8. Provisions shall be made for industry personnel to complete their Ph.D. at NIFTEM by making arrangements for the course work during evening and week ends. However, their admission shall be only through the prescribed procedure.

9. Dean (Academics) shall be the nodal officer for Ph.D. activities related to programmes run at NIFTEM

Annexure 3

Subject: M. Tech course in Food Biotechnology at NIFTEM

Considering the relevance of Biotechnology to Food Sciences an M. Tech programme in ñFood Biotechnology and Managementò shall be started at NIFTEM from Academic session 2013-14. A virtual Department will be created by combining the Faculty from different departments, who will run the programme and guide the students. HOD AES or HOD BAS shall co-ordinate the programme.

Annexure 4

Subject: Creation of a Virtual Department of Undergraduate studies and a Faculty for Postgraduate Studies

It has been decided to create a ñDepartment of Undergraduate Studies (DUS)ò at NIFTEM by drawing one Faculty member from each of the existing five departments. One of the Faculty shall be HOD of this department.

An important difference between DUS and other departments, however, shall be that DUS will not be a real department like the five other existing departments. This will be only a ñCore Facultyò for a specific task i.e. running undergraduate programmes at NIFTEM and hence will be a ñVirtualò or an ñAcademicò Department only.

In an Academic or a Virtual Department, Faculty members remain a part of their respective parent departments for all administrative, scientific and technical work.

DUS shall have a dedicated office to deal with the office work such as registration and record keeping of students. Faculty from different departments shall participate on need basis.

Further, a member of DUS Faculty has the role of a co-ordinator on behalf of his parent department and shall have teaching load like all other faculty members. Similarly, all other Faculty members of the parent departments shall participate in teaching undergraduate courses with their normal teaching load, as is the case at present

Further, in order to better co-ordinate Postgraduate teaching work, it is proposed that each of the five departments shall nominate one Faculty member as ñPG Teaching Co-ordinatorò who shall have the primary responsibility of looking after postgraduate teaching work of the department, like preparing time table, course allotment, student allotment to mentors, regular revision of curriculum etc. The five PG Teaching Co-ordinators together with the Dean (Academic) shall form a core ñFaculty for Postgraduate Studies (FPS)ò for running postgraduate programmes at NIFTEM. They shall co-ordinate for general issues related to postgraduate studies.

Based on the above decisions of the Academic Council the DUS and PG Faculty are constituted as below:

Department of Undergraduate Studies:
Dr. A. K. Dhawan HoD.
(Appointed as HoD for B. Tech programme vide order dated 06.12.2012)
Dr. Parmod Rai
Dr. Tripti Aggarwal
Dr. Nitin Mehta
Dr. Vijay Kumar
Dr. Anupama Panghal

Faculty of Post Graduate Studies
Dr. A. K. Dhawan, Dean (Academic)
Dr. Sanjay Bhayana
Dr. P. K. Paul
Dr. Neeraj
Dr. Parmod Rai
Dr. Neetu Kumra Taneja

Annexure 5

Subject: Deficiency courses for students with non related background

There shall be a one semester, five credit Institute level course in Biology for students as a preparatory course in B. Tech.. Only those students who have not taken biology as a subject at 11th and 12th level shall take this. It will be a non-credit course and students will have to clear it with a õsatisfactoryò grade in the first year of B. tech. programme.

Ph.D. students from non-related streams shall undergo preparatory courses as determined by HoD concerned.

Annexure 6

Subject: Credits for village adoption programme

The following changes are hereby made in credit hours of village adoption programme at NIFTEM:

(a) In view of the extensive syllabus to be covered, the credits for theory part of the village adoption programme are raised to two credits course (2+0+0) instead of one (1+0+0) as at present.

(b) The number of credits that a student will earn for work in villages under this programme shall be linked to the length of stay in the village. There will be one credit for each block of 5 to 7 days work in the village so that a student staying for 10 to 14 days gets two credits instead of one, as at present. The general rule will be that a student earns one credit for each block of approximately 40 hours of work in the village adoption programme .

(c) Village Adoption is a prestigious programme of NIFTEM. Therefore, there will be a separate ñVillage Adoption Programme Cellò and dedicated faculty to look after this programme. Therefore, there shall be a separate ñVillage Adoption Programmeò cell with specialists in Extension education. In long run, the same cell may look after other outreach activities of NIFTEM.

Annexure 7

Subject: International Exchange of Students

International Exchange Programs are extremely important to students where they get the opportunity to seek international exposure, acquaint themselves with new cultures and understand global educational standards. Such activities are important part of overall development of a student giving them awareness and help adopt alternative, multi-faceted approaches to learning. With changing global economic conditions, international exchange programs are becoming viable and effective prospects of learning and gaining international exposure. NIFTEMôs policy for International Exchange of Students shall be as below:

1. Outbound Students

NIFTEM shall support outbound exchange program for its students in order to add an international perspective to their education. Under this activity, students shall be allowed to time at a NIFTEM approved international educational institute/university. Following policy will apply to students going abroad under outbound exchange program:

1.1 NIFTEM has and is also in the process of developing MoU with some organizations abroad. These shall form the preferred destinations for outbound students. However, a student may contact other Foreign organizations to act as host. Once the host is finalized, the student shall seek formal permission from NIFTEM prior to going to any foreign organization. Such requests should be forwarded through the studentôs guide and Head of Department to the International Cell for approval of Competent Authority.

1.2 Ten B. tech students from each batch will visit abroad for one week during first year, 2 to 3 weeks during second year and 6 to 8 weeks during third year. Two M. Tech. students from each stream will visit abroad for 2 to 4 weeks in the first year and one full semester in second year.

1.3 When going for a full semester, the students must freeze their semester at NIFTEM prior to going abroad. There will be no tuition fee charged for freezing the semester.

1.4 The student must adhere to departure and return dates as specified in the application.

1.5 The duration of the semester(s) studied abroad will not be counted towards the calculation of time bar.

1.6 Students should have studied for at least two semesters at NIFTEM prior to proposed date for an outbound exchange program.

1.7 Based on the studentôs academic performance and discipline, first ten meritorious studentsôfrom B. Tech. and first two meritorious students of each of the M. Tech. streams will be given economy class onward and return air fare only (Tickets to be booked according to the Government of India Rules). Some more students may be considered for partial airfare (25 to 50%).

1.8 All expenditures of outbound exchange for those students not covered by NIFTEMôs Financial assistance will be borne by students themselves.

2.0 Inbound students

Inbound exchange activities allow students studying in foreign educational institutes/universities to study one semester at NIFTEM. The following policy will apply for inbound exchange program:

2.1 Inbound exchange program will only be allowed for students from international educational institutes/universities approved by NIFTEM.

2.2 The decision for enrolling students under inbound exchange program will be taken by NIFTEM on case to case basis depending on following factors:

2.2.1 The student must have a good academic record. The documents provided in this regard will be scrutinized by International Cell.

2.2.2 The student must submit a letter ensuring consent of his/her home university to study at NIFTEM under exchange program.

2.2.3 The student must be a regular student of his/her home university.

2.2.4 The student should be fluent in English language.

2.3 The student will be awarded official interim transcript for the courses he/she will study at NIFTEM under the inbound exchange program.

2.4 Tuition fee will be charged as per prevailing rate for the courses studied at NIFTEM.

2.5 All expenditures (lodging, ticket, etc) of inbound exchange students will be borne by students/ their parent

Annexure 8

Subject: Courses for ground level personnel: Evening and weekend classes

Food Processing Industry employs large number of personnel who will find upgradation of their skills at NIFTEM very useful. However, being full time employees/ owners of SME units, they are unable to attend during the normal time.

Selected courses from NIFTEM programmes that are of direct relevance to industries shall be offered as Evening and weekend courses for certification and upgradation of such ground level individuals.

Annexure 9

Subject: Minimum requirement of attendance for students at NIFTEM

The mandatory requirement of attendance for appearing in the examination and passing a course at NIFTEM which is now 75% is raised 90%. However, leave granted by the prescribed process shall count towards making 90%ò

Annexure 10

Subject: Periodicity of BoS and Academic Council meetings

The Board of Studies of each discipline shall meet at least twice a year: once before beginning of every semester. The Academic Council should meet at least four times each year: once every quarter. Meetings of the BoS shall be convened by the respective HoDs and of the Academic Council by the Registrar, NIFTEM.

Annexure 11

Subject: Academic Monitoring and Auditing Unit

An academic monitoring and auditing unit is hereby set up at NIFTEM. The functions of this unit will be:

(a) Prepare a daily status report of classes held, students attendance, seminars organized, invited lectures, video conferences and other academic activities on NIFTEM Campus and provide daily report to Dean (Academic), who will compile it on weekly basis and pass the information to Vice-chancellor NIFTEM.

(b) To Carry out students feed back, obtain and prepare Faculty self assessment reports

(c) Other academic audit activities as required to maintain high standards of academic work at NIFTEM.

Annexure 12

Subject: Revision in academic calendar for second Semester 2012-13

Existing		Proposed	
Teaching start:	07-01-2013	Teaching start:	07-01-2013
Annual Fest	22-02-2013 to 23-02-2013	Annual Fest	22-02-2013 to 23-02-2013
Mid-term exam	11-03-2013 to 16-03-2013	Mid-term exam	04.03.2012 to 08-03-2013
		Village Adoption program	11-03-2013 to 16-03-2013
		Midterm break	27-03-2013 to 30-03-2013
Preparation Leave	25-05-2013 to 28-05-2013	Preparation Leave/Class revision	01-06-2013 to 03-06-2013
End Semester Exams	29-05-2013 to 07-06-2013	End Semester Exams	04-06-2013 to 14-06-2013
Village Adoption program	08-06-2013 to 17-06-2013	Village Adoption program	18-06-2013 to 27-06-2013
		Declaration of result	25.06.2012
Summer Break	18-06-2013 to 07-07-2013	Summer Break	28-06-2013 to 28-07-2013 (for B. Tech only)
		Industrial Training for M Tech	01-07-2013 to 30-07-2013

Annexure 13

Subject: Approval of Board of Studies (BOS) minutes of different programmers

SEMESTER – III
FST 201
FOOD CHEMISTRY AND CONCEPTS OF NUTRITION
(3+1+2= 5 Credits)

Objectives:

- To get an insight into the proximate principles of food and their functions and briefly understand the effect of processing and storage on food constituents.
- To familiarize the students with the concepts of Nutrition and health.

Course Contents

Theory

UNIT-I

Introduction to food chemistry: Proximate composition of foods; Functional and nutritional aspects of various food constituents in brief.

Water: Definition of water in foods, physical properties of water and ice; structure of water and ice; interaction of water with solutes; sorption phenomenon; types of water; water activity.

UNIT -II

Carbohydrates: Definition, classification, structure of monosaccharides, disaccharides, oligosaccharides polysaccharides (starch, glycogen, cellulose, hemi-cellulose, lignins, pectins, gums and mucilages); chemical reactions of carbohydrates; effect of processing and storage on carbohydrates. *Introduction to nutritive and non-nutritive sweeteners*.

UNIT -III

Lipids: Definition, classification, structures, physical and chemical properties of lipids and fatty acids, effect of processing and storage on fats and oils. Refining of oils, hydrogenation and winterization, vegetable and animal fat, butters, frying and shortening.

UNIT -IV

Proteins: Amino-acids - definitions, classification, essential and non-essential amino-acids, structures and properties; peptides - peptide bonds and some important peptides; purification and denaturation of proteins, Protein interaction and degradation, protein-lipid complexes and protein-carbohydrate complexes. Major protein systems and factors affecting them. Metabolic antagonist and allergens associated with food proteins .classification and structures of proteins physical and chemical properties of proteins; important food proteins; changes of proteins on processing and storage with special emphasis on enzymatic and non-enzymatic browning such as Maillard reactions and Strecker degradation.

UNIT -V

Vitamins: structures and functions in brief. Minerals: Occurrence and functions in brief

Concept of balanced diet, Recommended Daily Allowances (RDA), antinutritional factors, Nutritional deficiencies, diseases and disorders.

Practical:

1. Determination of proximate composition of food - moisture, protein, crude fat, crude fiber, ash and total carbohydrates by standard AOAC procedures.
2. Determination of pH and total acidity of various food samples.
3. Qualitative test for carbohydrates (mono-, di- and polysaccharides) and amino-acids and their identification in unknown mixtures.
4. Qualitative test for proteins and fats/oils.
5. Determination of total sugars, reducing and non-reducing sugars in various food samples.
6. Quantitative estimation of proteins by Lowry and Biuret methods
7. Characterization of fats and oils
8. Estimation of vitamins - A, thiamine, riboflavin, ascorbic acid by titrimetric and HPLC methods.
9. Estimation of metals - Fe, Ca, P, Cu, Pb, As, Sn and Cl- by atomic absorption spectrometer and flame photometer.

Suggested readings:

- O R Fennema, Food Chemistry; McGraw Hill.
- H D Belitz and W Grosch, Food Chemistry; Springer Verlag.
- L H Meyer, Food Chemistry; AVI, New York.
- AOAC, Official Methods of Analysis of AOAC International; Washington DC
- R S Kirk and R Sawyor, Composition and Analysis of Foods; Longman Scientific and Technical, UK.
- M S Eastwood, Principles of Human Nutrition
- Manual of FSSAI

FST 202
FRUITS and VEGETABLES PROCESSING TECHNOLOGY
(3+0+2 = 4 Credits)

Objectives:

- To study the principles of fruit and vegetable processing, preservation, handling, including cold chain and by- product utilization.
- To understand the basic concepts of packaging of raw and processed fruits and vegetables.

Course Contents:

Theory:

UNIT -I

Fruits and vegetables as living products: Current status of production and processing of fruits and vegetables, composition and nutritive value of fruits and vegetables; spoilage of fruits and vegetables. Maturity standards for storage and desirable characteristics of fruits and vegetables of processing, fruit ripening, Post harvest treatments to enhance shelf-life, Washing, grading, Pre-cooling, Concept of evaporating cooling, conditions for transportation and storage,

UNIT-II

Cold chain and low temperature preservation: Types of cold preservation; Types of freezers and freeze concentrators, cooling above freezing point, cooling below freezing point. Pack house, Refrigerated transportation.

UNIT -III

Thermal processing: blanching, Canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control. UHT processing: Aseptic processing and packaging. Dehydration techniques of Fruits and Vegetables: Tray drying, osmotic dehydration, foam mat drying, spray drying, fluidized bed drying, freeze drying, microwave drying, vacuum drying, heat pump drying.

UNIT-IV

Products processing: Juice extraction and preparation of syrups, squashes, cordials, nectars, Jam, jelly, marmalade and candies; ketchup, pickles, chutneys and sauces; fruit juice concentrates and powders; fortified soft drinks, tomato product, vinegar; cut fruits and vegetable, fruit toffee; fruit flavors and essences; Minimally processed fruits and vegetables, Emerging technologies for fruits and vegetables processing.

UNIT-V

Technology of Dry Fruits and Nuts

By-products utilization: Extraction of active ingredient from by-products of fruits and vegetables or industrial waste.

Practical:

1. Estimation of sugar-acid ratio of fruits
2. Evaluation of washer and grader
3. Testing of adequacy of blanching
4. Pectin determination in fruits and vegetable products.
5. Preparation fruit juices and concentrates
6. Canning of fruits and vegetables
7. Preparation of jams and jellies, marmalade, preserves and candies
8. Preparation of pickles, chutneys
9. Preparation of tomato products
10. Drying of fruit and vegetables
11. Processing of mushrooms.

12. Visit to fruits and vegetable processing industries

Suggested Readings :

- Cruesss W.V. 2000. *Commercial Fruit and Vegetable Products*. Agrobios.
- MirceaEnachescaDanthy. 1997. *Fruit and Vegetable Processing*. International Book Publ.
- Srivastava R.P and Sanjeev Kumar. 1994. *Fruit and Vegetable Preservation*. *Principles and Practices*.International Book Distr.
- Sumanbhatti and Uma Varma. 1995. *Fruit and Vegetable Processing*. CBS.
- Thompson A.K. 1996. *Post Harvest Technology of Fruits and Vegetables*. Blackwell.
- Verma L.R and Joshi V.K. 2000. *Post Harvest Technology of Fruits and Vegetables*. Vols. I-II. Indus Publ.
- A.K Thompson, Fruits and Vegetables; Blackwell publishing
- S. Ranganna, Hand Book of Analysis and Quality Control for Fruits and Vegetable Products; Tata McGraw Hill
- S. Ranganna, Hand Book of Canning and Accepting Packaging; Tata McGraw Hill
- L. Somogyi, Processing Fruits: Science and Technology, Vol I : Biology Principles and
- Applications; Woodhead Publishing
- L. Somogyi, D.M. Barette and Y.H. Hui, Processing Fruits: Science and Technology, Vol II: Major Processed Products; Woodhead Publishing
- Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K. Nip, Handbook of Vegetable Preservation and Processing; Marcel Dekker

FST 203
MILK AND MILK PRODUCTS TECHNOLOGY
(3+0+3=5 Credits)

Objectives:

- To expose the students about the milk processing, traditional Indian dairy products and fermented milk product manufacturing.
- To develop competency in the students for adopting dairy processing and product manufacturing as an enterprise.

Course Contents:

Theory

UNIT -1

Milk: Definition, composition, White revolution, Present milk industry scenario and its future, Physical and chemical properties, nutritive value of milk and milk products and its national and international standards. Practices related to procurement and transportation of milk.

UNIT -II

Testing of milk and milk products: Detection of non-milk fats, water, non-milk proteins. Microbiology of milk: Milk as a substrate for bacteria, spoilage micro-organism, pathogenic micro-organism, sources of contamination, hygienic measures.

UNIT -III

Good hygienic practice in milk processing: Principal hazards, cleaning and disinfection in a dairy industry, definitions, cleaning and disinfection agents and processes. Reception, pasteurization, standardization, toning, homogenization, cream separation, market and special milk.

UNIT-IV

Technology of traditional Indian dairy products. Technology of fat rich dairy products like Cream, butter, ghee and margarine. Technology of fermented milk and milk products and probiotic milk based products.

UNIT -V

Sterilized flavored milk, UHT milk, Aseptic packaging and storage.

Practical :

1. To conduct the platform tests of milk sampling of dairy products.
2. Determination of physio-chemical properties of milk.
3. Testing efficiency of pasteurization.

4. Detection of common adulterants in milk and milk products.
5. Separation and standardization of milk.
6. Preparation of flavored milk.
7. Preparation of traditional Indian dairy products
8. Preparation of white and salted butter and ghee.
9. Visit to a dairy plant.

Suggested Readings:

- Smit, G., Dairy processing - improving quality; Woodhead Publishing.
- Walstra P., Geuits T.J., Noomen A., Jellema A. and Van Boekel M.A.J.S.,Dairy technology- Principles of milk properties and processes; Marcel Dekker Inc.
- Spreer E., Milk and dairy product technology; Marcel Dekker Inc.
- Gupta R.P., Dairy India year Book 2007.
- Robinson R.K., Modern dairy Technology, Vol I Advances in Milk processing.

FST 301
INSTRUMENTAL METHODS OF FOOD ANALYSIS
(2+0+3 = 4 Credits)

Objectives:

- Introduce students to various modern instrumental techniques in food analysis.
- Understand the applications, strengths and limitations of different methods.

Course Content:

Theory

UNIT-I

Introduction to Food Analysis: Good Laboratory Practice, safety in laboratory. Sampling and Sampling techniques. Sample preparation for analysis. Basic principles of Spectroscopy, UV and visible molecular absorption spectrometry, atomic absorption spectrometry emission spectrometry, fluorescence spectrometry, Atomic mass spectrometry, Infrared spectrometry.

UNIT-II

Basic principles of Chromatography and its separation Techniques: Liquids, GC, TLC, Super critical fluid extraction chromatography.

UNIT-III

Analysis of liquids: Total liquids concentration, Solvent extraction; Non-solvent liquid extraction methods; instrumental methods. Determination of liquid composition - Separation and Analysis by Chromatography; Chemical techniques. Analysis of Liquid oxidation.

UNIT-IV

Electrophoresis methods, Chemical methods; enzymatic methods; physical methods; immunoassays; analysis of polysaccharides fiber. Analysis of proteins Determination of overall protein concentration; protein separation and characterization; methods based on different adsorption characteristics separation due to size differences; separation by electrophoresis.

UNIT-V

Radiochemical Methods: Use of radio isotopes. Viscosity and Consistency Measurements of Food, Measurements of Rheological properties.

Practical

1. Introduction to Food Analysis Techniques.
2. Sampling techniques and methods of sample preparation.
3. Principles of colorimetry and spectrophotometry.
4. Determination of pH.
5. Determination of Titratable acidity.
6. Determination of moisture and Total solids.
7. Analysis of foods for pesticides and drug residues.
8. Test for Adulterants

Suggested Readings:

- S.S. Neilson, Food analysis; Aspen publishers, Gaithery Berg, Mary Land.
- AOAC methods for Food Analysis.
- Y. Pomeranz and C. E Meloan, Food Analysis, Theory and practice; AVI publishing company, INC West Port, Connecticut, USA.
- Fung, D.Y.C. and Matthews, R., Instrumental Methods for Quality Assurance in Foods; Marcel Dekker, Inc.

New York.
- Moskowitz, H. R., Food Texture: Instrumental and Sensory Measurement; Marcel Dekker, Inc., New York.
- Eram S Rao, 2013. Food Quality Evaluation ISBN:9789381156216

FST 302
CEREALS, PULSES AND OILSEEDS TECHNOLOGY
(3+0+2 = 4 Credits)

Objectives:
- To develop competence in processing of Cereals, Pulses and Oilseeds technology.
- To recognize the significance of quality parameters in selection, product development and value addition.

Course Contents:

Theory

UNIT-I

Status, production and major growing areas of cereals in India and world, Structure and chemical composition of cereals, pulses and oilseeds, Nutrition and anti-nutritional factors.

UNIT-II

Wheat Processing: Wheat classification, wheat grain structure, wheat roller flour milling, quality and milling functionality of wheat flour components and bakery ingredients. Paddy Processing and treatment for quality improvement, Modern rice milling operations, Confectionery.

UNIT-III

By product utilization e.g. bran: Novel product development ð Instant Rice, puffed products etc.
Coarse Cereals Products: Maize, sorghum, pearl millet and small millets processing and value addition.

UNIT-IV

Pulses: Pretreatment of pulses for milling, milling of major pulses. Methods to improve recovery. Oil seeds Processing: Groundnut, Mustard, Soybean, Sunflower, Safflower, Sesame and other oil bearing materials, Expeller and solvent extraction processing.

UNIT-V

Special Topics: Processing and utilization of Soya bean for value added products, Innovative products from cereals, pulses and oilseeds. Extrusion technology for cereals.

Practical:

1. Milling of cereals with emphasis on quality and recovery.
2. Study on production technology of puffed and flaked rice
3. Study on Oil extraction
4. Effect of antioxidants on shelf-life of oils.
5. Determination of triglyceride composition of oils.
6. Pulses: Milling characteristics and effect of treatments on recovery.
7. Products of Soybean- tofu, milk
8. Vist to rice mill
9. Visit to oil mill
10. Visit to flour mill
11. Visit to pulse mill

Suggested Readings :

- Chakraverty A & De DS. 1981. *Post-harvest Technology of Cereals, Pulses and Oilseeds*. Oxford & IBH.
- **Unit Operations** of Agricultural Processing. Authors, **K M Sahay**, K.K. Singh. Edition, 2, Publisher, Vikas Publishing House Pvt
- Kent, Cereal Technology; CBS
- Y. Pomeranz, Wheat Chemistry and Technology
- Chakraborty AC, Post Harvest Technology of Cereals
- DAV Dendy and BJ Dobrazczyk, Cereals and Cereal Processing: Chemistry and Technology
- S A Matz, Chemistry and Technology of Cereal Food and Feed

FST 303
BAKERY AND CONFECTIONARY TECHNOLOGY
(2+0+1 =3 Credits)

Objectives:

Course Contents:

Theory

UNIT-I

Global Status of bakery and confectionery industry. Review of raw materials and quality parameters of wheat flour, flour standards; 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 data.

UNIT-II

Bread: various methods of production and effect of various formulations and process parameters on quality. Staling of bread, losses during manufacture and methods to control them; machinery used in bakery industry, multigrain bread, gluten free products, traditional bakery products, shelf life.

Biscuits and ***Cookies***: Ingredients and flour specification; types of biscuits, doughs -developed doughs, short doughs, semi-sweet, enzyme modified doughs and batters importance of the consistency of the dough.

UNIT-III

Cakes: Flour specifications-, ingredients, manufacturing process and quality evaluation. Preparation of other bakery products - rusks, crackers, buns, muffins, pizza; raw materials, methods of production, quality parameters.

Confectionery manufacture: Raw materials used in the confectionery manufacturing and processing industry - including quality control methods. Cocoa, Sugar, Dried milk products, Special fats, Emulsifiers, Nut kernels. Production of cocoa liqueur from the cocoa bean, Dark, milk and white chocolate, manufacturing processes.

UNIT-IV

Chocolate Processing Technology : Compound coatings and 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.

UNIT-V

Sugar Confectionery manufacture: General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweets-Ingredients, Methods of manufacture- Types-Center-filled, lollipops, coextruded products. Manufacture of gums and jellies-Quality aspects

Manufacture of Miscellaneous Products: Caramel, Toffee and fudge-Liquorice paste and aerated confectionery, Lozenges, sugar panning and Chewing gum, Countlines-Quality aspects

Bakery Plant - Layout, setting up of units and hygienic conditions, operation and maintenance.

Practical:

1. Quality assessment of flour-physical, chemical and rheological tests.
2. Dough/ Batter rheology.
3. Leavening agents, Different tests for leavening action of baking powder, sodium-bicarbonate and ammonium bicarbonate.
4. Production of bread
5. Evaluation of bread.
6. Preparation of different varieties of biscuits, cakes, candies and chocolate.
7. Visit to bakery plants.

Suggested Reading:

- Y. Pomeranz, Modern Cereal Science and Technology, MVCH Publications, NY
- Samuel A. Matz , Bakery Technology and Engineering ,Chapman and Hall
- A Bent, E B Bennion, G S T Bamford , The technology of cake making, Blackie-Academic and Professional, UK.
- Duncan J R Manley, Technology of Biscuits, Crackers, and Cookies, Ellis Horwood Ltd.
- William Sultan Bakery Engineering and Technology, Practical baking, Matz. SA.
- EB Jackson, Sugar Confectionery Manufacture, Aspen publishers Inc., Great Britain.

FST 304
FOOD ADDITIVES AND INGREDIENTS
(3+0+3 = 5 Credits)

Objectives:

- To get an insight into additives that are relevant to processed food industry for shelf life extension, processing aids and sensory appeal.
- To develop an understanding of isolations of various biopolymers from food resources and their relevant applications.

Course Contents:

Theory

UNIT-I

Additives in food processing and preservation - classification and their functions. Safety and quality evaluation of additives and contaminants, acute and chronic studies, NOAEL, ADI, LD_{50}. Indirect food additives. GRAS and Naturally occurring compounds.

UNIT-II

Classification of Additives. Various additives such as preservatives, antioxidants, antimicrobials, colors, flavor, emulsifiers, sequesterants, humectants, hydrocolloids, sweeteners, acidulants, anticaking agents, buffering salts etc. with respect to chemistry, food uses and functions in food formulations acids, bases and buffers. International numbering system for Food Additives.

UNIT-III

Flavor Technology: Types of flavors, flavors generated during processing - reaction flavors, flavor composites, stability of flavors during food processing, analysis of flavors, extraction techniques of flavors, flavor emulsions, essential oils and oleoresins, authentication of flavors etc.

UNIT-IV

Ingredients used in food production e.g. sugar, starches/modified starches, fibres, proteins/protein hydrolysates and fats etc and their technology of production and application. Sugars and Sweeteners: Sugars, syrups, sugar alcohols, potent sweeteners, sugar products, caramelization. Sweetener chemistry related to usage in food products.

UNIT-V

Food Colours: Food colours - Types and properties, regulatory aspects, safety issues ï natural food colours - heme pigments, chlorophylls, carotenoids, anthocyanins and flavonoids, tannins, caramel and others artificial food colours. Nature Identical.

Practical:

1. Techniques of assessment of level of different class II preservatives and other additives in fruits, vegetables, cereals, dairy products, meat, poultry, milk and other processed products
2. Ingredients and sensory food attributes.
3. Tests pertaining to food flavours and oleoresins
4. Testing synthetic and natural colours

Suggested Readings :

- Branen, A. F. et al, Food Additives; Marcel Dekker.
- George, A. B., Encyclopedia of food and color additives, Vol III; CRC Press.
- Nakai, S. and Modler, H. W, Food proteins. Processing Applications; Wiley
- Inteaz Ali, Food Quality Assurance-Principles and Practices; CHIPS, Texas.

FST 305
MEAT, FISH AND POULTRY PRODUCT TECHNOLOGY
(3+0+3 = 5 Credits)

Objectives:

- To expose students to the techniques of processing, preservation and quality control of meat, poultry and their products.
- To impart knowledge of fish and marine product technology.

Course Contents:

Theory

UNIT-I

Introduction to meat and poultry industries; Pre-mortem selection of animals;Modern Abattoir Practices: slaughtering techniques of animal and slaughtering practices; Meat cuts and portions of meat; Meat quality; Inspection and grading of meat; Physico-chemical composition of muscle, connective tissue, intramuscular fat; Post-mortem changes in muscle; Conversion of muscle to meat.

UNIT -II

Chemical and nutritional composition of meat including toxins; The eating quality of meat - color, water holding capacity (WHC) and juiciness, texture and tenderness, odor and taste; Meat microbiology and safety; Spoilage characteristics of meat; Endogenous and exogenous infections; Preventive (prophylaxis) measures for avoiding meat spoilage.

UNIT -III

Meat processing- comminution, emulsification, curing, smoking, cooking, ageing and tenderization; Meat products - meat emulsion, fermented meats, sausages, ham, bacon and comminuted meat products; Meat analogs; Meat storage and preservation- by temperature control (refrigeration, freezing, thermal processing), by moisture control (dehydration, freeze drying, curing, IMF meat), by microbial inhibition (chemical preservation, ionizing radiation); Packaging of meat products. Meat production, processing and consumption trends. Prospects of meat industry; Meat plant sanitation and waste disposal; Meat industries in India; By-products from meat industries and their utilization.

UNIT -IV

Inspection of birds, poultry slaughter and dressing, Factors affecting quality of poultry; Classification of poultry meat; Composition and nutritional value of poultry meat; Processing of poultry meat, spoilage and control; By-product utilization; Poultry farms in India.

Egg and egg products- Structure, composition and functions of eggs; Changes in eggs due to ageing; Abnormalities in eggs; Functions of eggs in food products; Inspection and grading for egg quality; Preservation and safe handling of eggs; Coagulation of eggs, egg foams, egg powder and egg based products.

UNIT-V

Fish as raw material for processing and its physical properties. Factors affecting the quality of product and post harvest losses. Chilling and freezing of fish and other aquatic products. Physical, chemical, microbiological and sensory changes during storage. Principles of thermal processing. decimal reduction time, thermal death time, ðZò and ðFò values, 12D concept, determination of process time. Canning process for fish/shellfish. Value added and ready to use canned products. Retort pouch processing of fish and fishery products principles and techniques.

Hurdle technology and its application. Composition and role of muscle proteins, Factors influencing denaturation of muscle proteins. Gelation: mechanism of formation of gel, factors affecting the gel formation and its evaluation. Nutritional importance of fish meal and quality requirements. Nutritional importance of fish oil and methods to impart stability to fish oils on storage Unsaponifiables in fish liver oils. Value added products: Present market trends, scope and types of value addition, Important value added products. Coated products - Principles and type of coating, coating functions.

Practical:

1. Visit to meat processing plant and demonstration of art of meat cutting.
2. Physico-chemical and microbiological quality of different types of meat.
3. Canning of meat products and determination of thermal process time.
4. Preservation of meat by curing, freezing, smoking, drying and determination of shelf-life
5. Preparation of sausages, ham, bacon, fried chicken, meat patties, meat balls, egg pickles and meat pickles.
6. Estimation of nitrites/nitrates in processed meat products.
7. Estimation of Water Holding Capacity and emulsification capacity of various types of meat.
8. Physico-chemical and micro-biological quality of raw egg and their products.

9. Preservation of shell eggs and their products by various methods and studies their shelf-life
10. Studies on hygiene and sanitation in meat, poultry and egg processing plants.
11. Visit to meat/poultry/egg processing plant for hands on training.

Suggested Readings:

- Vaclavik V.A. and Christian EW, Essentials of food science; Springer International.
- Laurie R.A., Lawrieôs meat Science; Woodhead Publishing Ltd.
- Stadelman W.J. and Cotterill O.J., Egg science and technology; CBS Publishers.
- Pearson A.M. and Gillett T.A., Processed Meats; CBS Publishers.
- Stadelman W.J., Olson V.M., Shemwell G.A. and Pasch S., Egg and poultry meat Processing; Elliswood Ltd.
- Aitken A., Mackie M., Merritt S.H. and Windsor M.L., Fish Handling and Processing; Ministry of Agriculture, Fisheries and Food, Edinburgh.
- Balachandran K.K., Post-harvest Technology of Fish and Fish Products; Daya Publ. House.

FST 306
FOOD LAWS, STANDARDS AND REGULATION
(3+0+0 = 3 Credits)

Objectives:

- To introduce students with food laws, standards and its regulatory framework.
- To understand and produce the right product according to the norms and its regulations.

Course Contents:

Theory

UNIT -I

Introduction, concept of food safety and standards (FSSAI), food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of microbiological and chemical hazards. Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non thermal processing, irradiation of foods.

UNIT-II

Indian and Food Regulatory Regime (Existing and ***old***), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization. Legal Metrology act, Weight and Measurement act, Introduction to Factory Act.

UNIT-III

Introduction to OIE and IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export and Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963.

Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.

UNIT-IV

Risk assessment studies: Risk management, risk characterization and communication.

UNIT-V

Voluntary Quality Standards and Certification

GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices

ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS. ***Halal & Kosher Standard***.

Suggested Readings:

- Singal RS, Handbook of indices of food quality and authenticity; Woodhead Publ. Cambridge, UK.
- Shapton DA, Principles and practices of safe processing of foods; Butterworth Publication, London.
- Winton AL, Techniques of food analysis; Allied Science Publications New Delhi.
- Pomeranze Y, Food analysis - Theory and Practice; CBS Publications, New Delhi.
- Jacob MB, The chemical analysis of foods and food products; CBS Publ. New Delhi
- ***FSSAI website: www.fssai.gov.in***

- Eram S Rao, 2013. Food Quality Evaluation ISBN:9789381156216

FST 401
FOOD PRODUCTS DEVELOPMENT AND SENSORY EVALUATION
(2+0+3 = 4 Credits)

Objectives:

- Understand and apply various aspects of food product development including Food Science and Technology, Marketing and Consumer research.
- Develop products which meet consumer needs that are nutritionally and commercially viable and be skilled in shelf life assessment, testing of quality parameters and acceptability, packaging and labeling of a product.

Course Contents :

Theory

UNIT-I

New Proprietary Food Products: Sources for R&D initiative, Definition, Classification, Characterization, Factors shaping new product development- Social concerns, health concerns, impact of technology and market place influence. Market Survey, Consumer survey to identify new products in terms of Line Extension Repositioning Existing Products New form/Reformulation. New packaging of existing products Innovative products, Creative Products. Tapping traditional foods and unconventional sources of foods. Minimizing post harvest losses. Identification of concept and product for development, Market research for the concept and selected product, Identification of products, selection of one product and its standardization improving success.

UNIT -II

Bulk preparation of product, Packaging and Labelling of the product, Packaging design, graphics and labeling nutritional evaluation (estimation of relevant parameters), Shelf life testing of the product (testing for appropriate quality parameters- chemical, microbiological and nutrient content, acceptability studies), Product integrity and conformance to standard, Costing the product and determining the sales price, Advertising and test marketing the product, Report preparation.

UNIT-III

Overview of sensory principles and practices: General consideration in sensory testing, flowcharts of sensory evaluation. Anatomy, physiology and function of various senses.

UNIT-IV

Psychological methods Selection and screening of panel: Types of panel (Trained panel, discriminative and communicative panel). Methodology for sensory evaluation: Discriminative test - difference test: paired comparison, Duo-trio, triangle, ranking, Sensitivity Test, Descriptive test - category scaling, ratio scaling, flavor profile analysis, texture profile analysis, quantitative descriptive analysis.

UNIT-V

Effective Tests: paired performance test, ranking test, rating scale: hedonic rating, food action scale rating. Maintaining suitable environmental conditions: laboratory setup and equipments

Sample preparation, Basic statistical concepts for sensory evaluation: Hypothesis testing and sensory inference, variation of T Test, Nonparametric and binomial based, Statistical methods, Chi-square test, analysis of variation, Correlation regression.

Practical:

The lab course will cover different sensory test covered in theory with the interpretation of data for given products

Suggested Readings:

- Lyon, D.H.; Francombe, M.A.; Hasdell, T.A.; Lawson, K. (eds) ,Guidelines for Sensory Analysis in Food Product Development and Quality Control, Chapman and Hall, London.
- Amerine, M.A.; Pangborn, R.M.; Roessler, E.B.,Principles of Sensory Evaluation, Academic Press, New York.
- Kapsalis, J.G,Objective, Methods in Food Quality Assessment, CRC Press, Florida.
- Martens, M.; Dalen, G.A.; Russwurm, H. (eds), Flavour Science and Technology, John Wiley and Sons, Chichester.
- Moskowitz, H.R.(eds), Food Texture: Instrumental and Sensory Measurement, Marcel Dekker Inc., New York.
- Eram S Rao, 2013. Food Quality Evaluation ISBN:9789381156216

FST 402
ADVANCED FOOD PROCESSING METHODS
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT-I

High Pressure Processing: Principles of high pressure processing, use of high pressure to improve food safety and stability. Effects of high pressure on food quality: Pressure effects on microorganisms, enzyme, texture and nutrients of food. Other applications of high pressure processing.

UNIT-II

Pulsed electric fields processing: Historical background, PEF treatment systems, main processing parameters. Mechanisms of action: mechanisms of microbial and enzyme inactivation. PEF for processing of liquid foods and beverages, PEF Processing for solid foods. Food safety aspects of pulsed electric fields.

UNIT-III

Osmotic dehydration: mechanism of osmotic dehydration, effect of process parameters on mass transfer, determination of moisture and solid diffusion coefficient, application of osmotic dehydration.

Membrane separation: types, equipment, application. Osmotic membrane distillation.

UNIT-IV

Processing by radio frequency electric fields: radio frequency electric fields equipments, RFEF non-thermal inactivation of yeasts, bacteria and spores

Ultrasound processing: fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties.

UNIT-V

Alternate thermal processing: Microwave heating: dielectric properties of foods, heat and mass transfer in microwave processing, application of microwave processing for foods;

Radio-frequency processing: dielectric heating, material properties, radio-frequency heating and drying applications; Ohmic heating : Fundamentals of ohmic heating, electrical conductivity, modeling, treatment of products.

Hybrid drying technologies: combined microwave vacuum drying, combining microwave vacuum drying with other processes, equipment for microwave vacuum drying, product quality degradation during dehydration.

Practical:

1. Demonstration of High pressure processing equipment
2. Studies on high pressure inactivation of microbes.
3. Studies on high pressure inactivation of enzymes.
4. Studies on Pulse electric field inactivation of microbes
5. Studies on Pulse electric field inactivation of enzymes
6. Studies on osmotic dehydration of fruits & vegetables
7. Demonstration of membrane separation equipment and application on food
8. Ultrasound processing of food
9. Studies on microwave drying of food
10. Studies on vacuum drying of food

Suggested Readings:

- Sun, Da-Wen, Emerging Technologies for Food Processing, Academic Press.
- Barbosa-Canovas, Tapia and Cano, Novel Food Processing Technologies, CRC Press,
- Ohlsson, Minimal Processing technologies in the food industry, Woodhead Pub Limited.
- Nonthermal Processing Technologies for Food edited by Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M. Bala Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T.C. Yuan, Wiley-Blackwell.

FST 403
NUTRACEUTICALS AND FUNCTIONAL FOODS
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT-I

Basics of nutraceutical and functional foods: defining nutraceuticals and functional foods. Introduction to Health food and negative food. 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. Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc.

UNIT-II

Proteins, carbohydrates and Fats as functional foods and nutraceuticals, Proteins as functional food ingredients i.e. whey proteins, soya proteins etc. Complex carbohydrates and Fibres as functional food ingredients. Antioxidants and other phytochemicals, (isoflavones, lycopenes), phytosterols and their role as nutraceuticals and functional foods. Oils with MUFA, n3 and n6 PUFA as nutraceuticals and functional foods.

UNIT-III

Food as nutraceutical and functional foods, Probiotic foods and their functional role. Cereal products as functional foods - oats, wheat bran, rice bran etc. Functional fruits and vegetable products, oil seeds etc. Sea foods, Fat replacers, Beverages such as green tea, coffee, cocoa, fruit juices as functional foods and their protective effects. Herbs as functional foods, health promoting activity of common herbs.

UNIT-IV

Stability and safety issues, Stability and bio-availability of functional ingredients in foods, Effects of processing, storage and interactions of various environmental factors on the potentials of such foods, interaction if drugs and nutraceutical. Safety, regulatory issues and marketing for functional foods and nutraceuticals.

UNIT-V

Future of nutraceuticals and functional foods, Recent developments and advances in the areas of nutraceutical and functional foods and their role in nutrigenomics in health care.

Practical:

1. Extraction and estimation of nutraceuticals from cereals (glucan), isoflavones (legumes) capsaicinoids (peppers) organosulfur compounds (onions and garlic) and monosaturated fatty acids (oil seeds) and lecithins (legumes seeds.)
2. Isolation and determination of lycopene from in toes and tomato products. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
3. Preparation and evaluations of probiotic foods and study their health benefits.
4. Determination and quantifications of some nutraceutical and functional food compounds by GLC and HPLC.
5. Study and demonstration of the antimicrobial effects of plant tannins, alkaloids and sulfur compounds.

Suggested Readings:

- Mazza,G , Functional foods - biochemical and processing aspects, Technomic Publ. Lancaster, USA.
- Kirk, RS ,Pearson's composition and analysis of foods. Wesley Longman Inc. California, USA.
- Association of official analytical chemists ,Official Methods of Analysis , USA.
- Wildman, REC ,Handbook of Nutraceuticals and Functional Foods.
- Paul Paquin ,Functional and Speciality Beverage Technology, Woodhead Publishing Ltd., Cambridge, UK

FST 404
DIETETICS
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT-I

Basics of dietetics / diet therapy, Basic concept of diet therapy, Normal diet as a basis of therapeutic diets, Team approach to health and nutrition care, Therapeutic adaptations of the normal diet. Qualitative and quantitative adaptations. Introduction to enteral and parenteral nutrition. ***Concept of Vegetarian, non-vegetarian and vagon diet.***

UNIT-II

Dietary management of some common disorders, Etiology, clinical features, and nutritional management of infections and fevers , stress and trauma, GI tract- gastritis , peptic ulcers, diarrhoea, constipation, lactose intolerance, steatorrhoea and celiac disease, Liver - Infective hepatitis, Cirrhosis.

UNIT-III

Nutritional care for Weight management, etiology, clinical features and nutritional management and prevention. Overweight and obesity, underweight, eating disorders -anorexia nervosa and bulimia.

UNIT-IV

Common degenerative disorders, etiology, clinical features, nutritional management and prevention: Diabetes mellitus - Type 1 and Type 2, cardio-vascular disorders, hypertension, hyperlipidemias, atherosclerosis, metabolic syndrome.

Nutritional Management in Cancer - an overview, Etiology, nutrition management and prevention of common cancers

Renal disorders - an overview, Glomerulonephritis, nephrotic syndrome, CKD

UNIT-V

Food allergy and food intolerance. Clinical features and nutritional management. Introduction to Nutrigenomics in Diet-therapy. Introduction to Dietetic Food Product Development. Miscellaneous Disorders - an overview. Osteoporosis; Alzhimer' disease; Parkinson's disease.

Practical:

Calculation, preparation and evaluation of dishes or food items suitable for the following (incorporating appropriate consistency and nutrient modifications).

1. Obesity - Low energy, low modified fat.
2. Undernutrition / Underweight - High protein, high energy Fevers, stress, trauma etc - High energy, high protein + blenderized tube feed.
3. Gastro Intestinal Tract Disorders.
4. Diarrhoea - Fibre restricted, bland.
5. Constipation - High fibre.
6. Lactose intolerance - Lactose free.
7. Coeliac disease - Gluten free.
8. Infective Hepatitis -Modified fat.
9. Type 1and 2 Diabetes - Low fat, modified carbohydrate low glycemic load, high fibre, modified energy.
10. Hypertension and CHD - Restricted energy, low fat, low cholesterol, high fibre, low sodium.
11. Renal disease - Low HBV protein, modified sodium and potassium, calcium and phosphate.

Dietetic food product development - Project on developing 2-3 dietetic food products - standardization, shelf life, consumer evaluation etc.

12. Survey of Dietetic foods available in the market, their labelling and Consumer Survey for identifying scope of new/better dietetic foods.

Suggested Reading:

- Mahan, L. K. and Escott Stump. S., Krause's Food and Nutrition Therapy , Saunders Elsevier
- 2. Williams S.R., Basic Nutrition and Diet Therapy, Times Mirror Mosby College Publishing
- Joshi S ,Nutrition and Dietetics, Tata McGraw Hill.
- Bamji MS, Krishnaswamy K and Brahmam GNV. ,Ghafoorunissa and Krishnaswamy K , Diet and Heart Disease, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.

FST 405
ADVANCED DAIRY PRODUCT TECHNOLOGY
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT-I

Grading and quality of raw milk for condensed and evaporated milk, Heat stability of milk Technology of condensed and evaporated milk, physico Chemical changes during manufacturing of condensed and dried milk, role of stabilizers in evaporated milk.

UNIT- II

Technology and standards of dried whole milk, dried nonfat milk/SMP, baby foods, dried ice cream mix, dried gulab jamun mix, instantization.

UNIT -III

Classification of Ice cream, Frozen dessert, role of different dairy and non dairy ingredients in ice cream manufacturing Source of dairy and non dairy ingredients ,Figuring of ice cream mix.

UNIT-IV

Process of Ice-cream-manufacturing using animal and vegetable fat. Classification of cheese, Technology of manufacturing of various type of cheese viz cheddar gouda, swiss, mozzarella, feta, cottage etc.

UNIT-V

Microbiological and chemical changes during preparation ripening in cheese. Utilization and manufacturing of dairy industry byproducts like whey drinks, casein, WPC, lactose and lactose free milk.

Practical:

1. Testing of quality of milk for manufacturing of condensed and dried milk.
2. Pilot sterilization test.
3. Manufacturing of concentrated and dried Milk
4. Manufacturing of cheddar gouda, swiss, mozzarella, cottage cheese.
5. Figuring and manufacturing of ice cream mix, Manufacturing of ice cream.
6. Manufacturing of casein and whey drinks.

Suggested Readings:

- Zadow, J.G. (1994) Whey and lactose processing, Elsevier Applied Science, London.
- Kosikowaski F. Cheeses and Fermented milk Foods Ice Cream and frozen desserts Cheese.

FST 406
FISH PROCESSING TECHNOLOGY
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT -I

Impedance and Nutritive values of Fish : Fishing resources - Inland, marine, Brackish water fisheries'; harvesting methods- crafts - gears.

Composition and nutritive value of fish- protein, Omega 3 fatty acid, toxic components biochemical and microbiological changes in fish - Evaluation of fish qualities - transportation of fish- washing - Grading

UNIT-II

Fishery products :

Fish meal end oil - Chitin and Chitosan - fermented-fish 'products - fish paste products - fish protein concentrate - utilization of fish processing waste.

UNIT-III

Preservation of Fish :

Processing of fish and shellfish -freezing - individual quick freezing - canning - salting drying and dehydration - smoking of fish. Irradiation - fish mince and surumi.

UNIT-IV

Quality control of Fish :

Spoilage of fish - quality control of fresh fish. HACCP of dish - quality ~ of seafood.

Practical:

1. Chill storage studies.
2. Chemical, physical and sensory analysis, determination of shelf life.
3. Handling of fish, bivalves, prawns, mollusks, treatment with chemicals.
4. Evaluation of freshness of fish.
5. Filleting of fish, treatments, glazing, packaging,
6. Freezing curve, determination of freezing point.
7. Evaluation of pasteurization and sterilization, determination of TDT and F value Examination of canned foods.
8. Canning operations for different fish/ shellfish products.
9. Measurement of viscosity of fish proteins by Ostwald viscometer, effect of water washing on the quality of meat, Preparation of glucosamine hydrochloride and glucosamine sulphate.
10. Preparation of isinglass, collagen powder and collagen and chitosan.

Suggested Readings:

- Andrew L. Wmton and Kate Barber Wintoo, Fish and Fish products, Afro Botanical Publishers
- K. Gopakunuu:, fish Packaging technology {Materials and methods.), concept publishing company, New Delhi.
- Cop. Mallett, Frozen Food Technology, Chapman and Hall, London.
- Winton/Winton, Fish and Fish Products, Allied Scientific Publishers, India.
- J P Cherry, Protein Functionality in Foods.

FST 407
PROCESSING OF PLANTATION CROPS, HERBS AND SPICES
(3+0+3 = 5 Credits)

Course Contents:

Theory

UNIT-I

Introduction to Plantation Crops, Herbs and Spices processing, Processing of tea - various types of tea, chemistry of constituents, harvesting, fermentation, tea concentrates, decaffeination process. Evaluation and grading of tea. Processing of coffee - type of coffee, drying, fermentation, roasting and browning processes and their importance, chicory chemistry and technology. Analysis of tea and coffee quality components, standards and specification of tea and coffee products.

UNIT-II

Processing and analysis of cocoa bean, beverages and study of factors that affect quality and uses for the consumers.

UNIT-III

Introduction: Importance and role of spices in food processing, Classification and properties of spices, Scope of spice processing in India, Spices and culinary herbs: Types, spice qualities and specifications, uses and physiological effects, components, antimicrobial and antioxidant properties of spices and herbs, important spices and medicinal herbs added in food products and their processing.

UNIT-IV

Spice processing: Processing and manufacturing of major Indian spices and herbs, Pepper, cinnamon, cardamom, Nutmeg, saffron, Turmeric and Ginger, Minor spices- cloves, leafy spices, bay oregano, seed spices, common herbs-brahmi, tulsi, mint, thyme, curry leaves, lemon grass etc., ***Cryogenic processing of spices.***

UNIT-V

Medicinal values of herbs, condiments and spice products, spice blends and extractives, essential and encapsulated oils, salad dressings and seasonings, oleoresins, uses in processed foods, spice processing machineries. Packaging of spices and herbs: Packaging of spices, handling, Packaging machineries, uses and limitations.

Practical:

1. Tea - Withering and Drying with respect to product quality.
2. Coffee - Drying and processing
3. Cocoa processing and quality evaluation.
4. Identification of different spices.
5. Determination of moisture content in spices.
6. Demonstration of process of oil extraction of different spices.

7. Physico-chemical characteristics and their sensory evaluation of spice oil,
8. Analysis of principles constituents in pepper, ginger, chilly, and turmeric, analysis of spice oils and oleoresins.
9. Low temperature grinding of seed spices.
10. Estimation of solvent in spice oleoresin.

Suggested Readings:

- Kelnneth T. Farrell, Spices, condiments and seasonings,The AVI Pub.
- W. Purseglove, E G Brown, C L Green and S R Robbins, Spices, Longman Publica tions.
- Kenji Hirasa and Mitsno Takemasa, Spice Science and Technology, Marcel Dekker, Inc.
- S. Pruthi, Quality assurance in spices and spice products (Modern methods of analysis), Allied Publishers Limited.
- Barundeb Banerjee, Tea Production & Processing, Oxford & IBH Publishing Co Pvt Ltd
- Coffee: Growing, Processing, Sustainable Production: A Guidebook for Growers, Processors, Traders, and Researchers Jean Nicolas Wintgens, Wiley-VCH.
- Cocoa, 4th Edition by and R. A. Lass, ISBN: 978-0-470-69842-6, Blackwell Willey Publishing..
- Cocoa: production and marketing in India by V. N. Asopa, S. Narayanan, Oxford & IBH Publisher, ISBN, 8120404858, 9788120404854.

FST 408
BEVERAGE TECHNOLOGY
(3+0+3 = 5 Credits)

Course contents:

Theory

UNIT-I

Beverage - definition : why we drink beverage-ingredients-water, carbon" dioxide, sugar, flavours, colour, sweeteners, emulsifiers and stabilizers. Types of beverages and their importance; status of beverage industry in India; Manufacturing technology for juice-based beverages; synthetic beverages; technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks.

UNIT-II

Specialty beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy and imitation dairy-based beverages.

UNIT-III

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipments used for brewing and distillation, wine and related beverages, distilled spirits.

UNIT-IV

Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water; mineral water, natural spring water, flavoured water, carbonated water.

UNIT-V

Carbonated and non Carbonated beverages Procedures carbonation equipments and machineries-ingredients- preparation of Syrup packaging -containers and closures, Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry-Quality of water used in beverages threshold limits of ingredients.

Practical:

1. Chemical and microbiological analysis of raw water quality; Preparation of regional fruit juices.
2. Preparation of whey-based beverages; preparation of iced and flavoured tea beverage.
3. Preparation of carbonated and noncarbonated soft drinks; Preparation of wine and beer.
4. Preparation of soy milk, fruit milkshakes, herbal beverages; visit to relevant processing UNITs.

Suggested Readings:

- Technology of carbonated beverages, A VI Publication.
- A J Mitchal, Formulation and production of carbonated soft drinks, Blackie publishers.
- Hui et al, Hand book of food and beverage fermentation.
- Boulton, Brewing yeast and fermentation.

FST 409
FLAVOUR TECHNOLOGY
(3+0+3 = 5 Credits)

Course Contents :

Theory :

UNIT-I

Definition and description of flavour, flavour profile and its principal chemical constituents. Sensation of flavour vs taste odor/smell and mouth feel influence of chemical constituents on flavour and their interaction with flavour characteristics.

UNIT-II

Factors that affect the flavour and control of flavour in processed foods. Measurement of flavour, particularly for wine, tea, coffee, species and condiments.

UNIT-III

Flavour intensifier and their effects. Chemistry and technology (commercial preparations) of various flavour intensifiers.

Natural and synthetic flavouring substances and their chemical characteristics. Flavour components/constituents of fruit and vegetables, coffee, tea and cocoa bean, spices and condiments.

UNIT-IV

Changes in flavouring components and characteristics during cooking/processing of various foods. Effects of storage, processing, transportation and environmental conditions on flavour components/constituents.

UNIT-V

Processing (industrial/commercial) technologies/methods of flavouring compounds of plant foods and their utilization and applications.

Recent developments in flavour research, processing and technology.

Practical :

1. Extraction and separations of natural flavour components from fruits, vegetables tea, coffee spices and condiments.
2. Separation and fractionation of flavour volatiles compound into different categories namely acidic, neutrals and basic components.
3. Flavour analysis by gas chromatography (GC), uses of different GC columns for different compounds e.g. volatile and non-volatile flavour compounds.
4. Fractionation and determination of flavour isolates and concentrates by high pressure liquid chromatography (HPLC).
5. Determination and proper identification of flavour volatiles by mass spectrometry (MS) infrared (IR) and Fonrier transform infrared (FTIR) techniques and other suitable methods.
6. Sensory evaluation/organoleptic properties of different flavour compounds/ characteristics of plant and food materials.

Suggested Readings :

- Heath, HB (2005) Flavour chemistry and technology, CBS Publ., New Delhi. Fenaroli, G. Handbook of flavour ingredients, CRC Press. Bota Rica, New York Yamanishi, T. Recent advances in flavour researches, Dekker, New York.
- Cromin DA (1992). Techniques of analysis of flavors : chemical methods including sample preparations, Elsevier Pub!. London.
- Schreier, P (1995). Analysis of volatile: methods and application Elsvier,

FST 410
TECHNOLOGY OF FATS AND OILS
(3+0+3 = 5 Credits)

Course Contents:

Theory:

UNIT-I

What is fat? - Importance - chemical composition of fats. Triglycerides - their structure and composition - mono and diglycerides - free fatty acids - phosphatides- sterols, fatty acid alcohols - tocopherols.

UNIT-II

Nutritional aspects of fats and oils - metabolism - fat level in the diet and effect on health - non-allergenicity of edible oils - fat reduction in foods. Factors affecting physical characteristics of fats and oils - chemical reactions of fats and fatty acids. Important characteristics of oils from coconut, cotton seeds, palm, sunflower, sesame, safflower, rice bran, rape seed, mustard, linseed, soybean, castor and lard.

UNIT-III

Processing methods - Degumming, refining, bleaching, deodorizing, fractionation, hydrogenation, interesterification and esterification. Common products preparation - Salad and cooking oils, shortenings (baking and frying fats), hard butters, margarine and spreads, dressings for food (Mayonnaise and Salad dressings, pourable - type dressings, reduced calorie dressing), toppings, coffee whiteners, confectionaries coatings, low - fat spreads for traditional breakfast foods etc.

UNIT-IV

Growing demands on oils and lipids from traditional and convenience food markets, in terms of quality; functional, sensory and nutritional strengths; technologies to improve the edible oil pool in India.

Stability of oils and fats; value added products from vegetable oil refining industry like lecithin, wax, Vitamin-E, oryzanol. Alternative methods for extraction and processing of oils.

UNIT-V

Value added products from non-traditional oils and fat. By-products from bran oil and oil refining industry, utilization of lingo cellulosic waste from oil industry, bakery fats with zero trans fatty acids, refining procedures for edible oils with a note on analytical techniques in lipids.

Practical :

Common Test methods for Fats -

- Cold Test
- Colour, (Lovibond)
- Dropping point
- Flavour
- FFA
- Melting Point
- Oil stability index
- Peroxide Value
- Solid fat index
- Solid fat content
- Total lipids and thiobarbituric and reactive substances (TBARS)
- Karl-Fischer' titration- application.

Oilseeds :

- Experimental expeller processing
- Experimental solvent extraction
- Production of protein concentrates and isolates.
- Lab model hydrogenator (for hydrogenation of vegetable oils).
- Visit to oil mills

Suggested Readings :

- Bailey's industrial oils and fat products, D. Swern, Wiley - Inter Science, Publications, New York
- Food lipids B.B. Min, C,C Akoh, 1998- Marcel, Decker.
- Food Lipids and Health Decker D.B. Min, RE McDonald, 1996
- Food lipids: chemistry, nutrition, and biotechnology, by Casimir C. Akoh, David B. Min.
- Introduction to Fats and Oils Technology, 2nd Edition, by Editor:, Richard D. O'Brien, Walter Farr, and Peter J. Wan, ISBN:, 978-1-893997-13-4. AOCS publication

FST 501
Food Processing and Packaging
(Credits 3+0+2=4)

Course Objectives:

- To enable the students to use pilot plant scale systems to produce specific food products.
- To enable the students to identify and evaluate new food processing and packaging technologies.
- To enable the students to evaluate and communicate the effectiveness and efficiency of commercial food processing operations.

Course Contents:

Theory:

Unit - 1

General overview of food processing in India, Processing needs and technology gaps.

Dehydration: Dehydration fundamentals, Water activity, moisture content, sorption isotherm, psychometrics, drying techniques-solar drying, hot air drying, drum drying, spray drying, vacuum drying, microwave drying, radio frequency drying, IR drying, Freeze drying, foam mat drying, fluidized bed drying, heat pump drying, osmotic dehydration. Heat requirements and thermal efficiency of drying systems, heat utilization factor and thermal efficiency, selection of driers, performance testing of grain driers.

Unit - 2

Industrial Microbiology- Microbial products, Overview of upstream processing, Product recovery and downstream processing, Separation and disintegration of cells for product recovery operations, Handling of materials in microbial systems: Filtration, Centrifugation, Sedimentation, liquid-liquid extraction, Chromatography, Membrane separation (UF and NF) and electrophoresis.

Reactors: Types, working principles, aeration and agitation, design and analysis of biological fermentors and bioreactors; advances in continuous fermentation; Scale-up of fermentation processes.

Unit - 3

Introduction to Packaging, Functions of packaging, Classification of packaging material. Properties of packaging materials, Packaging systems for plant and animals products. Shelf life testing.

Unit - 4

Beverage: classification. Fermented beverages- production of beer, wine and distilled beverages; Functional beverages; Carbonated fruit drinks:- Raw materials, quality control and legislation of beverage products.

Unit - 5

Present scenario of meat processing in the country; Factors affecting quality of fresh and cured meats; Advances in meat and poultry processing; Fish processing and preservation, assessment of fish quality and fresh quality assurance of fresh fish; Frozen, dried, cured and ready to eat meat and fish products.

Practical:

- Drying performance study of different drying techniques.
- Freeze drying of foods.
- Centrifugation study to calculate efficiency
- Liquid-Liquid extraction to understand the extraction efficiency of different solvents in use.
- Sedimentation study to calculate sedimentation coefficient
- Demonstration of reactors
- Evaluation and identifications of package materials

Suggested Reading:

1. Ahmed T. 1997. Dairy Plant Engineering and Management. KitabMahal.
2. Chakraverty A & De DS. 1981. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.
3. Steinkraus KS. 1996. Handbook of Indigenous Fermented Foods. Marcel Dekker.
4. Kadoya T. (Ed). 1990. Food Packaging. Academic Press.
5. Mahadeviah M & Gowramma RV. 1996. Food Packaging Materials. Tata McGraw Hill.
6. Palling SJ. (Ed). 1980. Developments in Food Packaging. App. Sci. Publ.
7. Elementary Food Science, Fourth Edition, Ernest R. Vieira (1996) CRC
8. Essentials of Food Science, Second Edition, Vickie A. Vaclavik and Elizabeth W. Christian (2003) CRC
9. Food Science, Fifth Edition, Norman N. Potter and Joseph H. Hotchkiss (1995) CRC
10. Principles of Food Processing, Dennis R. Heldman and Richard W. Hartel (1997) CRC
11. Roberston G.L. 2006. Food Packaging: Principles and Practice. Taylor and Francis.

12. Ahevenainen R. 2003. Novel Food Packaging Techniques. Woodhead Publishing Ltd.
13. J. F. Hanlon, R. J. Kelsey, and H. R. Forcinia,1985 Handbook of Packaging Engineering, 3rd ed., Technomic Publishing, Basel.
14. Bioseparations: Principles And Techniques By B. Sivasankar
15. Biochemical Engineering : Principles and Concepts, by Inamdar, Syed Tanveer Ahmed, Third Edition,

FST 502
Advanced Instrumentation for Food Quality and Safety
(Credits 2+0+2=3)

Course Objectives:
The general objective of the course is to acquaint the student with the sophisticated and advanced instruments to determine food quality and also ensuring food safety thereby.

Course Contents:

Theory:
Unit-1:
Colour Characterization : Colour and appearance (gloss and translucence) monitoring through visual colorimeter, tri-stimulus colorimeters and reflectance spectrophotometer, CIE, Hunter-Lab, Munsel and other systems of three-dimensional expression of colour; Colour-based Sorting of foods; Computer Vision ï Principles, applications and Benefits.
Unit - 2
Moisture by Karl-Fischer Titrator/NIR Moisture Meter; Rheology of paste by Back Extrusion Cell; Rheological behavior of Newtonian and Non-Newtonian liquids by Rheometer; Texture profile analysis by UTM/Texturometer; Glass Transition Temperature by Differential Scanning Calorimeter; Drying characteristics of a single grain by Thermogravimetric Analyser.
Unit - 3
Dimensional change at different temperature by Dynamic Mechanical Analysis; Microstructure analysis by Scanning Electron Microscope; Crystallinity by X-ray Defractometer.
Unit - 4
Atomic Absorption Spectrophotometer for Analysis of Inorganic salts; Polarimeter for analysis of sugar Gas-Liquid Chromatograph for fatty acid profiling, Flavour components by High Performance Liquid Chromatograph, Amylose in starch by Spectrophotometer; Amino acids by capillary electrophoresis.
Unit - 5
Rheological characteristics of dough by Farinograph and Alveograph, Mixolab, Doughlab, Single Kernel Characterization System (SKCS) and NMR.
PracticalsFood analysis using HPLC
1. Fatty acid profile analysis using GLC
2. Sugar estimation using polarimeter
3. Colour measurement by Hunter Colour Lab.
4. Study of different types of viscometers viz., co-axial cylinder viscometer, spindle viscometer, falling-ball viscometer, extrusion viscometer, impeller viscometer, orifice viscometer.
5. Determination of Water activity by water activity meter.
6. Determination of Moisture by NIR Moisture Meter.
7. Determination of textural attributes by using Texture analyser.
8. Flow behaviour of fluid food products.
9. Use of Cone Penetrometer and FIRA-NIRD extruder for measurement of butter texture.
10. DMA study of food products.
11. Demonstration of Scanning Electron Microscope.
12. Determination of % crystallinity by X-Ray Defraction

Suggested Readings:
- Clifton M &Pomeranz Y. 1988. Food Analysis - Laboratory Experiments. AVI Publ.
- Gruenwedel DW & Whitaker JR. 1984. Food Analysis Principles and Techniques. Vol. I. Physical Characterization. Marcel Dekker.

- Gruenwedel DW & Whitaker JR. 1984. Food Analysis Principles and Techniques. Vol. II. Physicochemical Techniques. Marcel Dekker.
- Gruenwedel DW & Whitaker JR. 1984. Food Analysis Principles and Techniques. Vol. III. Biological Techniques. Marcel Dekker.
- Gruenwedel DW & Whitaker JR. 1984. Food Analysis Principles and Techniques. Vol. IV. Separation Techniques. Marcel Dekker.
- Leenheer AP, Lambert WE & van Bocxlaer JF. 2000. Modern Chromatographic Analysis of Vitamins. 3rd Ed. Marcel Dekker.
- Nollet LML. 1986. Handbook of Food Analysis. Vol. I. Marcel Dekker.
- Eram S Rao, 2013. Food Quality Evaluation ISBN:9789381156216

FST 503
Advanced Food Chemistry and Nutrition
(Credits 2+0+2=3)

Course Objective:

- To provide an understanding of the chemical function and properties of some specific food components.
- To provide an understanding of the chemical interactions of food components and their effects on sensory and nutritional quality, functional properties, and safety of foods.
- To impart knowledge about some nutritional concepts related functional foods and claim validation.

Course Contents:

Theory:

Unit - 1

Interactions among food components/packaging materials and their effect on sensory, nutritional and processing quality, Interactions among food flavors and packaging materials, Interactions among food additives and their significance in food processing, advanced separation techniques to food components

Unit - 2

Free radical chemistry; Reactive oxygen; Photosensitized oxidation; Metal catalyzed reactions; Redox reactions in biological systems; Antioxidants: Natural antioxidants; chemistry and mechanisms of action, techniques of evaluation of antioxidant activity, uses. Chemistry of alkaloids; Flavanoids.

Unit - 3

Food Carbohydrates: structural, analytical, physicochemical, biological interactions among food components and flavors. starch and its derivatives, Advanced glycation: end products and their nutritional significance; Natural Low Glycemic Sugars, Glucosinolates, Non-digestible oligosaccharides; Food lipid extraction and characterization

Unit - 4

Role of Proteins in Functional Food Formulations; Fractionation of proteins,New Alternative Proteins Ingredients; Encapsulation, Microencapsulation of Ingredients; Phytosterols; Polyphenols; Phytoestrogens; ϒ-fatty acids; Food dispersion systems.

Unit - 5

Functional Foods , Nutraceuticals and Nutrigenomics: Functional Foods & Nutraceuticals -market-Classification- International overview-Strategy-case studies-Food technologyôs impact-Product composition-methods for searching novel bioactive components in foods, clarifying the effectiveness & safety of the components, analyzing additive effects of various functional factors. Health foods ï Developing Functional Foods & Neutraceutical product - probioticsï Packaging -Labeling-manufacture-Role of Nutrigenomics in controlling non communicable diseases.

Practical:

1. Identification and estimation of antioxidants from fruits, vegetables, medicinal plants
2. Determination of natural pigments in foods
3. Estimation of polyphenols, flavanoids, alkaloids and to study their effect in vitro
4. Preparation and shelf life evaluation of foods using various packaging material
5. Estimation of sugars, determination of gelatinization
6. Estimation of protein and gluten content
7. Estimation of fat, extraction of food lipids and its characterization

8. Determination of fat acidity in flours, refractive index of fats
9. Estimation of crude fibre/ dietary fibre
10. Preparation and evaluation of prebiotic and probiotic functional foods and quality evaluation
11. Estimation of moisture content
12. Estimation of ash content

Suggested Readings:

1. Aurand LW, Woods A & Wells MR. 1987. *Food Composition and Analysis*. AVI Publ.
2. Birch GG & Lindley MG.1986. *Interactions of Food Components*. Elsevier.
3. Fennema OR. 1996. *Food Chemistry*. Marcel Dekker.
4. Kumar A and Gaonkar G. 1995. *Ingredient Interaction: Effect on Food Quality.* Marcel Dekker.
5. Macrae R, Roloson R and Sadlu MJ. 1994. *Encyclopedia of Food Science & Technology & Nutrition*. Vol. XVI. Academic Press.
6. Swaminathan M. 1988. *Essentials of Foods and Nutrition* Vol 1 & 2. Ganesh & Co. Madras.
7. Beccer GR (ed). 1991. *Human Nutrition Research Vol 4*. Academic Press, London, UK.
8. Martirosyan DM, Abate N (ed). 2010. *Functional Foods for Chronic Diseases Vol 1 to 5*. Food Science Publisher, Richardson, Texas.
9. Mazza, John Shi, Marc Le Mauger, 1998. Functional foods: Biochemical and Processing Aspects, CRC Press, New York.

FST 505
Post Harvest Management
(Credits 2+0+0=2)

Course Objectives:

To broaden and update the student knowledge on advanced methods for improving storage and prolonging shelf-life of food/agro produce ï both in fresh and through processing.

Course Contents:

Unit -1

Post harvest management for quality and shelf life of fruits and vegetables, procurement management, important factors for marketing and packaging, cold/modified atmosphere storage of these crops. Processing and preservation by CA, MA storage.

Unit - 2

Cereals and pulses, and oilseeds: production and utilization, milling fractions, grain quality standards, recent advances in handling, bag and bulk storage, prevention of storage losses ï traditional and modern methods, rat proof godown and rodent control, method of stacking, aeration system, fumigation, grain storage and packing for seed use.

Unit - 3

Supply chain concepts: system dynamics, coordination in supply chain, measuring supply chain performance, structural improvement, improvement in infrastructure, e-business and supply chain.

Unit - 4

Post harvest management and technology intervention for poultry farmers, fish cultivars and animal rearing. Management of dairy farms.

Unit - 5

UHT processing, canning and retorting, extrusion cooking, dielectric heating, microwave heating. Dehydro-freezing, Ultra-filtration and reverse osmosis; Processing and preservation by non-thermal methods: high pressure, pulsed electric field, hurdle technology.

IR heating, inductive heating and pulsed X-rays in food processing and preservation, Nanotechnology: Principles and applications in foods.

Suggested Readings:

- Chakraverty A. 1995. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.
- Morris Lieberman. 1983. Post-harvest Physiology and Crop Preservation. Plenum Press.
- FAO. 1984. Design and Operation of Cold Stores in Developing Countries. FAO.
- Hall CW. 1970. Handling and Storage of Food Grains in Tropical and Sub-tropical Areas. FAO Publ. Oxford & IBH.
- Multon JL. (Ed). 1989. Preservation and Storage of Grains, Seeds and their By-products. CBS.
- Ripp BE. 1984. Controlled Atmosphere and Fumigation in Grain Storage. Elsevier.

- Shefelt RL & Prussi SE. 1992. Post Harvest Handling ï A System Approach. Academic Press.
- Shejbal J. (Ed). 1980. Controlled Atmosphere Storage of Grains. Elsevier.
- Vijayaraghavan S. 1993. Grain Storage Engineering and Technology. Batra Book Service.
- Ahmed T. 1997. Dairy Plant Engineering and Management. Kitab Mahal.
- Barbosa-Canovas 2002. *Novel Food Processing Technologies*. CRC.
- Dutta AK and Anantheswaran RC.1999. *Hand Book of Microwave Technology for Food Applications*.
- Frame ND. (Ed.). 1994. *The Technology of Extrusion Cooking*. Blackie.
- Gould GW. 2000. *New Methods of Food Preservation*. CRC.
- Shi J. (Ed.). 2006*. Functional Food Ingredients and Nutraceuticals: Processing Technologies.* CRC.

FST 506
Food Texture and Rheology
(Credits 2+0+2=3)

Course Objectives:

1. To acquaint and equip the students with the textural & rheological properties of food materials.
2. To apply fundamental rheological methods for the solution of processing problems, &
3. To develop the understanding of microstructure and functionality of food and other biological systems.

Course Contents:

Theory:

Unit - 1

Texture classification, Relation of food texture with structure and rheology, Principles and practices of objective texture measurement.

Unit - 2

Sensory methods of texture and viscosity measurements and their correlation, Rheological properties of foods, Tube Viscometry, Rotational Viscometry.

Unit - 3

Common Rheological Instruments and Basic Concepts of Stress and Strain; Elastic Solids: Hookean and Non-Hookean Behavior, Fluid Behavior in Steady Shear Flow; Time-Independent Behavior: Shear-Thinning and Shear ï Thickening; Time-Dependent Behavior: Thixotropy and Anti-Thixotropy.

Unit - 4

Mathematical models and their application along with pipe line design and pump selection for non-Newtonian fluids; Recent advances in textural, rheological and visco-elastic characteristics of foods and their associated mathematical models.

Unit - 5

Yield Stress Phenomena: Concepts of Dynamic and Static Yield Stresses, Measurement Methods, Extensional Flow; Empirical Measurement Methods and Texture Profile Analysis, Farinograph; Mixograph; Cone Penetrometer; Bostwick, Warner-Bratzler Shear; Zhan., Viscometer; Kramer Shear Cell; Brookfield Disks and T-bars; Melt Flow Indexer, Attacking Problems in Rheological Testing

Practical:

Determination of viscosity of liquid foods, gumminess, chewiness, springiness and hardness of various fruits, vegetables and processed foods using texture profile analysis. Determination of force-distance relationship. Sensory evaluation/ subjective measurement and Correlation between subjective and objective measurements of foods.

Suggested Readings:

- Bourne MC. 2002. *Food Texture and Viscosity: Concept and Measurement*. Academic Press
- Deman JM. et. al. 1976. *Rheology and Texture in Food Quality*. AVI Publ.
- Journal of Texture Studies
- Mohsanin NN.1989. *Physical Properties of Plant and Animal Material*. Vol.I, II. Gordon and Breach Science Publ.
- Steffe JF. 1992. *Rheology and Texture in Food Quality*. AVI Publ.

FST 507
Food Product Development
(Credits 2+0+2=3)

Course Objectives:
To impart knowledge on product conceptualization and development.
Course Contents:
Theory:
Unit - 1
Introduction. Objectives. Defining New Food Products. Reason for new food product development. Types. Concept of Novel food. Life cycle for a food product. Ideas for the development of a New Food Product: internal and external sources. Advantages and disadvantages. Marketplace studies. Focus groups. Interviews. Consumer testing. Follow up studies.
Unit - 2
Concept of product development - product success and failure, factors for success, process of product development, managing for product's success. Innovation strategy. Product development process - product strategy, product design and process development, product commercialization, product launch and evaluation. The knowledge base for product development technology.
Unit - 3
Nutritional and sensory evaluation of a new product. Importance and implementation. Shelf life testing. Static, accelerated and use/abuse tests. Industrial criteria. Packaging: product requirements. Information and communication. Cost estimation. Direct and indirect costs. Overheads. Legal aspects to be applied in New Food Product Development. Composition, labelling and claims.
Unit – 4
Product Commercialisation: Product Launch and Evaluation
Unit-5
Role of consumers in product development. Managing the product development process. Improving the product development process - key message, evaluating product development, innovative matrices, striving for continuous improvement, improving success potential of new products, market exploration and acquisition, legal aspects of new product launch.
Practical:
Case study of product launch/mock exercises.
Suggested Readings:

- Clarke & Wright W. 1999. *Managing New Product and Process Development*. Free Press.
- Earle and Earle 2001. *Creating New Foods*. Chadwick House Group.
- Earle R, Earle R & Anderson A. 2001. *Food Product Development*. Woodhead Publ.
- Fuller 2004. *New Food Product Development - from Concept to Market Place*. CRC.

FST 509
Food Legislations and Standards
(Credits 3+1+0=4)

Course Objectives:
- To introduce students with food laws, standards and its regulatory framework.
- To understand and produce the right product according to the norms and its regulations.

Course Contents:
Theory
Unit - 1
Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of microbiological and chemical hazards. Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non thermal processing, irradiation of foods.
Unit - 2
Indian and Food Regulatory Regime, PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS), Auditing concept and Good Auditing Practices. Packaging laws and regulation
Unit - 3
Introduction to OIE and IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export and Import Laws and Regulations,

Export (Quality Control and Inspection) Act, 1963.

Unit - 4

Introduction to export/import of foods, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.

Unit - 5

Voluntary Quality Standards and Certification, GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices, ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS. Halal and Kosher.

Tutorial: Case study and Plant Audit

Suggested Readings:

- Singal RS. 1992. *Handbook of Indices of Food Quality and Authenticity*; Woodhead Publ. Cambridge, UK.
- Shapton DA.1991.*Principles and Practices of Safe Processing of Foods*; Butterworth Publication, London.
- Winton AL.1999. *Techniques of Food Analysis*; Allied Science Publications New Delhi.
- Pomeranze Y.2004.*Food Analysis - Theory and Practice*; CBS Publications, New Delhi.
- Jacob MB.1999. *The Chemical Analysis of Foods and Food Products*; CBS Publ. New Delhi.
- Eram S Rao, 2013. Food Quality Evaluation ISBN:9789381156216

FST 510
Nutrition and Health
(Credits 3+0+2=4)

Course Objectives:

- To introduce students with the concept of food nutrition and health.
- To understand and produce the relation of food with health and disease outbreak.

Course Contents:

Theory:

Unit - 1

Concept and definition of terms-Nutrition, Malnutrition and Health, Scope of Nutrition, Minimum Nutritional Requirement and RDA - Formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Factors affecting growth and development, Importance of Nutrition for ensuring, adequate development.

Unit - 2

Dietary Fibre - Classification, sources, composition, properties & nutritional significance; Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potasium, Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium); Vitamins - Bio-Chemical and Physiological Role Physiological role, bio-availability and requirements, sources, deficiency & excess.

Unit - 3

Concept of Community, types of Community, Factors affecting health of the Community, Nutritional Assessment and Surveillance: Meaning, need, objectives and importance, Nutritional assessment of human: Clinical findings, nutritional anthropometry, biochemical tests, biophysical methods, Diet survey, International, national, regional agencies and organizations, Nutritional intervention programmes to combat malnutrition.

Unit - 4

Health and Dimension of Health: Positive health versus absence of disease. Role of food in health, Study of the epidemiologic approach-determinants of disease preventive and their significance.

Unit - 5

Community Food Protection: Epidemiology of food borne disease-modes of transmission, Food borne disease and their control.

Suggested Readings:

Jelliffe, D. B. Assessment *of the Nutritional Status of the Community*; World Health Organisation.

Sain, D. R. Lockwood, R., Scrimshaw, N. S. *Methods the Evaluation of the Impact of Food and Nutrition Programmes,* United Nations University.

Ritchie, J.A.S. *Learning Better Nutrition.* FAO, Rome.

Swaminathan, M. Essentials of Foods and Nutrition, Vol. - I and II. Ganesh and Co. Madras.

FST 521
Nutraceuticals and Health Foods
(Credits 2+0+0 = 2)

Course Objectives:

- To cater to the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects.

Course Contents:

Theory:

Unit - 1

Introduction to nutraceuticals: definitions, synonymous terms, basis of claims for a compound as a nutraceutical, regulatory issues form nutraceuticals.

Unit - 2

Concept of angiogenesis and the role of nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders, Functional compounds: mechanisms of action, dosage levels, if any etc.

Unit - 3

Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols etc.; Formulation of functional foods, Nutraceuticals: stability and analytical issues, labelling issues.

Unit - 4

Clinical testing of nutraceuticals and health foods; Interactions of prescription drugs and nutraceuticals.

Unit - 5

Adverse effects and toxicity of Nutraceuticals; nutrigenomics ï an introduction and its relation to nutraceuticals.

Suggested Readings:

- Brigelius-Flohé J. and Joost HG. 2006. *Nutritional Genomics*: Impact on Health and Disease. Wiley VCH.
- Cupp J. & Tracy TS. *2003. Dietary Supplements*: Toxicology and Clinical Pharmacology. Humana Press.
- Gibson GR and William CM.2000. *Functional Foods* - Concept to Product.
- Goldberg I.1994. Functional Foods: Designer Foods, Pharma Foods.
- Losso J.N.*2007. Angi-angiogenic Functional and Medicinal Foods*. CRC Press.
- Manson. 2001. *Dietary Supplements*. Pharmaceutical Press.
- Campbell JE & Summers JL.2004. Dietary Supplement Labeling Compliance.
- Neeser JR and German BJ. 2004. *Bioprocesses and Biotechnology for Nutraceuticals*. Chapman & Hall.
- Robert EC. 2006. *Handbook of Nutraceuticals and Functional Foods*. 2nd Ed. Wildman.
- Shi J. (Ed.). 2006. *Functional Food Ingredients and Nutraceuticals*: Processing Technologies. CRC Press.
- Webb GP. 2006. *Dietary Supplements and Functional Foods*. Blackwell Publ.

FST 522
Food Microstructure and Texture
(Credits 2+0+0 = 2)

Course Objectives:

To know more about microstructure and texture of food and how these properties are measured and relate to human assessments of textural quality.

Course Contents:

Theory:

Unit -1

Examining food microstructures: history of food microstructure studies, light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, Image analysis: image acquisition, image processing and measurement analysis.

Unit - 2
Fundamentals of structuring: polymer, colloid, and materials science; food polymers, polymer solutions, phase transitions, colloids and surface chemistry, mechanical and rheological properties, rheology of foods, mechanical properties of food solids, food structure in the mouth and beyond.
Unit - 3
Micro-structural components and food assemblies: water and ice, proteins, lipids, carbohydrates, cells and cell membranes; Structural aspects of animal tissue, Structural aspects of plant tissue.
Unit - 4
Food structuring: traditional food structuring and texture improvement, approaches to food structuring, extrusion and spinning, structuring fat products, structure and stability.
Unit - 5
Gels, gelation mechanisms, mixed gels, the microstructure of gels, structure-property relations in gels. Food microstructure and quality: measurement of texture, structural aspects of food texture, quality and structure.

Suggested Readings:

- Aguilera JM. 1999, *Micro Structure: Principles of Food Processing Engineering,* Aspen Gaitherburg, MD.
- Barbosa-Cánovas GV. 1996. *Dehydration of Foods*. Chapman & Hall.
- Bechtel DB. 1983. *New Frontiers in Food Microstructure*. American Association of Cereal Chemists.
- Glasbey CA. 1995. *Image Analysis for the Biological Sciences*. Chichester, England, Wiley.
- Hartel RW. 1997. *Principles of Food Processing,* New York: Chapman and Hall.
- Moskowitz, 1987, *Food Texture*. Marcel Dekkker, Inc., New York.
- Russ JC. (Ed.). 1990. *Journal of Computer-Assisted Microscopy,* Plenum Pub Corp.

FST 523
Carbohydrate Chemistry and Technology
(Credits 2+0+0 = 2)

Course Objectives:
To cater to the emerging areas of industrial manufacturing, properties and applications of carbohydrates and their products in food product development and food packaging.
Course Contents:
Theory:
Unit - 1
Different carbohydrates in food products such as starch, cellulose, sugars, pectin, fibers (significance in diet, isolation from natural sources, chemistry & changes therein during processing).
Unit - 2
Chemical and enzymatic modification of carbohydrates especially starches and celluloses, manufacture of maltodextrins and corn syrups, Cyclodextrins: chemistry, technology and food applications.
Unit - 3
Interactions with other food constituents and their implications; Newer carbohydrates for food applications such as xanthan, dextran, pullulan, gellan, curdlan and ɓ-glucans (nutraceutical and functional properties).
Unit - 4
Stabilization of food systems, simulated and low-fat foods, Fat-substitutes based on carbohydrates, Carbohydrate-based biodegradable packaging.
Unit – 5
Suggested Readings:

- Eliasson AC. 1999.*Carbohydrates in Foods*. Marcel Dekker.
- Eliasson AC. 2004.*Starch in Food: Structure, Function and Applications*. Woodhead Publ.
- Kritchevsky D and Bonfield C. 1994. *Dietary Fiber in Health and Disease*. AACC.
- Roberfroid M. 2004. Inulin-Type Fructans: *Functional Food Ingredients*. Woodhead.
- Roy L, Whistler JN and Miller B. 1981.*CarbohydrateChemistry for Food Scientists*. AACC.
- Stephens A.M. 2000.*Food Polysaccharides and their Applications*. Marcel Dekker.
- Steve W Cui. 2000. *Polysaccharide Gums from Agricultural Products*: Processing, Structures and Functionality. CRC.
- Tomasik P. 2003. *Chemical and Functional Properties of Food Saccharides*. CRC.

FST 524
Lipid Chemistry and Technology
(Credits 2+0+0 = 2)

Course Objectives:
To cater to the emerging areas of industrial manufacturing, properties and applications of lipids and the products derived there from in food product development with the aim of improved nutritional and technological benefits.

Course Contents:

Theory:

Unit - 1
Nutritional aspects of food lipids and their sourcesï omega-3 and omega-6 fatty acids and their significance, Phytosterols and their nutraceutical significance.

Unit - 2
Measurement of lipid degradation parameters during deep-fat frying and storage of foods, Flavour emulsions and their stability.

Unit - 3
Fat powders like cream, butter, cod-liver oil etc. and techniques involved such as micro encapsulation, Fat substitutes based on carbohydrates and proteins.

Unit - 4
Formulation and characterization of low-fat spreads, whipped creams, margarines, mayonnaise, salad dressings etc; Bakery shortenings: chemistry, formulation and technology;
Trans-fatty acids: formation during processing and nutritional aspects; Enzymatic approach to tailor made fats.

Suggested Readings:

- Akoh CC. 2005. *Handbook of Functional Lipids*. Taylor & Francis.
- Dutta PC. 2004. *Phytosterols as Functional Food Components and Nutraceuticals*. Marcel Dekker.
- Garti N and Kiyotaka S. 2001. *Crystallization Processes in Fats and Lipid Systems*. Marcel Dekker.
- Gunstone F. 2006. *Modifying Lipids for Use in Food*. Woodhead.
- O'Brien RD. 1998. *Fats and Oils - Formualting and Processing for Applications*. Woodhead.
- Sikorski ZE. and Kolakowska A. 2002. *Chemical and Functional Properties of Food Lipids*. CRC.

FST 525
Protein Chemistry and Technology
(Credits 2+0+0 = 2)

Course Objectives:
To cater to the emerging areas of industrial manufacturing, properties and applications of proteins, and their products in food product development and food packaging.

Course Contents:

Theory:

Unit - 1
Protein structure and chemistry; Protein ï protein interactions, methods of evaluation of protein quality and amount, Conventional and novel sources of protein.

Unit - 2
Production of proteins, Protein concentrates/isolates from legumes, oilseeds, fish, seafood, leaf, microbes; Functional properties of proteins and their applications; Structure-function relationships of different food proteins; Textured vegetable proteins and different methods of texturization.

Unit - 3
High protein food formulations, Modification of proteins by enzyme (manufacture of protein hydrolysates, their characterization and applications), Chemical and physical methods.

Unit - 4
High protein food formulations, Modification of proteins by enzyme, Manufacture of protein hydrolysates, their characterization and applications, Interactions of proteins with flavors, polysaccharides, lipids and their technological effects; Protein based fat substitutes; Protein engineering.

Suggested Readings:

- Damodaran S and Paraf A. 1997.*Food Proteins and their Applications*. Marcel Dekker.
- Gennadios A. 2002. *Protein-Based Films and Coatings*. CRC.
- Sikorski ZE. 2001. *Chemical and Functional Properties of Food Proteins*. CRC.
- Yada R. 2004. *Proteins in Food Processing*. Woodhead.

FST 526
Snack Foods Technology
(Credits 2+0+0 = 2)

Course Objectives:

To provide knowledge of principles and characteristics of extruders and support systems for effective selection and operation, to review current practices for preparation of fried chips and other extruded snacks and also to demonstrate equipment in operation and familiarize students with practical aspects of snack foods processing technology.

Course Contents:

Theory:

Unit - 1

Technology for grain-based snacks: whole, roasted, toasted, puffed, popped and flaked grains; Coated grains: salted, spiced and sweetened; Batter and dough based products; Savory and farsans; Formulated chips and wafers; Papads; Instant premixes of traditional Indian snack foods.

Unit - 2

Technology for fruit and vegetable based snacks: chips, wafers; Technology for coated nuts ï salted, spiced and sweetened; Chikkis.

Unit - 3

Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging.

Unit – 4

Equipments for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping.

Suggested Readings:

- Edmund WL. 2001. *Snack Foods Processing*. CRC Press.
- Frame ND. 1994. *The Technology of Extrusion Cooking*. Blackie Academic.
- Gordon BR. 1997.*Snack Food*.AVI Publ.
- Samuel A.M. 1976. *Snack Food Technology*. AVI Publ.

FST 527
Beverages Technology
(*Credits 2+0+0 = 2*)

Course Objectives:

To provide a technical view of beverages and a full discussion of manufacturing processes in the context of technology and its related 112chemistry as well as a more fundamental appraisal of the underlying science.

Course Contents:

Theory:

Unit - 1

Types of beverages and their importance; Status of beverage industry in India; Manufacturing technology for juice-based beverages; synthetic beverages; technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks.

Unit - 2

Specialty beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts; Dairy and imitation dairy based beverages.

Unit - 3

Alcoholic beverages: types, manufacture and quality evaluation; Role of yeast in beer and other alcoholic beverages; Ale and lager type beer, Technology of brewing; Equipments used for brewing and distillation; Wine and related beverages; Distilled spirits.

Unit - 4

Packaged drinking water: definition, types, manufacturing processes, quality evaluation; Methods of water treatment; BIS quality standards of bottled water; mineral water, natural spring water, flavoured water and carbonated water.

Suggested Readings:

- Hardwick WA. 1995, *Handbook of Brewing*. Marcel Dekker.
- Hui YH et al 2004, *Handbook of Food and Beverage Fermentation Technology*. Marcel Dekker.
- Priest FG & Stewart G.G., 2006, *Handbook of Brewing*. 2nd Ed. CRC.
- Richard PV. 1981, *Commercial Wine Making - Processing and Controls*. AVI Publ.
- Varnam AH and Sutherland JP. 1994, *Beverages: Technology, Chemistry and Microbiology*. Chapman & Hall.
- Woodroof J.G. and Phillips GF. 1974, *Beverages: Carbonated and non Carbonated*. AVI Publ.

FST 528
Flavour Chemistry and Technology
(*Credits 2+0+0 = 2*)

Course Objectives:
To understand the science behind the art of flavoring foods, their analysis, the problem of off-flavors and the reasons thereof, development of flavors for specific applications, and legal aspects on use of flavours in food products.

Course Contents:
Theory:
Unit - 1
Sources of flavours: natural, processed and added; Flavour composites: natural, semi-synthetic and synthetic.
Unit - 2
Biogenesis of flavours in food ï natural and processed foods (Maillard Reaction and Lipid Oxidation).
Unit - 3
Subjective and objective analysis of flavours; Formulations of flavours; Adulteration; Flavour emulsions; Flavours production in fermented foods; Off-flavours in foods.
Unit - 4
Spices and spice-based products as flavours; Plantation crops as flavours: tea, coffee, cocoa and vanilla.
Unit - 5
Sensory evaluation of flavours, selection of flavourist, flavours and legal issues.

Suggested Readings:

- Ashurst PR. 1994. *Food Flavorings*. 2ndEd. Blackie.
- Burdock GA. 2004. *Fenaroli's Handbook of Flavor Ingredients*.5thEd. CRC Press.
- Deibler D and Delwiche J. 2004. *Handbook of Flavor*, Characterization: Sensory Analysis, Chemistry and Physiology. Marcel Dekker.
- Heath HB and Reineccius G. 1986. *Flavor Chemistry and Technology*. AVI Publ.
- Taylor A. 2002. *Food Flavour Technology*. Sheffield Academic Press.

FST 529
Confectionery Technology
(*Credits 2+0+0 = 2*)

Course Objectives:
To understand the science behind the manufacturing of confectionery items.

Course Contents:
Theory:
To provide an understanding of various classes of confectionary products, their manufacture and quality aspects.
Unit - 1
Raw Materials for Confectionery Manufacture, Comprehensive understanding of raw materials used in the confectionery manufacturing and processing industry, including quality control methods. cocoa, Sugar, Dried milk products, Special fats, Emulsifiers, Nut kernels, Alcoholic ingredients, The production of cocoa liqueur from the cocoa bean, Dark, milk and white chocolate, manufacturing processes.
Unit - 2
Chocolate processing Technology, Compound coatings and 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.
Unit - 3

Sugar confectionery manufacture, General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweetsï Ingredients, Methods of manufactureï Typesï Centerï filled, lollipops, co-extruded products. Manufacture of gums and jelliesï Quality aspects.

Unit - 4

Manufacture of Miscellaneous Products, Caramel, Toffee and fudgeï Liquorices paste and aerated confectionery, Lozenges, sugar panning and Chewing gum, Count lines Quality aspects, fruit confections.

Unit – 5

Flour confectionary Ingredients and flour specification; Types of dough: developed dough, short dough, semi-sweet, enzyme modified dough and batters; Importance of the consistency of the dough; Indian flour confections: manufacture, flour specification, ingredients, manufacturing process, types of chemically aerated goods.

Suggested Readings:

- Bent A, Bennion EB and Bamford GST.1997.*The Technology of Cake Making*.
- Blackie Academic and Professional, UK. 1997.
- Jackson EB. 1999, *Sugar Confectionery Manufacture*. 2nd Ed. Aspen Publ.
- Junk WR and Pancost HM. 1973. *Hand Book of Sugars for Processors*. Chemists and Technologists. AVI Publ.
- Manley DJR. 1983. *Technology of Biscuits, Crackers, and Cookies*. Ellis Horwood.
- Matz SA. 1992. *Bakery Technology and Engineering*. 3rd Ed. Chapman & Hall.
- Pomeranz Y. 1987. *Modern Cereal Science and Technology*. MVCH Publ.

SEMESTER – IV

BAS 202
BIOCHEMISTRY
(3+0+3 = 5 Credits)

Objectives:

- To develop an understanding of the principles of biochemistry and get an insight into the chemical reactions occurring at the cellular level for the synthesis and breakdown of biomolecules.
- To trace the interrelationships between various metabolic pathways.

Course Content:

Theory

UNIT -I

Introduction to Biochemistry: definition, objectives and scope; Acids, bases and buffers. Overview of chemistry of carbohydrates, proteins and lipids overview of isolation and purification of proteins (chromatographic separations, isoelectric focussing, gel electrophoresis/SDS-PAGE, ELISA), ultracentrifugation and molecular weight of protein; Functional properties of proteins (hydration, solubility, ionic charges, viscosity and diffusivity in solutions); Denaturation and renaturation of proteins.

UNIT -II

Enzymes- introduction, classification, structures and functions; Co-enzymes and co-factors; Active site; Mechanisms of enzyme action; factors affecting enzyme activity; specificity of enzymes; kinetics of enzyme action; enzyme inhibition; regulatory enzymes; lysozymes; modulators of enzymes, immobilized enzymes and use of enzymes in food processing.

UNIT - III

Introduction to metabolism. Overview of intermediary metabolism, biological oxidation, bioenergetics, electron transport chain, oxidative and substrate level phosphorylations. Metabolism of carbohydrates and regulation: definition and classification; Metabolic pathways for breakdown of carbohydrates ï glycolysis ï aerobic and

anaerobic, Anaerobic fate of pyruvate; pentose phosphate pathway, citric acid cycle, glycogen metabolism, gluconeogenesis

UNIT- IV

Metabolism of lipids and regulation: Pathways for breakdown and synthesis of fatty acids and lipids (oxidation pathways of even, odd chains and unsaturated fatty acids, lipid biosynthesis); Ketone bodies; Lipoproteins.

Metabolism of proteins: amino acid deamination, transamination, Urea cycle, amino-acids as biosynthetic precursors; protein biosynthesis.

UNIT –V

Cell and cellular organization; Outlines of digestive and excretory system, Brief introduction to nucleic acids ï structures of DNA and RNA, genetic code, replication, transcription and translation.

Practical :

1. Preparation of buffers and determination of pH by pH meter and pH indicators.
2. Separation of amino-acids and sugars by ascending paper chromatography.
3. Isolation of proteins and amino-acids by column chromatography
4. Separation of lipids by Thin layer chromatography
5. Estimation of Proteins by Bradfordôs method
6. Estimation of Reducing sugar by DNSA method
7. Estimation of DNA and RNS by UV spectrophotometer
8. Separation of proteins by SDS-PAGE
9. Assay of Salivary amylase activy.

Suggested Readings:

- Oser BL, Hawk's Physiological Chemistry; McGraw-Hill Book Co, New York.
- Varley H, Gowenlock AH and Bell M, Practical Clinical Biochemistry; Heinemann medical books Ltd., Vol I
- Lehninger A.L., Nelson D.L. and Cox MM , Principles of Biochemistry; MacMillan.
- Stryer L., Berg J.M. and Tymoczk J.L., Biochemistry; Freeman and Co.
- Voet D.J. and Voet J.G. , Fundamentals of Biochemistry; John Wiley and Sons.
- Murray et al., Harper's Illustrated Biochemistry
- Devlin T., Textbook of Biochemistry with Clinical Correlations
- sadasivam and manickam, Biochemical Methods

Courses offered by
Department of Agriculture and Environment Sciences

Following courses are offered by Department of Agriculture and Environmental Sciences as approved by Academic Council on 26.12.12.

BTech courses

I. Introduction to Agri-Practices- AES 202

Credits: 2+0+1 = 3

Objectives:

- To make the students aware of about agricultural practices.
- To teach the students about latest techniques in different streams of agriculture.

Course Content:

UNIT- 1

Introduction to agroclimatic zones of India, Package of practices for production of important cereals, pulses, oil seeds, sugar, commercial horticultural plants and fodder crops.

Weed Control: Weeds, their characteristics, dissemination and association with various crops; their multiplications; cultural, biological, and chemical control of weeds.

UNIT-2

Soil: physical, chemical and biological properties, Essential plant nutrients and other beneficial elements in soils and plants, soil testing and fertilizer recommendations, Problem soils and their reclamation

Plant growth regulator and their role in agriculture.

Seeds and Seed treatment : Seed production and processing technologies. Seed certification, seed testing and storage including cold storage. DNA finger printing and seed registration and distribution network**.**

UNIT- 3

Water management- Rainwater harvesting, water conveyance system, modern irrigation systems, Drainage of waterlogged soils, quality of irrigation water,

Intellectual Property Rights (IPR) issues, WTO issues and its impact on Agriculture and trade dynamics.

UNIT-4

Propagation techniques: Plant Tissue Culture Techniques and Applications in Plant Improvement- Seed culture, Embryo culture, Ovary or ovule culture, Organ culture, Shoot apical meristem culture, Somatic embryogenesis, Organogenesis, Micropropagation, Multiplication, Acclimatization, ELISA, Molecular markers using PCR and SDS-PAGE

UNIT-5

Integrated nutrient management, integrated pest management, integrated watershed management Vermi-composting and Bio-fertilizers; organic farming.

UNIT-6

Precision farming, protected cultivation, seed improvement programmes, postharvest infrastructure techniques.

Practicals:

- Procedure for soil sampling and testing
- Procedure for making vermicompost
- Hands on Tissue culture techniques and visit to tissue culture laboratory
- Visit to organic farming system

Suggested readings:

- The nature and properties of soils, Nyle C. Brady, Ray R. Weil, Prentice Hall, 2008
- Irrigation Management: Principles and Practices, Martin Burton, CABI. Copyright, 2010
- Plant Tissue Culture, M.P. Singh, Sunil Kumar, APH Publishing Corporation, New Delhi - 2009
- ICAR Handbook on agriculture

- ICAR Handbook on Horticulture

II. Environmental Studies
Credits: 4+0+0
Objectives:
- To introduce the students to environmental issues
- To provide them knowledge about the impacts of pollution on the environment

Course Content
UNIT 1: Multidisciplinary nature of environmental studies - Definition, scope and importance, need for public awareness.

UNIT 2: Natural Resources:
Renewable and non-renewable resources: Natural resources and associated problems.
a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. ÅRole of an individual in conservation of natural resources. ÅEquitable use of resources for sustainable lifestyles.
UNIT 3: Ecosystems
Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystems :- a. Forest ecosystem, b. Grassland ecosystem c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
UNIT 4: Biodiversity and its conservation
Introduction ï Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation, Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 5: Environmental Pollution
Definition, Cause, effects and control measures of -a. Air pollution, b. Water pollution c. Soil pollution, d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management : floods, earthquake, cyclone and landslides.
UNIT 6: Social Issues and the Environment
From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rahabilitation of people; its problems and concerns. Case Studies. Environmental ethics : Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.
UNIT 7: Human Population and the Environment
Population growth, variation among nations. Population explosion ï Family Welfare Programme. VII Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.
UNIT 8 : Field work
Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple

ecosystems-pond, river, hill slopes, etc.

Suggested references:

Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

III. VILLAGE ADOPTION - AES 101

Credits : 2+0+0 = 2

Objectives:

- To familiarize the students with the Indian rural scenario and its Agri-development status.
- To understand the impact of current Government policies and strategies

UNIT-I

Part I

- Indian Agriculture, importance of agrarian economy, its problems
- Agricultural Growth in India
- Recent Agricultural Problems in India
- Diversification of agricultural practices

Part II

- Concept of Rural Development. Scope and Importance of Rural Development
- Programmes of Rural Development - Objectives and Assessment of Programmes

UNIT-II

Part I

- Dimensions of Rural Development
  - Rural Electrification
  - Rural Transport

Part II

- Poverty and Unemployment
  - Rural Poverty
  - Rural Unemployment
  - Rural Indebtedness
  - Role of SHGs and Micro Finance in this context.
  - Rural Industrialization, Employment in unorganized sector

UNIT-III

Part I

- Agricultural labour
  - Efficiency of Agriculture labour
  - Impact of mechanization on Agricultural labour

Part II

- Schemes:
  - Food for Works Programme
  - Employment Guarantee Scheme
  - **M-NAREGA**
  - TRYSEM (Training Rural Youth for Self Employment)
  - Tribal Development Programme
  - Employment Assurance Scheme
  - Swarn Jayanti Gram Swarozgar Yojana

UNIT-IV

Part I

- Agricultural policy and impact
  - State Policies and Central Policies.
  - Central policies comparison with world.
  - Ceiling on land holding policy
  - Past and Present SEZ policy.
  - PPP & FDI

Part II:

- Food Quality
- Food Standards & Regulations

UNIT –V

Part I:

- Agricultural extension
- its importance and role
- methods of evaluation of extension programmes

Part II

- Training programmes for extension workers
- Role of Krishi Vigyan Kendra (KVK) in dissemination of Agricultural technologies

Role of Non Government Organization (NGO) and self- help group approach for rural development.

MTech courses

I. AES 501: Pre and Post Harvest Management of Fresh horticultural Produce
Credits: 3+0+3
Course Objectives:

- To provide knowledge about the key aspects of pre-harvest factors that affect produce quality and quantity.
- To provide a conceptual awareness of the key aspects of postharvest technology and the role they play in modern food supply.

Course content:
UNIT -1

Effect of environmental factors (light, temperature, RH, CO_2) and agronomical management (water quality, fertilizer dose & composition, **Soil,** etc.) on quality of fresh produce, An overview of the post harvest biology of horticultural crops maturity and maturity indices, measuring quality, safety factors, harvesting systems, preparation for market, packinghouse facilities and equipment, packaging, containers, unitization

UNIT - 2

Cooling prior to shipment: methods, evaluation of efficiency. Storage: methods, facilities, equipment, management of environmental conditions including controlled atmospheres. Ethylene treatments, Transport: systems, loading patterns, use of modified atmospheres.

UNIT - 3

Sanitation and other procedures related to decay and insect control, Food safety assurance, Standardization and inspection, Quality evaluation and control, Energy use in post harvest technology procedures, Harvesting and post harvest handling systems for various commodity groups.

UNIT - 4

Marketing fresh produce: socioeconomic and environmental considerations. An overview of current post harvest research in India and abroad. Integrated post harvest management essential for horticultural crops. Methods for determining quality of fresh commodities. Quality assurance of harvested horticulture perishables. Capital investment in post harvest technology and recovery of invested capital.

UNIT- 5

Cold Chain Management: Fundamentals of warehouse operations, basic warehouse exposures, operations technology, ammonia safety, ammonia refrigeration system, understanding energy use, logistic excellence, industrial truck operator training. Packaging Systems: Vacuum and gas packaging, aseptic packaging, retort packaging, CAP & MAP, active packaging, shrink packaging, lined cartonning system. Packaging Standards and Regulations: Laws, regulations, specifications and quality control, recycling of plastic packaging materials: Collection, separation and disposal.

II. AES 524: Environmental science
(Credit : 2+0+1)
Course objectives:

- To introduce with environmental issues
- To provide knowledge on environmental law

Course content :
UNIT - 1
Environmental Pollution

Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional and global aspects. Air: Sources of air pollutants, their behavior in the atmosphere. Effects of air pollutants on humans, animals, plants and properties. Control approaches. Water: Sources, effects, water pollution treatment. Soil: Sources and nature of soil pollution and its harmful effects. Environmental problems associated with noise pollution, oil pollution and radioactive pollution.

UNIT - 2

Natural resource Management

Definition- land, water, soil, plants and animals: quality of life: renewable and non-renewable resources: Mineral occurrences, prospects: Mineral resources: Mineral reserves, ore minerals, coal, petroleum, oil and natural gas: water- hydropower, including tidal power; ocean surface waves used for wave power, wind- wind power, geothermal heat- geothermal power and radiant energy- solar power: sustainable development.

UNIT - 3

Current Environmental Issues

Contemporary and emerging environmental issues of local, regional and global significance. Broadly the topics will be pertaining to: i) Linkage between population, development and environment ii) climate change ii) stratospheric Ozone depletion iii) water resources iv) environmental toxicants and human health and v) environmental episodic events, etc.

UNIT - 4

Solid and Hazardous Waste Management

Solid wastes: Definition, types, sources, characteristics, and impact on environmental health. Concepts of waste reduction, recycling and reuse. Collection, segregation and transport of solid wastes Handling and segregation of wastes at source. Collection and storage of municipal solid wastes. Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery. Composting, Vermicomposting, Incineration of solid wastes. Hazardous wastes: Definition, sources and characteristics: Hazardous waste categorization, generation, collection, transport, treatment and disposal.

UNIT - 5

Environmental law

Environmental legislation for protection of species and natural resources. Government policies for environmental conservation, Government agencies responsible for environment.

International organizations. International Environmental Legislation: protocols, treaties, conventions, standards, etc. Environmental standards in India. Legislation on management and handling of municipal solid wastes and hazardous wastes.

Principles and Strategies in Environmental Law - Chemically Dependent Agriculture; Risk and Law: Pesticide Paradigm, Safe Drinking Water: Science and Law; Air Quality Law: Margins of Safety, Vehicle Emissions and Public Transit, The Quiet Revolution in Plastics, The Tobacco Paradigm, Evolution of Tobacco Law, Renewable Energy Policies, Reflection and Lessons.

Practical

1. Air, water and soils sampling
2. pH, Biological Oxygen Demand
3. Organic Carbon, Hardness.

III. AES 523: Forest Plantation for Food and Environment

Course objective:

- To provide knowledge on the role of forests in food security
- To provide knowledge on the relationship of forests with climate change

Course content:

UNIT - 1

Introduction

Conceptual understanding of forest, differences between a forest and a plantation. Principal forest types of India. Major ecosystems of India. Impacts of diminishing forest resources, Implications of the increasing dependence on the cash economy; Incorporating food security issues into forest management and policy planning.

UNIT - 2

Food Resources from forests

Contribution of forest and farm tree foods to the household diet: The Plant Foods Collected, Animal Foods, The Contribution of Livestock Fodder ; Honey from the Forest; Fuel wood Energy ; The contribution of forest

food resources to the household food security: The Supplementary Role of Forest Foods, The Seasonal Importance of Forest and Farm Tree Foods, The Emergency Role of Trees, Changes in the forest resource and concomitant changes in the forest resource use, Incorporating nutrition issues into forest activities; Characteristics of small-scale forest-based processing and, gathering enterprises for rural households, The Role of Women in gathering enterprises.

UNIT - 3

Forest-based enterprise for Income and employment

The importance of forest-based enterprises for households: The Extent of Forest-Based Income Generation, The Contribution of Forest-Based Income to Household Budget; The participants in forest-based income earning activities: The Importance of Forest-Based Activities for Poorer Households, The Role of Women in Forest-Based Income Earning Activities; Forest-based income and household food security: Seasonal Income, Emergency Income, The constraints to the further development of forest-based small-scale enterprises

Tree cultivation, the household economy - Benefits and costs of tree components in farming systems: Home Gardens, Farm Woodlots, Extensive and Intermediate Systems; Tree cultivation and farmer objectives and resources: Production Objectives, Resource Availability Land, Markets and Marketing, Risk Management; Tree cash crops and food security, Planning, management and policy issues

UNIT - 4

Forest and climate change

Carbon(C) cycle in the forest; carbon related definitions e.g. C-pool, C-stock, C-flux, C-sink, C-source, Sequestration/uptake. Managing production forest for carbon and environmental values; forest conservation and mitigation. A broad view of assessment of C in Indian forests.

Conceptual understanding of Climate and Climate Change (CC); climate pattern in the last century; causes and consequences of climate change (what problems are created by the climate change). Green House Gas (GHG) and global warming; impact of global warming on CC; impact of CC on forest characteristics. Forest and soil as source or sink of carbon; effect of deforestation, degradation, landuse changes on the emissions. Role of forest in carbon management; options for CC mitigation through forest management; mitigation potential of forest sector in India. International efforts in combating global warming and CC.A brief understanding of UNFCCC (Kyoto protocol, NATCOM),IPCC,CBD, UNCCD, World Heritage Convention, UN Forum on Forest etc.

ELECTIVE COURSES

I. POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS

Credit: 2+0+1

Objective

To get acquainted with basic elements of post harvest technology

Contents

UNIT I

Importance & scope of post harvest management of Horticultural crops in Indian economy, Harvesting vs. physiological maturity, Harvesting indices, Post-harvest technology: Importance of post harvest management of food; Causes of post-harvest losses; General principles and method of preservation;

UNIT II

Morphology, structure and composition of Horticultural Crops; maturity indices and standards for selected fruits and vegetables; methods of maturity determinations, Physiological post harvest disorders - chilling injury and disease; prevention of post harvest diseases and infestation;

UNIT III

Factors affecting post harvest losses; Standards and specifications for fresh fruits and vegetable. Harvesting and handling of important Horticultural Crops, Harvesting tools and their design aspects; primary processing for sorting and grading at farm and cluster level

UNIT IV

Post-harvest physiological and biochemical changes in Horticultural Crops; ripening of climacteric and non-climacteric fruits; Storage practices: pre-cooling and cold storage, Zero energy cool chamber; Commodity pretreatments - chemicals, wax coating, prepackaging, VHT and irradiation. Introduction to cold chain and its management

UNIT V

Handling and packaging of fruits and vegetables; Post Harvest handling system for Horticultural Crops of regional importance such as citrus, mango, banana, pomegranate, tomato, papaya and carrot etc., packaging house operations; principles of transport and commercial transport operations. Integrated postharvest management of horticultural crops, recent advances in post harvest management of horticultural crops

Practical

- Scientific method for ripening and enhancing shelf life of fruits and vegetables
- Studies on Practice in judging the maturity of various fruits and vegetables.
- Determination of physiological loss in weight (PLW), total soluble solids (TSS), total sugars, acidity and ascorbic and content in fruits and vegetables.
- Visit to a cold chain infrastructure

Suggested Readings

1. Kadar AA.1992. Post-harvest Technology of Horticultural Crops. 2nd Ed. University of California.
2. Lal G, Siddapa GS & Tandon GL.1986. Preservation of Fruits and Vegetables. ICAR.
3. Verma LR. & Joshi VK. 2000. Post Harvest Technology of Fruits and Vegetables. Indus Publ.
4. Agmark standards by DMI, GoI.
5. Cold chain standards by NHB, GoI.

II. ENVIRONMENTAL SUSTAINABILITY IN FOOD SECTOR

Credit: 2+0+0

Objectives:

To develop an understanding of sustainability with a special focus on food sector

UNIT I: Concept of sustainability, Dimensions of sustainability- Economic dimension, Environmental Dimension and social dimension.

UNIT II: Environmental Sustainability in the context of food sector: Environmental Impact of Food supply chain - Impact of production of raw materials, processing, packaging, and transport. Air emissions, Water and waste water ï Water foot print, Energy ï Improving energy efficiency, Resource efficiency and waste management.

UNIT III: Life cycle assessment (LCA) of food products: The LCA process, Key principles of LCA, LCA of vegetables and fruits, LAC of processed food, LCA of other food products.

UNIT IV: Sustainability in - food transport, retails, consumers ï Role in environmental sustainability, Ecolabelling, Social aspect of food supply chain

Suggested Readings

1. Handbook of Sustainability for the Food Sciences (2012) By Rubén O. Morawicki. Publisher - Wiley Blackwell
2. Sustainability in the Food Industry (2012) edited by Cheryl J. Baldwin. Publisher - Wiley Blackwell

III. PLANT CELL AND TISSUE CULTURE

Credit: 2+0+1

Objectives:

Plant tissue culture is a very important tool in agriculture and food processing. Plant Tissue Culture Laboratories for industrial and commercial purposes including in food processing have been established around the globe. Therefore, a course in Plant Cell and Tissue Culture as a part of curriculum in Food

Processing aims at making the students aware of the procedures and applications of these important tools in food industry.

Contents:

UNIT I

History, basic concepts and general procedure: Cell Theory to totipotency; History of Plant Tissue culture including important work on tissue culture in India. Layout of a tissue culture laboratory, Aseptic procedures, growth of cultures under controlled conditions, steps in tissue culture, Basic terminology, Hardening or acclimatization, Aseptic areas, Dry heat methods, Wet heat, Ultra filtration , Chemicals, Antibiotics, UV

UNIT II

Nutritional requirements in plant tissue culture: role of inorganic salts, vitamins, amino acids and amides, carbon source, water, osmotica, nutrient matrix, charcoal, hormones, H-Ions.

Plant Hormones, their occurrence and functions, mechanism of action, applications of hormones in plant tissue culture Manipulation of cytokinin and auxin ratio affects organogenesis

UNIT III

Protoplast and cell culture: Technique of protoplast fusion, incompatibility barriers. The details of cell and protoplast culture, Callus cultures, Organ culture, Embryo culture, Meristem culture, Anther/ovule culture, Protoplast cultures, Somatic embryogenesis. Cryopreservation as a technique and its applications for storage of germplasm.

UNIT IV

Somaclonal variants as a source of variability for agriculturally important characters. Chemical mutagens such as EMS or nitroso-guanidine employed to create variability, occurrence of somaclonal variations in crops including sugarcane, potato, tobacco, tomato and rice and for agronomically important characters such as disease resistance, stress and herbicide tolerance.

UNIT V

Genetic fidelity of culture systems and common problems: Possible problems in tissue culture and their solutions: Culture contamination, explant death, no growth of explants, leggy shoots, unwanted callus, chlorotic leaves, poor or no rooting and other problems common to tissue cultures will be discussed

UNIT VI

Applications of cell cultures in Food Science: Multiplication of highly valued plant material: rare, new, imported plant varieties. Production of Natural Food flavors, additives and preservatives, Production of amino acids (glutamate, feed additives), organic acids, nucleotides (IMP, GMP) using cell culture tools. Biosynthesis of high value flavors, colors, preservatives, nutritional supplements etc. Vanillin from *Vanilla species*; Steviosides from *Stevia*, Ginseng saponines from *Panax ginseng*; Shikonin from *Lithospermum*

Practical:

- Preparation of explants
- Preparation of media
- Aseptic procedures
- Use of autoclaves
- Inoculation: Use of laminar flows
- Cell culture

Suggested Readings

1. Bhojwani, S. S. and Rajdan, M. K. (1983). Plant Tissue Culture: Theory and Practice: Developments in Crop Sciences, Amsterdam, Elsevier

2. Vasil, I. K. and Thorpe, T. A. (1994) (eds). Plant Cell and Tissue Culture. Dordrecht, The Nehterlands: Kluwer.

3. Smith, R. H. (2000). (ed). Plant Tissue Culture. Academic Press.

4. Dodds, J. H. and Roberts, L. W. (1996). Experiments in Plant Tissue Culture. Cambridge University Press, Cambridge