Agenda for P.G. Faculty Meeting (II/2023) to be held on August 05, 2023 at 12:00 noon in the Conference Hall, College of Agriculture

Item No.		Description
II/2023:01	:	Confirmation of Minutes of I/2023 meeting of Board of Faculty (PGS) held on February 02, 2023 (Minutes have been already circulated and are available on university website under College of PGS)
II/2023:02	:	Review of action taken on the decisions of I/2023 meeting of BOF (PGS)
II/2023:03	:	Accreditation of faculty members for Post Graduate Research
II/2023:04	:	Approval of Course Programme for M.Tech. (Food Processing Technology) and Ph.D. (Food Processing Technology) degree programme as per BSMA-ICAR starting w.e.f. I semester 2023-24
II/2023:05	:	Approval of Course Syllabus for M.Tech. (Food Processing Technology) and Ph.D. (Food Processing Technology) degree programme as per BSMA-ICAR starting w.e.f. I semester 2023-24
II/2024:06	:	Any other item with the permission of Chair.

Agenda II/2023:01 Confirmation of Minutes of I/2023 meeting of Board of Faculty (PGS) held on February 02, 2023 (Minutes have been already circulated and are available on university website under College of PGS)

No comment/modification for the minutes of I/2023 meeting held on February 02, 2023 has been received, therefore, the minutes as circulated are confirmed.

Item No. II/2023:02 Review of action taken (I/2023 meeting held on February 02, 2023)

Item No. I/ 2023:3	**:**	**Accreditation of P.G. Faculty members for Post Graduate Research**
		Agenda for accreditation of 14 faculty members for Ph.D. research & 02 faculty members for Master's research of our University and 08 faculty members/scientists for Ph.D. research & 04 faculty members/scientists for Master's research of outside institutions (with whom the University has entered into MoU) had been approved by Academic Council in its 393rd meeting held on February 09, 2023 under agenda item no. 2023:393:35.
Item No. I/ 2023:4	**:**	**Revision in degree nomenclature of Master's and Ph.D. programmes as per BSMA (ICAR)**

		Approved by Academic Council in its 393rd meeting held on February 09, 2023 under agenda item no. 2023:393:36 and approved by Hon'ble Board of Management in its 245th meeting (under resolution no. 245.36) held on February 14, 2023.
Item No. I/ 2023:5	**:**	**Admission Policy for Academic Year 2023-2024 for PG and Ph.D. programmes of the University**
		Approved by Academic Council in its 393rd meeting held on February 09, 2023 under agenda item no. 2023:393:32.
Item No. I/ 2023:6	**:**	**Admission Policy (2023-2024) for MBA Programmes**
		Dean, CABM to inform the status of ratification from Academic Council.
Item No. I/ 2023:7	**:**	**Implementation of SWAYAM / MOOC courses in PG degree programs in disciplines of Technology and Agri-Business Management/ Management and transfer of their credits**
		Approved by Academic Council in its 393rd meeting held on February 09, 2023 under agenda item no. 2023:393:37. As per resolution of Academic Council, the SWAYAM/MOOC courses equivalent to the courses of our University are to be submitted to Dean, PGS in each semester for obtaining approval of Hon'ble Vice-Chancellor. The list of courses from College of Technology and College of Agri-Business Management is still awaited.
Item No. I/ 2023:9(1)	**:**	**(i) Start of P.G. degree i.e., M.Sc. (Community Science) Extension Education & Communication Management as recommended by BSMA-ICAR from academic year 2023-2024** **(ii) Course programme for M.Sc. (Community Science) Extension Education & Communication Management** **(iii) Syllabus for M.Sc. (Community Science) Extension Education & Communication Management**
		Since, the agenda was not recommended, therefore, no action was required.
Item No. I/ 2023:9(2)	**:**	**Admission Policy for Admission to Ph.D. in Management w.e.f. Academic Session 2023-2024**
		Approved by Academic Council in its 393rd meeting held on February 09, 2023 under agenda item no. 2023:393:32.

II/2023:03 : Accreditation of faculty members for Post Graduate Research

Proposal from 06 faculty members of the University and 04 from the institutions with whom GBPUAT, Pantnagar has signed MoU were received for accreditation. These proposals were discussed and examined by the Accreditation Committee in its meeting held on July 04, 2023 at 4:00 P.M.

The minutes of the meeting of Accreditation Committee along with brief bio-data of faculty members is annexed. The Accreditation Committee has recommended that the faculty members as mentioned below may be accredited for P.G. research in the programme noted against each.

Sl. No.	Name of Faculty Member	Designation	Department	Recommended Accreditation level
1.	Dr. Sweta Rai	Asstt. Prof.	Food Science & Technology	Ph.D.
2.	Dr. Sabbu Sangeeta	Asstt. Prof.	Food Science & Technology	Ph.D.
3.#	Dr. Susheel Kumar Katariya	Assoc. Professor	Civil Engineering	Ph.D.
4.	Dr. Susheel Singh Bhandari	Asstt. Prof.	Mechanical Engineering	Ph.D.
5.	Dr. Sunita Jalal	Assoc. Professor	Computer Engineering	Ph.D.
6.	Dr. Geeta Pathak	Assoc. Professor	Electrical Engineering	Ph.D.
	The following scientists/faculty members of the institutes with whom our University has entered into MoU will be included in the student's advisory committee as Co-Chairman/Member.			
7.*	Dr. Pramod Prasad	Senior Scientist	Plant Pathology, ICAR-IIWBR, Regional Station Shimla	Ph.D.
8.**	Dr. Tripta Jhang	Principal Scientist	Plant Breeding & Genetic Resource Conservation, CSIR-CIMAP, Lucknow	Ph.D.
9.***	Dr. Sanjay Kumar	Director	ICAR-Indian Institute of Seed Science	Ph.D.
10.****	Dr. Soumen Naskar	Principal Scientist	School of Genetic Engineering, IIAB, Ranchi	Ph.D.

#Recommended with the condition that second published research paper will be provided latest by July 06, 2023 to Dean, PGS through proper channel.

*As per provisions of MoU signed with ICAR-IIWBR, Karnal.

** As per provisions of MoU signed with CSIR-CIMAP, Lucknow.

*** As per provisions of MoU signed with ICAR-Indian Institute of Seed Science, Mau.

**** As per provisions of MoU signed with ICAR-IIAB, Ranchi.

Minutes of the Accreditation Committee Meeting held on July 04, 2023 at 4:00 P.M. in the Committee Room of Directorate, Placement & Counselling

The following attended the meeting.

1. Dr. Ravi Saxena, Acting Head, Electrical Engineering
2. Dr. H.J. Shiva Prasad, Acting Head, Civil Engineering
3. Dr. S.K. Sharma, Head, Food Science & Technology
4. Dr. J.L. Singh, Head, Veterinary Medicine / Acting Head, VGO
5. Dr. S.D. Samantaray, Head, Computer Engineering
6. Dr. Pradeep Kumar, Head, Plant Pathology
7. Dr. Salil K. Tewari, Head, Genetics & Plant Breeding / Acting Dean, Agriculture
8. Dr. R.C. Srivastava, Acting Dean, CBSH (Nominee)
9. Dr. Manisha Gahlot, Acting Dean, Home Science
10. Dr. Avdhesh Kumar, Acting Dean, Fisheries
11. Dr. Lokesh Varshney, Head, Mech. Engg./Acting Dean, Technology
12. Dr. S.P. Singh, Dean, V.A.Sc.
13. Dr. R.S. Jadoun, Dean, CABM
14. Dr. Deepa Vinay, Registrar
15. Dr. K.P. Raverkar, Dean, PGS

The committee examined the applications of the following faculty members for their accreditation for PG research and recommended the following to guide Ph.D. research as mentioned against their names.

Sl. No.	Name of Faculty Member	Designation	Department	Recommended Accreditation level
1.	Dr. Sweta Rai	Asstt. Prof.	Food Science & Technology	Ph.D.
2.	Dr. Sabbu Sangeeta	Asstt. Prof.	Food Science & Technology	Ph.D.
3.#	Dr. Susheel Kumar Katariya	Assoc. Professor	Civil Engineering	Ph.D.
4.	Dr. Susheel Singh Bhandari	Asstt. Prof.	Mechanical Engineering	Ph.D.
5.	Dr. Sunita Jalal	Assoc. Professor	Computer Engineering	Ph.D.
6.	Dr. Geeta Pathak	Assoc. Professor	Electrical Engineering	Ph.D.
	The following scientists/faculty members of the institutes with whom our University has entered into MoU will be included in the student's advisory committee as Co-Chairman/Member.			
7.*	Dr. Pramod Prasad	Senior Scientist	Plant Pathology, ICAR-IIWBR, Regional Station Shimla	Ph.D.
8.**	Dr. Tripta Jhang	Principal Scientist	Plant Breeding & Genetic Resource Conservation, CSIR-CIMAP, Lucknow	Ph.D.
9.***	Dr. Sanjay Kumar	Director	ICAR-Indian Institute of Seed Science	Ph.D.
10.****	Dr. Soumen Naskar	Principal Scientist	School of Genetic Engineering, IIAB, Ranchi	Ph.D.

#Recommended with the concition that second published research paper will be provided latest by July 06, 2023 to Dean, PGS through proper channel.
*As per provisions of MoU signed with ICAR-IIWBR, Karnal.
** As per provisions of MoU signed with CSIR-CIMAP, Lucknow.
*** As per provisions of MoU signed with ICAR-Indian Institute of Seed Science, Mau.
**** As per provisions of MoU signed with ICAR-IIAB, Ranchi.

(Ravi Saxena)
Acting Head, Electrical Engg.

(H.J. Shiva Prasad)
Acting Head, Civil Engineering

04/07/2023
(S.K. Sharma)
Head, Food Science & Technology

04/07/2023
(J.L. Singh)
Head, Veterinary Medicine / Acting Head, VGO

04/07/2023
(S.D. Samantaray)
Head, Computer Engineering

4/7/23
(Pradeep Kumar)
Head, Plant Pathology

(Lokesh Varshney)
Head, Mech. Engg./
Acting Dean, Technology

(Salil K. Tewari)
Head, Genetics & Plant Breeding / Acting Dean, Agriculture

4/7/23
(R.C. Srivastava)
Nominee Dean, CBSH

(Manisha Gahlot)
Acting Dean, Home Science

(Avdhesh Kumar)
Acting Dean, Fisheries

(S.P. Singh)
Dean, V.A.Sc.

04/07/23
(R.S. Jadoun)
Dean, CABM

4/7/23
(Deepa Vinay)
Registrar

04/07/2023
(K.P. Raverkar)
Dean, PGS

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION

(03 copies are required on one page, on one side)

1.	Name	:	Dr. Sweta Rai
2.	Designation	:	Assistant Professor
3.	Date of birth	:	15/06/1983
4.	Department	:	Food Science and Technology
5.	Educational Qualification	:	Ph. D
6.	Field of Specialization	:	Food Technology
7.	Experience as Faculty member:		
	(i) Outside the University	:	Nil
	(ii) (a) In the University	:	w.e.f. 21/11/2015 to Continue
	(b) On present post		w.e.f. 21/11/2015 to Continue
8.	Publications:		
	(a) No. of Research papers published	:	11
	(b) No. of articles published	:	12
	(c) Books/Chapters in books	:	01
	(d) Other publications, if any	:	----

9. Details of courses taught:

Sl.No.	No. & Title of the course	Credit hrs.
	U.G. Level	
i.	AFS-311 Elements of Food Technology	3(2-0-2x3) =8
ii.	AFS-372 Post-Harvest Technology of Horticultural Crops	3(1-0-2x2)= 5
iii.	AFS-363 Bakery & Confectionary Products	3(2-0-1x3)=5
iv.	AFT-316 Bakery, Confectionary and Snack Products	3(2-0-1x2)=4
v.	AFS-365 Technology of Pulses and Oilseeds	3(2-0-1x3)=5
vi.	AFS-361 Technology of Cereals and Millets	3(2-0-1x3)=3
vii	AFS-378 Technology of Spices and Plantation products	3(2-0-1x3)=5
viii.	AFS-391 Packaging of Fresh & Processing Foods	2(1-0-1x3)= 4
ix.	AFS-312 Principles of Food Science & Nutrition	2(2-0-0)= 2
x.	AFS-441 Concentrated and Dehydrated milk products	3(2-0-1x3)=5
xi	AFS-350 Fundamentals of Food Processing	3(2-0-1x3)=5
xii	AFS/AFS-370 Post-Harvest Physiology & Handling of Fruits & Vegetables	3(2-0-1x3)=5
	P.G. Level	
i.	AFS-561 Technology of Cereal, Pulses & Oilseeds	3(2-0-1x3) = 5
ii.	AFS-733 Advance in Food Microbiology	2(1-0-3) = 4
iii.	AFS-685 Beverages and Snack Food Technology	3(2-0-1x3) =5
iv.	AFS-686 Product Design and Development	2(1x2+0) = 2

10. No. of Master's students guided (in case of Ph.D. research)

Name	ID.NO.	Thesis title	Year of completion
Ms. Maduri Popat Dukare	54218	"Study on preparation of value-added products from black soybean grown in Uttarakhand"	2021
Ms. Santoshi Rawat	55625	"Standardization of the process for vegan gummies supplemented with turmeric and black pepper"	2022
3. Mr. Arun Prakash	55360	"Standardization of process for ready to cook traditional black soybean *Dubbi*"	2022

Signature of staff member

Signature of Head of the Department

Signature of Dean College Concerned

Dean
College of Agriculture
24/5/23

Signature of Dean PGS

DEAN, P.G.S.

NO/CTE/CED/443
Dated 27-5-23

BRIEF BIODATA FOR MASTER'S/ PH.D. ACCREDITATION
(03 copies are required on one page, on one side)

1. **Name** : Dr. Susheel Kumar Katariya
2. **Designation** : Associate Professor
3. **Date of birth** : 26 / 12 / 1976
4. **Department** : Civil Engineering
5. **Educational Qualification** : Ph.D.
6. **Field of Specialization** : Structural Engineering
7. **Experience as Faculty member:**
   - (i) **Outside the University** : Lecturer, HBTU Kanpur w.e.f. 06.09.1999 to 15.03.2004
   - (ii) **In the University** : Assoc. Prof. w.e.f. 25.09.2007 to till now.
   - (iii) **On Present Post** : Assoc. Prof. w.e.f. 25.09.2007 to till now.
8. **Publications:**
   - (a) **No. of research papers published** : 06 (01 Journal + 05 Conferences)
   - (b) **No. of articles published** : Nil
   - (c) **Books/ Chapters in books** : 01
   - (d) **Other Publications, if any** : Nil

Office of the Dean, P.G.S. 28930 Date 9.6.23 Pantnagar

9. **Details of courses taught:**

Sl. No.	No. & Title of courses	Credit hrs.
	U.G. Level:	
1.	TCE 100, Engineering Drawing	3 (1-0-2 x 2)
2.	TCE 131, Solid Mechanics	4 (3-1-2)
3.	TCE 214, Materials Testing and Evaluation	3 (2-0-2)
4.	TCE 303, Structural Engineering	3 (3-0-0)
5.	TCE 305, Civil Engineering Construction and Drawing	3 (2-0-3)
6.	TCE 320, Estimation and Costing	3 (1-0-2x2)
7.	TCE 351, Design of Concrete Structures-II	3 (3-0-0)
8.	TCE435, Pre-stressed Concrete	3 (3-0-0)
	P.G. Level:	
1.	TCE 532, Advanced Solid Mechanics	3 (3-0-0)
2.	TCE 621, Limit State Design of Concrete Structures	3 (3-0-0)
3.	TCE 648, Composite Material	3 (3-0-0)
4.	TCE 739, Engineering Mechanics	3 (3-0-0)
5.	TCE 602, Theory of Elasticity	3 (3-1-0)
6.	TCE 606, Experimental Stress Analysis	3 (2-0-1)

10. **No. of Master's student guided (in case of Ph.D. research)**

Name	ID. No.	Thesis title	Year of completion
Varsha	43006	Numerical formulation and parametric investigations of the square and rectangular CFST columns subjected to axial loading	2018
Amit Rautela	50920	Numerical modelling for square CFST column filled with normal strength concrete under axial compression	2018
Gaurav Kashyap	50898	Numerical modelling for predicting the post-peak behaviour of circular CFST stub columns under axial loading	2018
Deepak Sharma	51227	Effects on compressive strength of recycled and natural aggregate concrete using black lintel powder subjected to elevated temperature and gradual cooling	2018
Prabhanshu Bisht	52479	Behaviour of RC building with outrigger system subjected to earthquake and wind effect.	2019
Harshit Sachan	54073	Numerical modelling for square and rectangular concrete-filled steel tubular columns.	2020
Pradeep S. Kanyal	55313	Non-linear finite element analysis of circular CFST columns under axial compression.	2022
Alok Bhatt	56990	Numerical modelling for stress-strain curve of confined concrete in rectangular and square CFST elements under axial compression	2023

Dean C.T. Office Receipt No. 1045 Dated: 24.5.23

HA.

DEAN. P.G.S. 09/06/23

Signature of Staff member

Signature of Dean College concerned

Head Civil Engineering Deptt.
Signature of Head of the Deptt.

Signature of Dean PGS
DEAN. P.G.S.

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION

(03 copies are required on one page, on one side)

1.	Name	:	SUSHEEL SINGH BHANDARI		
2.	Designation	:	ASSISTANT PROFESSOR		
3.	Date of birth	:	05/02/1981		
4.	Department	:	MECHANICAL ENGINEERING		
5.	Educational Qualification	:	PHD		
6.	Field of Specialization	:	Thermal Engineering		
7.	Experience as Faculty member:				
	(i) Outside the University	:	w.e.f.	to	
	(ii) (a) In the University	:	w.e.f.	to	
	(b) On present post		w.e.f.	22/12/2015	to continue
8.	Publications:				
	(a) No. of Research papers published	:	15		
	(b) No. of articles published	:	4		
	(c) Books/Chapters in books	:	2		
	(d) Other publications, if any	:	9		

9. Details of courses taught:

Sl.No.	No. & Title of the course	Credit hrs.
	U.G. Level:	
i.	TME-210 Fluid Mechanics	(3-1-2)
ii.	TME 450 Gas dynamics and Jet Propulsion	(3-1-2)
iii.	TME 446 Applications of Solar Energy	(3-0-0)
iv.	TME 102 Introduction to Environment Engineering and Disaster Management	(3-0-0)
	P.G. Level:	
i.	TME 502 Conduction and Radiation	(2-1-0)
ii.	TME 503 Convective Heat Transfer	(2-1-0)
iii.	TME 600/788/789 PG Seminar	(0-0-2)

:

10. No. of Master's students guided (in case of Ph.D. research)

Sl. No.	Thesis Title	ID NO	Year of completion
1.	Performance comparison of solar cooker using different Phase Change Materials during off sunshine hours.	Abhishek Kumar (52477)	2017-2019
2.	Performance studies on hybrid solar cooker using phase change materials and PV Technology.	Deepak Pal (54042)	2018-2021
3.	Performance studies on hybrid solar cooker using phase change materials with Internet of things based monitoring interface.	Pratyush Kukreti (55323)	2019-2022

Signature of staff member 7/6/23

Signature of Dean College Concerned 8/6/23

7/6/23

Signature of Head of the Deptt.

HEAD. MED

Signature of Dean PGS

DEAN, P.G.S.

30/6/2023

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION

(03 copies are required on one page, on one side)

1. Name : Sunita Jalal
2. Designation : Associate Professor
3. Date of birth : 23.11.1981
4. Department : Computer Engineering
5. Educational Qualification : Ph.D.
6. Field of Specialization : Computer Science and Engineering
7. Experience as Faculty member:
   - (i) Outside the University : -
   - (ii) (a) In the University : w.e.f. 06.12.2006 to 05.12.2019
   - (b) On present post : w.e.f. 06.12.2019 to till date
8. Publications:
   - (a) No. of Research papers published : 10
   - (b) No. of articles published : 1
   - (c) Books/Chapters in books : 1 book chapter
   - (d) Other publications, if any : 2 conference papers, 1 national seminar paper
9. Details of courses taught:

Sl.No.	No. & Title of the course	Credit hrs.
	U.G. Level:	
i.	Introduction to Computers & Programming (TCT100)	3
ii.	Data Structures (TCT201)	3
iii.	Design & Analysis of algorithms (TCT209)	3
iv.	Software Engineering (TCT421)	2
v.	Web Technology & Internet Programming (TIT361)	4
vi.	Data Mining & Warehousing (TCT473/TIT473)	3
vii.	Data Mining (TCT433)	3
viii.	Computational Scientific Tool (TCT212)	2
ix.	Project TCT490	6
x.	Project TCT495	8
	P.G. Level:	
i.	Advanced Database Management System(TCT512)	3
ii.	Object Oriented Modeling, Analysis & Design (TCT513)	2
iii.	Advanced Data Structure (TCT501)	3
iv.	Computational Scientific Tools For Research (TCT530)	2
v.	Machine Learning (TCT641)	3

10. No. of Master's students guided (in case of Ph.D. research) :

Name	ID.NO.	Thesis title	Year of completion
1. Ankur Singh Bisht	42827	Identification of Metamorphic Viruses	2013
2. Nisha Joshi	44053	Image Scrambling: Pixel Encryption based on Chaos Map	2014
3. Prerna Sharma	44209	Hand & Upper Body Based Hybrid	2014

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION

(03 copies are required on one page, on one side)

1.	Name	:	**Dr Geeta Pathak**
2.	Designation	:	**Assistant Professor**
3.	Date of birth	:	28-06-1979
4.	Department	:	Electrical Engineering, CoT
5.	Educational Qualification	:	PhD
6.	Field of Specialization	:	Power Electronics, Power Quality, Microgrids, Distributed Generation
7.	Experience as Faculty member:		15 Years 10 Months
	(i) Outside the University	:	NA
	(ii) (a) In the University	:	10.03.2007 till date
	(b) On present post		10.03.2007 till date
8.	Publications:		
	(a) No. of Research papers published	:	26
	(b) No. of articles published	:	--
	(c) Books/Chapters in books	:	02
	(d) Other publications, if any (National Patents)	:	02 (Granted) 01 (Filed)
9.	Details of courses taught:		14 Courses

Sl.No.	No. & Title of the course	Credit hrs.
	U.G. Level:	
i.	TEE-464, Power Electronics	03
ii.	TEE-443, Power Quality & FACTs	03
iii.	TEE-354 & TEC-381, Electrical Engineering Materials Science	02
iv.	TEE-220 & TEE-222, Network analysis and synthesis	04
v.	TEE-207, Electromagnetic Fields	03
	P.G. Level:	
i.	TEE-541, Instrumentation & Power Electronics: Taught 3 times	03
ii.	TEE628, Power Quality	03

10. No. of Master's students guided (in case of Ph.D. research) : 03

Name	ID.NO.	Thesis title	Year of completion
1. Mr. Chandradeep Singh, 2019-21	55596	Implementation of Control Schemes on DSTATCOM to Enhance Power Quality.	March, 2022
2. Ms. Tannu, 2020-22	56603	Performance Evaluation of Single Phase Dynamic Voltage Restorer with Various Control Techniques.	Jan., 2023
3. Ms. Kousar Jan, 2020-22	57014	Design and Analysis of Three Phase Active Series Compensator for Power Quality Improvement in Distribution System.	Jan. 2023

Signature of staff member

28/11/23

Signature of Head of the Deptt.

H.E.E.D.

Signature of Dean College Concerned

Signature of Dean PGS

DEAN, P.G.S.

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION

(03 copies are required on one page, on one side)

1. Name : Dr Tripta Jhang
2. Designation : Principal Scientist
3. Date of birth : 14.05.1973
4. Department : Plant Breeding and Genetic Resource Conservation
5. Educational Qualification : Ph.D (Genetics)
6. Field of Specialization : Metabolite targeted breeding
7. Experience as Faculty member: 14
   - (i) Outside the University : w.e.f. to
   - (ii) (a) In the University : w.e.f. to
     (b) On present post w.e.f. to
8. Publications:
   - (a) No. of Research papers published : 21
   - (b) No. of articles published :
   - (c) Books/Chapters in books : 3
   - (d) Other publications, if any Variety : 4

     Registration Report
9. Details of courses taught:

Sl.No.	No. & Title of the course	Credit hrs.
	U.G. Level:	
i.		
	P.G. Level:	
i.	AcSIR-10-ID-006: Biology of Inheritance	2(2+0)
ii.	AcSIR-10-ID-013: Plant Molecular Genetics	2(1+1)
iii.	BIO-CIMAP-2-1815: Molecular Breeding of Plants	1(1+0)
iv.	JNU BTB104: Basic Genetics:	2(1+1)

10. JNU PSC 201: Principles of Plant Breeding 3 (2+1)

Name	ID.NO.	Thesis title	Year of completion
1. Mr. Kanhaiya Lal	UGC-JRF AcSIR-Ph.D (10BB19A10013) (Batch -August 2019)	Characterization of selected floral mutants for their inheritance studies in *Anacyclus pyrethrum*	2019-Contd.

2. Ms. Shweta Dwivedi	UGC-SRF **AcSIR-Ph. D (10BB20J10002)** AcSIR- Ph. D (10BB20J10002) (Batch -January 2020)	Elucidation of the genetics of Withanamides and berry traits in Ashwagandha (*Withania somnifera* Dunal L.)	2020-Contd

Tripta Jhang
Signature of staff member
Tripta Jhang

Signature of Head of the Deptt.

Signature of Dean College Concerned

Signature of Dean PGS
DEAN, P.G.S.
30/6/2023

Dean
College of Agriculture

BRIEF BIO-DATA FOR MASTER'S/PH.D. ACCREDITATION
(03 copies are required on one page, on one side)

1	Name	:	Dr. Sanjay Kumar
2	Designation	:	Director, ICAR-Indian Institute of Seed Science
3	Date of Birth	:	15/10/1963
4	Department	:	Genetics and Plant Breeding
5	Educational Qualification		Ph.D.
6	Field of Specialization	:	Plant Breeding, Wheat breeding, Wheat rust resistance
7	Experience as Faculty member:	:	Joined as ARS scientist
	i. Outside University	:	
	ii. a) in the University	:	
	b) on present post	:	

8. Publications:

(a) No. of Research papers published : 112

(b) No. of articles published : --

(c) Books/Chapters in books : 05

(d) Other publications, if any :--

9. Details of courses taught:

Sl.No.	No. & Title of the course	Credit hrs.

U.G. Level: Nil

P.G. Level:

Sl. No.	Course No.	Title of Course	Credit Hours
i.	A 10	Elements of genetics and plant breeding	2+1
ii.	GEN 242	Advances in Plant Breeding	3+0
iii.	GEN 241	Fundamental Concepts of Plant Breeding	3+2
iv.	GEN 140	Intellectual Property Right	2+0

10. No. of Master's students guided (in case of Ph.D.research): Act as a Co-Guide

Signature of staff member
DIRECTOR
ICAR-Indian Institute of Seed Science
Kushmaur, Mau-275103 (U.P.)

Signature of Head of the Deptt.
Prof. & Head
Genetics & Plant Breeding

Signature of Dean College Concerned
DEAN
College of Agriculture
G.B. Pant Univ. of Agri. & Tech.
Pantnagar-263145 (Uttaraknand)

Signature of Dean PGS
DEAN, P.G.S.

II/2023:04 : Approval of Course Programme for M.Tech. (Food Processing Technology) and Ph.D. (Food Processing Technology) degree programme as per BSMA-ICAR starting w.e.f. I semester 2023-24

Following is the course programme for the M.Tech. and Ph.D. programme in **Food Science and Technology** presented for discussion:

M. Tech. Food Processing Technology

Major Courses		
AFT 601*	Conventional & Emerging Technologies in Food Processing	3(2-0-1)
AFT 602*	Emerging Technologies in Food Packaging	3(2-0-1)
AFT 603*	Industrial Manufacturing of Food and Beverages	3(2-0-1)
AFT 604*	Food and Flavour Chemistry	3(2-0-1)
AFT 605*	Food and Industrial Microbiology	3(2-0-1)
AFT 606*	Food Material and Product Properties	3(2-0-1)
AFT 607*	Food Quality, Laws and Regulations	2(2-0-0)
Seminar		
AFT 688	Master's Seminar	1
Optional Courses		8
Supporting Courses		
BPS 625	Statistical Methods	3(2-0-1)

Remaining 3 credits will be taken from any department/s of the university (600/500 series)

Common Courses		
BHS 500	Technical Writing and Communication Skills	1(0-0-1)
BHS /AAC502	Research, Research Ethics and Rural Development Programmes	1(1-0-0)
BPC 506	Basic Concepts in Laboratory Techniques	1(0-0-1)
AGP 518	Intellectual Property and its Management	1(1-0-0)
BHS 611	Library and Information Services	1(0-0-1)
Research		
AFT 690	Master's Thesis Research	30
	Total	**70 credits**

Ph. D. Food Processing Technology

Major Courses		
AFT 701*	Novel Technologies in Food Processing	2(2-0-0)
AFT 702*	Advances in Food Packaging	2(2-0-0)
AFT 703*	Advances in Food Manufacturing Technology	2(2-0-0)
AFT 704*	Advances in Food & Flavour Chemistry	2(2-0-0)
AFT 705*	Advances in Food and Industrial Microbiology	2(2-0-0)
Remaining credits will be chosen from the list of postgraduate courses of Food Processing Technology, 700 series		2
Seminar		
AFT 788	Doctoral Seminar I	1
AFT 789	Doctoral Seminar II	1
Minor/Optional Courses		6
Supporting Courses		
BHS 652	Research Methodology I	1(1-0-0)
BPS 653	Research Methodology II	3(2-0-1)
BHS 654	Research and Publication Ethics	2(2-0-0)
Research		
AFT 790	Ph.D. Thesis Research	75
	Total	**102 credits**

Minor Courses (For other departments)

AFT 601	Conventional & Emerging Technologies in Food Processing	3(2-0-1)
AFT 602	Emerging Technologies in Food Packaging	3(2-0-1)

List of Post Graduate Courses

AFT 601*	Conventional & Emerging Technologies in Food Processing	3(2-0-1)
AFT 602*	Emerging Technologies in Food Packaging	3(2-0-1)
AFT 603*	Industrial Manufacturing of Food and Beverages	3(2-0-1)
AFT 604*	Food and Flavour Chemistry	3(2-0-1)
AFT 605*	Food and Industrial Microbiology	3(2-0-1)
AFT 606*	Food Material and Product Properties	3(2-0-1)
AFT 607*	Food Quality, Laws and Regulations	2(2-0-0)
AFT 611	Technology of Cereals, Pulses & Oilseeds Products	3(2-0-1)
AFT 612	Technology of Milk & Milk Products	3(2-0-1)
AFT 613	Technology of Fruit & Vegetable Products	3(2-0-1)
AFT 614	Technology of Meat Poultry Fish and Egg Products	3(2-0-1)
AFT 615	Technology of Spices, Condiments, Herbs and Plantation Products	3(2-0-1)

AFT 616	Technology of Cocoa Chocolate and Confectionery Products	3(2-0-1)
AFT 621	Convenience Foods	2(1-0-1)
AFT 622	Traditional Foods	2(1-0-1)
AFT 623	Functional Foods and Nutraceuticals	2(1-0-1)
AFT 624	Frozen and Concentrated Foods	2(1-0-1)
AFT 631	Food Powders and Premixes	3(2-0-1)
AFT 632	Food Ingredients and Additives	3(2-0-1)
AFT 633	Aseptic Processing and Packaging	3(2-0-1)
AFT 634	Bioprocessing and Separation Technology	3(2-0-1)
AFT 635	Enzymes in Food Processing	3(2-0-1)
AFT 636	Food Process Automation and Modelling	2(2-0-0)
AFT 637	Zero Waste Processing	2(2-0-0)
AFT 638	Food Plant Utilities and Sanitation	2(2-0-0)
AFT 641	Special Problem	2(0-0-2)
AFT 642	Summer Internship	2(0-0-2)
AFT 643	Instrumental and Sensory Analysis of Food	3(1-0-2)
AFT 644	Product Design and Entrepreneurship Development	2(0-0-2)
AFT 687	Master's Special Problem	1/2
AFT 688	Master's Seminar	1
AFT 690	Master's Thesis Research	30
AFT 701*	Novel Technologies in Food Processing	2(2-0-0)
AFT 702*	Advances in Food Packaging	2(2-0-0)
AFT 703*	Advances in Food Manufacturing Technology	2(2-0-0)
AFT 704*	Advances in Food & Flavour Chemistry	2(2-0-0)
AFT 705*	Advances in Food and Industrial Microbiology	2(2-0-0)
AFT 711	Advances in Instrumental and Sensory Analysis of Food	2(0-0-2)
AFT 712	Plant Food Products	2(2-0-0)
AFT 713	Animal Food Products	2(2-0-0)
AFT 714	Food Process Modelling and Scale up	2(2-0-0)
AFT 787	Doctoral Special Problem	1/2
AFT 788	Doctoral Seminar I	1
AFT 789	Doctoral Seminar II	1
AFT 790	Ph.D. Thesis Research	75

II/2023:05 : Approval of Course Syllabus for Ph.D. (Food Processing Technology) degree programme as per BSMA-ICAR starting w.e.f. I semester 2023-24

Following is the course programme for the M.Tech. and Ph.D. programme in **Food Science and Technology** is presented for discussion:

Course no. : AFT 601
Course Title : Conventional and Emerging Technologies in Food Processing
Pre-requisite : Nil
Credit Hours : 3(2-0-1)

Why this Course?

A Master's degree student must be able to understand the basic principles in food technology in order to apply them further in different areas of food science.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain basic concepts of food processing -- conventional and emerging technologies.
2. Explain reasons of changes in food products during different unit operations.
3. Suggest implementable solutions related to food processing issues.

Catalogue Description

Unit I : Basic principles and methods of food processing and preservation
Unit II : High and low temperature preservation, drying and dehydration, concentration
Unit III : Membrane and Extraction Technology
Unit IV : Radiation, Microwaves, Radio Frequency, Hurdle Technology
Unit V : High Pressure, Ultrasounds Technology
Unit VI : New techniques in food processing– Pulsed Electric Fields, Ohmic Infra-red & Inductive heating, Cold plasma, pulsed X-rays, Cryo-processing and Nanotechnology

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Basic Principles and Concepts: food science, food technology, value addition, history, general principles and methods of food preservation, importance and scope	4
2.	Preservation by heating: Heat processing operations – pasteurization, sterilization, blanching, LTLT, HTST & UHT concepts, thermal resistance of the micro-organisms & enzymes. Determination of thermal process time, effect on quality	4
3.	Low temperature preservation: Refrigeration, refrigeration cycle, freezing, freezing point of selected foods, controlled atmospheric storage. refrigerated storage of various foods influence of freezing and	4

	freezing rate on the quality of food products, methods of freezing, storage & thawing of frozen foods, dehydro-freezing & dehydro-canning of food	
4.	Drying & dehydrations: Water activity & its effect on the keeping quality. Sorption isotherms & their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors affecting rate of drying, methods of drying various food products and types of driers & their suitability for different foods. intermediate moisture foods. Concentration: Applications in food industry. processes & equipment's for manufacture of various concentrated foods & their keeping quality	4
5.	Membrane Technology: Pressure activated membrane processes: MF, UF, NF and RO and their industrial application. Membrane distillation. Supercritical fluid extraction: Concept, property of super critical fluids SCF, extraction methods, application in food processing	4
6.	Radiations: Sources of radiations, mode of action. Effect on microorganisms &different nutrients, dose requirements for radiation preservation of foods. Microwave and radio frequency processing: Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Concept and Principle, Preservation techniques as hurdles and their principles, hurdle tech foods.	4
7	High Pressure processing: Concept, equipment for HPP treatment, mechanism of microbial and enzyme inactivation and its application in food processing, effect on food constituents. Ultrasonic processing: Properties of ultrasonic, types of equipment, application of ultrasonic as processing technique.	4
8.	Newer techniques in food processing*:* principle and application of High intensity light, pulse electric field, ohmic heating, IR heating, inductive heating, cold plasma, and pulsed X-rays in food processing and preservation, Cryo-processing of foods Nanotechnology: Principles and applications in foods.	4
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

S. No.	Practicals	No. of classes
1.	To evaluate the characteristics of treated water and liquid foods using MF, UF, NF and RO system	2
2.	To evaluate and compare conventional (aqueous, heat, solvent extraction) and emerging methods (super critical fluid extraction system) for bioactive compound extraction from food samples	2
3.	To study microwave system and to evaluate the effect of different power on drying characteristics of selected vegetable products	2
4.	To study microwave blanching of vegetable and determination of blanching efficacy	2
5.	Determination of thermal inactivation time of enzymes peroxidase & catalase	1
6.	To study the ultrasonicator and evaluate the effect of ultrasonication on micro- organism in sample	1
7.	To study the ultrasonicator and to evaluate the effect of ultrasonication on extracted juice yield from fruit pomace	1
8.	To evaluate the different pre-treatment on oil yield from oil seed cake	1
9.	To study ohmic heating system and to study the processing of fruit pup using ohmic heating system	1
10.	Determination of effect of solute concentration on hysteresis of moisture sorption isotherms in food systems	1
11.	To prepare nano emulsion and study of their characteristics	1
12.	To visit food industries utilizing advance food processing techniques	1
13.	To study the effect of different drying techniques/ hybrid drying techniques on fruits and vegetables	1
14.	**Practical Final Exam**	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain major conventional and emerging food preservation techniques and underlying principles.
2. Determine suitable methods of processing techniques for a chosen food.

Suggested Readings

1. Fellows PJ. 2005. Food Processing. Technology: Principle and Practice. 2"d H. CRC.
2. Ramaswamy 11 & Marcotte. M. 2006. Food Processing: Principles and Applications. Taylor & Francis.
3. Gould GW, 2000. New Methods of Food Preservation, CRC Press

4. Barbosa-Canovas, 2002. Novel Food Processing Technologies, CRC Press.
5. Dutta AK &Anantheswaran RC. 1999. Hand Book of Microwave Technology for Food Applications, CRC Press
6. Sun DW, 2015. Emerging Technologies for Food Processing, Elsevier Ltd
7. Kudra T and Mujumbar AS, 2009. Advanced Drying Technologies, CRC Press
8. Nema PK, Kaur BP and Mujumdar AS, 2018. Drying Technologies for Foods: Fundamentals and Applications, CRC Pres

Suggested e books

1. Da-Wen Sun. 2015. Emerging technologies for food processing. Academic Press, Elsevier Ltd, http://library.lol/main/904633FA7D0E775707416F09E958BF81
2. Rajakumari Rajendran, Anne George, Nandakumar Kalarikkal, Sabu Thomas. 2019. Innovative food science and emerging technologies: the science behind health. Apple academic press. http://library.lol/main/3387820B3F1E616A72B8B9FFF2A52BB8

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course no. : **AFT 602**
Course Title : **Emerging Technologies in Food Packaging**
Pre-requisite : **Nil**
Credit Hours : **3(2-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the basic principles in food packaging technology in order to apply them further in different areas of food science.

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic concepts of food packaging technologies.
2. Explain effect of packaging for enhancement of shelf life and other characteristics of food.
3. Suggest implementable solutions related to food packaging issues.

Catalogue Description

Unit I : Active and intelligent packaging
Unit II : Non-migratory bioactive polymers, time temperature and freshness indicators
Unit III : Packaging flavour interactions
Unit IV : MAP, Recycling packaging materials
Unit V : Green plastics
Unit VI : Safety and legislation

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Active and intelligent packaging: Active Packaging Techniques and intelligent Packaging Techniques, current use of novel Packaging Techniques, consumers and novel Packaging	2
2.	Oxygen scavengers: Scavenging technology, selecting right types of scavenging; Ethylene scavengers: Scavenging technology, selecting right types of scavenging; Carbon dioxide scavengers: Scavenging technology, selecting right types of scavenging; Other scavengers based on technology, selection and application in food industries.	3
3.	Antimicrobial food packaging: Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging.	2
4.	Non-migratory bioactive polymers (NMBP): Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications.	3
5.	Time Temperature labels and indicators (TTIs): Defining and classifying TTIs, Requirements for TTIs, development of TTIs, Maximizing the effectiveness of TTIs, Application of TTIs- to monitor shelf-life, and optimization of distribution	3

	and stock rotation, leakage indicators, oxygen indicators, micro-organisms indicators etc	
6	Freshness indicator in packaging: Compounds indicating the quality of packaged food products, freshness indicators, pathogen indicators, other methods for spoilage detection. Self-heating/rehydrating packages.	3
7	Packaging-flavour interaction: Factors affecting flavour absorption, role of food matrix, role of differing packaging materials, flavour modification and sensory quality, Study of packaging materials compatibility with foods.	3
8	Developments in modified atmosphere packaging (MAP): Permeability properties of polymer packaging, measurement of permeability – water and gases. Selection criteria of packaging films, Novel MAP gas, testing novel MAP applications, applying high oxygen MAP	3
9	Recycling packaging materials: Recyclability of packaging plastics, improving the recyclability of plastics packaging, testing safety and quality of recycled materials, uses of recycled plastics in packaging.	3
10	Green plastics for food packaging: Problems of plastic packaging wastes, range of biopolymers, developing novel biodegradable materials	2
11	Edible Films and Coatings: Properties, types, sources, applications, advantages, disadvantages, theories of plasticization, challenges and opportunities	3
12	Safety and legislative aspects of packaging: Regulatory considerations, plastic, metal, paper and glass packaging	2
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical schedule

Sr.	Practicals	No. of classes
1.	Determination of WVTR in different packaging materials	1
2.	Determination of GTR in different packaging materials	1
3.	Study of different ethylene scavengers and their analysis	1
4.	Study of different oxygen scavengers' systems and their analysis	1
5.	Application of anti-microbial packaging for moisture sensitive foods	1
6.	Evaluation of chemical residue migration from package to food	1
7.	Application of MAP packaging in selected foods	1
8.	Study of TTI label, leakage indictors etc	1
9.	Determination of oxidative changes in packaged foods	1
10.	Comparative evaluation of flexible and rigid packages for fragile foods	1
11.	Packaging of foods under inert atmosphere	1
12.	To study textural characteristics of fruits/ vegetable under MAP storage	1
13.	Shelf life evaluation of packaged food product	1
14.	Determination of oil and grease resistant test for packaging films	1
15.	Determination of respiration rate in fresh fruits and vegetables	1
16.	Effect of edible coating and films on respiration behaviour, chemical, physical and sensory characteristics and shelf life of fresh fruits and vegetables	1
17.	Visit to food packaging material manufacturing industry	1

	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain major conventional and emerging food packaging techniques and underlying principles.
2. Determine suitable methods of packaging of fresh and processed foods.

Suggested Readings

1. Ahvenainen R, 2001. Novel Food Packaging Techniques, CRC Press.
2. Robertson GL, 2012. Food Packaging, CRC Press.
3. Hanlon, JF, Kelsey RJ and Forcinio H. 1998. Handbook of Package Engineering, CRC Press.
4. Painy FA, 1992. A Handbook of Food Packaging, Blackie.
5. Rooney ML, 1988. Active Food Packaging, Chapman & Hall.
6. Coles R and Kirwan M, 2011. Food and Beverage Packaging Technology, Wiley-Blackwell.
7. Han J and Han J, 2005. Innovations in Food Packaging, Academic Press.

Suggested e books

1. Kit L. Yam. 2012. Emerging food packaging technologies: Principles and practice. Woodhead Publishing. https://libgen.is/book/index.php?md5=D8911674F291F693A0BB699D7A965CEE

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course no. : **AFT 603**
Course Title : **Industrial Manufacturing of Food and Beverages**
Pre-requisite : **Nil**
Credit Hours : **3(2-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the basic principles and concepts of industrial food manufacturing in order to apply them further in different areas of food science.

Aim of the Course
After studying this course, the student shall be able to:
1. Explain basic concepts of industrial manufacturing of food products.
2. Apply the technical knowledge and skill to guide and help food industries in manufacturing process.
3. Suggest implementable solutions related to food manufacturing issues.

Catalogue Description
Unit I : Manufacturing of cereal and grain products
Unit II : Manufacturing of fruit and vegetable products
Unit III : Manufacturing of chocolates and candies
Unit IV : Manufacturing of fats and oils
Unit V : Manufacturing of alcoholic and non-alcoholic beverages and packaged drinking and carbonated waters

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Grain products: Industrial manufacturing of grain based products: formulation, processes, machinery and material balance of baked, rolled, shredded, puffed, flaked, roasted products.	5
2.	Extrusion technology: Importance and applications of extrusion in food processing; Pre and post extrusion treatments; Manufacturing process of extruded products; Change of functional properties of food components during extrusion. Breakfast cereals, RTE/RTC foods, instant premixes, functional foods	3
3.	Fruit and vegetable products: Industrial manufacturing of fruit and vegetable based products: formulation, processes, machinery and material balance of minimally processed, Retorted products, IMF, high moisture stable foods, IQF; Machines and equipment for batch and continuous processing of fruit and vegetable products	8
4.	Chocolates and candies: Coating or enrobing of chocolate (including pan-coating); Maintenance, safety and hygiene of bakery plants.	2
5.	Fats and oils processing: Technology of refined oil, winterized oil, hydrogenated fat, texturized fat, by-products of fat/oil processing industries	3

	– oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its mechanism of application.	
6.	Beverages: Production technology of beer and wine Non-alcoholic beverages: Carbonated beverages: carbonation equipment, -ingredients-preparation of syrups-Filling system-packaging-containers and closures. Non-carbonated beverage: Coffee bean preparation-processing-brewing- decaffeination- instant coffee, Tea types-black, green, Fruit juices and beverages. Flash pasteurization, Aseptic Packaging of beverages Tea/coffee and cocoa beverages, Grain based and malted beverages.	8
7	Packaged drinking water: 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.	3
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical schedule

Sr.	Practicals	No. of classes
1	Preparation of fried snack foods	1
2	Preparation of extruded products	1
3	Preparation of puffed, roasted and flaked products	1
4	Development of instant food premixes	1
5	To study the effect of roasting time and temperature on quality of pop-corn	1
6	Determination of shelf-life and packaging requirements of snack food products	1
7	Preparation of fruit based ready to serve beverages	1
8	Preparation of fruit based squash, cordial and syrups	1
9	Preparation of dried and dehydrated fruits and vegetables	1
10	Preparation of soymilk and tofu	1
12	Preparation of canned products	1
13	Preparation of wines	1
14	Preparation of ice cream	1
15	Preparation of yogurt or dahi	1
16	Preparation of paneer	1
17	Preparation of concentrated milk and its products	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain major processed food products and their principles of preservation.
2. Prepare various food products from cereals, fruits, vegetables, legumes, and milk
3. Determine essential quality attributes for different food products.

Suggested Readings

1. Edmund WL, 2001. Snack Foods Processing, CRC Press.
2. Gordon BR. 1990. Snack Food, Springer US.
3. Frame ND, 1994. Technology of Extrusion Cooking, Springer US
4. O'Brien RD, 2008. Fats and Oils: Formulating and Processing for Application, CRC Press.
5. Davis B, Lockwood A, Alcott P and Pantelidis L, 2012. Food and Beverage Management, CRC Press.
6. Kunze W, 2010. Technology: Brewing and Malting, VLB.
7. Dhillon PS and Verma S, 2012. Food and Beverage: Production Management for Hospitality Industry, Abhijeet Publications.
8. Bamforth CW, 2006. Brewing: New Technologies, Woodhead Pub.

Suggested e books

1. Nirmal Sinha, Y.H. Hui, Ramesh C. Chandan, Stephanie Clark, Nanna A. Cross, Joannie C. Dobbs, W. Jeffrey Hurst, Leo M.L. Nollet, Eyal Shimoni, Erika B. Smith, Somjit Surapat, Fidel Toldrá, Alan Titchenal. 2007. Handbook of food products manufacturing. Wiley Interscience library.lol/main/FC2137CD1AE636DD6FDBB21DCE6DA2B3
2. Jorge E. Lozano. 2006. Fruit manufacturing: scientific basis, engineering properties, and deteriorative reactions of technological importance. Springer. http://library.lol/main/B1DAAEE6EE49D05E44438B129754955C

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course no. : **AFT 604**
Course Title : **Food and Flavour Chemistry**
Pre-requisite : **Nil**
Credit Hours : **3(2-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the various constituents in foods and changes during processing and storage as well as extraction of various flavouring compounds

Aim of the Course
After studying this course, the student shall be able to:

1. To acquaint with properties and role of various constituents in foods, interaction and changes during processing.
2. To acquaint with chemical compounds responsible for flavours and their chemistry.

Catalogue Description

Unit I : Study of water, carbohydrates, proteins and lipid
Unit II : Study of enzymes and their classification and theories, significance of vitamins and minerals in food processing
Unit III : Study of various flavouring compounds and their extraction techniques
Unit IV : Study of flavour analysis and flavours in different food products
Unit V : Encapsulation and stabilization of flavour

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Water molecule, types of water, hydrogen bonding, physical properties of water, water activity and its role in food processing and storage. Industrial significance of water.	3
2.	Carbohydrate- chemical makeup, classification and properties of carbohydrates, commercial and nutritional role of different carbohydrate.	4
3.	Protein- chemical makeup, classification and physical and chemical properties of proteins and amino acids. Protein gels, protein denaturation, commercial and nutritional role of proteins	3
4.	Lipids- classification, physical and chemical properties of lipids. Lipid oxidation and factors affecting it. commercial and nutritional role of lipids	3
5.	Enzymes- nomenclature and classification of enzymes. Theory of enzyme activation and inhibition. commercial application of enzymes and immobilized enzymes.	3
6.	Vitamins and minerals- significance of vitamins and minerals in food processing and nutritional point of view.	2
7.	Introduction and classification of food flavour, chemical compounds responsible for flavours. Anatomy of chemical senses. Chemical compounds classes and their flavour response. Flavour intensifiers: Flavour intensifiers and their effects, Chemistry and technology of	3

	various flavour intensifiers.	
8.	Flavour Extraction: Methods of flavour extraction, isolation, separation, and equipment. Flavour formulation: Creating and formulating flavour, Synthetic flavours, Blended flavouring, Flavouring compounds during food processing: Volatile and non-volatile flavouring compounds, non-enzymatic browning reactions.	3
9.	Flavour analysis: Sensory evaluation, discrimination analysis, descriptive analysis, Instrumental analysis (Absorption Spectroscopy (W/VIS), chromatography, mass spectrometry)	3
10.	Food Flavours in different food products: Principal components and properties, baked products, cheese, milk, meat, fish, wine, coffee, tea, chocolate, fruit and vegetable products and fermented foods	2
11.	Flavour encapsulation and stabilization: Principles and techniques of flavour encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavour and their applications in food industry, Packaging and flavour compounds interaction, packaging and storage	3
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Determination of moisture, protein, fat, total ash, crude fibre and carbohydrates	4
2.	Estimation of reducing, non-reducing and total sugars	2
3.	Determination of ascorbic acid	1
4.	Determination of pH and acidity of foods	1
5.	Qualitative identification of different flavouring compounds	2
6.	Extraction of essential oil/ flavouring compound of basil leaves by hydro distillation and SCFE	2
7.	Comparison of the quality of flavouring component obtained by hydrodistillation and SCFE	2
8.	Preparation of flavour emulsions and their stability	1
9.	Sensory evaluation of different flavours	1
10.	To study effects of staling on food flavours and its adverse effects	1
11.	Encapsulation of flavouring compounds	1
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. The student will gain an understanding of the chemical constituents and their role in food processing.
2. The student will be able to practically analyze the chemical properties of the food.
3. The student will gain a theory and practical understanding of various food flavour compounds and their generation and degradation.

Suggested Readings

1. Bamji MS, Rao NA & Reddy V. 2003. Textbook of Human Nutrition. Oxford & IBH.
2. Belitz HD.1999. Food Chemistry. Springer Verlag.
3. DeMan JM. 1976. Principles of Food Chemistry. AVI.
4. Fennema OR.1996. Food Chemistry. Marcel Dekker.
5. Meyer LH. 1987. Food Chemistry. CBS.
6. Swaminathan M. 1974. Essentials of Foods and Nutrition. Vol. II. Ganesh & Co.

Suggested e books

1. Owen R. Fennema. 1996. Food Chemistry. CRC Press. http://library.lol/main/3F410C68EBC46594D2F6379B6243A8C9
2. John M. de Man. 1999. Principles of Food Chemistry. Springer. http://library.lol/main/48EE360654005A0B4FA8FB1011355B48
3. James N. BeMiller and Roy L. Whistler. 2009. Starch: Chemistry and Technology. Academic Press. http://library.lol/main/B9E82C1B5D30A684EDD1EB9F5FE1D17F
4. C FISHER, T SCOTT, Carolyn Fisher and T. Scott. 1997. Food flavours: biology and chemistry. Royal Society of Chemistry. http://library.lol/main/5547CD4F08AF9AEDABB94FA91E3C6B68

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code **: AFT 605**
Course Title : **Food and Industrial Microbiology**
Pre-requisite : **Nil**
Credit Hours : **3(2-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the importance of microbial evaluation of food and identify the major groups of industrially important microorganisms and their role in preservation, spoilage and public health.

Aim of the Course
After studying this course, the student shall be able to:

1. To acquaint with different groups of microorganisms associated with food, their activities, destruction and detection in food.
2. To acquaint with the microbiology of different foods.
3. To acquaint with the maintenance of industrially important microorganisms and microbial growth kinetics

Catalogue Description

Unit I : Study of various microbes involved in food, factors affecting the growth of microbes, Principle of food preservation and different methods of preservation
Unit II : Food spoilage and microbial diseases
Unit III : Industrial microbiology, fermentation and Fermentors, microbial growth kinetics
Unit IV : Fermented food products, production of amino acid, vitamins, enzymes, antibiotics etc.

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Micro-organisms in foods: general characteristics, classification & identification of yeast, moulds and bacteria important in food industry. Factors affecting the growth of microorganisms.	3
2.	Preservation of food: classification of foods & general principle involved in their preservation. Low-temperature preservation: growth of microorganisms at low temperature, lethal effect of chilling, freezing and thawing.	2
3.	High-temperature preservation: heat resistance of microorganisms, effect of thermal processing on microbes-pasteurization, sterilization, canning, and dehydration.	3
4.	Chemical preservation, preservation by irradiation	2
5.	Food spoilage: spoilage of milk & milk products, spoilage of fresh and processed products (fruits& vegetables, meat, fish, poultry, cereals).	3

	Spoilage in canned products.	
6.	Microbial infections & intoxications: growth & survival of pathogens in food- Salmonella poisoning, Bacillary dysentery (Shigellosis), Streptococcal infection, Staphylococcal poisoning, Botulism, *E. coli* poisoning, cholera, *Clostridium perfringens* poisoning, *Bacillus cereus* poisoning, Fungal intoxications: *Aflatoxicosis*	3
7.	Introduction of industrial microbiology, Isolation, purification, and maintenance of industrially important microorganisms.	3
8.	Types of fermentation and fermenters. Microbial growth kinetics in batch, continuous and fed batch fermentation process.	3
9.	Fermented Food Products: fermented milk products, fermented cereal foods, fermented fruits & vegetables products, Vinegar, sausage, oriental foods, alcoholic beverages.	6
10.	Fermented microbial products: Commercial production of amino acids, vitamins, enzymes, antibiotics, organic acids and single cell proteins.	6
	Pre-final Examinations	2
	Assignment	1
	Total	**37**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Determination of microbial count- total viable, psychrophilic, mesophilic, thermophilic, lipolytic, proteolytic microorganisms	3
2.	Determination of yeast and mould counts	1
3.	Study of factors influencing growth of microorganisms	1
4.	Propagation and maintenance of starter culture	1
5.	Production of fermented milk products, fermented cereal products, fermented fruits & vegetables products.	2
6.	Examination of canned products	1
7.	Isolation and purification of industrially important microbes	2
8.	Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery	4
9.	Microbial examination of different types of food	1
10.	Determination of index microorganisms	1
11.	Direct microscopic counts and Dye reduction test	1
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. The student will be acquainted with different groups of microorganisms associated with food, their activities, destruction and detection in food.
2. The student will be acquainted with the microbiology of different foods.
3. The student will be acquainted with the maintenance of industrially important microorganisms and microbial growth kinetics

Suggested Readings

1. Banawart GJ. 1989. *Basic Food Microbiology*. 2nd Ed. AVI Publ.
2. Frazier J & Westhoff DC. 1988. *Food Microbiology*. 4th Ed. McGraw Hill.
3. Garbutt J. 1997. *Essentials of Food Microbiology*. Arnold Heinemann.
4. Jay JM, Loessner MJ & Golden DA. 2005. *Modern Food Microbiology*. 7th Ed. Springer.
5. Ray B. 2004. *Fundamentals of Food Microbiology*.3rd Ed. CRC.
6. Robinson RK. (Ed.). 1983. *Dairy Microbiology*. Applied Science.
7. Steinkraus KS. 1996. *Handbook of Indigenous Fermented Foods*. Marcel Dekker.

Suggested ebooks

1. M.R. Adams and M.O. Moss Food Microbiology. 2000. Royal Society of Chemistry. http://library.lol/main/E0949828FC79DE8A19C4B2A4167B3F0E
2. Bibek Ray. 2003. Fundamental Food Microbiology. CRC Press. http://library.lol/main/DC5E06A961E569F9F50FBB0D560BA2AF
3. Anavella Gaitán Herrera. 2001. Food Microbiology Protocols. John F T Spencer, Alicia L de Ragout Spencer (eds.). Humana Press. http://library.lol/main/BEE3B006B7A7B440FAD4129EF003E27A
4. Michael J Waites, Neil L Morgan, John S Rockey and Gary Higton. 2011. Industrial microbiology: An introduction. Blackwell http://library.lol/main/4918F1962904782279E49799A1BBA6FE

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 606
Course Title : Food Material and Product Properties
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?

A Master's degree student must be able to understand the basic properties of raw material used in food manufacture as well as influence of raw material and processing parameters on product properties and apply them further, in different areas of food science and technology.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain basic properties of foods
2. Demonstrate the effect of raw material properties on finished product quality.
3. Suggest implementable solutions for solving problems of colour, texture, flavour and shelf life etc. in various food products.

Catalogue Description

Unit I : Physico-chemical characteristics
Unit II : Mechanical and rheological properties
Unit III : Thermal, electrical and optical properties
Unit IV : Food micro-structure
Unit V : Functional properties
Unit VI : Sensory properties
Unit VII : Sorption behaviour

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: Biomaterials and their properties in relation to processing and product development. Physico-chemical characteristics: Shape, sphericity, size, volume, microstructure, density, porosity, surface area, coefficients of friction and angle of repose and influence of constituents on processing	5
2.	Mechanical and rheological properties: Flow behaviour of granular and powdered food materials, rheological models, creep phenomenon, stress – strain - time effects and relationships, and techniques of model fitting, Elastic vs. textural characteristics and textural profile analysis of food products	5
3.	Thermal, electrical and optical properties: Specific heat, thermal conductivity, phase transition, thermodynamics-basic principles and laws, Thermodynamic properties of moist air, kinetics of water absorption, heat capacity, thermal diffusivity, electrical resistance and conductance, dielectric constant, reflectivity, transmittivity and absorptivity of incident	5

	rays	
4.	Food microstructure: Methods and systems for food microstructure, determination of light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, image analysis: image acquisition, image processing, measurement analysis	5
5.	Functional properties: Dextrinization, Gelatinisation, Crystallisation, gelation, foaming, coagulation, denaturation and syneresis, foaming, emulsification.	5
6.	Sensory attributes: Sensory properties and correlation with objective indices, microstructure and its relation to texture from their mechanical models and its examination.	5
7.	Sorption behaviour of food: sorption isotherm, modelling	2
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical schedule

Sr.	**Practicals**	**No. of classes**
1.	To determine physical dimension and shape for suitability of processing and packaging of food materials	1
2.	To determine bulk, true density and porosity of samples	1
3.	To determine the angle of repose using rough and smooth surface	1
4.	Analysis of powder characteristics using powder flow analyser	1
5.	To determine the mixing and strength characteristics of wheat flour using farinograph mixograph / mixolab	1
6.	To determine the amylolytic activity using falling number of wheat flour	1
7.	Development of stress and strain curve and to study viscosity of Newtonian and non-Newtonian fluid	1
8.	Effect of temperature on viscosity profile of a food sample	1
9.	Texture profile analysis of foods samples	2
10.	Effect of temperature on textural profile of food	1
11.	Determination of thermal properties of foods using DSC	1
12.	To estimate dielectric constant of foods	1
13.	Organoleptic evaluation of food materials	1
14.	TEM and SEM, image analysis and image processing techniques	1
15.	To determine water activity of food	1
16.	To determine colour value of food, viz. Lab, whiteness index, yellow index, browning index	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain effect of raw material properties on product quality
2. Determine suitable raw material and processing methods for enhancement of quality of fresh and processed foods.

Suggested Readings

1. Rao MA and Rizvi SSH, 1986. Engineering Properties of Foods, Marcel Dekker.
2. Aguilera JM & Stanley DW, 1999. Microstructural Principles of Food Processing and Engineering, Springer.
3. Mohsenin NN, 1986. Physical Properties of Plant and Animal Materials, Gordon & Breach Science.
4. Bourne MC, 1981. Food Texture and Viscosity; Concept and Measurement, Academic Press.
5. Steffe JF, 1992. Rheological Methods in Food Process Engineering, Freeman Press.
6. Aguilera JM, 1999. Micro Structure: Principles of Food Processing Engineering, Springer.
7. Rahman MS, 2009. Food Properties Handbook, CRC Press.
8. Serpil S & Sumnu SG, 2006. Physical Properties of Foods, Springer-Verlag.
9. Pomeranz Y, 1991. Functional Properties of Food Components, Academic Press

Suggested e books

1. Serpil Sahin and Servet Gulum Sumnu. 2006. Physical Properties of Foods. http://library.lol/main/CDF4F6C327AB2C3D9F02EC0B590F1E41
2. Zdzislaw E. Sikorski. 2002. Chemical and Functional Properties of Food Components. CRC Press. http://library.lol/main/5D4821FF25B7313695CED5162691412F

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 607
Course Title : Food Quality Laws and Regulations
Pre-requisite : Nil
Credit Hours : 2(2-0-0)

Why this Course?

Food Quality Assurance is a required for Food Technology major at GBPUAT Pantnagar. The course introduces students to quality-related issues as they pertain to the manufacturing, processing, and/or testing of foods, with a major emphasis on food safety regulations, food safety management systems, and statistical process control. This is a terminal course and is not a pre-requisite for any other courses within the program.

Aim of the Course

Food quality and safety assurance courses belong in the core curriculum of every food science program. The overall goal of this course is to gain an understanding of how the food manufacturing industry manages food safety and quality. Because this is a Master's level course, students will be thoroughly evaluated on their written and oral technical communication skills which they will need to perform satisfactorily in the food industry. At the end of a successful semester, students will:

1. Recognize the major laws and regulations that govern food safety in Indian and at global level
2. Identify biological, chemical, and physical hazards associated with foods and the food system, their transmission and control
3. Select appropriate statistical control tools to assess food safety and quality.

Catalogue Description

Unit I : Food Quality Concept
Unit II : Defects and their measurement
Unit III : Quality control and quality assurance
Unit IV : Food Safety
Unit V : PRPs, HACCP
Unit VI : Standards and Certification

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Food quality: Definition and its role in food industry; Quality attributes, classification	2
2.	Physical Quality: Color and gloss: Definition, different colors, color measurement by spectrophotometer, Munsell color system and Lovibond tintometer; Viscosity and consistency in food quality Physical properties: Size and shape, weight, volume, weight volume ratio, length, width, diameter, symmetry, curvature, area	2
3.	Chemical Quality: Flavour: Definition and its role in food quality; Character impact compounds of spices and condiments, fruits, vegetables and	2

	processing conditions, sweeteners and other additives.	
4.	Sensory Quality: Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes; Odour: Definition, classification, neutral-mechanisms, olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction; Visual, auditory, tactile and other senses, vision, audition, oral perception other than taste	2
5.	Factors affecting quality estimation: Raw material, processing conditions, technical and instrumental factors, soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products, Attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation; Correlation of sensory and instrumental analysis	2
6.	Defects - classification. Genetic-physiological defects: Structural, off color, character; Entomological defects: Holes, scars, lesions, off coloring, curled leaves, pathological defects; Mechanical defects, extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects	2
7.	Quality inspection, quality control; Quality management and quality assurance: Total quality management, Quality management systems, Quality circles, SQC, Quality manuals, quality plan, quality policy, Six Sigma	3
8.	Food Safety: Concept, Hazards: Physical, chemical, biological; allergens, Nutritional and GM foods, Food infection and food poisoning, Food fraud, adulteration,	3
9.	PRPs – GAP, GMP, GHP, OPRPs	3
10.	HACCP – Hazard and Risk Concepts, Hazards Analysis, Risk Analysis, HACCP Steps and Principles, Preparation of HACCP Plan, Traceability and recall	7
11.	Standards: FSSA, ISO system: ISOI 9000, ISO 22000, BIS, BRC, Codex	2
12.	Certification: Definition; Certification types : GMP, HACCP, Kosher, Halal, Organic; certification procedures, certifying bodies; accrediting bodies, international bodies	2
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Hands on Practice Sessions

Learning Outcome

After the completion of course, students will be able to

1. Explain and apply the concept of quality and manage quality in food manufacturing units

2. Identify and characterize hazards and perform risk analysis
3. Prepare and implement HACCP plan
4. Help in internal audits and implement quality and safety standards.
5. Assist in certification of the company w.r.t. food regulations

Suggested Readings

1. Inteaz Alli. 2004. Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.
2. Ronald H. Schmidt and Gary E. Rodrick. 2003. Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.
3. R.E. Hester and R.M. Harrison. 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK.

Suggested e books

1. Giovanni Gurnari. 2015. Safety Protocols in the Food Industry and Emerging Concerns. Springer International Publishing. library.lol/main/27B0246313B6AAA2313A7509527D0E1D
2. J. Andres Vasconcellos. Quality Assurance for the Food Industry: A Practical Approach. 2003. http://library.lol/main/E9F3D837261690054EDD0D3E7A3F2D9D

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 611**
Course Title : Technology of Cereals, Pulses and Oilseed Products
Pre-requisite : **Nil**
Credit Hours : **3(2-0-1x3)**

Why this Course?

The Master's degree student in food technology must get acquainted with the technology of different processed products from cereals, pulses and oilseeds. The student must know production and consumption trends, structure, composition, quality evaluation, and processing technologies for product development and value addition of various cereals, pulses and oilseeds.

Aim of the Course

This course has been designed to provide in exposure w.r.t. technologies of commercial processing of various grains, so that the student becomes acquainted with the specific processing methods, their principles and applications.

Course catalogue

Unit I : Wheat processing
Unit II : Rice processing
Unit III : Maize processing
Unit IV : Sorghum processing
Unit V : Legume and oilseeds processing

Lecture Schedule

S. No.	Lecture topics	No. of classes
1	Wheat processing Composition of grain and environmental effects on its processing quality, enzymes of wheat and their role In the manufacture of wheat products; principles of wheat milling and its effects on Composition of flour, ageing of flour, by-products, chemical improvers - bleaching and maturing agents, self-rising flour, property of dough and its rheology, manufacture of wheat products bread, biscuits etc; formulation of premixes for bakery products; drum wheat, pasta goods and processed cereal foods for infants.	8
2	Rice processing Composition types of proteins, starch content, amylose and amylopectin fractions; presence and effect of lipases; distribution of vitamins; minerals, and proteins in rice grain and its relation to milling; rice milling operations and its effect on nutritive value; cooking quality; by-products of rice milling and their utilization; processed and prepared mixes based on rice.	8
3	Maize processing Composition, processing of corn for manufacture of corn grits, meal and flour; manufacture of corn flakes, corn syrup, corn starch, corn steep liquor, corn oil and canned corn.	6

4	Sorghum processing Chemical composition, milling and processing methods and value-added products	3
5.	Legumes and oilseed processing Composition of pulses and oilseeds, anti-nutritional factors, milling and processing methods of pulses, processing methods of cooking, extraction and processing methods of oilseeds, processing as protein isolate, properties and uses of oilseed meals, technology of vegetable protein isolates, barrier compounds in the utilization of oil seeds protein.	7
	Pre final Examinations	2
	Assignment	1
	Total	35

Practical Schedule

Sl. no	**Practical**	**No. of classes**
1.	Physicochemical and rheological examination of wheat and its products test weight, kernel hardness, gluten content, milling tests, Amylgraphic, Farinographic and Extensiographi tests.	4
2.	Evaluation of Rice-Amylose and Amylopectin determination, Gletini-zation temperature, water absorption tests.	2
3.	Experimental parboiling and assessment of degree of polishing	1
4.	Experimental baking of selected cereals-bread: Biscuits, bread and cakes	2
5.	Preparation of protein concentrates and isolates and their evaluation for protein content and solubility.	3
6.	Extraction of oil using expeller and solvent extraction methods.	3
7.	Visit to Food Processing Plants.	1
	Lab final Examination	1
	Total	**17**

Teaching Methods

1. Classroom Lectures and Presentations
2. Laboratory Practical

Learning Outcome

After the completion of course, students will be able to

1. Explain milling technologies of different cereals and pulses.
2. Composition of various legumes, cereals and oilseeds.
3. Analyze and evaluate the starch of rice and the process of parboiling.
4. Prepare protein concentrates and isolates and their evaluation

Suggested Readings

1. The Chemistry and Technology of cereals as food and Feed Matz.
2. Cookie and Cracker Technology, Matz.
3. Bakery Technology and Engineering- Matz
4. Bread Science & Technology - Pomeranz and Shallenberger
5. Cereal Science - Matz.
6. Flour milling processes - Scott.
7. Processed Plant Protein Food Stuff – Alt schul
8. Rice - Chemistry and Technology - Houston
9. Food Legumes- Processing and Utilization - Siegel and Fawcett.
10. Post-Harvest Technology of Cereals and Pulses - Chakravarty and De.

Suggested e books

1. Gavin Owens. 2001. Cereals processing technology. CRC Press; Woodhead Pub. http://library.lol/main/2DBD50354255BF42E6FEA766D1A63F60
2. G. Nagaraj. 2009. Oilseeds: Properties, Processing, Products and Procedures. New India Publishing. http://library.lol/main/5981012B6CFC8B6938009F3CFA55BF50

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 612
Course Title : Technology of Milk and Milk Products
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?
A Master's degree student must be able to understand the basic concepts about milk handling and processing technology.

Aim of the Course
After studying this course, the student shall be able to:
1. Explain basic concepts about milk handling and processing into different products.
2. Explain reasons how different operations related to milk processing may be handled for producing quality products.

Catalogue Description
Unit I : Introduction to milk processing and handling; Technology of fluid milk
Unit II : Technology of fermented milk products
Unit III : Technology of frozen milk products
Unit IV : Technology of evaporated and dried milk
Unit V : By-product utilization
Unit VI : Technology indigenous milk products and sanitization in dairy industry

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: Milk handling and unit operations in its processing.	1
2.	Technology of fluid milk: Importance of market milk industry in India, collection, chilling, transportation, cream separation, standardization and its calculation, pasteurization, sterilization, homogenization, packaging storage and distribution of fluid, U.H.T milk, Preparation and calculation of toned, fortified, reconstituted and flavoured milk manufacture at pilot scale.	6
3.	Technology of fermented milk products: Fermented milk: Principles and practices of manufacture, packaging, storage and marketing of *Dahi*, cultured buttermilk, Acidophilus milk. Cheese: Manufacture of hard, semi- hard, soft and processed cheese, storage, grading and marketing of cheese, cheese defects and their control Butter: Manufacture, packaging, storage and marketing of butter, butter defects and their control, Margarine.	5
4.	Technology of frozen milk product Technology of frozen milk products: Classification, manufacture, packaging, storage and marketing of ice- cream, Calculation of ice-cream mix, ices, *sharbat* etc. Defects of frozen products and their control	4
5.	Technology of evaporated and dried milk Technology of evaporated and dried milk: Manufacture of evaporated milk and	5

	powders, packaging, storage defects and their control.	
6.	By-product utilization Technology of dairy by- products: Utilization of skim milk, butter milk and whey for the manufacture or casein, lactose etc.	6
7.	Technology indigenous milk products and sanitization in dairy industry: Technology of indigenous milk products: Principles and practices of manufacture, packaging, storage and marketing of ghee, *khoa*, *channa* and milk- based goods Sanitary aspects of dairy plant building, equipment and their maintenance, Disposal of dairy plant waste Application of membrane technology in dairy industry	5
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Operation, cleaning and sterilization of dairy plant machinery involved in fluid milk processing.	1
2.	Preparation of toned, fortified reconstituted and flavored milks	2
3.	Manufacture of fermented milks	3
4.	To study the kinetics of enzymes and manufacture of cheeses	3
5.	Manufacture of butter	1
6.	Manufacture of ice-cream, ices, *sharbat*	2
7.	Manufacture of casein, ghee, *khoa*, c*hanna*	3
8.	Visit to dairy processing plant	2
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lectures and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about milk handling and processing into different products.
2. Elaborate different operations related to milk processing may be handled for producing quality products.

Suggested Readings

1. Market milk- N. H. Somer
2. Milk sterilization- Burton and others
3. By- products from milk – Whittier and Webb
4. Engineering for Dairy and Food Products- Farrol
5. Judging Dairy Products by Nelson and Trout
6. Homogenized milk by Trout, G.M

7. Ice- cream and related products- Frandsen and Arbuckle

Suggested ebooks

1. A H Varnam and Jane P Sutherland. 1994. Milk and milk products: technology, chemistry, and microbiology. Chapman & Hall. https://libgen.is/book/index.php?md5=020F2F962632296242ADF5493D4689CD
2. Walstra P, Geurts TJ, Noomen A, Jellema A and Van Boekel MAJS. 2017. Dairy Technology: Principles of Milk Properties and Processes. https://libgen.is/book/index.php?md5=0697532CF605BD8FF557E8ECF43652CB

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 613
Course Title : Technology of Fruit and Vegetable Products
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?

India is leading producer of fruits and vegetables and majority of the country's population is vegetarian therefore, processing of fruits and vegetables becomes essentially important for the country. A Master's degree student must understand the concepts of fresh commodity handling, storage and commercial processing and apply them further, in processing and development of fruits and vegetables based products.

Aim of the Course

After studying this course, the student shall be able to:

1. Determine factors affecting shelf life of perishables and suggest measures to enhance it.
2. Demonstrate methods of manufacture of various processed products from fruits and vegetables.
3. Suggest implementable solutions for solving problems related to quality (colour, texture, flavour and shelf life etc.) in various fruit and vegetable products.

Catalogue Description

Unit I : Fruit respiration and ripening
Unit II : Maturity, harvesting and storage
Unit III : Postharvest diseases and disorders
Unit IV : Hurdle technology and minimal processing
Unit V : Thermal and frozen preservation
Unit VI : Beverages
Unit VII : IMF, tomato products, pickles, chutney and sauces
Unit VIII : Biomolecules extraction and by-product utilization

Lecture Schedule

S. No.	Lecture topics	No. of classes
	Fruit Respiration and Ripening: Respiration processes, respiratory patterns climacteric and non-climacteric respiration, effect of respiration rate on shelf life, Factors affecting respiration, chemical modifications of ripening & senescence, Role of ethylene as ripening hormone, effect of applied ethylene, ethylene management for delay of ripening, artificial ripening, Changes in fruits during ripening	3
	Maturity and harvesting: Definitions, types of maturity, maturity standards, quality requirements for processing & storage, methods of harvesting.	3
	Post-harvest diseases & disorders & their management	2
	Storage: packing house operations, storage requirements for fresh produce, conventional storages, cold storage, controlled atmospheric storage, modified	3

	atmospheric packaging	
	Hurdle technology and minimally processed products, effect of hurdle identification and their application	1
	Thermally processed fruit and vegetable products: canning, bottling, pasteurization and sterilization, processes for commercially important products, examination of canned foods, Regulations and standards for thermally processed fruit and vegetable products	3
	Frozen fruit and vegetable products: freezing processes for important fruits & vegetables, Regulations and standards	2
	Unfermented fruit juices and beverages: Methods for juice extraction & clarification; preparation & preservation of fruit beverages RTS, nectar, squash, cordial, barley waters etc., fruit juice concentrates, carbonated fruit beverages, Regulations and standards	4
	Fermented fruit juices and beverages: Wines- definitions, classification, raw material and process requirements, chemical changes during alcoholic fermentation, Regulations and standards	2
10.	Intermediate moisture foods: Preparation of jams, jellies, marmalades, preserves etc.; theory of gel formation, defects of IMF, Regulations and standards	3
11.	Tomato products: Juice, puree, sauce, paste, ketchup; Hot extraction and cold extraction, problems in tomato products, Regulations and standards	2
12.	Pickles, Chutneys and Sauces: Role of salt in preservation, methods for manufacture, Common defects, Regulations and standards	3
13.	Extraction: Fruit, vegetable and herbal extracts, conventional and modern methods of extraction, preservation of extracts, fruit syrups and sherbets, health and detox waters, Regulations and standards	2
14.	By products from wastes of fruit & vegetable processing industry, pectin, vinegar pigments; methods for their manufacture, Regulations and standards.	3
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical schedule

Sr.	Practicals	No. of classes
1.	Understanding reversible and irreversible changes during chilling injury	1
2.	Identification and management of postharvest diseases	1
3.	Determination of cooling requirements of fruits and vegetables	1
4.	Thermal process calculations for canned and bottled products	1
5.	Determination of ERH and EMC for dried vegetables	2
6.	Extraction of pectin, pigments and other biomolecules from fruit and vegetable wastes	2
7.	Manufacture of low sugar jams and IMF	2
8.	Manufacture of health beverages	2

9.	Application of hurdles for preservation of fresh cut vegetables	1
10.	Manufacture of tomato products	2
11.	Quality analysis of fruit and vegetable products (TSS, acidity, sugars, Vit C, pectin, SO_2, salt, anti-oxidant activity, etc)	2
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration
3. Assignments

Learning Outcome

After the completion of course, students will be able to

1. Explain effect of raw material properties on product quality
2. Determine suitable raw material and processing methods for enhancement of quality of fresh and processed foods.

Suggested Readings

1. Verma, L.R. and Joshi, V.K. 2000. Postharvest Technology of Fruits and Vegetables - Handling, Processing, Fermentation and Waste Management. Vol. I & II, Indus Pub. Co. New Delhi, p1222.
2. Srivastava, R.P. and Kumar, S. 2002. Fruit and Vegetable Preservation-Principles and Practices. 3rd edn. International Book Distributing Co. Lucknow, p474
3. Sharma S.K. (2010) Postharvest Management and Processing of Fruits and Vegetables – Instant Notes. New India Pub. Agency, New Delhi, 390p. (ISBN 978-93-80235-20-2)
4. Sharma S.K. and Nautiyal M.C. (2009). Postharvest Technology of Horticultural Crops –A Practical Manual. New India Pub. Agency, New Delhi, 229p. (ISBN 978-81-90851-20-6)
5. Ilhadi M Yahia and Armando Carrillo Lopez 2019. Postharvest Physiology and Biochemistry of Fruits and Vegetables. Woodhead Publishing, Hampshire, UK.

Suggested e books

1. Mohammed Wasim Siddiqui and Asgar Ali. 2016. Postharvest management of horticultural crops: practices for quality preservation. Apple Academic Press. http://library.lol/main/05FAA4A65A6B1C29A15A94421933E0E9
2. Neeta Sharma. 2014. Biological Controls for Preventing Food Deterioration: Strategies for Pre- and Postharvest Management. Wiley-Blackwell. http://library.lol/main/7D1B4A29ADA612883E98DF9034CAF49A

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html
3. https://postharvest.ucdavis.edu/

Course Code : AFT 614
Course Title : Technology of Meat Poultry Fish and Egg Products

Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?

A Master's degree student must be able to understand the basic principles of different techniques, equipment, handling and quality standards that can be used to process and preserve the shelf-life of meat, egg and seafood products.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain the chemical and nutritional composition of poultry meat, egg and seafood and the changes they encounter during handling, processing and storage.
2. Explain various processing and preservation techniques in relation to poultry meat, poultry, egg and seafood and their products.
3. Explain the storage and marketing; quality and composition tests, sanitation in the processing plant.

Catalogue Description

Unit I : Introduction to Meat, Poultry and Fish
Unit II : Post Mortem Changes in meat
Unit III : Meat processing
Unit IV : Fish Processing
Unit V : Egg and poultry Processing

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction to Meat, Poultry and Fish: Meat Industry: Meat and meat products in India-an Industrial profile, Meat production and trade practices, Prospects and problems in production of fresh meat in India, Research and Development activities on meat, fish and poultry products, Gross and microstructure of muscle, Mechanism of muscle contraction and relaxation: Organization of skeletal muscle from gross structure to molecular level, Muscle Communication (sarcolemma, sarcoplasmic reticulum, Innervation). Muscle metabolism, Different types of connective tissues and their relevance to properties of meat. Myofilament proteins and their major functions. Nervous tissue, nerves and the nature of stimuli, membrane potential in nerve and muscle, Events that occur during relaxation and contraction.	8
2.	Post Mortem Changes in meat**:** Slaughtering and stunning of meat by different scientific methods- mechanical, electrical, chemical methods, ritual/religious methods of slaughter, Jewish, halal, jhatka and Spanish methods, Conversion of muscles to meat- homeostasis, exsanguination, circulatory failure to muscles, postmortem pH decline, rigor mortis, enzymatic degradation, properties of fresh meat-water holding capacity, color, pigment, Dressing and cutting of carcass in sheep, pig, cattle and beef, and mutton, and their fabrication: Breeds, Pre-slaughter care, handling of offal (edible and inedible). Cuts of beef, pork and mutton, Meat inspection and grading: Application and Enforcement of inspection	8

	laws, elements of inspection (sanitation, antemortem inspection, post-mortem inspection, condemnation, product inspection, laboratory inspection, labelling). Identification of inspected products, product inspection, types of grades, factors used to establish quality grades, conformation, fleshing and finish.	
3.	Meat processing: Ante-mortem examination of meat animals, Processing: Post mortem inspection, storage, tenderization, meat cuts and grades, packaging, Beef, mutton and pork as human food: cured meat products, sausages, by-products, frozen and canned meat products, Principles of various meat preservation techniques: chilling, freezing, curing, smoking, thermal processing, canning, dehydration, irradiation and hurdle concept, Restructured meat products: tumbling, massaging, chunking, forming, tearing, and forming, Value added products-luncheon meats, meat patties, meat loaves, meat balls and meat nuggets.	8
4.	Fish Processing: Chemical/Nutritional composition of Fish, Fish in human diet: protein, carbohydrates, lipids, vitamins etc., Processing of fish: steaking and filleting, freezing, canning, salting, drying of fish, production of fish paste, fish oils, sauces, fish protein concentrates, by-product processing., Allergens, infectious toxins and diseases.	3
5.	Egg and poultry Processing: Basic properties of egg-structure, composition, nutrition and functional characteristics of eggs, Grading, spoilage, storage and transportation of whole egg, Processing of eggs for liquid products (white, yolk and whole egg) and solid products (albumen powder and whole egg powder) for preservation through freezing and drying, Poultry- Kind of poultry, pre-slaughter care and consideration, Operation in preparation of dressed poultry-its storage and marketing, quality and safety, Processing of poultry: Special poultry products, Breaded poultry, smoked turkey, packaged precooked chicken, Freeze dried poultry meat, utilization of by-products	5
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

Sr. no.	Practicals	No. of classes
1	To study the effect of low and high oxygen atmosphere on meat colour.	2
2	To study the chemistry of myoglobin as it relates to the colour of the molecule.	1
3	To understand and compare the action of two meat tenderizing enzymes by applying the technique of electrophoresis.	2
4	To study the structure of the muscle under compound microscope.	1
5	Perform the slaughtering of the poultry birds.	1
6	Identification of different internal organs of poultry birds and their utilization for product preparation.	1
7	Dressing of Fish.	1
8	Determination of total volatile acids in fish.	1
9	Determination of buffering capacity of fish muscle.	1

10	Rapid estimation of hypoxanthine concentration in chill stored fish.	1
11	Determination of glycine in fish muscle.	1
12	Determination of protein fractions in fresh fish.	1
13	Cut out test for canned fishery products.	1
14	Determination of glycogen in fish muscle.	1
15	Industrial visit to meat industry.	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain the chemical and nutritional composition of poultry meat, egg and seafood and the changes they encounter during processing and storage.
2. Explain various processing and preservation techniques in relation to poultry meat, egg and seafood and their products.
3. Explain the storage and marketing; quality and composition tests, sanitation in the processing plant.

Suggested Reading

1. Henricksons. 1978. Meat Poultry and Sea Food Technology/ Prentice Hall
2. Robert RJ. 2012. Fish Technology/ Wiley-Blackwell
3. Mountney GJ. 1988. Poultry Meat and Egg Production/ Springer, Netherlands
4. Kerry J, Kerry J. 2002. Meat Processing/ Woodhead Publishing and David Ledwood
5. Levie A. 1979. Meat Hand Book, Avi Pub
6. Weiss GH. 1971. Poultry Processing. Noyes Data Corporation
7. Wheaton FW and Lawson TB. 1985. Processing of Aquatic Food Products John Wiley & Sons.
8. Mead G. 2004. Poultry meat processing and quality Woodhead Publishing
9. Sinha R. 2017. HACCP in Meat, Poultry and Fish Processing/ Random Publications
10. Sahoo J and Chatli MK. 2015. Textbook on Meat, Poultry and Fish Technology/ Daya Pub. House.
11. Sahoo J, Sharma DK and Chatli MK. 2016. Practical Handbook on Meat Science and Technology/ Daya Pub. House
12. Sahoo J, Sharma DK and Chatli MK. 2016. Practical Handbook on Meat Science and Technology/ Daya Pub. House
13. Sahoo J, Sharma DK and Chatli MK. 2016. Practical Handbook on Meat Science and Technology/ Daya Pub. House

Suggested e books

1. Fidel Toldrá. 2010. Handbook of Meat Processing. Wiley-Blackwell http://library.lol/main/EC65211C9BB0695F57CDD9FD160033C9

2. Leo M.L. Nollet and Fidel Toldra. 2006. Advanced Technologies For Meat Processing. CRC/ Taylor & Francis http://library.lol/main/1D568F93AFEA53F909653BF458E6C40F
3. Alan R. Sams . 2001. Poultry meat processing. CRC Press. http://library.lol/main/4A12A14B5513D87EA82CB79B58E769A6
4. G M Hall. 1997. Fish Processing Technology. Springer US. http://library.lol/main/10014A1D6D88C40ACDB63B6CCED3BA7B
5. Rabinarayan Mishra. 2021. Handbook on Fish Processing and Preservation. CRC Press http://library.lol/main/6FBD18DAD7D4AD8DDED39167A9F60680

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : **AFT 615**
Course Title : **Technology of Spices, Condiments, Herbs and Plantation Products**
Pre-Requisite : Nil
Credit Hours : **3(2-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the processing techniques and value addition of the spices and plantation crops and the extraction process of valuable or medicinal components of the spices.

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic and advance processing of spices and plantation crops
2. Explain the extraction of phytochemicals.
3. Suggest implementable solutions related to spice and plantation processing issues.

Catalogue Description

Unit I : Introduction to spices, Condiments, Herbs and Plantation crops and processing of major spices
Unit II : Processing methods of minor spices
Unit III : Effect of various processing methods on quality of spices
Unit IV : Value addition of spices
Unit V : Processing technology of tea and coffee
Unit VI : Processing technology of plantation crops

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: Definition of spices, Condiments, Herbs and Plantation crops, Status and scope of spice processing industries in India: sources, production, selection criteria, classification on the basis of origin, physical characteristics.	2
2.	Major spices: Post-Harvest and Processing Technology, composition, medicinal value, processed products of following spices (1) Ginger (2) Chilli (3) Turmeric (4) Onion and garlic (5) Pepper (6) Cardamom	8
3.	Processing Technology of Minor spices & herbs: Chemical composition, processing methods -All spice, Annie seed, sweet Basil, Caraway seed, Cassia, Cinnamon, Clove, Coriander, cumin, Dill seed, nutmeg, mint, Rose merry, saffron, sage	7
4.	Processing effect on spice quality: Effect of processing on spice quality, contamination of spices: adulteration and microbial spoilage in spices. Spices quality evaluation: Criteria for assessment of spice quality	2
5.	Value addition of spices: Spice Essential Oils: methods of extraction, isolation, and encapsulation, Spice Oleoresins: method of extraction,	3

	isolation, separation equipment, other value-added products of different spices.	
6.	Processing technology of tea: Black tea, green tea, oolong tea, production of instant tea	2
7.	Processing technology of coffee: Dry and wet processing, production of ground and instant coffee	2
8.	Processing technology of cacao, tamarind, coconut, cashew nut and oil palm	7
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Processing of turmeric and their quality evaluation	2
2.	Moisture and volatile oil content of spices	2
3.	Estimation of extractives, caffeine in tea and coffee	3
4.	Detection of microbial quality and adulteration in spices	2
5.	Aromatic compounds in spices	2
6.	Capsaicin content and Scoville Heat Units in chilies	2
7.	Curcumin content of turmeric	2
8.	Storage and packaging of spices	2
9.	Visit to spice processing Units	1
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. The student will gain an understanding of processing techniques used for plantation crops.
2. The student will be able to practically analyze the quality of spices.

3. The student will gain a practical understanding of processing plantation crops to derive edible products

Suggested Readings

1. Banerjee B. 2002. Tea Production and Processing. Oxford Univ. Press.
2. Minifie BW. 1999. Chocolate, Cocoa and Confectionery Technology. Third Edition. Aspen Publ.
3. NIIR. 2004. Handbook on Spices. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
4. Sivetz M and Foote HE. 1963. Coffee Processing Technology. AVI Publ.

Suggested e books

1. K V Peter. 2012. Handbook of herbs and spices: Volume 2, Second Edition. Woodhead Publishing. http://library.lol/main/592C8AE2127B4242F61286BA5F5603E7
2. K V Peter. 2012. Handbook of herbs and spices: Volume 1. Woodhead Publishing. http://library.lol/main/490C1911AE7F163D9947493771629365

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 616
Course Title : Technology of Cocoa, Chocolate and Confectionery products
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?
A Master's degree student must understand the basic processing methods for cocoa and chocolate production and value addition in confectionery products to apply them further in different areas of food science and technology.

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic processing of cocoa and chocolate.
2. Explain the processing methods for chocolate production
3. Understanding of confectionery value added products

Catalogue Description
Unit I : Introduction and cocoa processing
Unit II : Chocolate and confectionery technology for manufacturing
Unit III : Quality characteristics of chocolate and confectionary products
Unit IV : Machinery used in processing
Unit V : Standards and regulations

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: Cocoa, Occurrence, chemistry of the cocoa bean, analysis of cocoa beans,	2
2.	Processing of raw bean, changes taking place during fermentation of cocoa bean	2
3.	Cleaning, roasting, alkalization, cracking and fanning, Nib grinding for cocoa liquor, cocoa butter and cocoa powder, processing of roast bean; chemical changes during various stages of processing	4
4.	Chocolates: Types, ingredients, chemistry of chocolate manufacture, Mixing, Refining, Conching, Tempering, moulding etc. to obtain chocolate slabs, chocolate bars. Dark, milk and white chocolate and their manufacturing processes	4
5.	Confectionery: Ingredients and functions, technology for manufacturing of confectionery products.	2
6.	Enrobed and other confectionary products: Compound Coatings and Candy Bars, Tempering technology, Chocolate hollow figures, Chocolate shells, Enrobing technology,	3
7.	Manufacture of candy bars, Production of chocolate mass	2
8.	Quality characteristics of chocolate and confectionery products	2
9.	Machinery used in coca and confectionery industry.	2

7.	Packaging quality and storage of chocolates and confectionery products.	3
8.	Standards and regulations	3
	Pre-final Examinations	2
	Assignment	1
	Total	**32**

Practical schedule

Sr.	**Practicals**	**No. of classes**
1.	Effect of crunching on chocolate	1
2.	Effect of tempering on chocolate	1
3.	Effect of storage temperature on chocolate quality	2
4.	Effect of roasting on cocoa beans	1
5.	Effect of fermentation on cocoa beans	1
6.	Production of cocoa liquor	1
7.	Production of cocoa butter	1
8.	Fat expulsion during chocolate storage	2
9.	Production of milk chocolate and dark chocolate	1
10.	Effect of packaging on quality of chocolate	2
11.	Effect of packaging on quality of cocoa beans	2
12.	Visit to chocolate manufacturing industry	2
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain processing methods of coca bean and chocolate processing.
2. Determine suitable methods of packaging and quality characteristics of chocolate and confectionery products.

Suggested Readings

1. Minifie, BW, 1999. Chocolate, Cocoa and Confectionery Technology. Springer Science & Business Media.
2. Peter P.Grewling, 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Banerjee B. 2002. Tea Production and Processing. Oxford Univ. Press.
4. Sivetz M & Foote HE. 1963. Coffee Processing Technology. AVI Publ.

Suggested e books

1. Emmanuel Ohene Afoakwa. 2014. Cocoa Production and Processing Technology. CRC Press,

http://library.lol/main/4B7253C4960BE11D63D8515D3B2E4B45
2. Steve T. Beckett. 2009. Industrial Chocolate Manufacture and Use. Wiley-Blackwell. http://library.lol/main/2B7C8F288197629887C646EDFF487535

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 621
Course Title : Convenience Foods
Pre-requisite : Nil
Credit Hours : 2(1-0-1x3)

Why this Course?

A Master's degree student must be able to understand the basic principles of processing technology of convenience & RTE foods.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain the importance and demand of convenience foods in present day scenario
2. Explain various technical aspects of convenience and Read-to-eat foods.

Catalogue Description

Unit I : Overview of grain-based snacks
Unit II : Technology of Ready-to-eat and extruded snacks
Unit III : Ready-to-cook food products
Unit IV : Equipment for frying, baking and drying, toasting, roasting and flaking, popping, blending, coating, chipping.

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Overview of grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes	1
2.	Coated grains- salted, spiced and sweetened	1
3.	Flour based snack– batter and dough-based products; savoury and *farsans*; formulated chips and wafers, *papads*.	2
4.	Fruit and vegetable-based snacks: sauce, fruit bars, glazed, candy chips, wafers, *papads* etc.	1
5.	Ready-to-eat canned value-added fruits/vegetables and mixes and ready to serve beverages	1
6	Technology of Ready-to-eat baked products, drying, toasting, roasting, flaking *etc.*	1
7	Technology of extruded snacks	1
8	Coated nuts – salted, spiced and sweetened products- *chikkis*, fried groundnut *pakora*	1
9	Ready-to-cook food products- different puddings and curried vegetables, meat and meat food products etc.	1
10	Technology of instant cooked rice and other cereals- based food products	1
11	Technology of ready to eat instant premixes based on cereals, pulses etc.	1
12	Technology for RTE puffed snack- sand puffing, hot air puffing, explosion puffing, gun puffing etc.	1
13	Equipment for frying, baking and drying, toasting, roasting and flaking, popping,	2

	blending, coating, chipping.	
	Pre-final Examinations	2
	Assignment	1
	Total	18

Practical schedule

Sr.	Practicals	No. of classes
1.	Preparation of cereals based fried snack foods	2
2.	Preparation of legume based fried snack foods	2
3.	Preparation of cereal, pulses based ready-to-eat snack food by extrusion cooking and their quality evaluation	2
4.	Preparation of cereal grain based puffed products	1
5.	To study the effect of frying time and temperature on potato chips	1
6.	Development of instant food premixes	2
7.	Preparation of cereal and legume based roasted snack	1
8.	Preparation of flaked rice product	1
9.	To study the effect of roasting time and temperature on quality of pop-corn	1
10.	Determination of shelf-life and packaging requirements of snack food products	2
11.	Preparation of cereal and legume based roasted snack foods by vacuum frying	1
12.	Visit to industries manufacturing snack foods.	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain the importance and demand of convenience foods in present day scenario
2. Explain Technology for processing ready to eat and ready cook different products and equipment used for manufacturing of RTE products

Suggested Reading

1. Edmund WL 2001. *Snack Foods Processing*. CRC Press
2. Frame ND 1994. *Technology of Extrusion Cooking*, Blackie Academic.
3. Gordon BR 1997. *Snack Food* AVI Publ.
4. Samuel AM. 1976. *Snack Food Technology*. AVI Publ.
5. Manley D. 2000. *Technology of Biscuits*, *Crackersand Cookies* CRC Press
6. Deny AV and Dobraszczyk BJ. 2001. *Cereals and Cereal Products*, Aspen Publishers
7. Ram S and Mishra B. 2010. *Cereals: Processing and Nutritional Quality*, New India Publishers

Suggested e books

1. Carolyn Humphries. 2010. Convenience foods for the slow cooker. W Foulsham & Co. Ltd. http://library.lol/main/7E4FD1A0AAA8A3501319689EFDAAC8A0

2. Mohammed Wasim Siddiqui and Mohammad Shafiur Rahman. 2015. Minimally Processed Foods: Technologies for Safety, Quality, and Convenience. Springer International Publishing. http://library.lol/main/3F138A8C51337C4E75F9FC186CA3E041

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 622
Course Title : Traditional Foods
Pre-requisite : Nil
Credit Hours : 2(1-0-1x3)

Why this Course?

A Master's degree student must be acquainted with the sound knowledge of diversities in food, food habits and food patterns in India with focus on traditional foods.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain the historical and traditional perspective of foods and food habits
2. Explain the wide diversity and common features of traditional Indian foods and meal patterns

Catalogue Description

Unit I : Overview of traditional food products and its market in India
Unit II : Processing technology of different Indian breads
Unit III : Traditional food based on fruits, vegetables, cereals and legumes
Unit IV : Processing and preservation of Indian sweets and snacks
Unit V : Processing and preservation of baked foods and beverages

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Present status of traditional food products, Globalization of traditional food products; Plans and policies of the Government and developmental agencies.	1
2.	Techno-economic aspects for establishing commercial units for traditional products.	1
3.	Introduction to traditional foods of India, composition and nutritive values, microbial and biochemical diversity, quality and food safety challenges	1
4.	Industrialization, Socioeconomic Conditions and Sustainability of Traditional Foods.	1
5.	Overview of heat-desiccated, coagulated, fried, fermented traditional food products.	1
6	Process technology for Indian bread (chapatti), paratha, stuffed *paratha*, *panipoori*	1
7	Process technology for Indian fried foods- *poori, samosa, sev, fafda, chorafali, Jalebi*	1
8	Process technology for fermented traditional food and its improvement- pickle, *idli, khaman, nan, dahi, dhokla*, Spiced buttermilk etc	1
9	Process improvement in production of Indian sweets (*Halwasan, kajukatli, carrothalwa, Rabdi*, chocolate *burfi, Chikki etc*). Process improvement in production of puffed cereals and grains by microwave technique	1
10	New products based on fruits, vegetables and cereals	1

	Application of membrane technology; microwave heating, steaming, extrusion for industrial production of traditional food products (Shrikhand, Dhokla, wadi, murukku/chakri, Patra, Khandvi)	
11	Utilization and scope of legumes and grains in India for novel food products development like-flour, ready to eat products, flour- *idli* mix, *wada* mix, *puranpol* mix, *gota* mix *etc.*	1
12	Process technology for convenience traditional food products (ready to eat and serve -Curried vegetables, pulses and legumes), chutneys, paste Use of natural and permitted synthetic preservatives and new packaging systems for traditional food products.	1
13	Processing& Preservation methods of Sweets & Desserts: *Kulfi*, *Falooda, Kheer, khurchan, khoa/mawa, Rabri,jalebi, imarti, Gulab jamun, Peda, petha, rewdi, gajak,* milk *cake, balushahi, bal mithai, singoni, Ras-malayi,Gulqand, ghevar, rasgolla, chamcham, son halwa, son papri,* several varieties of *halwa, laddu, barfi* & *rasgolla.*	1
14	Processing & Preservation methods of Snacks: *Gujiya*, *kachauri*, *samosa*, *mirchibada*, *kofta*, potato chips, banana-chips*, mathri, bhujiya*, fried *dhals, bhujia, shakarpara, pakora, vada*.	1
15	Processing & Preservation methods of Baked Products: Biscuits, Toast, Candies, Cookies, Breads, Roti, Naan, Tandoori Roti, *parantha*, kulcha, puri, *bhatura*. Processing & Preservation methods of Preserves & Beverages: *Murabba*, *sharbat*, *pana*, *aampapad*, sharbat, Coconut water, milk (*khas*, rose), Alcoholic Beverages	1
	Pre-final Examinations	2
	Assignment	1
	Total	18

Practical schedule

Sr.	Practicals	No. of classes
1.	To study the effect of different combination of salt and oil in quality of traditional fermented food product (pickle)	2
2.	To study the effect of different starter culture on taste and texture of *idli*	1
3.	To evaluate the shelf life of stuffed paratha under different storage conditions	1
4.	To study the effect of time and temperature on quality of fried food products (*poori*/ *panipoori* etc.	1
5.	To study effect of sugar and Artificial sweeteners in the preparation of kajukatli	1
6.	To study the microwave heating in drying of *khaman*/ *dhokla*	1
7.	To study the effect of cold extrusion on mixing of vermicelli	1
8.	To prepare instant carrot *halwa* mix	1
9.	To study the effect of different packaging material on shelf life of traditional Indian food products	1
10.	To study the effect of different natural food preservatives in traditional sweets	1
11.	Preparation of spiced buttermilk	1

12.	Preparation of puffed cereals and grains	1
13.	Preparation and quality evaluation of Instant Premixes (*Puranmix*)	1
14.	Preparation of quality evaluation of dried malted moth bean powder	1
15.	Preparation of Indian traditional confections (*chikki*)	1
16.	Visit to ethnic food industry (Instant mixes/Pickle making)	1
	Practical Final Exam	**1**
	Total	**18**

Teaching methods and activities

1. Classroom lectures
2. Presentation
3. Practical demonstration

Learning outcome

After the completion of course, students will be able to

1. Explain the historical and traditional perspective of foods and food habits
2. Explain the wide diversity and common features of traditional Indian foods and meal patterns

Suggested Reading

1. Steinkrus KH. 1995. *Handbook of Indigenous Fermented Foods*. CRC Press
2. Wickramasinghe P. 2007. *The Food of India OM Book Service*
3. Aneja RP, Mathur BN, Chandan RC and Banerjee AK. 2002. *Technology of Indian Milk Products*, India Year Book Publications
4. Mangal R. 2013. *Fundamentals of Indian Cooking: Theory and Practice*

Suggested e books

1. Lois Ellen Frank. 2002. Foods of the Southwest Indian Nations. Ten Speed Press http://library.lol/main/7910F8A3B2221CD1A1DFC0C693A922CD
2. Nirmala Abraham, Theja Mahalingaiah, Padmini Balagopal, Suraj Mathema, Rita (Shah) Batheja, Ranjita Misra, Nimesh Bhargava, Chhaya Patel, Sharmila Chatterjee, Sudha Raj, Keya Deshpande, Nirmala Ramasubramanian Madhu, Gadia Janaki, Sengupta Karmeen, Kulkarni Geeta, Sikand. 2002. Indian Foods: AAPI's Guide To Nutrition, Health and Diabetes. Allied Publishers Private Limited. http://library.lol/main/8C2A89F2781BDB251BEF519E1F604655
3. VK Joshi. 2016. Indigenous fermented foods of South Asia. CRC Press LLC. http://library.lol/main/BDFDC1CBF5A7F1FEE32F522C8FC9BA8D

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 623**
Course Title : Functional Foods and Nutraceuticals
Pre-requisite : **Nil**
Credit Hours : **2(1-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the basic concepts about functional foods and nutraceutical products and their impact on health.

Aim of the Course
After studying this course, the student shall be able to:
1. Explain basic concepts about functional foods and nutraceuticals and related terms.
2. Explain reasons how different functional foods and nutraceuticals may affect various body functions and avoid different health related issues.
3. To enable the students to apply knowledge of nutraceuticals and functional foods for the development of food products.

Catalogue Description
Unit I : Introduction to various concepts of functional foods
Unit II : Specially designed foods for different age groups and health conditions
Unit III : Packaging, storage and marketing of health foods
Unit IV : Concepts of personalized nutrition for different health conditions

Lecture Schedule

Sr.	Lecture topics	No. of classes
1.	**Introduction:** Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods.,Current trends in the use of functional foods and nutraceuticals, Regulations and Health claims	1
2.	**Nutraceutical and functional food application s**and their health benefits. Nutraceutical compounds and their classification based on chemical and biochemical nature,	2
3.	**Innovations in Functional Food Industry** for Health and Wellness; Development of biomarkers to indicate efficacy of functional ingredients.	2
4.	**Nutraceuticals and Functional foods:** Nutraceuticals/ food components for specific disease such as cancer, heart disease, diabetes, obesity, anti-aging, arthritis. Cereals grains (Fibre, Polyphenolic compounds, Soybean (Oligosaccharides, Isoflavones, Phytosterols) Fruits and vegetables (Fibre, Lycopene, Lutein, zeaxanthin, Isothiocyanates) Fish/Fish oils (PUFAs, Omega-3fatty acids) Flaxseeds (Lignans, phytosterols, Omega-3fattyacids) Tea (Polyphenolic compounds)	3
5.	**Prebiotics and probiotics:** Prebiotics, Probiotics and synbiotics Definition Food Sources- Prebiotics [Dietary fibre, Oligosaccharides (Galacto oligosaccharides, Fructo oligosaccharides), Resistant Starch, Sugar alcohols, Traditional Fermented Foods as sources of Probiotics Strains of microorganims used as probiotics Substrate Utilization in the colon Role in Health and Disease, Mechanism of Action, Levels of Probiotics required for therapeutic efficacy	2

6.	**Specialty Foods:** Design of food for infants, children and old age. Functional Beverage: Selection of ingredients, health benefits and production. Extraction and delivery system: Non-thermal techniques, bio-processing techniques, dehydration techniques, effect on bioactive ingredients. Delivery system and controlled release of nutraceuticals.	3
7.	**Packaging, Storage, labelling:** Packaging requirements, storage and storage kinetics on quality of nutraceuticals, interactions of various environmental factors. Marketing and safety aspects: Marketing and safety and regulatory issues for functional foods and nutraceuticals.	2
8.	**Nutrigenomics:** concept of personalized medicine. Use of nano technology in functional food industry. Biological functionality of cruciferous vegetables, tropical, subtropical and temperate fruits, herbs and spices.	1
	Pre-final Examinations	2
	Assignment	1
	Total	**19**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Determination of antioxidant activity of given food sample by different techniques, viz. DPPH, FRAP, ABTS	1
2.	Determination of total phenolic content of given food sample.	1
3.	Estimation of dietary fibres of given food sample	1
4.	Estimation of lycopene in tomato	1
5.	Estimation of carotenoids of given food sample	1
6.	Determination of total flavonoid content of given food sample	1
7.	Effect of heat processing on ascorbic acid	1
8.	Determination of vitaminsA	1
9.	Estimation of pectic substances in plant sample	1
10.	Determination of beta carotene of given food sample	1
11.	To determine gas chromatography for bioactive components analysis	1
12.	To study the effect of drying on bioactive components of food sample	1
13.	To design the packaging requirement of functional foods	1
14.	Determination and qualifications of some nutraceutical and functional food compounds by HPLC	1
15.	Estimation of â-glucan	1
16.	To determine storage kinetics of nutraceutical	1
17.	Estimation of soluble/insoluble fibres of given food sample	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation

2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about functional foods and nutraceuticals and related terms.
2. Elaborate which functional foods and nutraceuticals may affect various body functions under different health conditions.

Suggested Readings

1. Chadwick R Henson S and Moseley B, 2003. *Functional Foods*, Springer-Verlag.
2. Jeffrey Hurst W, 2008. *Methods of Analysis or Functional Foodsand Nutraceuticals*, CRC Press
3. ShiJ,MazzaGandMaguerM,2002.*FunctionalFoods*,CRCPress.
4. WildmanREC,2006.*HandbookofNutraceuticalsandFunctionalFoods*,CRCPress.
5. VattemDAandMaitinV,2016.*FunctionalFoods,NutraceuticalsandNaturalProducts*,DEStechpublications.
6. GrumezescuAM,2016.*Nutraceuticals:NanotechnologyintheAgri-FoodIndustry*,Elsevier Inc
7. RizviSSH,2010.*Separation,ExtractionandConcentrationProcessesintheFood,BeverageandNutraceuticalIndustries*,WoodheadPublishing.
8. TomarSK,2011.*FunctionalDairyFoodsConceptsandApplications*,SatishSerialPublishing House.

Suggested e books

1. Robert Wildman. 2007. Handbook of nutraceuticals and functional foods CRC / Taylor & Francis. http://libgen.is/book/index.php?md5=D530C73B4B8526F8D741A737D5DD3F11
2. Debasis Bagchi, Francis Lau and Manashi Bagchi. 2010. Genomics, Proteomics and Metabolomics in Nutraceuticals and Functional Foods. Wiley-Blackwell http://libgen.is/book/index.php?md5=4B1104E49B9DDFEA6856306020CFF6DA

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 624**
Course Title : Frozen and Concentrated Foods
Pre-requisite : **Nil**
Credit Hours : **2(1-0-1x3)**

Why this Course?

A Master's degree student must be able to understand the basic concepts about different frozen and concentrated food products.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain basic concepts about freezing for different frozen and concentrated food products.
2. Explain how different frozen and concentrated food products can be produced using freezing principles, their packaging and storage.

Catalogue Description

Unit I : Introduction to Freezing principles, innovations in freezing and cold chain systems
Unit II : Quality and safety of meat, fish, fruits and vegetable frozen foods
Unit III : Packaging of frozen foods in suitable packaging materials
Unit IV : Concentrated milk preparation using membrane filtration and other systems

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction of Freezing: Concepts of glass transitions in frozen foods and biomaterials, Freezing loads and Freezing time calculation.	2
2.	Innovations in freezing process, freezing methods and equipment. Microbiology of frozen foods, Thermo-physical properties of frozen foods. Facilities for the Cold Chain: Cold store design and maintenance, Transportation and storage of frozen foods, Retail display equipment and management.	4
3.	Quality and safety of frozen foods: Quality and safety of frozen meat and meat product, poultry and poultry products, eggs and egg products, fish and shellfish, and related products, frozen vegetables and fruits, frozen dairy products, frozen ready meals and confectioners.	3
4.	Packaging of frozen foods: Selection of packaging materials, Plastic and paper packaging of frozen foods, Shelf-life prediction of frozen foods,	3
5.	Concentrated milk: Production and quality of evaporated and condensed milk. System for concentration: filtration, membrane filtration technique evaporators, heat exchangers Concentrated juice products: Production and quality of fruits and vegetable juice concentrate, puree and paste, tomato juice concentrates, mango pulp etc.	3
	Pre-final Examinations	2
	Assignment	1
	Total	**18**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Measure the glass transition temperature of food	1
2.	Calculate freezing load of food sample	1
3.	Calculate freezing time of a frozen foods	2
4.	Effect of cold chain on quality of fruits and vegetables	1
5.	Effect of cooling one egg quality	1
6.	Effect of chilling on meat quality	2
7.	Effect of freezing on meat quality	2
8.	Production of concentrated milk and check its quality	1
9.	Production of evaporated milk and check its quality	2
10.	Effect of clarification on juice quality	1
11.	Effect of juice concentration on quality of juice concentrate	1
12.	Effect of cold and hot break on tomato pulp quality	1
13.	Production of tomato puree and paste and check its quality	1
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about freezing and principles of preservation by freezing.
2. Elaborate different innovative techniques used for producing various frozen food products.

Suggested Readings

1. Kennedy CJ,2000.*ManagingFrozenFoods*,Elsevier
2. Erickson MC&HungYC,1997.*QualityinFrozenFoods*,Springer.
3. HuiYH,LegarrettaIG,Lim,MH,MurrellKD&NipWK,2004.*HandbookofFrozenFoods*,CRCPress.

Suggested e books

1. Y. H. Hui, Isabel Guerrero Legarretta, Miang Hoong Lim, K.D. Murrell and Wai-Kit Nip. 2004. Handbook of frozen foods. Marcel Dekker. http://library.lol/main/81D234764B21B0C50BCB58C3717E2ACA
2. Judith Evans. 2008. Frozen Food Science and Technology. Wiley-Blackwell. http://library.lol/main/C1B51866C4C9290AC75C3E62F29A34DD
3. Da-Wen Sun. 2005. Handbook of Frozen Food Processing and Packaging. CRC Press. http://library.lol/main/78D1597D2E74E7D0AE30042FE48A2EA8

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 631

Course Title : Food Powders and Premixes
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

Why this Course?

A Master's degree student must be acquainted with the techniques and skills to develop different powders and premixes for popular food products present in Indian Market.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain processing of food powders and premixes
2. Explain the effect of processing parameters on the stability of food powders and premixes
3. Characterize and explain the variation in stability of various premixes and powders during storage.

Catalogue Description

Unit I : Food powder properties
Unit II : Handling of food powders
Unit III : Production of food powders, its characterization and stability during packaging and storage
Unit IV : Food premixes
Unit V : Processing techniques of different food premixes

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Food powder properties: Particle size, shape, particle size distribution, density, Crystalline and amorphous microstructure of powders, cohesive forces in powders, adhesive forces and surface energies, stickiness of powders, surface structure of powders, fluidity of powders, compressibility of powders, mixing property of powders, segregation of powder particles, flow and packing properties	4
2.	Handling of food powders: Basic flow patterns in storage vessels, storage vessel design, mass-flow operation, the Jenike silo design method, the flow-no flow criterion, Powder conveying: Belt, screw, chain, pneumatic	4
3.	Size reduction and enlargement: principles, equipment, criteria for selecting comminution process, aggregation and agglomeration, instantization, fluidization in food powder production	2
4.	Encapsulation: Principles, methods of encapsulation, viz. spray drying, coacervation, extrusion, co-crystallization	2
5.	Powder Production: Spray, drum and freeze-drying process and equipment	3
6	Undesirable properties: Attrition, segregation, caking, dust explosion hazards, laboratory testing to assess explosion characteristics of dust clouds, safety from dust cloud explosion hazards, gassing of food powder	3
7	Microbial decontamination of food powders	1
8	Food powder rehydration: Principles of powder rehydration- wettability and sink ability, dispersibility, solubility, improvement of rehydration properties	3

9	Surface composition of food powders: Microscopy and spectroscopy techniques for analyzing the surface of food powder, factors affecting food powder surface composition, impact of powder surface composition on powder functionality.	2
10	Packaging and Storage: Packaging requirements, design of package, effect of environmental factors on quality of food powders, shelf-life test and prediction	1
11	Food Premix: Formulation, processing and packaging of Vitamin premix, mineral premix, fibres premix for food supplements	1
12	Dairy powders, Powder premixes of dairy sweetmeats, Infant formula powders Rice flour and related products, culinary powders and specialty products	3
13	Powdered egg, Meat and fish powders, Fruit and vegetable powders, Plant-based protein powders, Tea and coffee powders, Oil encapsulated powders	3
	Pre-final Examinations	2
	Assignment	1
	Total	0

Practical schedule

Sr.	Practicals	No. of classes
1.	Estimation of bulk properties: bulk density, true density, porosity	2
2.	Estimation of reconstitution powder properties: wettability, dispersibility, solubility	2
3.	Effect of moisture on lump formation and caking	1
4.	Estimate flowability of food powders	1
5.	Estimate hygroscopicity of powder	1
6.	Estimate glass transition and sticky point temperature of food powder	1
7.	Effect of bulk properties on packaging	1
8.	Measurement of particle size using particle size analyzer	1
9.	Measurement of surface properties of food powder using SEM	1
10.	Packaging of food powders	1
11.	Effect of storage on quality of food powders	1
12.	Production of various vitamin premix and its application	2
13.	Production of various mineral premix and its application	2
	Practical Final Exam	**1**
	Total	**0**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain processing of food powders and premixes
2. Explain the effect of processing parameters on the stability of food powders and premixes
3. Characterize and explain the variation in stability of various premixes and powders during storage.

Suggested Reading

1. Hong Yan. 2005. *Food Powders: Physical Properties, Processing, and Functionality*/ Springer US.
2. Bhandari BS, Bansal N, Zang M, Schuck P. 2013. *Handbook of Food Powders-Process and Properties*. Woodhead Publishing
3. Yasuo Arai. 1996. *Chemistry of Powder Production* Springer Netherlands
4. Masuda H, Higashitani K and Yoshida H. 2006. *Powder Technology: Fundamentals of Particles, Powder beds, and Particle Generation*/ CRC Press

Suggested e books

1. Bhesh Bhandari, Nidhi Bansal, Min Zhang, Pierre Schuck. 2013. Handbook of food powders: Processes and properties. Woodhead Publishing. http://library.lol/main/F7C7F87815D9615E4292227DA2B26B6C
2. Gustavo V, Barbosa-Canovas Enrique, Ortega-Rivas Pablo and Juliano. 2005. Food Powders: Physical Properties, Processing, and Functionality. http://library.lol/main/C752DA1184BFD4650B893E1CF6CD5DBD

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 632
Course Title : Food Ingredients and Additives
Pre-requisite : Nil
Credit Hours : 3(2-0-1x3)

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

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic concepts of food additives and food ingredients.
2. Explain their safe level of use and toxic levels
3. Explain different food additives used in food industry and functions of additives.

Catalogue Description
Unit I : Role of food ingredients and additives used in food industry
Unit II : GRAS additives and tolerance and toxic levels
Unit III : Preservatives, antioxidants and flavouring agents
Unit IV : Hydrocolloids
Unit V : Sweeteners and colouring agents
Unit VI : Humectants and acidulants

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Role of food ingredients and additives in food processing functional classification, intentional and unintentional food additives, toxicology and safety evaluation of food additives, beneficial effects of food additives	2
2.	Food additives generally recognized as safe (GRAS), tolerance levels and toxic levels in foods-LD 50 values of food additives, toxicological evaluation of food additives.	3
3.	General mechanism of action of preservatives; basis of selection; classes; Chemical preservative characteristics, antimicrobial spectrum, mechanism of action, toxicology, regulations, application in food.	3
4.	Antioxidants: Characteristics, types/classes/groups, mechanism of action/ working of antioxidants, functions, sources, application in food, limits. Toxic effects of synthetic antioxidants, synergistic effects of antioxidants, the role of free radicals in human body, Natural antioxidants.	3
5.	Flavouring agents: Flavour functions, selection; forms; sources; process of flavour creation; natural and synthetic flavouring; extractions methods; production process; application in food.	3
6.	Emulsifiers and Stabilizers: Characteristics/ functional properties; functions; basis of selection; types; mechanism of emulsion formation; mechanisms of emulsion stabilization and destabilization; application in	3

	food.	
7.	Hydrocolloids: Definition and functional properties, sources and application in food.	2
8.	Sweeteners: Characteristics, classification, applications in food, Limits and toxicology of non-nutritive sweeteners.	2
9.	Starch, protein, lipids, fibres and fructo-oligosaccharides: As functional ingredients; their isolation, modification, specifications, functional properties and applications in foods.	2
10.	Colouring agents: Properties and functions; classification; sources of natural and synthetic colours, applications in food, Extraction methods, levels of use, misbranded colours, colour stabilization.	2
11.	Humectants, clarifying agents, Stabilizers and thickeners, Bleaching and maturing agents, Humectants, Sequestrants/ chelating agents, Anti-caking agents, Buffering agents,	2
12.	Acidulants: definition; characteristics; sources; functions and their application in food processing.	1
	Pre-final Examinations	2
	Assignment	1
	Total	**31**

Practical schedule

Sr.	Practicals	No. of classes
1.	Determination of benzoic acid in food samples	1
2.	Estimation of sulphur dioxide in food samples	1
3.	Estimation of sorbic acid in cheese and yoghurt	1
a.	Determination of nitrate and nitrites in foods	1
4.	Detection and determination of aspartame by thin layer chromatography	2
5.	Liquid chromatographic determination of caffeine, benzoate and saccharin in soda beverage	2
6.	Identification of natural colours	1
7.	Isolation, identification and estimation of synthetic food colours	2
8.	TLC detection of antioxidants in fats and oils	1
9.	TLC detection of emulsifiers	1
10.	Detection of alginates in foods (chocolate, ice cream)	1
11.	GC determination of menthol in mentholated pan masala	2
12.	Isolation and modifications of protein, starch, lipids, fibres from the raw and processed food sample	4
13.	Visit to food packaging material manufacturing industry	1
	Practical Final Exam	**1**
	Total	**22**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Explain different food additives used in food industries
2. Determine safe levels of additives and toxic levels.

Suggested Readings

1. Branen AL, Davidson PM and Salminen S. 2001. Food Additives, Marcel Dekker.
2. George AB. 1996. Encyclopaedia of Food and Colour Additives, CRC Press.
3. Nakai S and Modler HW. 2000. Food Proteins: Processing Applications, Wiley VCH.
4. Gerorge AB. 2004. Fenaroli's Handbook of Flavour Ingredients, CRC Press.
5. Branen AL, Davidson PM, Salminen S and Thorngate JH, 2001. Food Additives, Marcel Dekker.
6. Madhavi DL, Deshpande SS and Salunkhe DK. 1996. Antioxidants: Technological, Toxicological and Health Perspective, Marcel Dekker.
7. Stephen AM. 2006. Food Polysaccharides and Their Applications, CRC Press.
8. Smith J and Shum LH. 2011. Food Additives Data Book, Wiley-Blackwell.
9. Baines D and Seal R. 2012. Natural Food Additives, Ingredients and Flavourings, Woodhead Publishing

Suggested e books

1. Michael Ash and Irene Ash. 2008. Handbook of Food Additives. Synapse Information Resources Inc. http://library.lol/main/2C1EC8361D81BA8636FFEEE49DF7230F
2. Semih Otles. 2005. Methods of Analysis of Food Components and Additives. CRC Press. http://library.lol/main/3CA3D18C4B88D8782339BBFC302B212E

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 633**
Course Title : Aseptic Processing and Packaging
Pre-requisite : **Nil**
Credit Hours : **2(1-0-1x3)**

Why this Course?
A Master's degree student must be able to understand the basic principles of aseptic processing of foods and their packaging.

Aim of the Course
After studying this course, the student shall be able to:
1. Explain basic concepts about aseptic processing and packaging and related terms.
2. Explain reasons how aseptic processing and packaging would be improving the quality of food products.

Catalogue Description
Unit I : Introduction to various concepts of aseptic processing.
Unit II : Quality Assurance in aseptic processing
Unit III : Sanitary design and Equipment requirements
Unit IV : Packaging of aseptic processed foods

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: present and future of aseptic processing, Advantages and disadvantages, processing of semi-solid and fluid and particulate foods.	2
2.	Aseptic processing operations: pre-sterilization, loss of sterility, water-to-product and product-to-water separation, cleaning, control, CIP	4
3.	Quality Assurance: Effect of aseptic processing on nutrients, microorganisms, in-process and post-process assurance, HACCP, regulatory aspects of aseptic processing and packaging, Shelf life modules for aseptically processed products.	3
4.	Sanitary design and Equipment requirements: Pumps, Heat exchangers, homogenizers, aseptic process and packaging system for retail and institutional packages	4
5.	Packaging of aseptic processed foods: Packaging materials characteristics, aseptic filling, sterilization of packaging materials, package design, aseptic packaging system, type of pack and equipment: Fill and seal, Form, fill and seal, Erect, fill and seal, Thermoform, fill, sealed, Blow mold, fill, seal; geometry, materials and size of retail and bulk package, seal and closures	3
	Pre-final Examinations	2
	Assignment	1
	Total	**19**

Practical Schedule

Sr.	Practicals	No. of classes

1.	Effect of aseptic processing on microbial quality of juice based beverage	2
2.	Effect of aseptic processing on vitamins in selected foods	2
3.	Effect of aseptic processing on minerals in selected foods	2
4.	Effect of aseptic processing on colour pigments in selected foods	2
5.	Effect of aseptic processing on browning of milk	2
6.	Effect of aseptic processing on viscosity of milk	1
7.	Effect of aseptic processing on proteins in selected foods	1
8.	Effect of different chemical sterilant on microbial quality of packaging material	1
9.	To estimate chemical sterilant residue on packaging materials	1
10.	Estimation of package integrity and leakage	1
11.	Shelf life model sand prediction	2
	Practical Final Exam	**1**
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about functional foods and nutraceuticals and related terms.
2. Elaborate which functional foods and nutraceuticals may affect various body functions under different health conditions.

Suggested Readings

1. Robertson GL, 2012.Food *Packaging: Principle sand Practices*, CRC Press.
2. David JRD, Graves RH and Szemplenski T, 2016. *Handbook of Aseptic Processing and Packaging*, CRC Press.
3. Reuter H, 1993. *Aseptic Processing of Foods*, CRC Press.
4. Willhoft EM, 1993. *Aseptic Processing and Packaging of Particulate Foods*, Springer.
5. Tomar SK, 2011. *Functional Dairy Foods Concepts and Applications*, Satish Serial Publishing House.

Suggested e books

1. Jairus R. D. David, Ralph H. Graves and Thomas Szemplenski. 2012. Handbook of Aseptic Processing and Packaging https://libgen.is/book/index.php?md5=36056D42F253D5333CD5A7CB36B6924B
2. N. Buchner. 1993. Aseptic Processing and Packaging of Particulate Foods. Dr Edward M. A. Willhoft (eds.). Springer US https://libgen.is/book/index.php?md5=536D82F2195FF7A9035C74FEA9E28172

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 634

Course Title : Bio-processing and Separation Technology

Pre-requisite : Nil
Credit Hours : 3(2-0-1)

Why this Course?
A Master's degree student must be able to understand the basic principles methodologies of bio-processing and separation technology for producing value added food products.

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic concepts about converting raw materials into value added bio-processed products.
2. Explain reasons how different separation technologies could be employed to develop high priced value added food products.

Catalogue Description

Unit I : Introduction and understanding principles of various solid, liquid and gas separation processes.
Unit II : Various separation processes for solid, liquid and gas phase to develop value added products.
Unit III : Membrane Separation Technology
Unit IV : Powder preparation technology and SCFE

Lecture Schedule

S. No.	Lecture topics	No. of classes
	Introduction: Introduction to various separation processes, Gas-Liquid, Gas–Solid, Liquid-Liquid, Liquid-Solid separation.	2
	Concept of phase equilibrium, Stage equilibrium, Stage efficiency, Equilibrium concentration; Single stage contact equilibrium, counter-current multiple contact stages, Concept of equilibrium line and operating line, Determination of optimum number of contact stages by analytical and graphical method; Rate of extraction, Rate of gas absorption, Individual and overall mass transfer coefficient;	5
	Calculation of tower height for gas absorption for both dilute and concentrated solution. Construction and working mechanism of different extraction equipment like single stage extraction, Multiple stage static bed system, Bollmann extractor, Hildebrandt extractor, Roto cell extractor.	3
	Various separation processes Solid Separation Process, Introduction, Concept of size, Shape, Cut-size, Sieving, Magnetic separation, Eddy-current separation, Wet separation, Ballistic separation, Colour separation.	4
	Wet Separation Process, liquid-solid and liquid- liquid separation by hydro cyclones, Surface velocity classifier, Elutriators, Impingement separator, Electrostatic precipitation, Distillation: Introduction, boiling point diagram, differential or simple distillation, Flash or equilibrium distillation, Continuous rectification with and without reflux, Reflux ratio, Optimum reflux ratio, Batch distillation, Application of distillation in food processing.	5

	Membrane Separation Technology: Introduction to micro-filtration, Ultrafiltration, Reverse osmosis, Electro dialyses, dialyses, physical characteristics of membrane separation, Factors affecting reverse osmosis process, Concentration polarization, Design of reverse osmosis and ultra-filtration systems, Operation layout of the modules, Electrodialysis, Fabrication of membranes, Application of membrane technology in food industry.	6
	Powder Technology: Classification of powder, Separation of powder, Sieving, Air classification, Factors affecting air classification, Cyclone application, Air separation, Particle size distribution.	3
	Supercritical Fluid Extraction: Introduction, Properties of SCF, Food application, Application of SCFE in analytical technique, Pharmaceutical application.	4
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Determination of contact equilibrium in counter current and multiple contact model systems.	2
2.	Determination of rate of extraction in gas-liquid, gas-solid, liquid-liquid and liquid-solid systems.	4
3.	Study of working mechanisms of different extraction equipment.	2
4.	Evaluation of physical separation techniques based on size, shape and densities, magnetic, eddy current, ballistic and colour separation.	2
5.	Use of air classification, hydro cyclones, electrostatic and distillation techniques for fractionation and separation.	2
6.	Application studies on Microfiltration, Ultrafiltration, reverse osmosis and dialysis.	2
7.	Estimation of soluble/insoluble fibres of given food sample	2
	Practical Final Exam	**1**
	Total	**17**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about functional foods and nutraceuticals and related terms.
2. Elaborate which functional foods and nutraceuticals may affect various body functions under different health conditions.

Suggested Readings

1. Saravacos GD and Maroulis ZB. 2011. *Food Process Engineering Operations* CRC Press

2. Smith PG.2011. *Introduction to Food Process Engineering* Springer.

Suggested e books

1. Kang Hu and James Dickson. 2015. Membrane Processing for Dairy Ingredient Separation. Wiley-Blackwell http://libgen.is/book/index.php?md5=D5291CDD944073CCD7F99BA6C7CE1861
2. Kai Knoerzer, Pablo Juliano and Geoffrey W Smithers. 2016. Innovative Food Processing Technologies. Extraction, Separation, Component Modification and Process Intensification. Woodhead Publishing http://libgen.is/book/index.php?md5=B33E8D6B6BD883733E0614D03289A4EB

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 635
Course Title : Enzymes in Food Processing
Pre-requisite : Nil
Credit Hours : 3(2-0-1)

Why this Course?
A Master's degree student must be able to understand the extraction and purification of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and also apply the various factors affecting enzymatic activity.

Aim of the Course
After studying this course, the student shall be able to:

1. To develop an understanding of enzymes useful in food product technology and food processing with respect to production and purification protocols, applications in commodity technologies, and their impact on sensory and nutritional quality.

Catalogue Description
Unit I : Introduction to enzymes, classification and properties
Unit II : Production of enzymes
Unit III : Application of enzymes in various food products
Unit IV : Application of enzymes in the production of flavour

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Enzymes – classification, properties, characterization, kinetics and Immobilization	3
2.	Fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and their downstream processing.	5
3.	Enzymes for production of protein hydrolysates and bioactive peptides, maltodextrins and corn syrup solids (liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup), fructose and fructo-oligosaccharides.	7
4.	Enzymes as processing aids: Role of enzymes in cheese making and whey processing	2
5.	Role of enzymes in fruit juices (cell wall degrading enzymes for liquefaction, clarification, peeling, debittering, decolourization of very dark coloured juices such as anthocyanases)	3
6.	Role of enzymes in baking (fungal α-amylase for bread making; maltogenic α-amylases for anti-staling; xylanses and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes);	4

7.	Role of enzymes in meat and meat processing (meat tenderization); egg processing	2
8.	Enzyme processing for flavours (enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides; flavours from hydrolyzed vegetable/animal protein); enzymatic approach to tailor- made fats.	7
	Pre-final Examinations	2
	Assignment	1
	Total	**36**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Microbial production of enzymes	2
2.	Determination of stability of enzymes (temperature, pH and storage)	4
3.	Determination of activity of enzymes	2
4.	Applications of enzymes in baking	2
5.	Starch and protein hydrolysis	2
6.	Tenderization of meat using enzymes	2
7.	Production of cheese using different enzymes	2
8.	Extraction and clarification of juices using enzymes	1
	Practical final exam	1
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Practical demonstration

Learning Outcome

After the completion of course, students will be able to

1. The student will gain an understanding of the factors that affecting the stability of enzymes
2. The student will be able to practically analyze the application of enzymes in food industry.
3. The student will gain a theory and practical understanding of flavour production using enzymes

Suggested Readings

1. Flickinger MC & Drew SW. 1999. *Encyclopedia of Bioprocess Technology*. A Wiley- Inter Science Publ.
2. Kruger JE *et al*. 1987. *Enzymes and their Role in Cereal Technology*. American Association of Cereal Chemists Inc.
3. Nagodawithana T & Reed G. 1993. *Enzymes in Food Processing*. Academic Press.
4. Tucker GA & Woods LFJ. 1991. *Enzymes in Food Processing*.
5. Whitehurst R & Law B. 2002. *Enzymes in Food Technology*. Blackwell Publ.

Suggested e books

1. Robert J Whitehurst and Maarten Van Oort. 2009. Enzymes in Food Technology. Wiley-Blackwell http://library.lol/main/7692E0707706CB6574D57A3D0EE70EFF
2. Barry A. Law. Enzymes in Food Technology. http://library.lol/main/E52FC11E8EC6C1BB8174F8C38AFE900B
3. Kwan-Hwa Park. 2008. Carbohydrate-active Enzymes: Structure, Function and Applications. Woodhead Publishing Ltd http://library.lol/main/AFB7E0D4A7B47ED04F18D91A169CF238

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 636
Course Title : Food Process Automation and Modelling
Pre-requisite : Nil
Credit Hours : 2(2-0-0)

Why this Course?

Productivity and efficiency in any process or industry are the key to success and food processing industry is not an exception for this. A Master's degree student must understand the principles and concepts modelling for a food process design, equipment design, image processing or networking and apply them further, in different areas of food science and technology.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain principles and concepts of modelling.
2. Develop model for food processing, equipment design, process efficiency etc.
3. Suggest implementable solutions for solving problems related to process efficiency and productivity in various food industries.

Catalogue Description

Unit I : Principles of modelling
Unit II : Food process modelling
Unit III : Food process equipment design
Unit IV : Digital image processing
Unit V : Artificial neural network modelling
Unit VI : Automation in food process unit operations

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Principles of modelling: Linear programming-concepts, graphical and algebraic solution; Simplex method; Duality theory; Post-optimality analysis; Sensitivity analysis; Transportation and assignment models; Computer applications to LP, queuing theory; Project scheduling and management by PERT-CPM; Integer programming; Non-linear programming; Simulation; Goal programming; Decision theory; Markov chains; Sequencing problem.	6
2.	Food process modelling: The principles of modelling, kinetic modelling, the modelling of heat and mass transfer; introduction diffusion equation, the Navier-stokes equations, heat and mass transfer in porous media Luikov's equation. Modelling thermal processes: cooling and freezing, modelling product heat load during cooling & freezing. Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change. Modelling thermal processes: heating, introduction, processing of packed and solid foods, continuous heating and cooling processes, Modelling food quality and	5

	microbiological safety. Case Studies in Modelling, Control in Food Processes	
3.	Food process equipment design: Design considerations of agricultural and food processing equipment. Design of food processing equipment, Dryers, design of dryers. Determination of heat and air requirement for drying grains. Types of heat exchanger. Design of heat exchangers and evaporators. Design of material handling equipment like belt conveyor, screw conveyor, bucket elevator and pneumatic conveyors	5
4.	Digital image processing: digital representation of image, morphological image processing – dialation, erosion, opening and closing, line and edge detection, thresholding, segmentation, techniques for finding length, breadth, perimeter, surface area, eccentricity and surface roughness of solids. Machine Vision-Based Measurement Systems for Fruit and Vegetable Quality Control in Postharvest. Genetic algorithm optimization: traditional optimization techniques and their limitations, non-traditional method, fitness function in biological evolution, computational procedure for optimization of independent parameters using Genetic algorithm	6
5.	Artificial neural network modelling: Developing predictive model between independent and dependent parameters by using Artificial neural network –Neural network architecture, weights and bias values of neurons, least square method for NN parameters optimization, matrix representation and computation of the values of NN parameters.	5
6.	Automation in different unit operations of food processing: Raw food material sorting, grading, size reduction, mixing and agitation, thermal processing, dehydration, packaging, CIP, quality control. Bottle Washing Machine Automation, Bottling Plant Drive System, Demineralization Plant Control System, Labelling Machine Control system, Charger level automation, Reverse Osmosis plant automation, Thermal plant automation, Dehydration and freezing plant automation	5
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Classroom lectures and presentation
2. Practical demonstrations and Practice sessions

Learning Outcome

After the completion of course, students will be able to

1. Explain principles and concepts of modelling
2. Develop model for food processing, equipment design, process efficiency etc.

Suggested Readings

1. Najim K. 1989. Process Modeling and Control in Chemical Engineering - CRC Press
2. Das H. 2005. Food Processing Operations Analysis. Asian Books Private Limited

3. Ahmed J and Rahman S. 2012. Handbook of Food Process Design.Wiley-Blackwell
4. Tijskens LMM, Hertog MLATM and Nicolai BM. 2001. Food Process Modelling Woodhead Publishing
5. Bernd H. 2017. Measurement, Modeling and Automation in Advanced Food Processing. Springer International Publishing
6. Moreira RG. 2001. Automatic Control for Food Processing Systems Aspen publishers

Suggested e books

1. Bernd Hitzmann. 2017. Measurement, modelling and automation in advanced food processing. Springer. http://library.lol/main/C040E352E1EA3103490C9ACFB216D4B1

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number: AFT 637

Course Title : Zero Waste Processing
Pre-requisite : Nil
Credit Hours : 2(2-0-0)

Why this Course?

Wastes generation in food industry is inevitable and it causes environmental issues. A Master's degree student in Food Technology must understand the principles and concepts food industrial wastes utilization and management and apply them further, in any industry or research situations.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain types of wastes generated in food industry.
2. Demonstrate ways to minimize waste generation and possible methods for their utilization and management
3. Suggest implementable solutions for solving problems related to waste management in food industries.

Catalogue Description

Unit I : Waste types and related regulations
Unit II : Food waste separation
Unit III : Co-product recovery techniques
Unit IV : Waste management in different industries

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction: Food processing waste and by-product, ISO 14000 for environmental management system, biochemical and nutritional aspects of food processing by- products. Waste minimization: Chain management issues and good housekeeping Procedures, minimise energy use in food Processing, minimise water use in food processing.	8
2.	Food waste separation: microbiological risk management, Effects of postharvest changes in quality on the stability of plant co-products, Separation technologies for food wastewater treatment and product recovery.	8
3.	Co-product recovery techniques: Enzymatic extraction and fermentation for the recovery of food processing products, Supercritical fluid extraction and other technologies for extraction of high-value food processing co-products, Membrane and filtration technologies, recovery of nutraceuticals, micronutrients, functional ingredients, Natural dyes.	8
4.	Waste management in different industries: Meat, cereal, dairy, fish, fruit and	8

	vegetable, vegetable oil, plantation crops processing, waste management of food packaging. Food processing waste water treatment and gas production from solid food processing	
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Classroom lectures and presentation
2. Practical demonstrations and industrial visits

Learning Outcome

After the completion of course, students will be able to

1. Explain types of wastes generated in food industry.
2. Demonstrate ways to minimize waste generation and possible methods for their utilization and management

Suggested Readings

1. Waldron K. 2009. Handbook of Waste Management and Co-product Recovery in Food Processing Woodhead Publishing
2. Arvanitoyannis IS. 2007. Waste Management for the Food Industries Academic Press
3. Nout MJR and Sarkar PK. 2013. Valorisation of Food Processing By-Products CRC Press

Suggested e books

1. K Waldron. 2007. Handbook of waste management and co-product recovery in food processing. CRC Press. library.lol/main/CE46C9D4FBE348676EA734F1747139E9
2. Ioannis S. Arvanitoyannis. 2007. Waste Management for the Food Industries. Academic Press. library.lol/main/526D9AEBD3D7F34CB5538C1F85734B74

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 638
Course Title : Food Plant Utilities and Sanitation
Pre-requisite : Nil
Credit Hours : 2(2-0-0)

Why this Course?

Sanitation of the plant is very important to ensure food safety and enhance quality and productivity in the industry. A Master's degree student must understand the principles and concepts of plant design and sanitation requirements, as well as the regulatory requirements in different countries to become better suited for academic and industrial job roles.

Aim of the Course

To acquaint the student with the requirements of food plant design, sanitation requirements and the applicable regulations for the same in different countries, to enable him become capable of solving problems of the industry and ensure compliance with legal requirements.

Catalogue Description

Unit I : Principles of Food Plant Design
Unit II : Sanitation of equipment and plant premises
Unit III : Waste disposal
Unit IV : Sanitation schedule

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	General principles of food plant Design and layout, CIP system, sanitizers used in food industry. Personnel hygiene and assessment of surface sanitation by swab and rinse method	8
2.	Sanitation of coolers/chillers/freezers, Design of warehouses, conventional & modern storage structures for fruits, vegetables, meat and marine products, pest and rodent control	8
3.	Waste disposal for Food Plant Hygiene and Sanitation, ETP design and layout, Food hygiene and safety in transportation, with a focus on warehouse storage and refrigerated ships, Process water quality and treatments at plant level, Process plant sanitation - chemistry and water in CIP	8
4.	Preparation of a sanitation schedule for food preparation area, testing of sanitizers and disinfectants, Steam generation and performance, Boiler operation, forced and induced draught. Flue gas composition and performance analysis, Process air generation, air requirement & supply system. Air Moving and vacuum equipment, Power supply system for food process plants and plant earthing	8
	Pre-final Examinations	2
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Classroom lectures Presentation

2. Plant visits

Learning Outcome

After the completion of course, students will be able to

1. Explain principles and concepts of food plant design
2. Develop a sanitation plan for food processing plants
3. Dispose off the wastes generated safely as per regulations

Suggested Readings

1. Marriott NG and Gravani RB. 2006. Principles of Food Sanitation, 5th edition
2. Rao DG. 2010. Fundamentals of Food Engineering, PHI learning Private Ltd.
3. James A. 2013. The Supply Chain Handbook, Distribution Group
4. FAO, US. 1984. Design and Operations of Cold Store in Developing

Suggested e books

1. Michael M. Cramer. 2006. Food plant sanitation: design, maintenance, and good manufacturing practices. CRC Press. http://library.lol/main/EB5E8DED9A54358AEA14C4001D981086
2. Antonio Lopez-Gomez, Gustavo V and Barbosa-Canovas. 2005. Food Plant Design. CRC Press. http://library.lol/main/A3567F1630C543C1FD58D6FBECB272FF

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 643
Course Title : Instrumental and Sensory Analysis of Food
Pre-requisite : Nil
Credit Hours : 3(1-0-2x3)

Why this Course?

Quality evaluation during processing and storage is essential component of every food processing operation. At Master's level student must be acquainted with the techniques of instrumental and sensory quality analysis. This course is designed with higher emphasis on practical training, to provide exposure about major instrumental and sensory techniques used for quality evaluation of food.

Aim of the Course

This course aims at providing knowledge about the principles and first-hand experience on instrumental and sensory quality evaluation of different food products.

Catalogue Description

Unit I : Proximate analysis
Unit II : Chemical quality analysis
Unit III : Sensory Analysis

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Good practices in a food testing laboratory	1
2.	Instrumental and human error: measures to reduce error	2
3.	Principles of analysis of moisture, protein, fat, carbohydrates, ash	2
4.	Principles of analysis of vitamins and minerals	1
5.	Principles of analysis of major bioactives and plant pigments	1
6.	Principles of analysis of additives	1
7.	Principles of analysis of pesticides and toxins	1
8.	Detection of different food additives and adulterants.	1
9.	Sensory analysis: general testing conditions, requirements of sensory laboratory; organizing sensory evaluation programme. Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests;	2
10.	Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, aroma, taste, colour and gloss; Detection, threshold and dilution tests	1
11.	Current sensory evaluation approaches, Applications and limitations of e-nose, e-tongue, Data Analysis for Electronic sensory judgment and validation approaches. Computer-aided sensory evaluation of foods, statistical analysis of sensory data.	1
12.	Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements; Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing	2

	and Consumers studies, limitations Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control	
	Pre-final Examinations	2
	Assignment	1
	Total	**19**

Practical Schedule

Sr.	Practicals	No. of classes
1.	Estimation of proximate composition of bread, jam and paneer	3
2.	Estimation of vitamins and minerals in food products	3
3.	Estimation of major bioactives and plant pigments	4
4.	Estimation of major food additives	3
5.	Estimation of pesticides and toxins in various foods	2
6.	Detection of different food additives and adulterants	2
7.	Determination of textural profile of foods	2
8.	Selection and training of sensory panel	1
9.	Detection and threshold tests	2
10.	To perform sensory evaluation by difference tests – Paired Comparison Test, Triangle Test, Duo-Trio Test, Ranking test etc.	4
11.	Principal component analysis of sensory data using software	2
12.	Statistical data analysis of instrumental and sensory data and its interpretation	2
	Practical Exam	1
	Total	**31**

Teaching Methods/ Activities

1. Classroom Lecture
2. Practical training

Learning Outcome

After the completion of course, students will be able to

1. Explain principles and concepts of various quality tests done for foods
2. Perform quality analysis of different foods

Suggested Readings

1. Rao E. S. (2013). Food Quality Evaluation,Variety Books.
2. Meilgard (1999). Sensory Evaluation Techniques, CRC Press
3. Early, R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.
4. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
5. Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. Marcel Dekker.

6. Maslowitz, H. 2000. Applied Sensory Analysis of Foods. Vols. I, II. CRC Press, Boca Raton, FL, USA.
7. Piggot, J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science Publ.
8. Rai, S.C. and Bhatia, V.K. 1988. Sensory Evaluation of Agricultural Products. Indian Agricultural Statistics Research Institute (ICAR), New Delhi.
9. Harry, T. Lawless, Hildegarde Heymann. 2010. Sensory Evaluation of Food: Principles and Practices. 2nd Ed., Springer, New York or Dordrecht Heidelberg, London.

Suggested e books

1. David Kilcast. 2010. Sensory Analysis for Food and Beverage Quality Control: A Practical Guide. Woodhead Publishing Ltd. http://library.lol/main/41ADA772EC3775C7EFB4C1FE23476BB0
2. Ashutosh Kumar Shukla. 2022. Food Quality Analysis: Applications of Analytical Methods Coupled With Artificial Intelligence. Academic Press. http://library.lol/main/20835DE781567989883C195A80245CA9

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 644
Course Title : Product Design and Entrepreneurship Development
Pre-requisite : Nil
Credit Hours : 2(0-0-2x3)

Why this Course?

Every product has a life in the market after which, its business becomes infeasible. In that situation, we need to develop new products as well as update existing products. New product development is a regular and continuous process in food industry. Similarly, new business also need to be developed for meeting market demands. This course is designed to provide a practical exposure w.r.t. new product development, entrepreneurships and startups in food industry. A Master's degree student in Food Technology must understand the concepts of new product development, entrepreneurship and startups, apply them for developing his own industry of help other for the same.

Aim of the Course

To provide a practical exposure w.r.t. new product development, entrepreneurships and startups in food industry.

Catalogue Description

Unit I : New Product Development
Unit II : Entrepreneurship and Startups
Unit III : Detailed Project Report
Unit IV : Communication Skills

Practicals

S. No.	Practicals	No. of classes
1.	Exploration of opportunities and methods of new product development	2
2.	Perform gap analysis for new product development	4
3.	Develop innovative ideas for few products or services related to food processing	3
4.	Documentation of entrepreneurship and start-up, incubation concepts; regulations and government initiatives (Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/ SSIs. Export and Import Policies relevant to food sector. Venture capital)	3
5.	Documentation of ways of managing an enterprise (planning, monitoring, evaluation and follow up); managing competition; entrepreneurship development programs; social responsibility of businesses	2
6.	Analysis of characteristics of domestic and export markets	2
7.	Analysis of banking and financing systems, schemes and opportunities for enterprises and start-ups	2
8.	Develop conceptual design, flow sheet, material and energy balance	2

	calculations of any Food Plant.	
9.	Create business plan, financial plan, profitability analysis and DPR for any one or few new enterprises	5
10.	Demonstrate Effective Communication Skills: Structural and functional grammar; verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; comprehension of general and technical articles, summarizing and abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussions.	5
	Presentations	4
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Discussions, demonstrations, survey, documentation, presentations
2. Industry visits

Learning Outcome

After the completion of course, students will be able to

1. Perform gap analysis for exploring new opportunities for food businesses
2. Create business plans and detailed project reports for food businesses
3. Setup his / her own food business or help others in doing so.

Suggested Readings

1. Hu, R. 2005. Food Product Design A Computer-Aided Statistical Approach, Technomic Publishers
2. Moskowitz H R, Saguy S. and Straus T. 2006. An Integrated Approach to New Food Product Development, CRC Press
3. Moskowitz H R, Porretta S. and Silcher M. 2006. Concept Research in Food Product Design And Development, Blackwell Publishing Ltd.
4. Peters MS and Timmerhaus KD. 2005. Plant Designs and Economics for Chemical Engineers, McGraw Hill, 5th Edition,
5. Ahmad T. 2009. Dairy Plant Engineering and Management., Kitab Mahal, 8th Edition.
6. Rob Walling 2010. Start Small, Stay Small: A Developer's Guide to Launching a Startup. The Numa Group, LLC
7. Eric Ries 2017. The Lean Startup How Todays Entrepreneurs Use Continuous Innovation To Create Radically Successful Businesses. Crown Business Pub.

Suggested e books

1. Robert Walsh. 2009. The Web Startup Success Guide. Apress. library.lol/main/63259C75B21627900FB7597FCDF3D333
2. Rob Walling. 2010. Start Small, Stay Small: A Developer's Guide to Launching a Startup. The Numa Group, LLC. library.lol/main/A9B3622F6628F69B61EA0C62ADE4DB26

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def

2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 701
Course Title : Novel Technologies in Food Processing
Pre-requisite : AFT 601 or equivalent
Credit Hours : 2(2-0-0)

Why this Course?

Novel technologies in food processing are advantageous for different regions still their adoption is limited to specific situations. It is obvious that there are some research gaps that need to be covered and also some more innovations need to be done for bringing the novel technologies upto the stage of commercialization. A doctorate degree student in Food Technology must develop his own philosophy of looking into any kind of research or a scientific fact. This covers training with case studies, innovations and problem-solving challenges, so that every student develops his / her own philosophy of looking into different practical situations.

Aim of the Course

To develop analytical and problem-solving wisdom in the student, so that the acquired knowledge and experience may be used in future to address real life situations in food industry.

Catalogue Description

Unit I : Advances in novel extraction technologies
Unit II : Advances in novel heating technologies
Unit III : Advances in novel drying technologies
Unit IV : Advances in technologies for shelf life enhancement
Unit V : Advances in technologies for waste valorization

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Advances in modern food processing technology: Case studies, technology gaps, applications and innovations in : Supercritical fluid extraction	3
2.	Deep eutectic solvent extraction	3
3.	Membrane processing	3
4.	Microwave and radio frequency processing	3
5.	High Pressure processing	3
6.	Ultrasonic processing	3
7.	Ozonization	3
8.	Plasma Technique	3
9.	Novel drying techniques	3
10.	Shelf life and shelf life prediction	3
11.	Waste valorization	3
	Mid Term	1
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Discussions
2. Case studies
3. Presentations

Learning Outcome

After the completion of course, students will be able to

1. Discuss and logically present his / her own philosophy about modern techniques of food processing and their application
2. Identify research gaps for each of the modern techniques, that obstruct it from being used under a particular set of situation
3. Suggest innovative solutions for problem solving on case to case basis

Suggested Readings

1. Gould GW. 2000. New Methods of Food Preservation, CRC Press.
2. Barbosa-Canovas, 2002. Novel Food Processing Technologies, CRC Press.
3. Dutta AK and Anantheswaran RC, 1999. Hand Book of Microwave Technology for Food Applications, CRC Press.
4. Sun DW. 2015. Emerging Technologies for Food Processing, Elsevier Ltd.
5. Kudra T and Mujumbar AS. 2009. Advanced Drying Technologies, CRC Press.
6. Kilkast D and Subramanium P. 2000. The Stability and Shelf Life of Food. CRC Press.
7. Doona C J and Feeherry F E. 2007. High Pressure Processing of Foods. Blackwell Publishing Ltd.
8. Christopher Doona, Kenneth Kustin, Florence Feeherry 2010. Case Studies in Novel Food Processing Technologies: Innovations in Processing, Packaging, and Predictive Modelling (Woodhead Publishing Series in Food Science, Technology and Nutrition). Woodhead Pub.
9. J. Peter Clark 2009. Case studies in food engineering: learning from experience. Springer-Verlag New York
10. Peter W B Phillips; et al 2012. Innovation in agri-food clusters : theory and case studies. CABI

Suggested e books

1. Christopher Doona, Kenneth Kustin, Florence Feeherry. 2010. Case Studies in Novel Food Processing Technologies: Innovations in Processing, Packaging, and Predictive Modelling. Woodhead Publishing. http://library.lol/main/224C88BA8B6D10D074489D7774E55EF3
2. J. Peter Clark. 2017. Case studies in food engineering: learning from experience. Springer-Verlag New York. http://library.lol/main/23FC4285A054405A45F30DBB98728D62
3. Peter W B Phillips; et al. 2012. Innovation in agri-food clusters : theory and case studies. CABI. http://library.lol/main/D46F4E90E202A23DC1DB4506AA645361

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 702
Course Title : Advances in Food Packaging
Pre-requisite : AFT 602 or equivalent
Credit Hours : 2(2-0-0)

Why this Course?

Packaging technology is one of the integral parts of every processed food product. Shelf life and quality characteristics of foods are largely influenced by package properties. A doctorate degree student must be able to understand the basic principles as well as advancements in food packaging technology to develop his own philosophy of looking into any kind of research or a scientific fact. This course covers training with case studies, innovations and problem-solving challenges, so that every student develops his / her own philosophy of looking into different practical situations.

Aim of the Course

To develop analytical and problem-solving wisdom in the student, so that the acquired knowledge and experience may be used in future to address real life situations in food industry.

Catalogue Description

Unit I : Advances in active and intelligent packaging
Unit II : Enhancing package properties
Unit III : Case studies

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Recent advances in Active and Intelligent Packaging	3
2.	Techniques for enhancing package properties	2
3.	Chemistry of food packaging	3
4.	Anti-microbial packaging	3
5.	Non-migratory bioactive polymers	3
6.	Freshness indicator	2
7.	Biodegradable packaging	3
8.	Edible Films and Coatings	3
9.	Aseptic packaging	3
10.	Self-heating packaging	3
11.	Hydrate packages	3
12.	Package Recycling	2
	Mid Term	1
	Assignment	1
	Total	**35**

Teaching Methods/ Activities

1. Discussions
2. Case studies
3. Presentations

Learning Outcome

After the completion of course, students will be able to

1. Discuss and logically present his / her own philosophy about advances in food packaging technology their application
2. Identify research gaps for each of the advanced methods that still obstruct it from being used under a particular set of situations
3. Suggest innovative solutions for problem solving on case to case basis

Suggested Readings

1. Ahvenainen R. 2001. Novel Food Packaging Techniques, CRC Press.
2. Rooney ML. 1988. Active Food Packaging, Chapman & Hall.
3. Coles R and Kirwan M. 2011. Food and Beverage Packaging Technology, Wiley-Blackwell.
4. Han J and Han J. 2005. Innovations in Food Packaging, Academic Press.
5. Yam K and Lee D. 2012. Emerging Food Packaging Technologies, Woodhead Publishing.
6. Mihindukulasuriya SDF and Lim LT. 2014. Nanotechnology Development in Food Packaging- a Review. Trends in Food Science and Technology, 149-167.
7. Souza VGL and Fernando L. 2016. Nano-particles in Food Packaging-Biodegradibility and Potential Migration to Food – A Review. Food Packaging and Shelf Life, 63-70.

Suggested e books

1. Swalm CM. 1974. Chemistry of food Packaging. ACS. http://library.lol/main/05DB345A48252A6F288D9372EC5DD067
2. Joseph P. Kerry. 2012. Advances in meat, poultry and seafood packaging. Woodhead Publishing. http://library.lol/main/A14E9DA09895D2F923685263EC414A12

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 703**
Course Title : Advances in Food Manufacturing Technology
Pre-requisite : **AFT 603 or equivalent**
Credit Hours : **2(2-0-0)**

Why this Course?

The development of science leads to continuous improvements in food manufacturing processes and enhance their efficiency. A doctorate student must be acquainted with the latest developments in existing food manufacturing processes as well as with the newer methods developed for food processing. Commodity specific understanding of the food processing is essential; therefore, this course is too relevant for the degree.

Aim of the Course

After studying this course, the student shall be able to:

1. Explain basic concepts about advanced food manufacturing technologies.
2. Explain reasons how different operations related to advanced food packaging systems may be utilized.

Catalogue Description

Unit I : Introduction to various modern and advanced food manufacturing technologies
Unit II : Case studies of Advances in modern food processing technology
Unit III : Various advanced food manufacturing technologies for novel foods
Unit IV : Modern and advanced food packaging systems

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction to various modern and advanced food manufacturing technologies adopted in food industry in India and abroad.	1
2.	Advances in modern food manufacturing technology: Case studies, technology gaps, applications and innovations in technologies mentioned below:	2
3.	Preservation through non-thermal technology	2
4.	Membrane Technology	2
5.	High Pressure Processing of Foods	1
6.	Hurdle Technology: Modern and advanced packaging systems: Active and intelligent packaging techniques:	2
7.	Micro-encapsulation of food ingredients for better delivery	1
8.	Supercritical Fluid Extraction	2
9.	Manufacturing resource planning, Inventory control, Production planning, Production scheduling, Material requirement planning, Resource planning, Capacity requirement planning. Job scheduling	3
	Mid Term Exam	1
	Assignment	1
	Total	**18**

Teaching Methods/ Activities

1. Classroom Lectures and Presentation
2. Discussion

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about advanced food manufacturing technologies for novel foods.
2. Elaborate different Modern and advanced food packaging systems.

Suggested Readings

1. Badiru AB. 2015. Global Manufacturing Technology Transfer: Africa-USA Strategies, Adaptations, and Management, CRC Press.
2. Hitomi K. 1996. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics, CRC Press.
3. Yamane Y and Childs T. 2013. Manufacturing Technology Transfer: A Japanese Monozukuri View of Needs and Strategies, CRC Press.

Suggested ebooks

1. Nirmal Sinha, Y.H. Hui, Ramesh C. Chandan, Stephanie Clark, Nanna A. Cross, Joannie C. Dobbs, W. Jeffrey Hurst, Leo M.L. Nollet, Eyal Shimoni, Erika B. Smith, Somjit Surapat, Fidel Toldrá, Alan Titchenal. 2007. Handbook of food products manufacturing. Wiley Interscience. https://libgen.is/book/index.php?md5=FC2137CD1AE636DD6FDBB21DCE6DA2B3
2. I. McFarlane. 1995. Automatic Control of Food Manufacturing Processes. Springer.https://libgen.is/book/index.php?md5=4E3DD1FCC465874A09FEEC6461A08D19

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 704
Course Title : Advances in Food and Flavour Chemistry
Pre-requisite : AFT 604 or equivalent
Credit Hours : 2(2-0-0)

Why this Course?
To understand the functionality of the various food components and science behind the art of flavouring foods, and legal aspects of use of flavours in food products.

Aim of the Course
After studying this course, the student shall be able to:

- To acquaint with functional properties of various constituents in foods, and effect of different processing and storage on the functionality of various food components.
- To understand the science behind the art of flavouring foods, their analysis, the problem of off-flavours and the reasons thereof

Catalogue Description

Unit I : Study the functional properties of various food components
Unit II : Purification of proteinaceous foods and food allergens, food dispersion, surface and interfacial phenomena
Unit III : Sources and biogenesis of flavours
Unit IV : Analysis of flavours and preparation of flavour-based product
Unit V : Sensory evaluation of flavours and legal issues

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Functional properties of carbohydrates, lipids and proteins	4
2.	Effect of processing and storage on the functionality of carbohydrates, lipids and proteins	4
3.	Purification of proteinaceous foods, metabolic antagonists & food allergens.	3
4.	Food dispersion, surface and interfacial phenomena, food sols, food gels, emulsion and foams.	2
5.	Sources of flavours (natural, processed and added), Flavour composites (natural, semi-synthetic and synthetic)	4
6.	Biogenesis of flavours in food – natural and processed foods (Maillard Reaction and Lipid Oxidation).	4
7.	Analysis of flavours; Formulations of flavours, adulteration, Flavour emulsions, Flavours production in fermented foods, Off-flavours in foods.	4
8.	Spices and spice-based products as flavours, Plantation crops as flavours- tea, coffee, cocoa and vanilla.	4
9.	Sensory evaluation of flavours, selection of flavourist, flavours and legal issues.	4

Mid Term Exam	1
Assignments	1
Total	**35**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Assignments
3. Discussion

Learning Outcome

After the completion of course, students will be able to

1. The student will gain an understanding of the functional behaviour of various compounds of food
2. The student will be able to understand the biogenesis and analysis of flavours.

Suggested Readings

1. Ashurst PR. 1994. Food Flavorings. 2nd Ed. Blackie.
2. Burdock GA. 2004. Fenaroli's Handbook of Flavor Ingredients.5th Ed. CRC Press.
3. Deibler D & Delwiche J. 2004. Handbook of Flavor, Characterization: Sensory Analysis, Chemistry and Physiology. Marcel Dekker.
4. Heath HB & Reineccius G.1986. Flavor Chemistry and Technology. AVI Publ.
5. Taylor A. 2002. Food Flavour Technology. Sheffield Academic Press.
6. Fennema OR.1996. Food Chemistry. Marcel Dekker.

Suggested e books

1. Hans-Dieter Belitz, Werner Grosch, Peter Schieberle. 2009. Food Chemistry. Springer-Verlag Berlin Heidelberg. http://library.lol/main/11A68AA66FB120ACB7A3673DA168A1E2
2. Owen R. Fennema. 1996. Food Chemistry. CRC Press. http://library.lol/main/3F410C68EBC46594D2F6379B6243A8C9

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Code : AFT 705
Course Title : Advances in Food and Industrial Microbiology
Pre-requisite : AFT 605 and equivalent
Credit Hours : 2(2-0-0)

Why this Course?
To expose to the recent advances and applications in the area of food microbiology.

Aim of the Course
After studying this course, the student shall be able to:

1. To acquaint with the production of various microbial-generated products and their evaluation
2. To understand the modern methods of cell culture

Catalogue Description

Unit I : Relevant microbial groups and their growth
Unit II : The behaviour of microbes against new processing methods
Unit III : Role of bioprocessing in the preservation of food, use of microbes for production of food from waste of food industry
Unit IV : Microbial food processing, enzymes, pigments, biocontrol agents and biopesticides
Unit V : Development and use of biosensors, biopolymers
Unit VI : Modern methods of cell culture

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Foods as ecological niches, Relevant microbial groups, Microbial growth in food: intrinsic, extrinsic and implicit factors	4
2.	Microbial behaviour against the newer methods of food processing, Adoption and resistance development	3
3.	Bioprocessing in the preservation of food, starter microorganisms and their action on food constituents.	3
4.	Use of microbes to produce food from byproducts of food industry. Recent development in fermented food and beverage industry.	3
5.	Microbial food & their processing.	4
6.	Production of microbial enzymes and pigments	3
7.	Biocontrol agents and biopesticides.	3
8.	Microbes as test organisms as sensors and as tools for future applications in energy production and food and non-food industrial products.	4
9.	Industrial production of bioplastics and biopolymers	2
10.	Modern methods of cell culture: synchronous and co-cell culture, continuous cell culture in liquid and solid media, Cell immobilization and applications, Pre and probiotics cultures.	4

Mid Term Exam	1
Assignments	1
Total	**35**

Teaching Methods/ Activities

1. Classroom Lecture and Presentation
2. Assignments and group discussion

Learning Outcome

After the completion of course, students will be able to

1. The student will gain an understanding the behaviour of microbes against different processing methods
2. The student will be able to understand and generate biosensors.
3. The student will be able to produce various industrially important microbial products

Suggested Readings

1. Adams M. 2006. *Emerging Food-borne Pathogens*. Woodhead Publ.
2. Adams MR & Moss MO. 2000. *Food Microbiology*. Panima.
3. Easter MC. 2003. *Rapid Microbiological Methods in the Pharmaceutical Industry*.
4. Harrigan W. 2003. *Laboratory Methods in Food Microbiology*. University of Reading, UK, Elsevier.
5. James MJ, Loessner MJ & David A. 2005. *Modern Food Microbiology*. 7th Ed. Golden Food Science Text Series.
6. Pederson CS.1979. *Microbiology of Food Fermentations*. AVI Publ.
7. Roberts R .2002. *Practical Food Microbiology*. Blackwell Publ.
8. Rossmore HW. 1995. *Handbook of Biocide and Preservative*. Blackie
9. Wood JBB. 1999. *Microbiology of Fermented Foods*. Vols. I, II. Blackwell Academic.
10. Yousef AE. 2002. *Food Microbiology: A Laboratory Manual*. AVI.

Suggested e books

1. James M. Jay. 2000. Modern Food Microbiology. Springer. http://library.lol/main/0145C28E43145CECC5B553ABA9719286
2. Nduka Okafor. 2007. Modern Industrial Microbiology and Biotechnology. Science Publishers. http://library.lol/main/6DE232D4748C872D4290303D01110E24

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 711
Course Title : Advances in Instrumental and Sensory Analysis of Food
Pre-requisite : AFT 643 or equivalent
Credit Hours : 2(0-0-2x3)

Why this Course?

Quality evaluation during processing and storage is essential component of every food processing operation and every new research. At doctoral level student must be acquainted with the latest techniques of instrumental and sensory quality analysis. This course is designed with all emphasis on practical training, to provide confidence and practical exposure about major advanced instrumental and sensory techniques used for quality evaluation of food.

Aim of the Course

This course aims at providing knowledge and first-hand experience on advanced instrumental and sensory quality evaluation of different food products.

Catalogue Description

Unit I : Sample preparation
Unit II : Advanced Chemical quality analysis
Unit III : Advanced Sensory Analysis
Unit IV : Data Analysis

Practical Schedule

	Sr.	Practicals	No. of classes
		Sampling and sample preparation	1
		Rheological and textural measurements	2
		Spectroscopy (UV/Vis, fluorescence, IR, FTIR, NIR, NMR, atomic absorption)	2
		Mass spectrometry	2
		ICP, polarimetry, refractometry, microscopic techniques in food analysis	2
		Chromatographic techniques: Adsorption, column, partition, affinity, ion exchange, size exclusion, GC, GLC, HPLC, HPTLC, GCMS, LCMS)	2
		Color measurement	1
		Food microstructure analysis	2
		Enzyme analysis	2
10.		Microbial techniques	3
11.		The biotoxin challenge in food analysis	2
12.		Authenticity and traceability	2
13.		Computer-aided sensory evaluation of foods, and statistical analysis of sensory data.	3
14.		Simplified and advanced functional binding assays in food analysis	2
15.		Separation techniques: Gel filtration, dialysis, electrophoresis, sedimentation, ultrafiltration and ultracentrifugation, solid phase extraction, supercritical fluid extraction, isoelectric focusing, isotopic techniques, and manometric techniques	2
16.		Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies,	2
		Practical Exam	2
		Total	**34**

Teaching Methods/ Activities

1. Practical training

Learning Outcome

After the completion of course, students will be able to

1. Explain principles and concepts of various advanced food quality tests
2. Perform food quality analysis of using advanced methods

Suggested Reading

1. Rao E. S. (2013). Food Quality Evaluation,Variety Books.
2. Meilgard (1999). Sensory Evaluation Techniques, CRC Press
3. Early, R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.
4. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
5. Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. Marcel Dekker.
6. Maslowitz, H. 2000. Applied Sensory Analysis of Foods. Vols. I, II. CRC Press, Boca Raton, FL, USA.
7. Piggot, J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science Publ.
8. Rai, S.C. and Bhatia, V.K. 1988. Sensory Evaluation of Agricultural Products. Indian Agricultural Statistics Research Institute (ICAR), New Delhi.
9. Harry, T. Lawless, Hildegarde Heymann. 2010. Sensory Evaluation of Food: Principles and Practices. 2nd Ed., Springer, New York or Dordrecht Heidelberg, London.

Suggested e books

1. David Kilcast. 2010. Sensory Analysis for Food and Beverage Quality Control: A Practical Guide. Woodhead Publishing Ltd. http://library.lol/main/41ADA772EC3775C7EFB4C1FE23476BB0
2. Ashutosh Kumar Shukla. 2022. Food Quality Analysis: Applications of Analytical Methods Coupled With Artificial Intelligence. Academic Press. http://library.lol/main/20835DE781567989883C195A80245CA9

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 712**
Course Title : **Plant Food Products**
Pre-requisite : **AFT 611 and AFT 613 or equivalent**
Credit Hours : **2(2-0-0)**

Why this Course?
A Master's degree student must be able to understand the basic concepts various plant food products and their processing technology.

Aim of the Course
After studying this course, the student shall be able to:
1. Explain basic concepts about plant foods production, handling and processing into different novel products.
2. To understand the present scenario in India with respect to processing of different plant foods
3. To study the need for processing foods, composition and nutritive value of plant foods and storage practices.
4. Explain reasons how different plant food products could be good alternatives for animal products.

Catalogue Description
Unit I : Introduction to Plant food products, sources and classification
Unit II : Cereals, Millets and Pseudo cereals
Unit III : Fruits and Vegetables
Unit IV : Nuts and Oil seeds
Unit V : Plant based Beverages and Other Products

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction to plant food products, sources and classification.	1
2.	Advances in modern food processing technology: Case studies, technology gaps, applications and innovations in: Cereals, Pulses, Millets (Psuedo cereals); Fruits & Vegetables; Nuts and Oilseeds; Plant based beverages and Textured plant proteins	4
3.	Cereals, Pulses, Millets and Pseudo cereals Nutrititive value, Composition and structure of Cereals-an overview. -Post Harvest Processing and Technological Aspects of Cereals -Quality and Grading of Grains -Recent Advances in Milling of Rice, Wheat and Millets -Flour Fortification to Improve Nutritive Value Specialty Corn for Value Addition Breakfast Cereals- An Overview -Nutritive value and Composition of Pulses and Legumes-An overview. Milling and Processing of Pulses for Value Added Products	6

	-Germination, Decortication and Splitting of pulses and legumes -Elimination of Toxic Factors -Fermented and Non-Fermented Soy Products -Current trends in plant based protein consumption, e.g. Pea Protein	
4.	**Fruits and Vegetables:** Post-harvest handling of fresh fruits and vegetables, Minimally processed fruits and vegetables, advances in chilling, freezing, and drying - Nutritive value, Composition and Classification of fruits and vegetables -An overview. - Post Harvest Management Techniques, Processing and Preservation of Fruits of Himalayan Regions, Temperate Fruits and Tropical Fruits - Controlled Atmosphere Storage of Perishables - Packaging Requirements, Methods of Packaging and Quality Aspects of Minimally Processed Fruits and Vegetables - Modified Atmosphere Packaging of Fruits and Vegetables - Frozen, Canned, Dry Storage of Fruits and Vegetables - Ohmic Processing of Foods, Extrusion Technology, High Pressure Technology, Ozonation, Dehydration and Sun Drying - Effect of Gamma Radiation on Physio-chemical and Sensory Qualities of Fruits and vegetables - Innovative Techniques in Minimal Processing of Fruits and Vegetables. - Value Added Products, Alcoholic and non-alcoholic beverages	6
5.	**Nuts and Oil seeds:** -Extraction and refining of oil -Hydrogenation, plasticizing, tempering of oils -Esterification, Structured Lipids -Raw pressed oils -Blending of oils -Value Added Products (Margarine, Vanaspati Ghee, Mayonnaise, Peanut butter, Almond Butter, Nut Milk, Coconut Products) - Process for obtaining tailor-made fats and oils; Speciality fats and designer lipids for nutrition and dietetics.	5
6.	Plant based Beverages and Other Products: -Tea, Coffee -Cocoa Processing	4
7.	Textured Plant proteins: Development of plant protein-based meat, egg, poultry etc.	4
	Mid Term Exam	1
	Assignment	1
	Total	**32**

Teaching Methods/ Activities

1. Classroom Lectures and Presentation
2. Discussion

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about present scenario in India with respect to processing of different plant foods.
2. Elaborate different operations related to processing plant foods, composition and nutritive value of plant foods and storage practices.

Suggested Readings

1. Khetarpaul N (2010) Emerging Trends in Post-Harvest Processing and Utilization of Plant Foods. ATPA.
2. Rodrigues S and Fernandes FAN, 2016**.** Advances in Fruit Processing Technologies, CRC Press.
3. Smith DS, Cash JN, Nip WK and Hui YH. 1997. *Processing Vegetables: Science and Technology,* CRC Press.
4. Chakraverty A and Singh RP. 2016. *Postharvest Technology and Food Process Engineering*, CRC Press.
5. Frame ND. 1994. *Technology of Extrusion Cooking*, Springer US
6. O'Brien RD. 2008. *Fats and Oils: Formulating and Processing for Application*, CRC Press.
7. Davis B, Lockwood A, Alcott P and Pantelidis L. 2012. *Food and Beverage Management*, CRC Press.
8. Dhillon PS and Verma S. 2012. *Food and Beverage: Production Management for Hospitality Industry*, Abhijeet Publications.

Suggested ebooks

1. DK Salunkhe and SS Deshpande. 1991. Foods of Plant Origin: Production, Technology, and Human Nutrition. Springer US. https://libgen.is/book/index.php?md5=F93F7161276568B2AAF3E6894734749A

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : **AFT 713**
Course Title : Animal Food Products
Pre-requisite : **AFT 612 and AFT 614 or equivalent**
Credit Hours : **2(2-0-0)**

Why this Course?
A Master's degree student must be able to understand the basic concepts various animal food products and their processing technology.

Aim of the Course
After studying this course, the student shall be able to:

1. Explain basic concepts about animal foods production, handling and processing into different novel products.
2. To understand the present scenario in India with respect to processing of different animal foods
3. To study the need for processing foods, composition and nutritive value of animal foods and storage practices.

Catalogue Description

Unit I : Introduction to animal food products
Unit II : Advances in modern food processing technology
Unit III : Post mortem changes in meat
Unit IV : Special Animal products
Unit V : Meat analogues and restructured meat products
Unit VI : Fish processing
Unit VII : Milk processing
Unit VIII : Allergens from meat, poultry and fish products.

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Introduction to animal food products, sources and classification.	3
2.	Advances in modern food processing technology: Case studies, technology gaps, applications and innovations in Meat, fish and poultry products.	4
3.	Gross and microstructure of muscle, Pre-slaughter care, ante and post mortem, slaughter, handling of offal (edible and inedible). Methods to improve tenderness,	4
4.	Special Animal Products: Special poultry products, Breaded poultry, packaged precooked chicken, Freeze dried poultry meat. Egg preservation, egg powder production, plant-based meat products	6
5.	Meat analogues and restructured meat products	4
6.	Production of fish paste, fish oils, sauce, fish protein concentrates. Irradiation of fish and fisheries products, packaging of fish products, quality control and quality assurance	4
7.	Milk and Milk Products: - Substitutes for milk and milk products. Casein and caseinates, lactose, whey protein concentrates and isolates, milk	6

	coprecipitates, and other by-products. Technology of baby foods, weaning foods, therapeutic foods; Fortification and enrichment; Probiotic milk product; Lactose free	
8.	Allergens, from meat, poultry and fish products.	2
	Mid Term Exam	1
	Assignment	1
	Total	0

Teaching Methods/ Activities

- Classroom Lectures and Presentation
- Discussion

Learning Outcome

After the completion of course, students will be able to

1. Describe concepts about present scenario in India with respect to processing of different animal foods.
2. Elaborate different operations related to processing plant foods, composition and nutritive value of animal foods and storage practices.

Suggested Readings

1. Sahoo J, Sharma DK and Chatli MK. 2016. Practical Handbook on Meat Science and Technology, Daya Pub. House.
2. Kerry JP, Kerry JF and Ledwood D. 2002. Meat Processing, Elsevier
3. Nollet ML. 2012. Handbook of Meat, Poultry and Seafood Quality, Wiley-Blackwell
4. Aneja et al. 2002. Technology of Indian Milk Products. Dairy India Publ. De S.1980. Outlines of Dairy Technology. Oxford Univ. Press.
5. Rathore,NS et al. 2008.Fundamentals of Dairy Technology- Theory & Practices. Himanshu Publ
6. Walstra et al. 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

Suggested ebooks

1. Aaron M. Altschul and Harold L. Wilcke. 1981. New Protein Foods. Animal Protein Supplies. AcademicPress https://libgen.is/book/index.php?md5=693E90204C62183290C8AE97CC7E92EB
2. Fidel Toldrá. 2010. Handbook of Meat Processing. Wiley-Blackwell http://library.lol/main/EC65211C9BB0695F57CDD9FD160033C9
3. Leo M.L. Nollet and Fidel Toldra. 2006. Advanced Technologies For Meat Processing. CRC/Taylor & Francis http://library.lol/main/1D568F93AFEA53F909653BF458E6C40F
4. Alan R. Sams . 2001. Poultry meat processing. CRC Press. http://library.lol/main/4A12A14B5513D87EA82CB79B58E769A6
5. G M Hall. 1997. Fish Processing Technology. Springer US. http://library.lol/main/10014A1D6D88C40ACDB63B6CCED3BA7B

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

Course Number : AFT 714
Course Title : Food Process Modelling and Scaleup
Pre-requisite : AFT 636 or equivalent
Credit Hours : 2(2-0-0)

Why this Course?

Productivity and efficiency in any process or industry are the key to success and food processing industry is not an exception for this. A doctorate degree student must understand the principles and concepts modelling for a food process design, equipment design, image processing or networking and apply them further, in different areas of food science and technology. This course covers training with practice sessions and problem-solving challenges, so that every student develops his / her own philosophy of looking into different practical situations.

Aim of the Course

To develop analytical and problem-solving wisdom in the student, so that the acquired knowledge and experience may be used in future to address real life situations in food industry.

Catalogue Description

Unit I : Advances in modelling
Unit II : Process modelling for processing, enzyme inactivation and quality retention

Lecture Schedule

S. No.	Lecture topics	No. of classes
1.	Advances in application of modelling in food processing industry	3
2.	Modeling of high and low temperature processing	6
3.	Kinetic modeling of microbial growth and its destruction	6
4.	Kinetic modeling of enzyme inactivation	6
5.	Kinetic modeling of nutrient retention	6
6.	Modelling for scale up of food processing	6
	Mid - term	2
	Total	**35**

Teaching Methods/ Activities

1. Discussions
2. Practice sessions
3. Presentations

Learning Outcome

After studying this course, the student shall be able to:

1. Develop model for food processing, equipment design, process efficiency etc.
2. Suggest implementable solutions for solving problems related to process efficiency and productivity in various food industries.
3. Suggest innovative solutions for problem solving on case to case basis

Suggested Readings

1. Najim K. 1989. Process Modeling and Control in Chemical Engineering - CRC Press
2. Das H. 2005. Food Processing Operations Analysis. Asian Books Private Limited
3. Ahmed J and Rahman S. 2012. Handbook of Food Process Design.Wiley-Blackwell
4. Tijskens LMM, Hertog MLATM and Nicolai BM. 2001. Food Process Modelling. Woodhead Publishing
5. Bernd H. 2017. Measurement, Modeling and Automation in Advanced Food Processing. Springer International Publishing
6. Moreira RG. 2001. Automatic Control for Food Processing Systems Aspen publishers

Suggested e books

1. Bernd Hitzmann. 2017. Measurement, modelling and automation in advanced food processing. Springer. http://library.lol/main/C040E352E1EA3103490C9ACFB216D4B1

Suggested websites

1. https://libgen.is/search.php?req=Food+Science+Emerging&open=0&res=25&view=simple&phrase=1&column=def
2. https://www.pdfdrive.com/food-science-books.html

II/2024:06 : Any other item with the permission of Chair.