

Training modules for 1-2 weeks on skill development in food processing

Module No.	Module Title	Duration (Hrs)
01	Processing of Cereal and Value Addition	25
02	Processing of Pulses and Their Value Addition	25
03	Oilseeds Processing, Value Addition and By-Product Utilization	25
04	Processing and Value Addition Fruits and Vegetable	50
05	Alcohol beverage	25
06	Baking Technology	25
07	Confectionary Technology	25
08	Processing and Value Addition of Plantation Crops	25
09	Food Beverage Techniques	50
10	Functional Foods and Nutraceuticals	25
11	Traditional Foods and their Indigenisation	25
12	Handling and Safe Storage of Food Grain	25
13	Sugarcane Processing and Sugar Technology	25
14	Technology of Wine making	25
15	Technology of Brewing	25
16	Food Packaging and Labeling	25
17	Food Safety and Microbial Analysis	50
18	Food Supply Chain Management	25
19	Skill Development in Sensory Assessment Technique	25
20	Manufacturing Techniques of Food Processing Machineries	25
21	Operation and Maintenance of Food Processing Equipment	25
22	Instrumentation and Automation in Food Industry	25
23	RTE, RTC and RTS Food Products	25
24	Performance Evaluation of Food Processing Machinery	25
25	Rice Milling Techniques	50
26	Manufacturing of Extruded Products	25
27	Processing and Value Addition of Spices & Condiments	25

MODULE - 01

1.	Title of the Module	:	Processing of Cereals and Value Addition
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 01
4.	Entry Qualification	:	10 th Standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a) Understand and appreciate the composition and characteristics of grains and grams b) Develop different processed food products with increased shelf life
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Major and minor cereals - introduction - nutrients constituents; Post harvest management of cereals - equipment for post harvest processing; Equilibrium Moisture Content (EMC) of cereals; Storage of major and minor cereals.	Determination of physical properties; moisture and proximate composition of major cereals; Study of grain handling equipment; study of storage structures			
Total hours for this sub-module			1	1	3
2.	Flour milling - - different types of mills, <i>Chakki</i> and wheat roller mills; Major products and by-products of wheat milling - Durum wheat products - special flours for bakery and extruded products; Packaging and equipment used for wheat products	Identification - characteristics of different types of wheat; Flour milling of wheat in <i>chakki</i> and other mills; Analyses of flour characteristics; Study of packages and equipment used for different wheat products.			
Total hours for this sub-module			1	1	3
3.	Rice Milling - terminologies - principles; Machinery for rice milling - hullers, grain scalpers/cleaners - types of dehuskers - sheller - rice polishers, rice graders - colour sorter; Modern rice mill - Mini rice mill; Raw and parboiled rice - advantages - different techniques; Importance of grain dryers; Ageing of rice; BIS	Rice milling studies with laboratory equipments – calculation of milling yield, head yield and polish percent; Experiments on traditional and modern methods of parboiling; Drying study of paddy with dryers; Study of modern rice milling machinery and mini-rice mill; Operation and maintenance of rice			

	Grades of rice; Difference between <i>Indica</i> and <i>Japonica</i> varieties of rice - specialties and uses	milling machinery.			
	Total hours for this sub-module		1	1	3
4.	Maize and millets - Characteristics - nutritional composition; Milling machinery - Domestic flour milling equipment – dehulling, pearling, grinding, flour sifting - product process equipment; Major and minor millets - traditional process technique; Nutritional superiority of minor millets	Analyses of proximate composition of coarse cereals; Dehulling - Pearling studies of millets; Processing of coarse grains - popping - malting - weaning food - snacks; Operation and maintenance of various coarse grains processing machinery.			
	Total hours for this sub-module		1	1	3
5.	Flour quality - Physical - chemical characteristics; Flour improvers - enrichment; convenient baked foods - Ready to cook pasta - Ready to eat expanded products -fundamentals - functions of ingredients - formulation - unit operations, different methods of mixing - baking leavened and unleavened products - suitable packaging - equipments.	Determination of flour colour - Grader; Determination of gluten in wheat; Determination of Falling Number; Dough Raising Capacity; Preparation of baked and extruded products and its evaluation; Determination of effect of ingredients and additives; Operation and maintenance of cold and hot extruders			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description of equipment	Quantity
1	Porosity Apparatus	1
2	Protein Analyzer	1
3	Spectro-photometer	1
4	Solvent extraction apparatus	1
5	Texture Analyzer	1
6	Grain Cleaner / Grader	1
7	Wheat Milling unit	1
8	Grain Popping unit	1
9	Bakery Oven	1
10	Bread Slicer	1
11	Bakery utensils	5 set
12	Minor millet dehulling equipments	1 Sets
13	Hot air oven	1
14	Desiccators	2
15	Moisture Dishes	100
16	Lab model rice milling equipments	1 set
17	Rice sorter	1

18	Rice quality testing kit	1
19	Pasta machine	1
20	Hot extruder	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 20' x 30'
- b. Demonstration & Practical Class Room : 40' x 60'

11. Power requirement

10 kW

12. Qualifications of Instructor

- M.Tech (Food Science & Technology)
- ME (Food Process Engineering)

13. Suggested Readings

Text Books

- 1) Chakraverty, A. (1995). *Post Harvest Technology of Cereals, Pulses and Oilseeds*. Oxford and IBH Publishing Co, Calcutta.
- 2) Samuel Matz (1992). *The Chemistry and Technology of Cereals as Food and Feed*. Chapman & Hall
- 3) Kent N.L. and A.D. Evans (1994). *Technology of Cereals*, 4th Edition, Elsevier Science (Pergaman) Pub., Oxford, UK,
- 4) Sahay, K.M. and K.K. Singh (1994). *Unit Operations of Agricultural Processing*. Vikas Publishing House Pvt. Ltd., New Delhi.
- 5) Salunkhe, D.K., Kadam, S.S. (1989). *Handbook of World Food Legumes: Chemistry, Processing and Utilization*. (3 vol. set), CRC Press, Florida.
- 6) Hamilton, R.J. and Bharti, A. Ed. 1980. *Fats and Oils: Chemistry and Technology*. Applied Science, London.
- 7) Blanshard J.M.V., Frazier, P.J. and Galliard, T. (1986). *Chemistry and Physics of Baking*. Royal Society of Chemistry, London.
- 8) Durbey, S.C. (1979). *Basic Baking: Science and Craft*. Gujarat Agricultural University, Anand Gujrat, India.
- 9) Pomeranz, Y. (1978). *Wheat: Chemistry and Technology*. American Assoc. of Cereal Chemists. St. Paul, Minnesota, USA.
- 10) Pomeranz, Y. (1987). *Modern Cereal Science and Technology*. VCH Pub., New York.
- 11) Wolf, I.A. (1983). *Handbook of Processing and Utilization in Agriculture*. (2 vol. set). CRC Press, Florida.

MODULE – 02

1.	Title of the Module	:	Processing of Pulses and Their Value Addition
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 02
4.	Entry Qualification	:	10 th Standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to be: a. Production executive, Dal Mill operators, Maintenance assistant, Lab assistant
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Pulses - important - production; Structure and nutrient composition - anti-nutritional factors; Pulse milling - small, medium and large capacity mills; terminologies ; Adulteration	Pulse grains - Determination of physical and cooking qualities, moisture content, proximate analyses; identification of adulterants.			
Total hours for this sub-module			1	1	3
2.	Commercial methods of pulse processing - pulse milling - traditional methods, wet and dry milling methods; grading; mini dal mills, modern commercial dal mills - importance - pretreatments - dal quality	Drying - Open yard drying, in-bin drying, tray drying, tunnel drying, fluidized bed drying, LSU drying. Identification of pulse storage insects - insect control agents; Study of cleaning and grading machinery;			
Total hours for this sub-module			1	1	3
3.	Handling and storage of pulse grains; different drying systems; control of pulse beetle in pulse storage - physical methods, fumigation	Study of pre-conditioning treatments of different pulses; hands-on-training in different mini dal mills; Study of modern dal mills; Traditional milling and domestic level processing; Milling yield			
Total hours for this sub-module			1	1	3
4.	Value addition - suitability of flour required for different products; roasted - fried - malting - canning of pulses - papad process - extruded	Value added products from different pulses - canning of fresh pulses - malted products; roasting, frying – papad - Preparation of extruded			

	products; Utilization of by-products from dal mills - composition and nutritional value, consumption	products; Utilization of byproducts - alone or in combination			
	Total hours for this sub-module		1	1	3
5.	Cost analysis - operation & maintenance of pulse processing equipments;, labeling, packing and storage; hygiene and quality assurance	Quality analysis - identification of faults and corrective steps in production process - sensory evaluation - packaging - machinery			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description of tools and machineries	Quantity
1	Flaking machine	1
2	Pitting machine	1
3	Mini Dal Milling Machines (different popular units)	1
4	Parboiler	1
5	Sieve shaker	1
6	Germinator	1
7	Scourer	1
8	Solar dryer/tunnel drier, fluidized bed dryer and LSU dryer	1 each
9	Extruder	1
10	Canning machineries, Seamer, Reformer, Sealing machine	1
11	Papad press	1
12	Insect traps for storage	1 set
13	Spiral separator	1
14	Gravity separator	1
15	Screen separator	1
16	Pulverizer & (animal) feed mixer	1
17		

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 20' x 30'
- b. Demonstration & Practical Class Room : 40' x 60'

11. Power requirement

10 kW

12. Qualifications of Instructor

M.Tech (Food Science & Technology)
ME (Food Process Engineering)

13. Suggested Readings

Text Books

- 1) Chakraverty, A. 2000. Third Edition. *Post Harvest Technology Of Cereals, Pulses And Oilseeds*. Oxford & IBH Publishing & Co. Pvt. Ltd., New Delhi.
- 2) Sahay, K.M. and K.K. Singh. 1994. *Unit Operations In Agricultural Processing*, Vikas Publishing House Pvt. Ltd., New Delhi, p.340.
- 3) Henderson, S.M. and R.L. Perry. 1995. *Agricultural Process Engineering*, John Willey and Sons, New York. p.234.
- 4) Pande, P.H. 1994. *Principles of agricultural processing*, Kalyani Publishers, Ludhiana, p.278.
- 5) McCabe, W.L. and J.C. Smith. 2001. *Unit Operations In Chemical Engineering*. McGraw Hill Kogakusha Ltd., Tokyo. p.1028.
- 6) Mohsenin, N.N. 1986. *Physical Properties Of Plant And Animal Materials*, Gordon and Breach publishers, New York. p.1206.
- 7) Multon, J. L., A.M. Reimbert, D. Marsh and A.J. Eydt. 1989. *Preservation And Storage Of Grains, Seeds And Their Byproducts*. CBS Publishers and Distributors, Delhi.

MODULE – 03

1	Title of the Module	:	Oilseeds Processing, Value Addition and By-product Utilization
2	Sector	:	Food Processing and Preservation
3	Code	:	SDT 03
4	Entry Qualification	:	10 th Standard
5	Minimum Age	:	18 years
6	Terminal Competency	:	After completion of the course the candidate will be able to be: a) Production executive, Oil Mill operators/Maintenance assistant, Lab assistant
7	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Oilseeds - Physical and chemical properties - different types of oil - domestic/industrial uses; Quality of oil – different standards; Rancidity of oils & its prevention; Aflatoxin in oil bearing materials	Determination of oil contents of oilseeds; Determination of specific gravity, colour, viscosity, etc. of oils Determination of acid, iodine and saponification values			
Total hours for this sub-module			1	1	3
2.	Handling and storage of oilseeds; Dehulling of oilseed; Size reduction and pretreatment of oilseeds for oil extraction; Mechanical oil expression - principles of operation of <i>ghani</i> , rotary, hydraulic press and screw expeller; Purification of oil – gravity settling, filter press;	Mechanical expression of oil from laboratory model equipments Study of oil extraction in <i>ghani</i> , rotary, hydraulic press and screw expellers and calculation of extraction efficiency. Study of filter press; Maintenance of oil milling equipments			
Total hours for this sub-module			1	1	3
3.	Oil milling process in common oilseeds – groundnut, mustard, sesame, coconut, sunflower, safflower and cotton seed; Oil extraction process in palm oil; Extraction processes of virgin coconut oil	Visit to different commercial oil milling establishments to study oil extraction in - <i>ghani</i> , rotary, hydraulic press and screw expellers Laboratory oil extraction in soxhlet apparatus with different solvents			
Total hours for this sub-module			1	1	3
4.	Solvent extraction process - batch and continuous processes; Refining of oil; dewaxing and degumming processes; bleaching of oils;	Study of solvent extraction technique of edible oil in pilot scale unit; Refining of different types of oil using convention methods;			

	decolourising and deodorization processes; Production of value added products; Hydrogenation of edible oils; margarine; By-product - defating of oil meals	Refining of oil in the pilot model oil refining unit; Preparation of value added products - coconut - peanut, direct edible products - fried / roasted oil seeds; By-product utilization			
	Total hours for this sub-module		1	1	3
5.	Packaging and storage of edible oils – requirements - types of packages; Chemical changes during storage of oil; Labeling of oil packages - statutory requirements; quality regulations - FSSAI, ISI and AGMARK standards	Study of tin filling and seaming of oils; Study of auto form fill seal machines for pouch filling of oil Studies on storage of oil with different packaging materials			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description of tools	Qty
1	Soxhlet apparatus	1
2	Ghani	1
3	Power Ghani	1
4	Rotary press	1
5	Hydraulic press	1
6	Screw press	1
7	Expellers	1
8	Filter press	1
9	Pilot model oil Solvent extraction plant	1
10	Pilot model oil Refining Unit	1
11	Centrifuge	1
12	Form fill sealing machine	1
13	Deep fat fryer	1
14	Moisture meter	1
15	Hot air oven	1
16	Oil analyses equipments for – colour, sp gravity, pH, turbidity, viscosity	1 set

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 20' x 30'
b. Demonstration & Practical Class Room : 40' x 60'

11. Power requirement : 10 kW

12. Qualifications of Instructor

M.Tech (Food Science & Technology)
ME (Food Process Engineering)

13. Suggested Readings

Text Books

- 1) Acharia, K.T. (1990). *Oil Seeds and Oil Milling in India*. Oxford and IBH publication, New Delhi.
- 2) Harry Lawson. (1997). *Food Oils and Fats, Technology, Utilization and Nutrition*. CBS Publishers and Distributors, New Delhi.
- 3) Hilditch, T. P. (1943). *Industrial Chemistry of the Fats and Waxes*, Baillier, Tindall and Cox, London.
- 4) Kirschenbauer, H.G. (1944). *Fats and Oils*, Reinhold Publishing Corporation, New York.
- 5) Panda, H. (2000). *Essential Oils – Hand Book*, National Institute of Industrial Research - ISBN, New Delhi.
- 6) Weiss, T.J. (1970). *Food Oils and Their Uses*. The AVI Publishing Company, Inc., Westport, Connecticut.
- 7) Williams, P. and Nand J. Devine. (1984). *The Chemistry and Technology of Edible Oils and Fats*. Pergamon Press, London.

MODULE – 04

1.	Title of the Module	:	Processing and Value Addition of Fruits and Vegetable
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 04
4.	Entry Qualification	:	8 th Standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a. To develop proficiency skill in producing different processed fruits and vegetables food products b. Operating & maintenance of the modern Equipments & machineries c. Make different processed food products with quality assurance d. Process of Packaging, Storing & marketing
7.	Duration (in Hrs)	:	2 weeks (50 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Food preservation - introduction - principles - methods - importance - scope of fruit and vegetable processing; Spoilage - causes and preventive measures - defects; Standards - FSSAI, GMP, ISO, APEDA applications for fruit and vegetable products	Equipments and tools used in fruit and vegetable processing industry; floor plan layout for fruits and vegetable processing industry Hygienic practices in food processing industry			
Total hours for this sub-module			2	2	6
2.	Preservation by high and low temperature - importance – principles - advantages - methods - pasteurization, sterilization, canning - canning of acid, non acid foods; mechanical defects & spoilage; Refrigeration - factors affecting the quality of refrigerated products - spoilage - maintenance of refrigerator and its importance	Canning of fruits and vegetables - apple, orange, pineapple, tomato, cucumber, gerkin and beans; Refrigeration - cold storage unit - quality of refrigerated foods - Storage of fruits and vegetables under Refrigeration condition			
Total hours for this sub-module			2	2	6

3.	Preservation by very low temperature - Freezing - difference between refrigeration and freezing - methods of freezing, steps involved in freezing - types of freezing, - maintenance of freezers and refrigerators - quality parameters Preservation by drying and dehydration - pretreatments - solar drying - mechanical drying - freeze drying, dehydro freezing; merits and demerits - advantages - factors affecting drying	Storage of fruits and vegetables under Freezing; refrigeration process - quality analysis of the fruits and vegetables; Drying and dehydration of fruits and vegetables - solar drying - Mechanical dehydration – pretreatments			
Total hours for this sub-module			2	2	6
4.	Preservation by sugar - importance - principles of gel formation - preparation of jam, jelly, marmalades, preserve, candy, glazed, crystallized fruits; Unfermented fruit beverages - preparation and preservation - squash, RTS beverages, Nectar, cordial, syrup, crush, concentrate - methods of extraction, clarification and pasteurization	Production of fruit jam, jelly, marmalade, RTS from fresh fruits and clarified fruit juice, fruit cheese, preserve and candies; Preparation of unfermented beverages -RTS , clarified fruit juice, squash, cordial, nector and crush			
Total hours for this sub-module			2	2	6
5.	Preservation by chemicals - definition - application and role, types - permitted preservatives - permissible limits and health hazards - control of microbial growth; Preservation by salts and acids - Pickling - types and principles - pickling with salt, acids and oil - sauce and ketchup - Problems in pickle making – causes of spoilage - packaging	Use of chemical preservatives in fruit and vegetable products – limitations; Preparation of pickles and chutneys with salt, oil, vinegar; relishes and sauces; production of tomato puree and paste - sauce, ketchup			
Total hours for this sub-module			2	2	6
Total Contact Hours Individually for Theory, Demonstration and Practical			10	10	30
Grand Total of Contact Hours			50		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Construction of Zero Energy Cool Chamber	1
2	Mini Solar Drier	1
3	Blanching unit	1

4	Pulper	1
5	Juicer	1
6	Refracto-meters	3
7	pH Meter	1
8	Penitrometer	1
9	Autoclave unit	1
10	Tray Drier	1
11	Vacuum Drier	1
12	Utensils	5 Sets
13	Canning unit	1
14	Package Testing equipments	1 set
15	Chromo-meter	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 600 sqft
- b. Demonstration & Practical Class Room :2000 sqft

11. Power requirement

- 3 phase connection
- Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

- M.Tech (Food Science & Technology)
- ME (Food Process Engineering)
- MSc. (Food Science and Nutrition)

13. Suggested Readings

Text Books

1. Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.
2. Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003.
3. Potter, N.N. and Hotchkiss J. H. Food Science. CBS publishers and distributors. 1996.
4. Srivastava, R.P.O and Kumar, S. Fruit and vegetable preservation, International Book distribution Company, Lucknow, 1994.
5. MC.Williams, M and Paine, H. Modern Food preservation. Surjeet Publications, Delhi, 1984.
6. Cruess, W.V. . Commercial fruits and vegetable products, Anees Offset press, New Delhi, 1997.
7. Pandey. Post harvest technology of fruits and vegetable principles and practices, New Delhi, 1997.
8. R.K. Meena and Yadav. Horti marketing and post harvest management
9. Giridharkar Siddhappa G.S. and Tandon G.A. Post harvest technology of fruits and vegetable principles and practices

MODULE - 05

1.	Title of the Module	:	Alcohol beverage
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 05
4.	Entry Qualification	:	Minimum 12 th standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: b. Have thorough knowledge on production and quality parameters of alcoholic beverage production c. Understand the packaging principles and techniques
7.	Duration (in Hrs)	:	1 week (25Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Introduction to Industrial microbiology - definition, concepts, scope, history of industrial microbiology - Role of brewery science in food industry; Basic concepts on isolation- Media composition- favourable atmospheric conditions- Importance of media sterilization-contamination - types of cultures-maintenance and importance.	Structure - cleaning - assembling - Calibration of fermentor electrodes - Fermentor filters preparation; Broth mixing - rheological studies- fermentation broth.- sterilization - Setting up fermentation console - Post sterilization procedures Water loss studies in sterilization studies.			
Total hours for this sub-module			1	1	3
2.	Introduction to fermentation - Fermentor - structure - direct and in-direct fermentation - enzymes effect organisms used medium and atmosphere; Introduction to alcoholic beverages – types of alcoholic beverages – microbial fermentation Principles of fermentation – organism of commercial fermentation -types of alcoholic beverages - nutritional quality of different alcoholic beverages - Social Implications of alcoholic Beverages – trade on alcohol	Fermentation – inoculation- production – beer-monitoring fermentation; Alcoholic beverage-wine production- quality assessment; Visit to a production factory			
Total hours for this sub-module			1	1	3

3.	Suitability for malting - Principles - Physiological and enzymatic transformations - types - wine – beer - cider - ale - fenny - peri sherry - production technologies; Introduction to distillation - types of distilled alcoholic beverages - whisky - brandy-rum-gin-vodka-champagne-scotch - fermentation characters- production technologies	Production of fermented and flavoured alcoholic beverage – sherry, fenny - Monitoring of fermentation process and recording the changes			
Total hours for this sub-module			1	1	3
4.	Packaging – Definitions, functions, importance, properties and selection of packaging material. Casking, Kegging, Bottling and Canning; Sensory – chemical and bio-chemical –attributes contribute to consumer appreciation	Packaging – alcoholic beverage – quality of packaging material			
Total hours for this sub-module			1	1	3
5.	Nutrition -Digestion and effects on the body - Usage in medicines - Impact of alcohol consumption; National and international bodies governing the alcohol business - Standards in national and international level	Medicinal use - alcohol - visit to distillery unit to study the problems in large scale production, quality analysis, national and international standards; Visit to a pharma company to study the medicinal usage of alcohol, marketing strategies; Visit to central excise office to study alcohol related laws			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description of equipments	Qty. (No.)
1.	Fermentor 5 litre capacity	1 for 5 students
2.	Laminar air flow chamber	2
3.	Auto clave	4
4.	Hot air oven	3
5.	Incubator	3
6.	Weighing balance	4
7.	Gas stove	2
8.	Fridge with freezer	2
9.	Working table with sink & without sink	1
10.	BOD incubator	2
11.	Storage racks	4
12.	pH meter	2
13.	Deep freezer	2
14.	Spectrophoto meter	2
15.	Shaker	2
16.	Centrifuge	4
17.	Walk in cooler	1
18.	Cell counter	5
19.	Water distillation unit	2
20.	Glass distillation unit	2

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 1000 square feet
- b. Demonstration & Practical Class Room : 2000 square feet

11. Power requirement

3 phase connection

12. Qualifications of Instructor

M.Sc. in Fermentation technology
M.Sc in Brewery science
M.Sc in industrial microbiology

13. Suggested Readings

Text Books

1. Y. H. Hui, Lisbeth Meunier-Goddik, Jytte Josephsen, Wai-Kit Nip, Peggy S. Stanfield. 2004, Handbook of Food and Beverage Fermentation Technology. CRC Press
2. Bakker, Joke / Clarke, Ronald J. 2011 Wine flavor chemistry. Wiley-VCH
3. Alan J. Buglass. 2011. Handbook of Alcoholic Beverages Technical, Analytical and Nutritional Aspects. Volume I and II A John Wiley and Sons, Ltd., Publication.
4. J Piggott . 2011. Alcoholic beverages: Sensory evaluation and consumer research. Wood Head Publishing.

MODULE - 06

1.	Title of the Module	:	Baking Technology
2.	Sector	:	Food Processing
3.	Code	:	SDT-01
4.	Entry Qualification	:	Minimum 5 th Standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: d. Formulate and develop process techniques and product techniques in bakery e. Maintain good package and shelf life of the products f. Implement food quality and safety in process lines and products
7.	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Baking - introduction - principles - classification - role of ingredients - Baking chemistry and technology - Quality assessment - Dough rheology - rheological properties - mixograph/ farinograph/extensograph/ viscoamylograph Standards, regulations and quality control for bakery products. Specifications for bakery ingredients BIS/FSSA standards for ingredients and products	Calculate baker's percent, formula percent, and conversion bakers to formula percent. Quality test - colour, gluten, ash, SDS-sedimentation volume, falling number, alkaline, water retention capacity, water absorption, sieve analysis - rheological test Standard requirements of atta, maida, fortified maida. Standard requirements for wheat flour – bread - biscuit Significance of functional tests in relation to bread, biscuits, cake			
		Total hours for this sub-module	1	1	3
2.	Bread - ingredients - additives - chemical leavening agent - different types of bread - methods of bread preparation - bread spoilage and remedies - quality aspects of bread and its standards. Biscuits and cookies - ingredients - industrial processing techniques - mixing methods - types of biscuits - difference between biscuits and cookies - faults and remedies - standards and quality	Baking of bread - different mixing methods - types of leavened and unleavened breads - bread related products - determining dough characteristics - dough raising capacity - Pelshenke value Biscuits and cookies - different types - Preparation of nankhatai - melting moments - golden cookies - checkerboard cookies - butter biscuit			
		Total hours for this sub-module	1	1	3

3.	Cake - ingredients - methods of mixing - preparation of fancy cakes and sponge - types of cakes - cake faults and remedies - quality and standards. Pastry - introduction - ingredients - basic formulation - different types of pastry - flaky, puff and danish pastry, shortcrust pastry, filo pastry, choux pastry - Cold and hot pastries. Pie - types and methods - quality and standards	Preparation of different types of cakes - Plain, fancy cakes flavoured cake, sponge cake, pineapple upside down cake - plum cake Methods of preparation - types of pastry - Preparation of flaky pastry, puff pastry, danish pastries, shortcrust pastry, filo pastry, choux pastry			
		Total hours for this sub-module	1	1	3
4.	Bakery decorations - classification - basic preparation techniques - Decoration of bakery goods - tools and equipments used Functional bakery products - functional ingredients - bakery goods with soya, ground-nut, whole wheat meal, non gluten flour - millet, rice flour, maize etc.	Decoration of bakery products - Icing and glazing techniques - decorative fondants Composite flours and their suitability for use in different types of baked products. Baking and quality evaluation of bread, biscuits, cake, pastries and its products			
		Total hours for this sub-module	1	1	3
5.	Plan layout and requisites for establishing bakery - Cost economic of the bakery products - project report. Bakery hygiene and sanitation - Cleaning agents - Sanitizers: Physical and chemical - Factors affecting effectiveness of sanitizer Equipments used for bakery product processing leavened and unleavened products - Packaging requirements.	HACCP plan, GMP for bakery Floor plan layout for a bakery unit - Cost economics of bakery General cleaning and sanitizing program - Cleaning methods - Clean-out-of-Place - Manual cleaning Equipments used in bakery - Introduction of tools and equipments of bakery products. Suitable packaging materials for bakery products.			
		Total hours for this sub-module	1	1	3
	Total Contact Hours Individually for Theory, Demonstration and Practical		5	5	15
	Grand Total of Contact Hours		25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description of tools	Qty. (No.)
1.	Bread knife	4
2.	Pallet knife	4
3.	Chopping knife	4
4.	Bread mould	20
5.	Soft brush	4
6.	Oven trays	20
7.	Cake mold	10
8.	Cookies cutter	10

9.	Piping bag and ss nozzle	4
10.	Steel and plastic scraper	5
11.	Pizza cutter	4
12.	Cake mould	10
13.	Scissors	2
14.	Chocolate and toffee moulds and dies	10
15.	Butter paper	10
16.	Wire whisk	3
17.	Ss spoon and fork	10
18.	Measuring jug	5 set
19.	Rolling pin SS or wood	5
20.	Lab apparels	25 sets

S.No.	Description of equipments	Qty. (No.)
1	Convention oven	1
2	Spiral kneader	1
3	Planetary mixer	1
4	Dough sheeter	1
5	Cookie depositor & wire cutting	1
6	Enrober	1
7	Bread slicer	1
8	Induction or LPG stove	1
9	Fridge with freezer	1
10	Working table with sink & without sink	1
11	Balance	2
12	Storage racks	4

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 600 sq.ft.
- b. Demonstration & Practical Class Room : 1500 sq.ft.

11. Power requirement

Total power requirement : 50 kW

12. Qualifications of Instructor

M.Tech. (Food Technology) / M.Sc.(Food Science and Nutrition)

13. Suggested Readings

Text Books

- 1) Amsterdam, 1985. Cakes and pastries, Time - life books.
- 2) Baker's Handbook on Practical Baking, (1994). US Wheat Associates, New Delhi.
- 3) Bernard, W. Minifie, (1997). Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi.
- 4) Bernard, W.M. (1989). Chocolate, cocoa and confectionery, Science and Technology, 3rd Edn. AVI Book Published by Van Nostrand Rein hold, New York.
- 5) Dominic, W.S. Wong, (1996). Mechanism and theory in food chemistry, First Edition, CBS Publishers and Distributors, New Delhi.

- 6) E.B. Jackson, (1999). Sugar Confectionery Manufacture, Second edition, Aspen publishers Inc., Great Britain
- 7) Gordon Booth, R. (1997). Snack foods, CBS Publishers and Distributors, New Delhi.
- 8) Kent, N. L. and Evers, A. D. (1994). Technology of Cereals: Woodhead Publishing Limited, Cambridge.
- 9) Khetarpaul, N., Grewal, R., and Jood, S., (2005). Bakery Science and Cereal Technology, Daya Publishing House.
- 10) Matz, Samuel A, (2004). The Chemistry and Technology of Cereals as Food and Feed, (3rd Edition) CBS Publishers, New Delhi, first reprint.

MODULE – 07

1.	Title of the Module	:	Confectionery Technology
2.	Sector	:	Food Processing and Preservation
3.	Code	:	
4.	Entry Qualification	:	Minimum 10 th Standard
5.	Minimum Age	:	18 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: g. Formulate and develop process techniques and product techniques in confectionery h. Maintain good package and shelf life of the products
7.	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	History - traditional confections, types - Confectionery - introduction - development - ingredients used - sugars - types and role - thickening, gelling, binding agents and its application in confectionery - role of chemical additives - whipping, release agent, acidulents, milk and milk products, flavours, for confectionery - emulsifiers and other additives, starch derivatives, colours	Production of invert sugar, fondants, chikki, milk chocolate, Traditional Indian confection, Shrikhand wadi, flour confectionary, decorative cake, milk cake, petha, fruit candy, fruit toffee, rasgulla			
Total hours for this sub-module			1	1	3
2.	Production of glucose syrup, acid hydrolysis, enzyme hydrolysis Caramel: Definition, composition, factors affecting quality of caramel, caramel manufacture process, batch type, continuous types, checking of faults in caramel, toffee, candy, chewing gum and bubble gum	Preparation toffee, caramel, Preparation of creams, marshmallow and nougats, chewing and bubble gums			
Total hours for this sub-module			1	1	3

3.	High boiled sweets: Introduction, composition, properties of high boiled sweets, preparation of high boiled sweets, traditional, batch and continuous method of preparation. different types of higher boiled sweets, recipes	Lolypops (high boiled sweets), Machineries required Packaging requirements			
Total hours for this sub-module			1	1	3
4.	Cocoa confectionery - primary and secondary processing fermentation, drying, roasting, processing; production of cocoa butter, cocoa powder and its quality; Chocolate processing - mixing, refining, conching, tempering, molding, cooling, coating, fat bloom - commercial manufacturing of chocolate and its uses in confectionery.	Cocoa bean, processing, roasting, fermentation, drying cocoa butter, cocoa powder; Preparation of chocolate, hand dipped chocolates, molded chocolates, type of Couverture, tempering the chocolate (Pre-crystallization), Chocolate standards			
Total hours for this sub-module			1	1	3
5.	Cleaning and Sanitation in confectionery - General cleaning and sanitizing program - Cleaning methods - CIP - Clean-out-of-Place - Manual cleaning - Properties of food soils - Cleaning agents - Sanitizers: Physical and chemical - Factors affecting effectiveness of sanitizer	Hygiene and sanitation in confectionery, Standards, regulations and quality control for confectionery products; Floor plan lay out for a small scale confectionery unit. Cost economic of confectionery products.			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	14
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Confectioners operate confectionery manufacturing and processing machinery such as boilers, baling presses, compressors, conveyor driven machinery, and storage silos, tanks and bins. They may also operate jar filling systems or wrapping machines. Confectioners may also operate industrial kitchen equipment such as ovens and cookers, deep fryers, steamers and mixers, as well as regular kitchen appliances such as microwaves and refrigerators. They may also operate laboratory equipment such as sonic and water baths, chemstations, stirrers and centrifuges. They are usually required to wear safety equipment.	-
2	Weighing balance	1
3	Spectrophotometer	1

4	Steel containers	1
5	Textrometer	1
6	Chocolate and toffee moulds and dies	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 200 sqfeet
- b. Demonstration & Practical Class Room : 300 sqfeet

11. Power requirement

220 v 3 phase

12. Qualifications of Instructor

B.Tech. (Food TEchnology)/ B.Sc.(Food Technology)

13. Suggested Readings

Text Books

1. Sugar Confectionery and Chocolate Manufacture, R. Less and E.B. Jackson.
2. Industrial Chocolate Manufactory and Use, S.T. Beekelt
3. Chocolate, Cocoa & Confectionery Sci and Tech., Bernared W. Minifie
4. Basic Baking, S.C. Dubey.
5. Chocolate, cocoa and confectionery: Bernard, W. Minifie, CBS Publishers and Distributors, New Delhi.
6. Chocolate, cocoa and confectionery, Science and Technology, Bernard, W.M. 3rd Edn. AVI Book Published by Van Nostrand Rein hold, New York.
7. Sugar Confectionery Manufacture, Second edition, E.B. Jackson, Aspen publishers Inc., Great Britain

MODULE - 08

1.	Title of the Module	:	Processing and Value Addition of Plantation Crops
2.	Sector	:	Plantation crops
3.	Code	:	SDT 08
4.	Entry Qualification	:	12 th Standard
5.	Minimum Age	:	18 yrs
6.	Terminal Competency	:	After completion of this training the participant will be able to: a) Jobs in Plantation crop processing industries, Production executive, Machine operators, maintenance executives, Quality testing - lab assistant
7.	Duration (in Hrs)	:	1week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Plantation Crops - commercial important - harvesting - maturity indices - methods of harvesting; production and processing - Supply chain management - marketing; Tea - recent trends in processing - different forms - value addition - byproducts - packaging and storage - grading of tea - quality analysis; Coffee - processing - different methods - packaging and storage - recent trends - quality of coffee	Maturity indices of various plantation crops; Methods of harvesting; Production and packaging of tea by different methods; Quality testing, Tea grading; Sensory evaluation; Unit operations coffee processing; Physico-chemical changes during roasting; Grinding of coffee beans using different mills; Performance evaluation of coffee pulper cum washer			
Total hours for this sub-module			1	1	3
2.	Cocoa - primary and secondary processing - unit operations - machinery involved - value added products from cocoa - packaging - storage - quality of cocoa and its products; Coconut - production and processing - oil extraction methods value added products - utilization - recent developments in coconut processing machineries - product quality - packaging and storage	Cocoa harvesting and primary and secondary processing; Commercial manufacturing of chocolate; Quality analysis; Performance evaluation of coconut dehusker, coconut punch, splitter; Oil extraction by different mechanisms, compare the quality yield; Byproducts processing coconut vinegar and its quality evaluation			
Total hours for this sub-module			1	1	3

3.	Palm oil and palm kernel oil - unit operations - uses - byproducts from oil palm industry - purification - packaging and storage - quality evaluation of oil palm products; Cashew - processing method - unit operations - grading - packing of cashew - quality evaluation - value added products; Cashew apples - Use - By-products during processing - CNSL	Performance evaluation of palm harvester; Extraction of palm oil and palm kernel oil; Other byproducts - kernel powder; Quality analysis of palm products; Different roasting methods for cashew; Demonstration of deshelling techniques; Packaging methods; Cashew apple products; Different grades of cashew			
Total hours for this sub-module			1	1	3
4.	Rubber - processing - maturity indices - latex formation - tapping - unit operations involved - different forms of rubber - secondary products from rubber - byproduct utilization - grades - quality requirements; Arecanut - present scenario - production - mature and green nuts - processing - machineries involved - value added products - packaging and storage products - quality evaluation and by product utilization of arecanut	Formation of rubber sheets from latex; Different methods of drying and different grades of rubber; By-product production; Quality evaluation of rubber; Demonstration of unit operation in arecanut processing; Dehusking - drying; Supari production By-products from arecanut; Quality evaluation			
Total hours for this sub-module			1	1	3
5.	Food Safety and quality aspects related to products; Pre requisite programmes to increase quality in plantation crop processing industries; GMP in plantation processing for enhancing product quality; Application of HACCP in any one processing Industry; Entrepreneurships in Plantation crop processing sector	FSSAI regulations; Demonstration of PRP's related to plantation crop processing; Demonstration of GMP's; HACCP plan development for processing plant; Viable project plan preparation			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description of tools and machineries	Quantity
1.	Fluidized vibratory bed dryer	1
2.	Uruli roaster	1
3.	Coffee pulper cum washer	1
4.	CTC machine	1
5.	Vibratory type grader	1

6.	Rotary type grader	1
7.	Hammer mill	1
8.	Attrition mill	1
9.	Pin mill	1
10.	Ball mill	1
11.	Areca nut dehusker	1
12.	Cashew desheller	1
13.	Conching machine	1
14.	Tempering machine	1
15.	Coconut dehusker	1
16.	Tender coconut cutter	1
17.	Screw press oil extraction	1
18.	Plate and frame press	1
19.	Rubber – machineries Dispersion kneader; Hot feed rubber extruder; Rubber bale cutter; Calender machines	1
20.	Hydraulic press	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room :One- 300 sq feet
- b. Demonstration & Practical Class Room :One- 1000 sq ft. Existing labs/ workshops/ Pilot plants has to be utilized

11. Power requirement

Total power requirement : 50 kW

12. Qualifications of Instructor

M.Tech Food Engineering/ M.Tech Agricultural Engineering/ MSc. Food Science & Technology

13. Suggested Readings

Text Books

- 1) Pandey, P. H. 2002. Post Harvest Engineering of Horticultural Crops through Objectives. Saroj Prakasam, Allahabad.
- 2) Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest Technology. Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi. PP. 514.
- 3) ASTA, 1997. Official analytical methods of the American Spice Trade Association, Fourth Edition.
- 4) Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins. 1981. Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1: 605.
- 5) Pruthi, J.S. 1980. Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA. pp. 1-450. .
- 6) Pruthi, J.S. 2001. Minor Spices of India – Crop Management and Post Harvest Technology.
- 7) Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi.PP. 782.
- 8) Sivetz, M, and Desrosier, N.W. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport,Connecticut. First edition.
- 9) Handbook of Herbs and Spices : Volume 3 Vol. 3 by K. V. Peter (2006, Hardcover) : K. V. Peter (2006)
- 10) Spices: Vol.05. Horticulture Science Series By N.Mini Raj and K.V.Peter

Journals

- 1) Journal of spices and plantation crops
- 2) Indian J. Arecanut, Spices & Medicinal Plants
- 3) Journal of spices and aromatic crops

E- Reference

- 1) www.indianspices.com
- 2) www.coconutboard.gov.in
- 3) www.tide-india.org/projects/06diffusion-arecanut-processing.html
- 4) <http://www.fao.org/docrep/v5030e/V5030E00.htm>
- 5) <http://www.sspindia.com/fruits-and-vegetable-equipment.html>

MODULE – 09

1.	Title of the Module	:	Food Beverage Techniques
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 09
4.	Entry Qualification	:	8 th standard
5.	Minimum Age	:	16 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: i. Operation and maintenance of the modern equipment and machinery used in food beverage industry. j. To make non-alcoholic beverages. k. Process of packaging and storage and maintaining the quality of products
7.	Duration (in Hrs)	:	2 Week (50 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Beverage - terminology - beverage industry in India - types - importance - role and quality of ingredients - additives - manufacturing technology - fruit and synthetic beverages - technology of low calorie, dry beverages - processing of isotonic and sports drinks. Specialty beverages - tea, coffee, cocoa, instant coffee, spices, plant extracts, herbs, nuts, dairy and imitation dairy based beverages - types and standards - processing of and its significance	Processing of RTS, squash as per FSSAI; Processing of low calories beverage, isotonic drinks, sports drinks, coffee and instant coffee, iced and flavoured tea beverage; Quality assessment of beverages; Microbial test; E.coli in the water			
Total hours for this sub-module			2	2	6
2.	Water – importance – types – packaged drinking water, mineral water, natural spring water, flavoured water, carbonated water – manufacturing processes – methods of water treatment – purification and its significant – softening technology of hard water – quality assessment – raw and processed water – quality standards of packaged drinking water and mineral water BIS	Processing of mineral water; Equipments used for mineral water plant; Test quality of packaged water; Checking the quality of packaging materials; Purification techniques, Quality of water used in beverages threshold limits of ingredients; Estimation of mineral content of water; Microbiological safety of drinking water;			

	Total hours for this sub-module		2	2	6
3.	Carbonated and non Carbonated beverages - carbonation of soft drinks, isotonic, sports drinks - carbonation equipments - ingredients - preparation of syrup - packaging containers and closures - filling inspection and quality controls - Processing of flavoured, carbonated water; Water treatment plant	Carbonation equipments and machines, threshold limits of ingredients; Processing methodology of carbonation; Estimation of carbon dioxide in carbonated water; Natural foods for processing of beverages; quality assessment of beverages			
	Total hours for this sub-module		1	1	3
4.	Food additives used in beverages. Quality control in a beverage industry. Machineries used in different fruit juice extraction. Role of food additives in beverage; Types of beverages from grains, herbs and medicinal plants. Manufacturing of malted beverages, herbal beverages and medicinal beverages;	Estimation of preservative effect in beverage; Study on the changes in quality during storage; Operation of machineries in beverages; Studies on preparation of malted beverages; Processing of herbal beverages; Processing of therapeutic beverages; Assessing the chemical constituents in the selected medicinal plants			
	Total hours for this sub-module		2	2	6
5.	Alcoholic and nonalcoholic beverages - types - organisms involved - processing and preservation technology; Alcoholic beverages - distilled - flavoured - nutritional content and medicinal use - packaging - biochemical changes - types of food additives used - quality assessment of the beverages - processing of beverages from exotic fruits and domestic fruits; exotic fruits; Packaging and storage requirements of beverages	Production of alcoholic beverages; Production of wine, beer - quality assessment of alcoholic beverage for iso-propanol content; quality assessment of raw materials used for beer production - germination test; Estimation of alcohol content in beverages; Quality evaluation; processing of beverages from exotic fruits, domestic fruits, underutilized fruits; Packaging studies of beverages from exotic and domestic fruits			
	Total hours for this sub-module		2	2	6
Total Contact Hours Individually for Theory, Demonstration and Practical			10	10	30
Grand Total of Contact Hours			50		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Refractometer	5
2	Filter	1
3	Evaporator	1
4	Dryer	1
5	Measuring jar	Set 5
6	Stopwatch	5
7	Weighing balance	5

8	Stove	5
9	Gun thermometer	5
10	Juice extractor	1
11	Carbonator	1
12	Bottling and capping machine	1
13	Fermentor	1
14	Pasteurizer	

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room :600sqft
- b. Demonstration & Practical Class Room :1600sqft

11. Power requirement

3 phase electricity supply

12. Qualifications of Instructor

M. Sc.(Food Science and Nutrition/Food Technology)

13. Suggested Readings

Text Books

- 1) Carbonated Soft Drinks: Formulation and Manufacture by David P. Steen and Philip R. Ashurst
- 2) Handbook of alcoholic beverages by Alan J. Buglass
- 3) Handbook of water and waste water treatment plant operations by Frank R. Spellman

MODULE – 10

1.	Title of the Module	:	Functional Foods and Nutraceuticals
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 10
4.	Entry Qualification	:	Graduate with Science stream
5.	Minimum Age	:	23 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a. Importance of functional foods and nutraceuticals in human diet b. Learn techniques to develop functional foods and nutraceuticals
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Functional foods - terminology - different classes - role for human health - properties, structure and functions - whole functional foods, functional ingredient - nutritional genomics - product development processing and preservation of foods - standard and specifications - packaging - safety and shelf life - marketing - relation of functional foods and nutraceutical and drugs - herbs in functional foods	Estimation of proximate composition, total phenols; ascorbic acid; micronutrients phenolics and alkaloids using TLC; Extraction of free amino acid; crude fiber; crude pectic			
	Total hours for this sub-module		1	1	3
2.	Nutritive and non-nutritive food components with potential health effects - concept of free radicals and antioxidants - effect of processing on nutrient Types of Functional and nutraceutical foods and physical characteristics - functional foods and component soya , soy proteins, soy isoflavones - nuts - flaxseeds in cardiovascular disease prevention - wheat, rice and millets and their health effects; Finger millet products and their health benefits;	Quality assurance of developed functional foods; Estimation of dietary fibre in foods; Finger millet product development; ω -fatty acids in flaxseeds; Calcium estimation in finger millet; Quality assurance of developed nutraceutical foods; Estimation of Curcumin / Lycopene; Extraction and identification of Isoflavones by TLC; Estimation of piperine from Pepper by TLC, iron in finger millet by titrimetric method			

	Total hours for this sub-module		1	1	3
3.	Role of Dietary fibers in disease prevention Properties, structure and functions of various nutraceuticals. Factors affecting the properties; Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals; Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids, Tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline. Terpenoids; Vegetables, Cereals, milk and dairy products as Functional foods; Health effects of common beans, <i>Capsicum annum</i>, mustards, Ginseng, garlic, grape, citrus fruits, fish oils, and sea foods Food as remedies Nutraceuticals bridging the gap between food and drug	Estimation of Chlorophyll; Detection and estimation of metals – Fe, Cu, Zn, Mg, Se; Estimation of crude fat contents of foods by Soxhlet's method; Estimation of starch fractions in cereals; Determination of antinutritonal properties; Estimation of total phenols; Estimation of tannins, phytic acid Estimation of Saponin;			
	Total hours for this sub-module		1	1	3
4.	Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc; Probiotics as functional foods; Brief idea about some Nutraceutical rich - Role of processing on non nutrients - probiotics; Prebiotics as functional ingredients; Recent advances in techniques - functional foods efficacy - RDA	Estimation of trypsin inhibitor activity; Microbial analysis Preparation of review article on recommended daily allowances of minor nutrients Understanding of clinical work protocols			
	Total hours for this sub-module		1	1	3
5.	Industrial Scenario on functional foods and nutraceuticals. Nutraceuticals and the Future of Medical Science and Consumers' views on Nutraceuticals; New technologies in development of functional foods and Nutraceuticals; Consumers evaluation, marketing strategies, Regulatory issues of functional foods; Knowledge on global regulations; Labeling and	Detection of food additives; Extraction and estimation of total sugars from food products; Estimation of total Nitrogen and protein of foods by Micro Kjeldahl methods;			

	claims on the products;The role of marketing in the introduction of functional foods			
	Total hours for this sub-module	1	1	3
	Total Contact Hours Individually for Theory, Demonstration and Practical	5	5	15
	Grand Total of Contact Hours	25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	UV Spectrophotometer	1
2	Kjeldhal Unit (Protein & Nitrogen)	1
3	Macro centrifuge 10,000 rpm	1
4	Digital pH meter	1
5	Micro Pipette 100ml, 1000ml	1
6	Colorimeter	1
7	Thin layer chromatography kit (TLC Kit)	1
8	Refrigerator	1
9	Electronic Balance 0.001g, 0.01g	1
10	Hot Water bath	1
11	Cold Water bath	1
12	Hot Air Oven	1
13	Hot Plate	1
14	Vortex Mixer	1
15	Muffle Furnace	1
16	Soxhlet Extraction apparatus	1
17	Incubators	1
18	Magnetic stirrer	1

S. No	Description of Glasswares	Capacity	Qty
1.	Oil flasks	--	12
2.	Oil Extraction set	--	1 set
3.	Thimbles	--	12
4.	Standard flask	1 Lit	6
5.	Standard flask	500 ml	6
6.	Standard flask	250 ml	6
7.	Standard flask	100 ml	20
8.	Standard flask	50 ml	10
9.	Beaker	1000 ml	4
10.	Beaker	500 ml	6
11.	Beaker	250 ml	20
12.	Beaker	100 ml	20
14.	Boiling tubes	50 ml	25
15.	Test tubes	25ml	25
16.	Conical Flask	100 ml	25
17.	Measuring jar	10ml, 25ml, 50ml, 100ml – each 6	4x6

18.	Measuring jar	250ml, 500ml, 1000lit – each 2	3x2
19.	Funnel	2.5 cm; 7.5 cm	Each 10
20.	Conical Flask	250 ml	10
21.	Petri Plates	--	25
23.	What man no 1 Filter paper	--	2 boxes
24.	Desiccators	--	2
25.	Burette	25ml	12
26.	Crucible	--	12
27.	Wash bottles	--	6
28.	Bunsen burners	--	2
29.	Digestion flasks	500 ml	12
30.	Distillation unit	-	2

S. No	Chemical Name	Quantity	No.	Grade
1.	Acetic acid	2.5L	1	LR
2.	Acetone	2.5L	1	LR
3.	Ammonia Solution	500ml	2	AR
4.	Ammonium Ferrous Sulphate	500g	1	LR
5.	Ammonium hepta Molybdate	100g	1	LR
6.	Ammonium Sulphate	500g	1	LR
7.	Anthrone	25g	1	LR
8.	Arsenous Oxide	100g	1	AR
9.	Barium chloride dehydrate	500g	1	LR
10.	Benzoic acid	500g	1	LR
11.	Bromocresol Green (pH Indicator)	5g	1	LR
12.	Calcium Hydroxide	500g	2	LR
13.	Cupric Sulphate	500g	5	LR
14.	Cupric Sulphate	500g	1	AR
15.	Cyclo Hexane	2.5L	3	LR
16.	Dextrose	500g	1	AR
17.	D-Glucose	500g	1	LR
18.	Di Potassium Hydrogen Ortho Phosphate	500g	1	LR
19.	Dichloromethane	2.5L	6	LR
20.	Dichloromethane	2.5L	1	AR
21.	E.D.T.A di sodium salt	100g	1	LR
22.	EDTA	500g	1	LR
23.	Ferrous Sulphate	500g	1	LR
24.	HCl	2.5L	1	LR
25.	Hexane	2.5L	5	LR
26.	Iodine	100g	1	LR
27.	Iodine	500g	1	LR
28.	L-Ascorbic Acid	250g	1	LR
29.	Lead Nitrate	500g	1	LR
30.	Liquid Ammonia	500ml	1	LR
31.	Mercuric Oxide	100g	1	LR
32.	Methanol	2.5L	1	LR

33.	Methanol (HPTLC Grade)	2.5L	1	LR
34.	Nitric Acid	2.5L	1	LR
35.	Ortho Phosphoric Acid	500ml	1	LR
36.	Oxalic Acid	500g	1	LR
37.	Petroleum Ether	2.5L	1	LR
38.	Phenol	500ml	1	LR
39.	Potassium Dichromate	500g	1	LR
40.	Potassium Dihydrogen Phosphate	500g	1	AR
41.	Potassium Hydroxide	500g	1	AR
42.	Potassium Metasulphate	500g	1	LR
43.	Potassium Sodium Tartarate	500g	1	AR
44.	Potassium Sulphate	500g	2	LR
45.	Sodium Acetate	500g	1	LR
46.	Sodium Meta bisulphate	500g	1	LR
47.	Sodium Nitrate	500g	1	LR
48.	Sodium Sulphate	500g	1	LR
49.	Solo Chrome Black	25g	1	LR
50.	Tris Hydrochloride	100g	1	GR

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room :600sqft
- b. Demonstration & Practical Class Room :1600sqft

11. Power requirement

220 v 3 phase

12. Qualifications of Instructor

M.Sc. or Ph.D. in Food Science and Technology, Food Process Engineering

13. Suggested Readings

Text Books / journal articles

1. Essentials of Functional Foods by M K Schmidl and T P Labuza, An Aspen Publications
2. Application of probiotics in processed foods,2002, J. processed food industry,K S Premavalli et.al
3. Functional foods – An overview,2002, J.Indian Food industry, K S Premavalli et.al
4. Finger Millet: A Valued Cereal by K S Premavalli.2012, Nova Publishers
5. Hand book of fermented functional foods by Edward R. Farnworth
6. Advances in preservation and processing technology of fruits and vegetables by Rajarathnam
7. Quality control for value addition in food processing by Devraj
8. Functional Foods and Nutraceuticals by Rotimi E. Aluko

MODULE – 11

1	Title of the Module	:	Traditional Foods and their Indigenisation
2	Sector	:	Food Processing and Preservation
3	Code	:	SDT 011
4	Entry Qualification	:	8 th Standard
5	Minimum Age	:	18 years
6	Terminal Competency	:	After completion of the course the candidate will be able to: a. Operating & maintaining the equipments used for various unit operations involved for making food products b. To make indigenous food products c. Processing, packaging & storage of food products d. Maintaining the quality of food products
7	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

Sl. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Traditional foods and their importance; Importance of primary, secondary, and tertiary processing. Concept of value addition, conversion of raw materials to consumer foods, Knowledge of importance of indigenous food products & their market value; Cereals, millet based foods; Pulses, nuts based food; Fruits and Vegetable based foods; Oilseeds based products; Knowledge of Traditional foods Knowledge of different industrially important indigenous food products in India, Knowledge of ingredients used for making these kind of products; Quality assurance of raw material, standards & grades; Milk and milk products; Meat, fish and other animal foods; Sugar; Spices and their products	Regional variation in food products Study of various source required for production of indigenous food products, practicing hygiene and safety aspects in food preparation; Cereal products preparation; Fruit products preparation; Spice products; Quality evaluation of Ingredients involved for making these products; Milk and milk products preparation; Meat, fish and other animal products preparation; Sugar and Carbohydrate foods products preparation; Spices and their products preparation			
Total hours for this sub-module			1	1	3

2	Industrialisation of Indian foods Process & technology involved for production of indigenous food products, process parameters, key parameters which influence final product quality; Primary processed foods;Secondary processed foods; Machineries for primary foods; Food processing machineries; Raw materials, process and technology involved for production of indigenous food products, process parameters, key parameters which influence final product quality; Knowledge of changes occurring in raw materials during initial stage to end products. Effect of addition of ingredients on final products; Cereals, pulses flours and products; Fats and oils; Spice powders; Pickles, value added products	Practice to make common indigenous food products; Survey on commercial availability of primary processed foods; Survey on commercial availability of secondary processed foods; Listing the commonly used food processing machines; Practice to make common indigenous food products Observations of changes occurring in raw materials like starch gelatinization; baking, puffing, fermentation etc. Demonstration and preparation of various food products			
Total hours for this sub-module			1	1	3
3	Knowledge of machineries involve in such kind of products; Technology involved in processed foods; Fruit products; Dehydrated products; Fried products; Ready to eat products; Knowledge of processing and changes occurring in raw materials during initial stage to end products. Effect of addition of ingredients on final products; Heating; Chemicals treatment; Fermentation	Practice to operate machines; how to operate, studies on parameters affecting the machine performance; Demonstration and preparation of various food products; Observation of changes occurring in raw materials such as starch gelatinization; baking, puffing, fermentation etc.; Measuring various product qualities of finished products; sensory analysis of final product, consumers acceptability evaluation; Cooking of cereal products; Roasting of oilseeds; Baking of cookies; Fermentation of milk/vegetables			
Total hours for this sub-module			1	1	3

4	Knowledge of machineries involved in such kind of products. Trouble shooting, safety & maintenance operation involve in machineries; Knowledge of precautions taken, safety measures & safety hazard; As in 4 and 5; Trouble shooting and measures; Knowledge of product quality evaluation; Method of techniques of proper packaging of finished products & proper storing in cooling & ambient places, Packaging of indigenous food products; FSSAI, 2006; Standards for raw materials; Standards for processed foods; Standards for ingredients	Practice to operate machines; how to operate, changing parameters; Learning practically these trouble shooting & maintenance operations; finding fault & quick actions for remedies; Flour mill; Roaster; Juice extractor ; Dehydrator; Practice on packaging with sealing, storing & marketing. Marketing through agents, salesman and retailers etc. Measuring the product qualities Raw material checking; Sensory analysis of final product; Food acceptance			
Total hours for this sub-module			1	1	3
5	Maintaining records and filling up format for booking of various indigenous food products; Method of techniques of proper packaging of finished products & proper storing in cooling & ambient places, Packaging of indigenous food products; Maintaining records and filling up format for booking of various indigenous food products	Practice on packaging with sealing, storing & marketing. Marketing through agents, salesman and retailers etc; Practice on collection of orders and delivery of such kind of products; Practice on collection of orders and delivery of such kind of products			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

* Visit to Food Industry

9. Lists of Tools and Equipments for a Batch

Sl. No.	Description	Quantity
1	General requirements like vessels, balances, trays, water storage facilities, oil container, mould, boiling pan, cutting knife, table, different size containers etc. (To be shared)	04 for each tools
2	Other general requirements for Good manufacturing practices	15 sets each
3	Planetary mixer; 3 gear/ Food processor	02 No
4	Grinder, Sieve set boxes	02 No
5	Oven (Standard size with controlling feature)	02 No
6	Packaging machine	02 No
7	Moisture box	02 No
8	Work table marble top standard size	02 No
9	Storage rack standard size	05 No.
10	Moulds	02 No

11	Cutting knives	02 No
12	Dies; Sealing machine; Hot plate Induction stoves	02 No
13	Juice extractor	02No
14	Fermentor	02 No
15	Tool cabinet	02 No
16	First aid box	02 No
17	Discussion table	02 No
18	Weight Box	02 No
19	Other common facilities for training	As required

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 1000 square feet
- b. Demonstration & Practical Class Room : 2000 square feet

11. Power requirement : 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor : M.Sc.E (Food Science & Nutrition)
M.Tech (Food Science & Technology)
B.Sc. / B.Tech (FST)

13. Suggested Readings

Text Books /Journal

- 1) Tuber and root crops by M.S.Palaniswami & K. V. Peter
- 2) The New Cultures of Food by Adam Lindgreen & Martin K. Hingley
- 3) Foods of the Southwest Indian Nations by Lois Ellen Frank
- 4) Food and Culture by Pamela Goyan Kittler, Kathryn P. Sucher
- 5) Mint Money with Traditional Foods by B. R. Badekar
- 6) Convenience Foods for Defence Forces based on Traditional Indian Foods,2000,Defence Science Journal,K S Premavalli

MODULE - 12

1.	Title of the Module	:	Handling and Safe Storage of Food Grain
2.	Sector	:	Food grains
3.	Code	:	SDT 12
4.	Entry Qualification	:	Minimum 12 th Standard
5.	Minimum Age	:	16 yrs.
6.	Terminal Competency	:	After completion of this course the participant would be able to a) Identify the pests damage in grain storage b) Recommend IPM for pests in grain storage
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Grain Storage - Ecosystem approach - Overview of grain storage issues - Losses resulting from poor storage; Grain storage overview; Handling and storage losses in India for grains; Monitoring the grain during storage; Safe storage practices; Grain drying, handling and milling; Parboiling and processing of paddy; Grain drying equipment and practices; Grain milling equipment and practices	Visit to Grain Milling Facility and a Bulk Storage Godown (FCI); Visit to FCI storage structures; Discussion on losses in grain handling; Visit to Private Traders' storages; Understanding grain eco-system through visiting storage scenario in villages; Discussion on Grain handling; Visit to grain milling industries; Visit to Modern Grain Mills industries; Discussing the equipment for parboiling, drying and milling; Visit to Wheat Flour Mills; Discussing the milling equipment for wheat			
	Total hours for this sub-module		1	1	3
2.	Stored product insect pests - cereals, pulses, oilseeds, milled products, spices, condiments, dried fruits and nuts; Identification of stored product pests; Understanding the behavioural dynamics of life stages of insects and pests; Appreciation of losses due to pests in grain trade; Storage microorganisms and storage mites - Grain and seed borne pathogens and their management	Stored product insects and pests; Grain sampling for insect infestation; Detecting insect presence through various techniques; Insect control measures; Studying insect traps; Identification of microorganisms in infected grain; Evaluating different methods of control; Identifying storage mites and fungi; Measures to control storage micro-organisms			

	Effect of storage mites, fungi and microorganisms on grain storage				
	Total hours for this sub-module		1	1	3
3.	Biochemical changes in stored commodities due to pest infestation; Biochemical changes in food grains due to storage pests; Effect of insect infestation or microbial infection on the nutritional changes during storage; Aflatoxin content in grains due to microbial infection; Physical and chemical methods of pest control; Importance of temperature and moisture; Insect control by physical methods	Estimating the quality changes during different period of storage in infested/infected grain; Assessment of quality changes due to storage pests, Nutritional changes due to stored grain pests; Estimation of aflatoxin content in infected grain; Effects of Temperature and Moisture on Pest Population; Understanding the dynamics of moisture movement within grain bulk; Understanding the importance of grain temperature and its link to infestation			
	Total hours for this sub-module		1	1	3
4.	Rodents and their management ; Detection of rodent infestation - Physical methods of control; Chemical methods of control; Food safety laws and standards; Principles and methods of post harvest IPM; Preventive and curative measures - Gadgets used in storage pest management Modified atmospheric storage for stored grain insect pest management Physical control measures for management of stored product pest management with special reference on techniques Botanicals for the management of pests of stored grains	Identification of rodents and burrows; Control measures for rodent infestation; Food Safety Regulations related to rodent infestation; Evaluating different methods of insect control; Evaluating insect control strategies; Evaluating insect control strategies			
	Total hours for this sub-module		1	1	3
5.	Methods of detection of insect infestation in grains and estimation of losses ; Staining method - Density or floatation method - Gelatinization method - Cracking floatation method; Aural/Ninhydrin colour reaction - Carbondioxide determination method - X-ray radiographic method; Fumigation of grain storages; Basics of Fumigation; Fumigants- alternative fumigants for grain protection - Aluminium phosphide - Methyl Bromide CO ₂ fumigation	Detection of insect infestation by various methods; Insect detection by any two methods; Insect detection by any two methods; Fumigation with Aluminium phosphide and CO ₂ ; Equipment and procedure required for fumigation; Fumigation of grain storages with Aluminum phosphide; Fumigation of grain storages with carbon dioxide			
	Total hours for this sub-module		1	1	3

Total Contact Hours Individually for Theory, Demonstration and Practical	5	5	15
Grand Total of Contact Hours	25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description	Quantity
1.	Microscopes	1
2.	Weighing balance	1
3.	Moisture meter	1
4.	Hot air oven	1
5.	Environmental chamber	1
6.	Grains and flour for culturing	1
7.	Insect cage for culturing insects	1
8.	Plastic containers	1
9.	Sealing machine	1
10.	Racks	1
11.	Small metal bins	1
12.	Laminar flow chamber	1
13.	Glassware and chemicals	1
14.	Sample probes	1
15.	Fumigation accessories	1 set
16.	Gas sensors for CO ₂ detection	1
17.	Glasswares and minimal lab wares	1
18.	Insect collection pumps and work table	1

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room : 600 sqft
- b. Demonstration & Practical Class Room : 2000 sqft

11. Power requirement : 10 kW power
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

M.E or M.Tech in Food/Agricultural Engineering or MSc Entomology

13. Suggested Readings

Text Books

- 1) Cotton, Richard T. 2007. Insect Pests of Stored Grain and Grain Products.
- 2) Ghosh, S.K. 2003. Integrated Management of Stored Grain Pest.
- 3) Bhargava, M.C. & K.C.Kumawat. 2010. Pests of Stored Grains and Their Management
- 4) Bhadriraju Subramanyam and David W. Hagstrum. 2000. Alternatives to Pesticides in Stored-Product IPM
- 5) Bhadriraju Subramanyam.1995. Integrated Management of Insects in Stored Products
- 6) David W. Hagstrum and Bhadriraju Subramanyam. 2008. Fundamentals of Stored-Product Entomology
- 12) David W. Hagstrum and Bhadriraju Subramanyam.2006. Fundamentals of Stored Product Entomology
- 13) Marcel Dekker. 2002.Handbook of Food Toxicology
- 14) David Rees.2004. Insects of Stored Products
- 15) Jerry W. Heaps .2006. Insect Management for Food Storage and Processing, Second Edition

MODULE - 13

1.	Title of the Module	:	Sugarcane Processing and Sugar Technology
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDA 13
4.	Entry Qualification	:	12 th Standard
5.	Minimum Age	:	18 yrs
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a. Operation & maintain the equipments used for various unit operations involve for Sugar production b. Process of packaging & storage c. Byproduct utilization
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Maturity of sugarcane, cutting and cleaning of sugar cane - Deterioration of cane after cutting, loading and unloading, cane carriers, cane kickers, revolving knives, crushers, shredders - Milling of sugar cane - Extraction of juice, composition, purification of juice; Practice to product - good quality sugarcane juice to make sugar, jiggery, Purification steps, concentration of juice; Knowledge of importance on sugar processing & sugar production in food industry & its market value. Various possible products after sugarcane processing.	Peeling of sugarcane, Extraction of juice from sugarcane crusher; Milling efficiency; Quality parameters- Composition; Non-sugar constituents in sugar cane juice Juice Brix by brix hydrometers and by hand refractometers Pol and purity of juice; Brix, Pol and purity of, massecuites and molasses; Pol% bagasses, moisture % bagasse, preparatory index; Pol% sugar, moisture % sugar, ash % sugar; Phosphate in juice, calcium oxide in juice, glucose ash ratio.			
Total hours for this sub-module			1	1	3

2	Different steps involved for sugar production; operating parameters, necessity, change in raw materials after applying the operation, Clarifying and bleaching agents, Hot and cold imbibition. Peeling of sugarcane, Cane Carriers, rotating knives and fibrizers/shredder; Milling (Juice extraction): Extraction of juice from sugarcane, study of different type of cane peeler and cane crushers. Purification of sugar cane juice, Bottling of sugarcane juice, bottling equipment, leaf filter, centrifuge.	Purification of sugar cane juice; Bottling of sugarcane juice; bottling equipment; Study of vacuum filters and , centrifuge Extraction of juice and clarification; Boiling of juice and clarification; Making the molds; Testing the quality of jaggary			
	Total hours for this sub-module		1	1	3
3	Knowledge of Machineries involve in Sugar production like Evaporators, Conveyor, Filter , materials handling equipments Clarification: Evaporation and heating: Crystallization: Centrifuging: Drying: sugar refining Grading and Bagging: Effluent treatment etc; Process of manufacture of jaggery unit operations involved; knowledge of different types jaggery, quality evaluation of jiggery. Utilization of Press mud and molasses	To determine the quality of molasses; To determine the Pol % and Moist % of the Filltercake; Proximate composition of Press mud and Iolation of wax from pressmud; Determination of brix % bagasse Production of ethanol from molasses; Demonstration of different unit operation involved in sugar production; Practice to operate these machineries; controlling parameters; Evaporators, filters and material handling, performance evaluation of evaporator; Crystallizers and centrifugal machines			
	Total hours for this sub-module		1	1	3

4	Methods of techniques of proper packaging of sugar & Proper storing of sugar, moisture control during storage, Knowledge of storage and packaging techniques and materials; Quality control of Sugar & confectionary; Keeping and refining qualities of raw sugar; Chemical treatment to prevent deterioration Knowledge of precaution taken & safety hazards Safety measure, trouble shooting operation involve & handling of equipments Practice on grading, packaging, sealing; storing & marketing of sugar. Quality evaluation of sugar; Learning of sugar refining By product utilization of sugar Industries like bagasse, Press mud molasses; ethyl alcohol production.	Identification of faults & immediate action avoiding damage of equipments; maintenance & cleaning operation of evaporators and filter maintenance & cleaning operation of crushers, evaporators, rotating vacuum filters, crystalizers, centrifugal machines, hoppers etc. Boiler water pH, and TDS ; Boiler water Hardness; Waste disposal and effluent treatment. Grading, of sugar; Packaging and sealing of sugar; Determination of purity of phosphoric acid by Sodium hydroxide method; Determination of CaO content in lime by using pattern and Redder indicator			
Total hours for this sub-module			1	1	3
5	Maintaining various records; Good receive note, weight chart, quality control chart etc. Cleaning and Sanitation in sugar industry - Cleaning and sanitizing program Cleaning methods: CIP, Clean-out-of-Place - Manual cleaning, Properties of food soils Cleaning agents - Sanitizers: Physical and chemical, Factors affecting effectiveness of sanitizer; Grading and marketing of sugar and jaggery. Use of baggase as fuel; Drying of baggase, fuel value of baggase. Practice on collection of order of sugar, maintaining records	Crystal size, Purity of sugar; Sulphur Di Oxide content in sugar; Sugar dryers; Elevators Drying of baggase ; Fuel value of baggase; Practice on collection of order of sugar, maintaining records; Practice on collection of order of sugar, maintaining records			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T-Theory, D-Demonstration, P-Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1.	General requirements like vessels, balances, trays, water storage facilities, oil container, mould, boiling pan, cutting knife, table,	04 for each tools

	different size containers etc. (To be shared)	
2.	Other general requirements for Good manufacturing practices	15 sets each
3.	Sugarcane crusher	02 No
4.	Load carrying machine	02 No
5.	Juice collection tank	02 No
6.	Pumping machine	02 No
7.	Evaporators	02 No
8.	Materials handling devices for carrying different materials	02 No
9.	Clarification unit	05 No.
10.	Refining unit	01 No
11.	Conveyor	02 No
12.	Packaging unit	02 No
13.	Tool cabinet	02 No
14.	First aid box	02 No
15.	Discussion table	02 No
16.	Weight Box	02 No
17.	Polarimeter	-
18.	Spectrophotometer	-
19.	Hydrometers	-
20.	Other common facilities for training	As required

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room : 600 sqft
- b. Demonstration & Practical Class Room : 2000 sqft

11. Power requirement : 10 kW power
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

M. Sc.(Sugar Technology), Diploma in sugar Technology with minimum 5 years experience

13. Suggested Readings

Text Books

1. The complete book on sugarcane processing and byproducts of Molasses by H-Panda- Asia Pacific Business Press Inc.
2. Sugar Confectionery Manufacture – E.B. Jackson – A Chapman and Hall Food Science Book – An Aspen Publication (1999).
3. System of Technical Control For Cane Sugar Factories In India - 2005 by N.C. Verma.
4. Hand Book of Sugar Technology by R.B.L. Mathur.
5. Hand Book of Cane Sugar Engineering by E. Hugot.
6. Text Book of Qualitative Analysis by Vogel.
7. Cane Sugar Factory Control by Banerji.
8. Hand of book of cane sugar – Meade & Chen
9. Introduction to cane sugar technology – Jenkins G. H.
10. Unit operation in cane sugar production – John H. Payne
11. Manufacture of sugar from sugarcane – C. C. M. Perk
12. Efficient Management for sugar factories – Mangal Singh
13. Cane sugar manufacture in India – D. P. Kulkarni

MODULE – 14

1	Title of the Module	:	Technology of wine making
2	Sector	:	Food Processing and Preservation
3	Code	:	SDT 14
4	Entry Qualification	:	12 th Standard
5	Minimum Age	:	18 yrs.
6	Terminal Competency	:	After completion of the course the candidate will be able to: a. Trained man power to work in winery b. Marketing wines
7	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

S. No	Theory	Practical	Contact Hours		
			T	D	P
1	Alcoholic beverages: Distilled and undistilled; Present national and international grape scenario, Varieties of wine grapes and its improvement : commercial classification of grapes, indigenous germplasm; varietal situation; description of varieties suitable for wine making, need for varietal improvement; objective of improvement; methods of improvement; Quality improvement; Harvesting and post-harvest management; Fermentation process development, scale of up Process; Contamination of wine during processing and effect of contaminants on quality of Wine; sensory evaluation	Study of different grape varieties; Physical parameters of grapes; PH, Acidity and TSS of grapes; Volatile acidity, free SO ₂ ; Harvesting and crushing of grapes; Estimation of reducing & total sugar by copper reduction technique; Preparation of mother culture and starter culture for wine production; Preparation of red and white wine; Wine clarification : Removal of protein from wine by hydrolysis, precipitation and adsorption method; Preparation of Fortified Wines			
Total hours for this sub-module			1	1	3

2	Biochemistry of alcoholic fermentation during wine production, sugar degradation; pathway, alcoholic fermentation, regulation of sugar utilizing metabolic pathway; pastures effect and Crabtree effect of glycerol, metabolic factors in yeast that control the formation of acetic acid etc. Biochemical changes due to commercial yeast strains: adaptation of yeast in fermentation media, addition of sulfur dioxide and effect of pH during crushing, nutrient balance during fermentation etc.	Alcohol, Ethanol, Acetaldehyde content of wine by titrametric method; Wine yeast; Technology of production of still and sparkling wines; Nutritional and health benefits of grapes and wines; Protein stability test / Heat stability test of wine Estimation of phenols; Stuck fermentation: causes and solutions; Exploitation of other fruits for wine making; Modalities in sensory evaluation of wine			
	Total hours for this sub-module		1`	1	3
3	Monitoring and controlling of fermentation parameters of wine: monitoring and viability and cell number of yeast during must preparation, controlling microbial growth during wine production, effect of pH, temperature, CO ₂ , amount of sugar consumed; Wine machineries: Destemer, Crusher, Pneumatic/ hydraulic press, Screw pumps, Fermentation tanks with cooling jackets/ cooling system, Filters, Vaccumized bottling plants, Wine cold stabilization tanks, Water softening plant, Oak woodvats and barrels for maturation of wine, certification wine machineries etc Production technology of wine, different types of grape wines, still and sparkling wines production of wine from fruits other than the grapes, Application of colors and additives in grape wine productions etc.	Additives in Wine making; Pneumatic Press; Destemer Crusher; Filters Study of Fermenters; Cold Stabilizer; Chilling Plant and Heat exchanger; Water treatment plants			
	Total hours for this sub-module		1	1	3

4	Packaging technology, labeling & storage of wines, Economic feasibility studies; of wine productions, wine marketing etc.; wine spoilage Sensory evaluation of wine.; New concept of wine production: organic, biodynamic wine etc; Flavor development and maturation of wine, types of flavoring compounds etc.; Biotechnology in Viti culture, Wine as a functional food, Factors affecting during storage or aging of wine.	Fining equipments (Filtration); Bottling, Corking, labeling, foiling and Packing unit; Equipment used in sparkling winemaking; White wine production and recommended varieties; Red wine production and recommended varieties; Marketing and Standards of Wine; Production of wines other than grapes. Techniques of testing wine:- Selection of glass, serving temperature, Design of room for wine testing			
Total hours for this sub-module			1	1	3
5.	Cleaning and Sanitation in Winery General cleaning and sanitizing program; Cleaning methods:CIP, Clean-out-of-Place; Manual cleaning; Properties of food soils Cleaning agents; Sanitizers: Physical and chemical ; Factors affecting effectiveness of sanitizer Studies on factors affecting quality of wine Wine standards, Rules and regulations, wine additives; Project report ; Introduction, Market survey, Raw materials, Process of manufacture, plant & machinery, land & building, Project economics, Annexures of charts/financial aspects	Wine spoilage; Sensory evaluation and score card:- Rose worthy score card, Devis score card; and sparkling wine score card; Visit to vineyard; Tartarate and bitartarate stability test / cold stability test; Determination of acetaldehyde / phenol content of wine; Adulteration of wine; Cleaning and Sanitizing agents; Visit to the winery			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Pneumatic press,	1
2	Chilling plant, bottling unit,	1
3	Autoclave,	1
4	Hot air oven,	1
5	Incubator,BOD Incubator,	1
6	Deep freezer,	1
7	Refrigerator,	2
8	Laminar air flow bench,	1
9	Vortexmixer/shaker,	1

10	Hot plate,	1
11	Water bath shaker incubator,	1
12	PH meter,	10
13	Colorimeter,	2
14	Compound microscopes (5),	1
15	Steel distillation plant,	1
16	Orbital incubator Shaker,	1
17	Analytical weighing balance,	1
18	Paper chromatographic cabinet,	1
19	TLC assembly,	1
20	Homogenizer,	1
21	Magnetic stirrer,	1
22	UV-Visible spectrophotometer,	1
23	Fabricated S.S. Fermenter (50 L),	1
24	Flame Photometer,	1
25	Sonicator Crusher, Pycnometer,	1
26	Hydrometer,	1
27	Refractometer,	5
28	Refrigerator	1
29	, Centrifuge	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 600 sq.ft.
b. Demonstration & Practical Class Room : 1500 sq.ft.

11. Power requirement

Total power requirement : 50 kW

12. Qualifications of Instructor

: ME./ M.Tech (Food Science & Technology)
M.E / B.Tech in Food Process
Engineering/Agricultural Engineering
with minimum 3 years experience

13. Suggested Readings

Text Books

1. The Grape, Improvement, Production and Post harvest management by K.L. Chadha
2. Fruits: Tropical & subtropical by T.K. Bose
3. General Viticulture by A.J. Winkler
4. Viticulture in Tropics by K.L. Chadha
5. Principles and practice of winemaking, by. Boltan R.B Chapman and Hall.
6. Wine Microbiology Science and Technology. Glaudio Delfins and Formica J. V.
7. The art and science of Wine. James Halliday and Hough Johnson. Mitchell Beazley International Ltd. Landon.
8. Prescott S.C. and Dunn C.G. (1983) Industrial Microbiology, Reed, G. (Ed.) AVI
9. Tech Books.
10. Technology and Biochemistry of Wine Vol. I and II Jan Farkas, Gordon and Breach science publishers.
11. Microbial Technology Vol. I and II by Pepler and Perlman.
12. Advances in Biotechnology Vol. I and II by Murray Moo-Young.

13. Wine analysis and production by Bruce W. Zoecklein Kenneth C. Fugelsang, Barry Gump, Fred. Nury, CBS Publication, Delhi.
14. Wine analysis and Production by Bruice W. Zecke.
15. Principle and Practices of Wine making by Roger B. Boulton.
16. Winery utilities by David R. Storm.
17. Wine Microbiology by Kenneth C. Fugelsang
18. Application of Sensory Evaluation in Wine Making by Susan E. Duncan
19. Principles of sensory evaluation of foods by M.S. Amerine, Academic press, New York
20. Handbook of analysis and quality control for fruit and vegetable products by S. Ranganna, Tata McGraw Hill Pub. Co. Ltd. New Delhi.
21. Food Safety and Standards Act, 2006 by P. K. Das

MODULE – 15

1.	Title of the Module	:	Technology of Brewing
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 15
4.	Entry Qualification	:	12 th Standard
5.	Minimum Age	:	18 yrs.
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a. Trained man power to work in brewery b. In malt industry c. Marketing of beer
7.	Duration (in Hrs)	:	1 Week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Alcoholic beverages: Distilled and undistilled Introduction, Types of Barley, preparation of barley malt History of brewing, Malts, Mash tun adjuncts and brewing liquor; Milling, mashing and wort separation systems. The hop-boil and copper adjuncts, wort clarification, cooling and aeration.	Preparation of barley malt; Studies on physical quality of malt; Chemical analysis of malt; Preparation of mother culture and starter cultures for beer production. Preparation of malt powder; Preparation of mash and mashing; Separation of mash; Wort boiling			
		Total hours for this sub-module	1	1	3
2	Fermentation process development, scale of up; process. Contamination of beer during processing and effect of contaminants on quality of Beer; Monitoring and controlling of fermentation parameters of beer	Wort separation; Fermentation; clarification of beer; Aging of beer; Sensory evaluation of Beer; Stuck Fermentation: Causes and Solutions in brewery ; Removal of protein from beer by hydrolysis, precipitation and adsorption method; Major problems in Beer production; Defects in Beer			
	Total hours for this sub-module		1	1	3

3	Brewery equipments; Types of beers, aging of beers ; Contamination of beer during processing and effect of contaminants on quality of beer. Water treatment plants	Studies on factors affecting quality of beer; Fermentors Oak Wood Barrels and its Effect on Flavour of beer; Design of Brewery equipments; Contamination of beer during processing and effect of contaminants on quality of Beer; Cold Stabilizer; Chilling Plant and Heat exchanger; Water treatment plants			
Total hours for this sub-module			1	1	3
4	Hops: composition, acids, chemistry of brewing; Packaging technology, labeling, storage of beers and marketing of beer etc.	Fining equipments (Filtration); Bottling, Corking; labeling, foiling and Packing unit Nutritional and Health Benefits of beer; Analysis of lagger beer; Hops: chemistry; Analysis of hops for acids; Brewers yeast: Morphology; Physiology of brewers yeast; Marketing and Standards of beer;			
Total hours for this sub-module			1	1	3
5	Cleaning and Sanitation in brewery General cleaning and sanitizing program; Cleaning methods: CIP, Clean-out-of-Place; Manual cleaning; Properties of food soils Cleaning agents; Sanitizers: Physical and chemical, Factors affecting effectiveness of sanitizer International rules and standards for beers; Project report Introduction, Market survey, Raw materials, Process of manufacture, plant & machinery, land & building, Project economics, Annexures of charts/financial aspects	Tartarate and bitartarate stability test / cold stability test; Determination of acetaldehyde / phenol content of beer; Spoilage of beer; Adulteration of beer; Cleaning and Sanitizing agents; Beer bottle washing; Corking of beer and pressure of CO ₂ ; Visit to the brewery			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Grinders	2
2	Chilling plant, bottling unit,	1
3	Autoclave,	1
4	Hot air oven,	1

5	Incubator,BOD Incubator,	1
6	Deep freezer,	1
7	Refrigerator,	2
8	Laminar air flow bench,	1
9	Vortex mixer/shaker,	5
10	Hot plate,	1
11	Water bath shaker incubator,	1
12	PH meter,	10
13	Colorimeter,	1
14	Compound microscopes (5),	1
15	Steel distillation plant,	1
17	Analytical weighing balance,	1
18	Paper chromatographic cabinet,	1
19	TLC assembly,	1
20	Homogenizer,	1
21	Magnetic stirrer,	1
22	UV-Visible spectrophotometer,	1
23	Fabricated S.S. Fermenter (50 L),	1
26	Hydrometer,	2
27	Refractometer,	5
29	Centrifuge	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement : 220 v 3 phase

12. Qualifications of Instructor : M.Tech / ME (Food Science & Technology)
M.Sc. (Packaging Technology)

11. Power requirement

12. Qualifications of Instructor

M.Sc. or Ph.D. Fermentation Technology, Biotechnology or Food Technology

13. Suggested Readings

Text Books

1. Brewing Science and Practice by Briggs, Boulton, Brookes and Stevens 2004, Woodhead Publishing Limited, USA.
2. Food Biotechnology edited by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin, Taylor & Francis Group 2006.
3. Biotechnology by B. D. Singh, Kalyani publication, 2000.
4. Fermentation a practical approach by McNeil and L M Harvey, published in the
5. Practical Approach Series, Indian publication, 2007.
6. Microbial Technology Vol. I and II by Peppler and Perlman.

MODULE - 16

1	Title of the Module	:	Food Packaging and Labeling
2	Sector	:	Food Processing
3	Code	:	SDT 16
4	Entry Qualification	:	Minimum 12 th Standard
5	Minimum Age	:	17 yrs.
6	Terminal Competency	:	After completion of this training the participant would be able to a) To familiar the students with the operation and maintenance of modern as well as traditional packaging methods b) To train the students to determine the appropriate packaging requirement for a food material
7	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Definitions, objectives and functions of packaging and packaging materials - types of packaging materials: paper: glass, methods of bottle making; metals: tinplate containers, tinning process, components of tinplate, types of cans, aluminum containers, lacquers; plastics: types of plastic films, laminated plastic materials Properties of packaging materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, methods of testing and evaluation; barrier properties of packaging materials; theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate and its measurement, water vapor transmission rate and its measurement	Testing of packaging materials for quality assurance like determination of thickness, GSM, grease resistance, bursting strength, tearing resistance, WVTR, puncture resistance Familiarization of types of packaging material, Measurement of tin coating weight by Clarke's method Visit to a package manufacturing plant			
Total hours for this sub-module			1	1	3

2	Packaging equipment and machinery - vacuum machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machine; carton making machine	Vacuum packaging and determination of storage life Testing the compression strength of the boxes			
Total hours for this sub-module			1	1	3
3	Food packaging systems- different forms of packaging such as rigid, semirigid and flexible forms, retortable pouches - packaging system for dehydrated foods, frozen foods, dairy products, fresh fruits and vegetables, meat, fish, poultry, sea foods, vanaspati ghee & basamati rice	Packaging of food material in seal and shrink packaging machine and study its shelf life, Testing of strength of glass containers by thermal shock test, Testing of strength of filled pouches by drop tester			
Total hours for this sub-module			1	1	3
4	Standard packages - package laws and regulation – general guidelines on giving declarations - SWMA, PFA rules, Ingredients, FPO rules, MFPO rules, Agmark rules	Packaging of powder foods and estimation of shelf-life Visit to a food packaging plant			
Total hours for this sub-module			1	1	3
5	Food Packaging and Labelling Labeling requirements for packed food and food products as per FSSA 2006, SWMA and nutritional labeling requirements.	Visit to food package manufacturing industries			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Qty
1.	Vacuum packaging machine	1
2.	Texture Analyzer	1
3.	Form & fill sealing machine	1
4.	Gas packaging machine	1
5.	Seal & shrink packaging machine	1
6.	Fruit & vegetable packaging (bag) machine	1
7.	Bottle filling machine	1
8.	Carton making machine	1
9.	Cup filling machine	1

10.	Ghee packaging machine	1
11.	Drop Tester	1
12.	Crush Tester	1
13.	Shear Tester	1
14.	Slip Friction Tester	1
15.	Thickness Tester	1
16.	Cobb Tester	1
17.	Vibration Tester	1
18.	Water vapor permeability tester	1
19.	Mechanical tool box	1 set
20.	Electrical tool box	1 set
21.	Chemicals, glass ware, packaging materials	as per the requirement

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement

: 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

: M.Tech / ME (Food Science & Technology)
M.Sc. (Packaging Technology)

13. Suggested Readings

Text Books

- 1) Coles R, McDowell D & Kirwan M.J. 2003. *Food Packaging Technology*. Oxford Blackwell.
- 2) Crosby NT. 1981. *Food Packaging Materials*. Applied Science Publication.
- 3) Gordon L Robertson. 2006. *Food Packaging: Principles and Practice*. 2nd Ed. CRC Press.
- 4) Mahadeviah M & Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw Hill.
- 5) Raija A. 2006. *Novel Food Packaging*. Woodland Publication Co.
- 6) Sacharow S & Grittin RC. 1980. *Principles of Food Packaging*. AVI Publication.
- 7) *Modern packaging technology*, EIRI Board of Consultants and Engineers.

MODULE – 17

1.	Title of the Module	:	Food Safety and Microbial Analysis
2.	Sector	:	Food processing industries and R & D units
3.	Code	:	SDT 17
4.	Entry Qualification	:	Minimum graduate with Science (Biology /Medical) stream
5.	Minimum Age	:	23 yrs
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a) Understand the beneficial uses of micro-organisms in the food industry b) Utilize laboratory techniques to identify micro-organisms in foods; c) Understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e. pH, temperature etc.) on the growth and response of micro-organisms in food industries
7.	Duration (in Hrs)	:	2 weeks (50 Contact hours)

8. Module Contents

S.No	Theory	Practical	Contact Hours		
			T	D	P
1	Importance of Food microbiology in food industry. Occurrence of Microorganisms and Sources of Microorganisms in food. Identification of microorganisms by direct methods like Morphology, Arrangements of bacterial cells, Structure and Chemical composition and indirect method like detection of degradative enzymes as proteases, lipases, amylases, and cellulases. Differentiation of bacteria, fungi and actinomycetes occurring in food; Importance of Food microbiology in food industry. Occurrence of microorganisms and their role; Sources of Micro-organisms in food; Major Characteristics of micro-organisms; Morphology, Structure and nomenclature of micro-organisms. Nature of food spoilage by microorganisms (bacteria, fungi, and virus), enzymes, pests and rodents. ; Food spoilage & different	Good laboratory practices, cleanliness, sanitation and safety measures to be adopted in a food microbiology lab. Glassware handling and usage, washing, identification and care of equipments, lab facilities; Selection and storage of chemicals, media ingredients, sanitation and hygiene practices for rooms, articles, personnel; Cleaning of work surface, hands, needles, loops; Disposal methods for used articles, hazard prevention; Protocols: preparation of solutions required for media, cotton plug making for tubes, flasks, pipettes; Influen; of various intrinsic and extrinsic parameters on the microbial activity during food storage; Various types of media and their preparation in lab; Sterilization of media – Steam sterilization, intermittent steaming, dry			

	types of food contaminations; Spoilage caused by microbes (bacteria, fungi, and viruses), enzymes; Spoilage of foods, caused by pets and rodents; Contamination and spoilage of: Cereals and pulses	hot air, filter sterilization; Sampling and, Cultivation of micro-organisms; Enumeration and identification of coliforms from water using MPN technique; Examination of spoilage in foods			
	Total hours for this sub-module		2	2	6
2	Contamination and spoilage of: Cereals and pulses; sugar and sugar products; Sources of microbial spoilage in vegetables and fruits and detection; Microbial spoilage of flesh foods; eggs; milk and milk products; Food contamination and Toxin production : Contamination and spoilage of sugar and sugar products ;Contamination and spoilage of vegetables and fruits; Microbial contamination and spoilage of flesh foods/ meat & eggs; Microbial contamination and spoilage of milk and milk products; Techniques of preservation in food processing industries - canning, controlled atmosphere, cold storage and drying Water activity, intrinsic and extrinsic parameters influencing storage of processed food; Physical conditions required for growth of food microbes; Microbial Examination of common food items; Maintenance and preservation of pure cultures; Normal Growth Cycle (growth curve) of bacteria, growth phases, synchronous growth and continuous culture.	Handling of bacteria, yeasts and fungi and pure culture techniques, aerobic and anaerobic systems, broth inoculation, agar tube inoculation , Handling of bacteria, yeasts and fungi and pure culture techniques broth inoculation, agar tube inoculation; Handling of bacteria under aerobic and anaerobic systems; Detection of <i>E. Coli</i> , <i>Yersinia</i> , <i>Staphylococci</i> , & <i>Salmonella</i> from food samples; Detection of <i>Campylobacter</i> , <i>Bacillus cereus</i> , <i>Cl. botulinum</i> from food samples; Identification and examination of spoiled canned food Rapid analysis for testing the quality of milk; Detection of <i>Staphylococci</i> , <i>yersinia</i> , <i>campylobacter</i> , <i>B.cereus</i> , <i>Cl.botulinum</i> & <i>Salmonella</i> from food samples in selective and differential media; Visual examination of microbial growth,			
	Total hours for this sub-module		2	2	6
3.	Types of microbial spoilages and detection in in the canned food-flat and flipper,Spoilage of processed meat, fish, milk and milk products; Pure cultures and cultural characteristics; Mixed cultures; selective methods; Methods isolating pure cultures; Maintenance and preservation of pure cultures; Microbial Examination of Food: Pure cultures and cultural characteristics – Mixed cultures; selective methods – Methods isolating pure cultures – Maintenance and preservation of pure cultures.Physical conditions required for growth – Temperature, Gaseous requirement, pH, miscellaneous physical requirement; Light microscopy and staining techniques for identifying microorganisms-simple and differential staining techniques.; Beneficial	Sampling and, Cultivation of micro-organisms: Serial dilution techniques, Membrane filtration; Enumeration and identification of coliforms from water using MPN technique; Staining techniques and handling of microscopes; Preparation of smears, use of monochrome staining, gram stain, acid fast stain; Techniques for Spore stain and capsule stain; Identification and examination of spoiled canned food; Rapid analysis for testing the quality of milk; Detection of <i>Staphylococci</i> , <i>yersinia</i> , <i>campylobacter</i> , <i>B.cereus</i> , <i>Cl.botulinum</i> & <i>Salmonella</i> from food samples in selective and differential media			

	activities of microbes in foods; Probiotics; their use in Food Microbiology; Role of microorganisms in pickled products; Role of microorganisms in jams.				
	Total hours for this sub-module		2	2	6
4	Cultural media-liquid, solid and semisolid media. Simple media, selective media, enrichment media and differential media and their use; Microorganisms used in food fermentations; Fermented food and beverage production – wine & beer; Microbiology of traditional fermented foods - <i>Idli, Dosa</i> ; Microbiology of curd and yogurt; Food safety: definition, food safety issues, factors affecting food safety, importance of safe foods; Food additives and contaminants: various kinds of additives- food colour. Preservatives, artificial sweeteners, toxins, adulterants and pesticide residues; Introduction to food safety: definition, food safety issues; Factors affecting food safety, importance of safe foods; Food additives and contaminants: various kinds of additives- food colours; Preservatives, artificial sweeteners, toxins, adulterants and pesticide residues	Visual examination of growth, description of colony morphology, turbidity measure by colorimetry; Examination of microorganisms from floors, equipments, plants, machineries; Examination and identification of first and second stage of cell morphology; Use of disinfectants, phenol coefficients; Tests for establishing sensitivity to chemicals, antibiotics, chemotherapeutics, and minimal inhibitory concentrations.; Staining techniques Preparation of smears, use of monochrome staining, gram stain, acid fast stain, spore stain, capsule stain, flagella stain, fluorescent stain, staining, card and handling of microscopes; Techniques used in Food quality analysis ; Determination of food pathogens in processed foods; Aflatoxin detection by TLC; Aflatoxin detection by TLC.			
	Total hours for this sub-module		2	2	6
5	Sanitation in food processing plant, Sanitizers- detergents, disinfectants. Food quality evaluation- sensory, physical, chemical and microbiological tests; Sanitation in food processing plant; Sanitizers- detergents, disinfectants; Food quality evaluation; Sensory, physical, chemical and microbial tests for evaluation of food quality. Food safety standards-regulatory agencies- Bureau of Indian Standards (BIS), AGMARK, ISO. Concepts of GMP, HACCP. Food safety standards-regulatory agencies- Bureau of Indian Standards (BIS); Food Safety Standards : AGMARK; ISO Certification; Concepts of GMP, HACCP.	Bright field; UV fluorescent microscopy, magnification, use of stage micrometer and ocular disc for determining size of microorganisms.; Determination of Synthetic color in foods; Determination of Food Preservatives -I ; Determination of Food Preservatives –II; Determination of artificial sweeteners by UV Spectrophotometric method; Determination of food pathogens in processed foods; Detection of common food adulterants in raw / unprocessed foods – I; Detection of common food adulterants in raw / unprocessed foods – II; Detection of common adulterants in processed foods – I; Detection of common adulterants in processed foods - II			
	Total hours for this sub-module		2	2	6
Total Contact Hours Individually for Theory, Demonstration and Practical			10	10	30

Grand Total of Contact Hours	50
-------------------------------------	-----------

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No	Experiment	Name of the Instrument	Qty.
1.	Sterilization techniques and equipments, Preparation of culture media	Autoclave Horizontal	1
2.			
3.	Isolation of microorganisms & Enumeration	Incubators	1
4.	Examination of anaerobic microorganisms in food	Anaerobic jar	1
5.	Detection of Biological oxygen demand for the microorganisms	BOD incubator	1
6.	Preservation of foods at low temperature and for storage of microbial cultures	Refrigerator	1
7.	Distilled water for experiments	Water Distillation System	1
8.	Burning laboratory harmful waste, converts to ash, discarding purpose.	Electrical Incinerator	1
9.	Food preservation with chemicals and at low temperature	Deep freezer	1
10.	Moisture studies for food samples,	Desiccators	1
11.	Enumeration of microorganisms in food by aerobic plate count method, Enumeration of yeast and molds in foods by direct plating technique	Micro Pipettes	2
		1ml fixed	2
		1ml variable	2
		10 ml	
12.	Sample preparation, filtration for isolation and purification of microorganisms	Membrane filtration unit	1
13.	Preparation of culture media.	pH /EC /TDS meter	1
14.	Sterilization techniques and equipments.	Hot Air Oven	1
15.	Microbiological works	Vertical Laminar Flow Chamber	Each 1 No
16.	Reagent preparation, Serial dilution etc	Vortex mixture	2 Nos
17.	Reagent preparation, Sample preparation, Serial dilution, etc	Magnetic stirrer with hot plate	1
18.	Sterilization techniques and equipments.	Sonicator	1
19.	Media preparation and other experiments	water bath	1
20.	Estimation of toxin production in foods by molds, Rapid detection of food borne pathogens	TLC Set	1
21.	Washing of glassware washing and other utensils	Dish washer	1
22.	Isolation of microorganisms & Enumeration.	colony counter	2
23.	Drying of Food products and microorganisms Encapsulation of probiotic bacteria	Freeze Dryer	1
24.	Microbial growth determination	UV Spectrophotometer	1
25.	Enumeration of microorganisms in food by aerobic plate count method	Air sampler	1
26.	Microscopic examination of microorganisms	Dark field and phase contrast Digital Microscope	1
27.	Bacterial cell count	Haemocytometer	1
28.	Microbial growth determination	Shaking Incubator	1
29.	Microbial growth determination	Fermentor	1

30.	Media preparation	pH meter	1
31.	Extraction	centrifuge	1
32.	sampling	Heating mantle	1
33.	Weighing of food samples	Electronic balances	2
34.	safety precautions	Fire extinguisher	1
35.	medical safety precautions	Eye washer	1
36.	Microbiological work	Bunsen burner	2
37.	Microbiological work	Spirit lamp	2
38.	Temperature recording	Thermometer	2
39.	Microbiological work	Plate spreader	2
40.	Microbiological work	Auto Loop sterilizer	1
41.	Microbiological work	Inoculating loop	5
42.	Nutrient agar medium, nutrient broth, Potassium dihydrogen phosphate, Peptone, Sodium chloride Potassium dichromate , Conc. Sulphuric acid . Sterile sampling bags, Agar , Plate count agar ,Yeast and mold agar , Potato dextrose agar ,Chlortetracycline hydrochloride, Tartaric acid , Lauryl tryptose broth , Brilliant green bile broth , EC medium , Levines Eosin methylene blue agar , Tryptone ,MRVP test reagent , Koser Citrate medium .p-dimethyl aminobenzaldehyde (for Kovacs reagent), Baird-Parker agar , Trypticase soy broth , Sodium pyruvate , Brain heart infusion broth , Coagulase plasma,Toluidine blue ,SS agar, MSA agar, EMB agar, Macconkey agar, MRS agar, MRS broth, Sodium Hydroxide, Hydrochloric acid, buffer tablets	Chemicals	-
43.	Autoclavable petridishes, culture tubes, beakers, conical flasks, measuring cylinders, absorbent & Nonabsorbent cotton, Autoclavable Test tubes, Autoclavable screw cap tubes, Burette borosilicate , Burette stands , Measuring cylinders graduated, Universal bottles, McCartney bottles, Funnels glass, Buchner flasks, Beakers, Conical flasks , Volumetric flasks, Milk dilution bottles with screw caps, glass Pipettes, Glass bottles with polypropylene (autoclavable) screw caps, Durham tubes and Brushes for bottle washing.	Glassware's	-
44.	Test tube stand, petri plate holders,pH paper, Aluminium foil, autoclavable micro tips, Enamel trays	Plastic wares	-

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room : 40' X 30'
- b. Demonstration & Practical Class Room : 50'x40'

11. Power requirement

: 3 phase power connection

Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

: M.Sc. (Microbiology/ Food Microbiology)

13. Suggested Readings

Text Books

- 1) Food Microbiology – Adams
- 2) Food Microbiology by W. C. Frazier & D.C. Westhoffs, IV th edn., TMH (1993).
- 3) An Introduction of Microbiology _ P. Tauro
- 4) Food Microbiology – James M. H Jay
- 5) Food Hygiene, microbiology & HACCP – 3rd edition – S.J. Forsythe & P.R. Hayes
- 6) Developments in Food Microbiology, R. Davis. Appl.Sci.Publ, London 2004
- 7) Fermented Food Biotechnology H. A. Modi Aavishkar Publisher, Jaipur 2011
- 8) Graham, H.D. 1980: The safety of foods, AVI publishing company Inc. Westport.
- 9) Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London.
- 10) Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
- 11) Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
- 12) Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi
- 13) Guide to Improve Food Hygiene - Gaston and Tiffney
- 14) Practical Food Microbiology & Technology - Harry H. Weiser, Mountney, J. and Gord, W.W.
- 15) Food Poisoning and Food Hygiene - Betty C. Hobbs
- 16) Principles of Food Sanitation - Marriott and Norman, G.
- 17) Hygiene and Sanitation in Food Industry - S. Roday
- 18) Fundamental Food Microbiology. (4th Edition). Bibek Ray, Arun Bhljnia; CRC Press.
- 19) Modern Food Microbiology. (6th Edition). James M. Jay.
- 20) Manual of Methods of Analysis of Foods. Food Safety and Standards Authority of India. Ministry of Health, Govt. of India
- 21) Basic Food Microbiology. John E. Rushing, P.A. Curtis, A.M. Fraser*, D.P. Green,. D.H. Pilkington, D.R. Ward and L.G. Turner.

MODULE – 18

1.	Title of the Module	:	Food Supply Chain Management
2.	Sector	:	Food Processing
3.	Code	:	SDT 18
4.	Entry Qualification	:	12 th Standard
5.	Minimum Age	:	18 yrs.
6.	Terminal Competency	:	After completion of this training the participant will be able to a) Become an entrepreneur b) Marketing professional in food business c) Logistics provider d) Food Trading e)
7.	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Supply chain, logistics, Evolution of logistics concept, Logistical mission and strategic Issues, Logistics in India, Importance of logistics management, Strategic logistics planning process, Operational objectives, Components of logistics management, Functions of logistics management, Integrated logistics system, Agribusiness Environment & Policy - Agricultural Production Management - Business Ethics & Global Business Environment; Sources of cereals and legumes, fruits and vegetables, milk and milk products, meat and meat products, marine products in India, its importance in national economy. Supply chain business opportunities, Market, Assessment, Technical Analysis, and Financial Analysis, Forecasting, Facilities and Aggregate Planning. Food Processing Unit Operations -1; Introduction Business logistics; The supply chain; Importance of Logistics/Supply Chain (SC) Costs analysis Logistics customer service Supply and distribution lines lengthening with greater complexity Quick customized response;	Strategic logistics planning process, Functions of logistics management, Integrated logistics system, Elements of the supply chain; Life Cycle Assessment Studies of Food Products; Detection of microbial spoilage of food; Sensory evaluation of food; The Cold Chain; The major cold chain technologies: Dry ice; Gel packs; Eutectic plates.			

	Logistics Food supply chain management; from farm to fork, Elements of the supply chain, Transport and storage, Social and environmental concerns associated with the food supply chain; Post Harvest Food Management - Supply Chain Management ,The major cold chain technologies; Dry ice, Gel packs, Eutectic plates, Liquid nitrogen, Quilts, Reefers; Refrigerated Containers; Managerial Economics; Fresh Food and Supply Chain Management Challenges; Life Cycle Assessment Studies of Food Products; Retail logistics - cold chain has the following impacts - major cold chain technologies;				
	Total hours for this sub-module		1	1	3
2.	Principles of Logistics: Production and sale of food products at globale level, and the life cycle of the product is short. The right and wrong of logistics are influencing the success or failure of corporate management. Learning CSF(critical success factor) of Logistics through the study of successful food industry. Quantitative Management Analysis; Food safety The risk management, internationally agreed definition, framework and process of risk management. Risk analysis, risk assessment, risk management and risk communication; Food Safety and Standards - Agricultural Marketing - Production and Operations Management; Commodity Markets and Futures Trading - Retail Management - Management Concepts - Business Communication	Liquid nitrogen; Quilts, Reefers; Refrigerated Containers; Study of retail logistics; Food Processing Unit Operations- 2; Safety in the supply chain: Biological hazards; Isolation of <i>Salmonell</i> ; Isolation of <i>S. aureus</i> ; Study of physical hazards.			
	Total hours for this sub-module		1	1	3
3.	Organizational Behavior - Human Resource Management - Financial Management of Agribusiness Managerial Accounting and Control; Function of a package, packaging materials, their structural qualities and performance including moisture and gas transmission, interaction of food and the packaging material, methods of package testing, performance evaluation and design of packaging systems for plant and animals products. Food packaging and law, shelf life testing, modern and traditional packaging material, physical and chemical properties, production, storage and recycling of packaging materials, regulation and equipment analysis of various existing packaging system and standards. Smart and intelligent packaging. Micro Finance for	Study of different packages; Properties of packaging material: physical; Properties of packaging material: chemical; Visit to packaging industry. Food Processing Unit Operations- 3 Special packaging methods : vacuum; Special packaging methods : gas Special packaging methods: shrink packaging; MAP.			

	Agribusiness - Rural Marketing				
	Total hours for this sub-module		1	1	3
4.	Economic Environment and Business Laws - Agribusiness Cooperative Management; Traceability system: In order to nurture a diverse viewpoint capable of understanding and analyzing traceability, Recalls	Research Methodology for Management; Preparation of project report; Management of finance; Study of present handling practices; Visit to mandi; Information Technology and Systems for Management; Barcodes; RFID; Recalls; Visit to logistic/supply chain.			
	Total hours for this sub-module		1	1	3
5.	Quality Management in Agribusiness - Agribusiness and Society; International food Legislation & Standards Concepts and trends in food legislation. International and federal standards: Codex alimentarius, ISO series, food safety in USA. Legislation in Europe: EU, Enforcers of Food Laws Approval Process for Food Additives Nutritional Labeling. Distribution 1. Purpose of Quality Control : Raw Material Safety, Product Value, Accident Prevention; QC Issues in Food System : Raw Material Sourcing, Manufacturer, Distributer, Retailer; Safety/Quality/Price required by consumers : Consumer Needs The practices of QC in wholesalers The practices of QC in retailers; Contract Farming - International Agricultural Trade; Project report; Introduction, Market survey, Raw materials, Process of manufacture, plant & machinery, land & building, Project economics, Annexures of charts/financial aspects Food Trade Barrier Basis, trends and composition of India's Foreign trade. Analysis of Exim policy. Institutes for promotion of Indian agricultural/horticultural trade and export inspection agencies. Export documentation, Procedures etc. Role of Institute like Export/Import Bank and ECGC (Export Credit Guarantee Corporation). Food Regulation in an open economy, Trade related regulations, Global food Regulatory Framework, food safety, Regulating Quality, Emerging Food Regulation; safety/ risk management, CSR (Corporate Social Responsibility) risk communication, etc. in food supply chain.	Approach to and Current State of Food Safety Assurance: The Age of Food Shortage and the Age of Food Glut Deregulation: Advances in Distribution and Food Safety due to Deregulation Future of Indian Agriculture: Basic Food, Agriculture and Farming Community Planning, and the Transition to Agribusiness; Global food supply chain; Supply Chain Risk HACCP, GAP; Current State of Food Safety Assurance; E-trading; Visit and study of the level of "Food Safety Administration" in Wholesalers and Retailers of Food ; Visit to contract and cluster farm; Preparation of project report; Visit to fruit exporting unit.			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15

Grand Total of Contact Hours	25
-------------------------------------	-----------

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Particulars	Quantity
1.	Computer with internet and Software packages	10

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement : 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

MSc (Extension) / M.Tech. (Food Technology) / MBA Management

13. Suggested Readings

Text Books

- Food Supply Chain Management: Economic, Social and Environmental Perspectives (Pullman, M. and Z. Wu, 2011: Routledge ISBN-10: 0415885884)
- Food Supply Chain Management Eds by Michael A. Bourlakis and Paul W. H. Weightman, Published by Wiley-Blackwell. Amazon.com INC.
- Food Supply Chain Management **Edited by:** Jane F. Eastham, Liz Sharples and Stephen D. Ball by Elsevier Ltd.
- Food Safety for the 21st Century: Managing HACCP and Food Safety throughout the Global Supply Chain by Carol Wallace, William Sperber, Sara E. Mortimore. Wiley, John & Sons,
- Textbook of Logistics and Supply Chain Management by D.K. Agrawal Macmillan Publishers India Limited.

MODULE – 19

1	Title of the Module	:	Skill Development in Sensory Assessment Techniques
2	Sector	:	Food processing industries and R & D units
3	Code	:	SDT 20
4	Entry Qualification	:	Graduate with Science stream
5	Minimum Age	:	23 yrs
6	Terminal Competency	:	After completion of the course the candidate will be able to: a) Develop proficiency skills in basic knowledge of sensorial testing of food and beverages b) Design and conducting the sensorial testing of food and beverages c) Data analysis of the response of the panelist d) Drawing conclusions of the sensorial testing
7	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

Sl. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Basics of sensory science; Pre-requisites for sensory analysis; Definition of sensory analysis; Knowledge on sensory vs organoleptic evaluation; Sensory characteristics of food Factors influencing the sensory evaluation Taste; Odour; Texture; Flavour.	Understanding the basics of sensory test; Understanding the characteristics and factors affecting sensory evaluation;			
		Total hours for this sub-module	1	1	3
2.	Taste: an important sensory attribute; Classification of basic taste; Classification of foods based on taste ; Taste quality in food systems; Food taste acceptance; Programme of a course for panel finalization; Theoretical concept of sensory test programme such as set of sensory test and panelist; Types of sensory tests and its application with example; Types of sensory panelist and basis of their uses in various sensory evaluation.	Evaluation of taste of several products; Study the types of sensory evaluation for recognizing the four basic taste			
		Total hours for this sub-module	1	1	3

3.	Concept of sensory laboratory; Strategic requirement for sensory laboratory; Factors affecting its application for certain sensory test; Components of the sensory laboratory; Threshold tests for four basic tastes; Threshold types; Determination of threshold concentration; Factors affecting the results of threshold tests; Concept of developing questionnaire: Basics of the statistical tests required for sensory data analysis, namely, ANOVA, t-test etc. in reference to min. number of judges or panelist required for conducting a certain test, procedure adopted and way to analyze data	Understanding the sensory evaluation laboratory; Tests with sucrose concentration series; Tests with sodium chloride concentration series; Tests with pure water concentration series; Understanding the concept of sensory evaluation, data collection and analysis			
		Total hours for this sub-module	1	1	3
4.	Sensory analysis; Selection of sensory type; Selection of evaluation panelist or judges for the selected sensory test; Requirements of the sensory laboratory; Preparing samples and conduct of test; Concept of the Difference test; Developing questionnaire for the selected test; Selecting judges and analyzing their response	Understanding the preparation for; sensory evaluation and conduct of test; Understanding the preparation for a sensory evaluation and conduct of test			
		Total hours for this sub-module	1	1	3
5.	Concept of the tests; Developing questionnaire for the selected test; Selecting judges and analyzing their response	Conducting sensory test to characterize the nature of difference using ranking test			
		Total hours for this sub-module	1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Sensory laboratory with one sample preparation and master chamber and min. 20 panel chambers	1
2	Raw materials as per the laboratory test	1
3	Lab materials - glasswares	-
4	Kitchen equipments and materials	
5	Testing materials	

6	Tasting beakers	
7	Foods for testing	
8	Computer with statistical software	
9	Odorants, essential oils	

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement : 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor : M.Tech (Food Science & Technology)
M.Sc. (Food Science & Nutrition)

13. Suggested Readings

Text Books

- 1) Sensory science- Principles and Applications in Food Evaluation by V.K. Joshi published by Agrotech Publishing Academy, Udaipur 2006.
- 2) Sensory Evaluation: A Practical Handbook, by Sarah Kemp, Tracey Hollowood, Joanne Hort published by Wiley-Blackwell, UK, 2009
- 3) Sensory Evaluation of food: Theory and Practice. Gisela Jellinek, VCH Publications

MODULE - 20

1.	Title of the Module	:	Manufacturing Techniques of Food Processing Machineries
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 20
4.	Entry Qualification	:	ITI / Diploma
5.	Minimum Age	:	19 years
6.	Terminal Competency	:	After completion of the course the candidate will: a. Gain an understanding of machines tools and various manufacturing techniques b. Get sufficient practice in manufacturing and fabricating equipment and prototypes c. Gain skill in the operation of machine tools
7.	Duration (in Hrs)	:	1 week (25 credit hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Engineering Properties of Materials; Wood-Metals- Cast iron-types-Other metals- properties; Alloys and Steel-Heat treatment of steels - purpose and method of heat treatment. Annealing, hardening-tempering- surface hardening Special Metals and New Materials for Manufacturing; Plastics and rubber; Introduction to manufacturing processes; Casting; Forming process; Fabrication process; Metal removal process	Carpentry and Fitting Skill Development; Identification of carpentry tools and Exercise in planning a wooden block; Half lap joint and tee halving joint; Identification of fitting tools & Exercise in filing a metal piece, Making a "L" joint and square joint; Smithy and Forging Skill Development; Identification of smithy tools; Exercise in making a ring and "S" hook; Practice in making square rods; Visit to Forging workshops and observe forging jobs			
Total hours for this sub-module			1	1	3
2.	Casting Process in Detail; Accessories for casting-Casting sand preparation; Types of Moulds and Patterns; Errors in Casting; Special casting processes; Forming Process in Detail; Smithy – Grain flow-Tools; Forging- Power tools; Rolling-Extrusion; Specialized jobs	Casting Skill Development; Familiarizing with the accessories of casting and foundry; Design of moulds and patterns; Practising casting; Visit to foundry Unit and study the different moulding and casting process; Forming Skill Development; Familiarising with smithy laboratory and accessories; Practising making smithy jobs; Practising making smithy jobs; Visit to foundry Unit and study the			

		different moulding and casting process			
	Total hours for this sub-module		1	1	3
3.	Fabrication Process in Detail; Welding –Basics of joints; Types of welding; Specialized welding processes; Rivetting, Brazing and Soldering; Metal Removal Process in Detail; Drilling; Lathe; Milling; Planing and Shaping; CNC machines	Fabrication Skill Development; Familiarizing welding workshop and accessories; Practising different joints; Gas welding and spot welding; d. Rivetting, Brazing and Soldering; Skill in Machine Shop Practice; Drilling jobs; Planing, Screw cutting, Drilling etc; Milling gear teeth; Shaping jobs; Visit to CNC Units and study the precision metal removal processes			
	Total hours for this sub-module		1	1	3
4.	Working with Plastics and Rubber; Types of plastics- Composition- Properties; Manufacturing practices for plastics; Special plastics; Working with Stainless Steel for Food Industry; Types of stainless steel and its importance; Manufacturing practices for stainless steel; Sheet metal works	Manufacturing process for plastics- Compression moulding- transfer moulding- moulding and blow moulding. Injection moulding- jet; Specialized skills on manufacturing with SS; Practising manufacturing with steel; Sheet metal works; Specialized jobs with SS			
	Total hours for this sub-module		1	1	3
5.	Lay out of Work Shop; a. Selection of machines for manufacturing; b. Lay out based on power consideration; c. Safety measures; d. Worker’s training; Overview of food processing machineries; Familiarize about the primary, secondary and tertiary processing equipment, parts- working principles- operation and maintenance	Case studies; Manufacturing Primary processing equipment; Manufacturing Secondary processing equipment; Manufacturing Tertiary processing equipment; Performance evaluation of the developed equipment and improving the efficiency techniques			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration & practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description	Quantity
1	All Geared Lathe 6'	3
2	Shaping Machine	1
3	Slotting Machine	1
4	Drilling Machine	1
5	Pedestal Drilling Machine	1

6	Grinding Machine	1
7	Universal Milling Machine	1
8	Powder Hack Saw	1
9	ARC welding kit	1
10	Gas welding Kit	1
11	CNC Machining Centre	1
12	Carpentary Tools	1 Set
13	Fitting tools	1 Set
14	Smithy tools	1 Set

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room : 600 sq.ft.
- b. Demonstration & Practical Class Room : 4000 sq.ft.

11. Power requirement

100 kW
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

B.E. Mechanical Engineering/ Agricultural Engineering

13. Suggested Readings

Text Books

- 1) Adithan, M. And A.D.Gupta. 2001. Manufacturing Technology. New Age International (P) Ltd. Publishers, Chennai.
- 2) Hajra Chowdry, S.K.1986. Elements Of Workshop Technology, Vol.I & II. Manufacturing Process. Asian Book Co., New Delhi.
- 3) Khanna, O.P. 1990. A Textbook On Welding Technology. Dhanpat Rai. New Delhi.
- 4) Khurmi, R.S. And J.K. Gupta. 2000. A Textbook Of Workshop Technology. Publication Division Of NIRJA Construction And Development Co. (P) Ltd. Ramnagar, New Delhi-110055.
- 5) Sharma, P.C. 2004. A Textbook Of Production Technology. S. Chand & Company Ltd. Ram Nagar, New Delhi-110055.

MODULE - 21

1	Title of the Module	:	Operation and Maintenance of Food Processing Equipment
2	Sector	:	Food Processing and Preservation
3	Code	:	SDT 21
4	Entry Qualification	:	ITI or Diploma
5	Minimum Age	:	18 yrs
6	Terminal Competency	:	After completion of the course the students will understand the basic knowledge on working principle and maintenance of food processing equipments
7	Duration (in Hrs)	:	1 week (25 contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Pumps – Types - Selection - Specification - Industrial application - Centrifugal pump - Head developed by pump- Cavitations - Special effect pumps - Positive displacement pump - Compressors & Blowers; Introduction and types of pumps; Compressors and blowers	Performance evaluation of centrifugal and positive displacement pumps; Evaluation of centrifugal pumps; Evaluation of plunger pumps; Evaluation of gear pumps; Maintenance of pumps; Evaluation of compressor; Evaluation of blower; Maintenance of compressors and blowers			
	Total hours for this sub-module		1	1	3
2.	Size Reduction, crushing & grinding -Laws of crushing - close circuit & open circuit - Dry & wet, free & choke grinding - Jaw crusher - Roll crusher - Hammer mill - Ball mill; Theory of size reduction; Introduction of different types of mills; Size enlargement operation; Granulation - Flocculation-extrusion; Theory of granulation, flocculation; Theory of extrusion	Energy calculation in ball mill, attrition mill, roll crusher and Jaw; Evaluation of ball mill; Evaluation of attrition mill; Evaluation of ball mill; Evaluation of ball mill; Operation and maintenance of different mills; Performance evaluation of cold extruder and extruder; Practice with extruders; Operation and maintenance tips			
	Total hours for this sub-module		1	1	3
3.	Mechanical Separation Operations Sampling - Screening - Elutriation - Froth Flotation - Jigging - Heavy media separation; Theory	Performance evaluation of mechanical separator (Spiral, indented, gravity); Evaluation of spiral separator; Evaluation of indented cylinder separator;			

	of Mechanical Separation equipment; Particulate Separating Equipment Cyclone Separator-Bag Filter-Electrostatic Precipitator-Electromagnetic Separator; Basic principles of particle separation equipment; Applications of separation equipment	Evaluation of specific gravity separators; Evaluation of air screen cleaners; Maintenance of mechanical separators; Performance evaluation of cyclone separator, bag filter; Evaluation of cyclone separator; Evaluation of bag filter; Evaluation electrostatic precipitator; Maintenance and trouble shooting of particle separators			
	Total hours for this sub-module		1	1	3
4.	Filtration and Washing, Constant Rate and Constant Pressure Filtration, Batch and Continuous Filtration equipment - Filter Aids-Simple problems; Theory, principles and applications of filtering equipment; Mixing & mixing equipment-Types of impellers used in stirred tank - Study of power consumption of mixers-Construction and working of stirred tank mixer & sigma mixer a. Theory of mixing and mixing equipment	Performance evaluation of reverse osmosis, plate filter and centrifuge; Practical on reverse osmosis; Practical on plate filter; Practical on centrifuge; Design, maintenance and trouble shooting of filtration equipment; Performance evaluation of ribbon blender and kneader; Evaluation of ribbon blender; Evaluation of dough mixer; Evaluation of planetary mixer; Evaluation of cake mixer; Repair and maintenance of mixers			
	Total hours for this sub-module		1	1	3
5.	Different types of Conveyor Equipment- Belt Conveyor-Apron Conveyor-Bucket Elevator-Screw Conveyor- Pneumatic Conveyor; Construction and working principle of different types of conveyors; Theory and application of apron conveyors; Storage & Handling of Solids-Silos and Bins; Basics of storage; Bins, Silos and accessories; Dryers and Drying Equipment; Basic theory of drying; Introduction to drying equipment	Performance evaluation of screw conveyor, bucket elevator; Operation, evaluation of belt conveyors; Operation, evaluation of screw conveyors; Operation, evaluation of bucket elevators; Operation, evaluation of apron conveyors; Maintenance of conveyors; valuation of different insect traps; Design practice of storage systems; Selection of accessories of bins and silos; Operation and maintenance of silos and bins; Evaluation of insect traps; Monitoring of solids in storage; Practice with dryers; Evaluation of grain dryers; Evaluation of dryers for food processing			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipment for a Batch

S. No.	Description	Quantity
1	Centrifugal pump	2
2	Models of positive displacement pump	1
3	Ball mill	1
4	Attrition mill	1
5	Hammer mill	1
6	Cold extruder	1
7	Extrusion unit	1
8	Gravity separator	1
9	Cyclone separator	1
10	Bag filter	1
11	Spiral separator	1
12	Reverse osmosis equipment	1
13	Ribbon blender	1
14	Kneader	1
15	Screw conveyor	1
16	Bucket elevator	1
17	Insect traps	1 set
18	Roll crusher	1
19	Jaw crusher	1
20	Centrifuge separator	1
21	Drum dryer	1
22	Tray dryer	1
23	Vacuum dryer	1
24	Speciality dryer	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 600 sq.ft.
- b. Demonstration & Practical Class Room : 1500 sq.ft.

11. Power requirement

Total power requirement : 50 kW

12. Qualifications of Instructor

: M.E / M.Tech in Food Process
Engineering/Agricultural Engineering

13. Suggested Readings

Text Books

- 1) Unit operations of Chemical Engineering, 4th ed. / McCabe and Smith / McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo
- 2) Introduction to Chemical Engineering / Badger & Banchero / McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo
- 3) Introduction to Chemical Engineering / Ghosal, Sanyal and Dutta / Tata McGraw Hill, New Delhi
- 4) Chemical Engineering, Vol. 2 & 5 / Coulson & Richardson / Pergamon Press, Oxford
- 5) Principles of Unit Operations, 2nd ed. / Foust & others / John Wiley & Sons Inc., London

MODULE – 22

1.	Title of the Module	:	Instrumentation and Automation in Food Industry
2.	Sector	:	Food Processing and Preservation
3.	Code	:	SDT 22
4.	Entry Qualification	:	Minimum graduate with Science stream preferably with mathematics
5.	Minimum Age	:	23 years
6.	Terminal Competency	:	After completion of the course the candidate will be able to: l. Develop proficiency in of instrumentation required in food industry. m. Monitor sensors and control systems with the food processing machines
7.	Duration (in Hrs)	:	1 week (25 credit hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Basics of electronics a. Current laws, voltage laws and theorems, Resistance, Inductance and capacitance; Network theorems; Transformer basics; Diodes - Semi conductor basics; PN Junction Diode c. Diode as rectifiers; Zenor diodes	Familiarising with bread board- Resistor colour codes- Oscilloscope- Meters; Building simple circuits with RLC; Checking network theorems; Transformer characteristics; Understanding semi conductors; Diode characteristics; Building power supplies using rectifiers; Bridge circuits			
	Total hours for this sub-module		1	1	3
2.	Transistors; Bipolar junction transistors; Transistor characteristics; Transistor as amplifier; Transistor as switch; Operational Amplifiers; Introduction- Impedance advantage of Op-Amps; Inverting and Non inverting amplifiers; Difference, Summing, Differentiation and Integration functions of Op-Amp; Op-Amp circuits for signal generation and signal processing	Understanding transistors; Drawing Transistor characteristics; Amplifier circuits; Switching circuits; Characteristics of inverting and non inverting op-amps; Building Op-Amp summation and difference ; Building Op-Amp circuits for integration and differentiation; Building feed back circuits for signal generation and processing			
	Total hours for this sub-module		1	1	3

3.	Oscillators and Filters; Transistor oscillators; Wien Bridge oscillators; RC phase shift oscillators; LC oscillators-Hartley and Colpitts type; Digital Electronics - Integrated circuits; Logic Gates; Advances in digital electronics; Microprocessors	Practice with different types of oscillator circuits; Timer circuits with IC 555; Understanding different logic gates Building circuits with ICs; Tutorial with 8085 microprocessors			
Total hours for this sub-module			1	1	3
4.	Instrumentation; Static and dynamic characteristics of an instruments; Introduction to sensors and sensing elements for temperature, pressure, flow, level, speed, force, torque, pH, colour, opacity, viscosity, etc; Transducer; Signal conditioning; Control Systems - Introduction to control system and controller; Types of control system, advantages and disadvantages; Comparison between on-off, PD and PID controllers; Selecting suitable control circuits with feed backs	Measurement of process variables Calibration and its importance; Working with transducers and associated circuitry; Signal conditioning circuits; Practice with designing control circuits			
Total hours for this sub-module			1	1	3
5.	Data logging - Datalogging basics; Interface between data logger and sensors; Microprocessor and control circuits; PLC and its working; Automation - Introducing automation in food industry b. HMI/SCADA systems for automation- Advantages of real time data of high precision	Data logger, microprocessor based data loggers and PLC operation; Visit to corporate industries and study the features of HMI/SCADA systems			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1	Working tables	5
2	Multi-meters	4
3	Power supply (const. current, const. voltage, variable voltage both for ac and dc	2 unit each
4	Diode	8
5	Training PCB	2sets

6	SCR application demonstration kit	2sets
7	OpAmp IC # 744 demonstration kit	2sets
8	IC #555 demonstration kit	2 sets
9	Logical gates demonstration kits (with all gates)	2 sets
10	Thermocouple/RTD/pressure/level/flow sensors use and calibration	2 sets
11	Data logger with compatibles item 10 sensors	1 set

10. Space Required for Conducting the Module (in square feet)

- a. Theory Class Room : 600
- b. Demonstration & Practical Class Room : 2000

11. Power requirement : 5 kW power; Stand-by power supply (Power GenSet)

12. Qualifications of Instructor : M.E. Electronics/Instrumentation

13. Suggested Readings

Text Books

- 1) Salivahanan, S. N. Suresh Kumar and A. Vallavaraj. 2006. Electronic devices and circuits. Tata McGraw-Hill Publishing Co. Ltd. New Delhi
- 2) Ernest O Doebelin, 1990. Measurement Systems – Application and Design. McGraw-Hill Publishing Co. London
- 3) Gupta B.R. 1999. Electronics and instrumentation. Second Ed. Wheeler Publishing, New Dehli
- 4) Singh, S.K. 2005. Industrial Instrumentation. 2nd Ed. Tata McGraw-Hill Publishing Co. Ltd. New Delhi

MODULE – 23

1.	Title of the Module	:	RTE, RTC and RTS Food Products
2.	Sector	:	Food processing and value addition
3.	Code	:	SDT 23
4.	Entry Qualification	:	10 th Standards
5.	Minimum Age	:	14 yrs
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a) Operating & maintain the equipments used for various unit operation involve for making any food products b) To make RTE, RTS & RTC food products c) Process of packaging & storage
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Concept of value addition. Conversion of raw material to consumer foods. Knowledge of importance of RTE, RTC and RTS food products. Ready-to-Cook, market value of RTE, RTC and RTS food products; Knowledge of different industrially important RTE, RTC & RTS food products, Knowledge of ingredients use for making these kind of products; Quality assurance of raw material, standards and grades	Demonstration of various source required for production of Ready-to-Eat, Ready-to-Cook and Ready-to-Serve (RTE, RTC and RTS) food products; Quality evaluation of Ingredients involve for making these products, knowing grades & classification			
Total hours for this sub-module			1	1	3
2.	Process & technology involve for production of RTE, RTC and RTS food products, process parameters, key parameters which influence final product quality; Knowledge of changes occurs in raw materials during initial stage to end products. Effect of addition of ingredients on final products	Practice to make common RTE, RTC and RTS food products; Changes occurs during processing in raw materials like gelatinization, denaturization, browning reaction etc.			
Total hours for this sub-module			1	1	3

3.	Knowledge of machineries involve in such kind of products like extruder, pasta making machine, bakers, mixer, molding machine etc.; Knowledge of product quality evaluation; standards for national & international markets; Sensory evaluation of final products	Practice to operate these machines; how to operate, changing parameters; Quality evaluation of finished products – rheological, textural and sensory analysis			
Total hours for this sub-module			1	1	3
4.	Trouble shooting, safety & maintenance operation involve in machineries; Knowledge of precaution taken & safety hazard; Environmental concern & Pollution measure; Method of techniques of proper packaging of finished products & proper storing in cooling & ambient places, Packaging of RTE , RTC & RTS food products	Learning practically these trouble shooting & maintenance operations; finding fault & quick action for remedies; Practice on packaging with sealing, storing and marketing. Marketing through agents, salesman and retailers etc.			
Total hours for this sub-module			1	1	3
5.	Dehydration and retort processing techniques for the development of RTE and RTC products; Maintaining records and filling up format for booking of various RTE, RTC & RTS food products	Dehydration and osmo dehydration of foods, Retort processing of breakfast, meals and snack foods; Practice on collection of orders and delivery of such kind of products			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S. No.	Description	Quantity
1.	General requirements like vessels, balances, trays, water storage facilities, oil container, mould, boiling pan, cutting knife, table, different size containers etc. (To be shared) (cooker, baby boiler – one unit)	04 for each tools
2.	Other general requirements for Good manufacturing practices	15 sets each
3.	Planetary mixer; 3 gear/ Food processor	02 No
4.	Grinder, Sieve set boxes	02 No
5.	Oven (Standard size with controlling feature)	02 No
6.	Packaging machine	02 No
7.	Moist box	02 No
8.	Work table marble top standard size	02 No
9.	Storage rack standard size	05 No.
10.	Moulds	02 No
11.	Cutting knives	02 No

12.	Dies; Sealing machine; Hot plate Induction stoves	02 No
13.	Tool cabinet	02 No
14.	First aid box	02 No
15.	Discussion table	02 No
16.	Weight Box	02 No
17.	Other common facilities for training	As required

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room** : 1000 square feet
b. Demonstration & Practical Class Room : 2000 square feet

11. Power requirement : 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor : ME (Food Process Engineering)
M.Tech (Food Science & Technology)
ME (Food Process Engineering)

13. Suggested Readings

Text Books

- 1) Fast R.B & Cardwell E.F. Breakfast cereals and how they are made (2000) American Association of Cereal Chemists. St. Paul Minnesota
- 2) Harper J.M. Extrusion of Foods. Vol. 1 & 2 (1991) CRC Press, Inc.) Boca Raton, Aorida

MODULE – 24

1.	Title of the Module	:	Performance Evaluation of Food Processing Machinery
2.	Sector	:	Food Processing
3.	Code	:	SDT 24
4.	Entry Qualification	:	Minimum ITI/Diploma/12 th Standard
5.	Minimum Age	:	16 yrs
6.	Terminal Competency	:	After completion of the course the candidate will be able to: a) Understand the basics of food processing machinery b) Evaluate the performance of the machinery c) Repair and maintenance of the machinery
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Basic knowledge in manufacturing practices - Carpentry, Fitting, Welding, Smithy, Drilling, Shaping, Turning, Milling, Boring; Basic knowledge in maize, wheat and paddy processing, Evaluation of rice processing machinery - parboiling, cleaners, graders, rubber roll sheller, paddy separator, polishers, and stitching machinery	Basic manufacturing practices - Carpentry, Fitting, Welding, Smithy, Drilling, Shaping, Turning, Milling, Boring; Evaluation of rice processing machinery – parboiling plant, cleaners, rubber roll sheller, paddy separator, polishers, graders, stitching machinery, repairs and maintenance			
	Total hours for this sub-module		1	1	3
2.	Basic knowledge in types of pulses, Evaluation of pulse processing machinery - cleaners, graders, dehusker, splitter, Gota machine, polishers; Basic knowledge in major and minor millets - Evaluation of millet processing machinery - cleaners, dehusker, polishers, popping machines	Evaluation of pulse processing machinery – cleaners, graders, conditioner, dehusker, splitter, Gota machine, polishers, repairs and maintenance; Evaluation of millet processing machinery – cleaners, dehusker, polishers, popping machine, repairs and maintenance			
	Total hours for this sub-module		1	1	3

3.	Basic knowledge in nuts and oil seeds - Evaluation of oil seeds processing machinery - cleaners, graders, rotary, expeller, filter; Basic knowledge in spices and condiments - size reduction - Evaluation of size reduction machinery - ball mill, burr mill, hammer mill, pin mill, roller mill - and colloidal mill	Evaluation of oil seeds processing machinery – cleaners, graders, rotary, expeller, filter, Repairs and maintenance; Evaluation of fruit processing machinery – graders, deseeding machine, pulper, homogenizer, evaporator, cooler, retort, repairs and maintenance			
Total hours for this sub-module			1	1	3
4.	Basic knowledge in fruit types, processing, uses, Evaluation of fruit processing machinery - graders, deseeding machine, pulper, homogenizer, evaporator, cooler, retort, repairs and maintenance; Basic knowledge in milk and milk processing - Evaluation of milk processing machinery - pasteurizer, sterilizer, cream separator	Evaluation of fruit processing machinery - graders, deseeding machine, pulper, homogenizer, evaporator, cooler, retort, repairs and maintenance; Evaluation of milk processing machinery - pasteurizer, sterilizer, cream separator			
Total hours for this sub-module			1	1	3
5.	Basic knowledge on different types of extruders and dryers for processing of food crops; Basic knowledge in packaging machinery for solid, semi solid and liquid products, form fill packaging	Evaluation of dryers for solid, semi solid and liquid food and extruders for RTE and RTC food products; Evaluation, repairs and maintenance of Packaging machinery			
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description	Quantity
1.	Carpentry tools	4 sets
2.	Fitting tools	4 sets
3.	Welding – arc welding	2 sets
4.	Welding – gas welding	2 sets
5.	Smithy tools	4 sets
6.	Lathe	1
7.	Drilling machine	1
8.	Shaper	1
9.	Parboiling set up with dryer	1
10.	Paddy cleaner	1
11.	Rubber roll sheller	1
12.	Paddy separator	1

13.	Rice polisher – abrasive	1
14.	Rice polisher – friction	1
15.	Rice grader	1
16.	Bag Stitching machine	1
17.	Weighing scale	1
18.	Pulse cleaner	1
19.	Pulse grader	1
20.	Pulse conditioning set up	1
21.	Pulse dehusker	1
22.	Gota separator	1
23.	Millet cleaner with different sieves	1
24.	Millet dehusker and polisher	1
25.	Popping machine	1
26.	Rotary	1
27.	Oil expeller	1
28.	Filter press	1
29.	Ball mill	1
30.	Burr mill,	1
31.	Hammer mill,	1
32.	Pin mill	1
33.	Fruit grader	1
34.	Pulper	1
35.	Deseeding machine	1
36.	Homogenizer	1
37.	Double jacket kettle	1
38.	Retort	1
39.	Bottle filling machine	1
40.	Bottle sealing machine	1
41.	Retort packing machine	1
42.	Pasteurizer	1
43.	Sterilizer	1
44.	Cream separator	1
45.	Hand Gloves	10 sets
46.	Cutting pliers	5 sets
47.	Screw drivers	5 sets
48.	Open end spanners	5 sets
49.	Ring spanners	5 sets
50.	Wrenches	5 sets
51.	Hand drilling machine	1
52.	Work tables	5
53.	Storage rack for keeping tools	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement

: 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

: M.Tech (Food Science & Technology)

13. Suggested Readings

Text Books

- 1) Hajra Chowdry, S.K. 1986. Elements of workshop technology, Asian Book, New Delhi.
- 2) Sahay, K.M. and Singh, K.K. 2007. Unit operations in Agricultural Processing, Vikas Publishing House, New Delhi
- 3) Chakravarthy, A. Post harvest technology of cereals, pulses and oilseeds, 1988 Oxford & IBH Publishing Company.
- 4) Earle, R.L. 1985. Unit operations in food processing. Pergamon Press. Oxford. U.K.

MODULE 25

1.	Title of the Module	:	Rice Milling Techniques
2.	Sector	:	Grain Processing
3.	Code	:	SDT 25
4.	Entry Qualification	:	Minimum 8 th / 10 th Standard
5.	Minimum Age	:	18 yrs
6.	Terminal Competency	:	After completion of this training the participant will have: a) Knowledge in the various rice processing operations b) Overall knowledge in various machineries available in different sections of Rice Processing Industry. c) To assess the quality of Paddy/rice and various by-products d) Operate the Rice milling machinery
7.	Duration (in Hrs)	:	2 week (50 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1	Rice Processing - importance of process Paddy - History of rice processing - Different types of rice available in world and Indian market - Requirement of space for different capacity of mills; Importance of knowledge on rice milling techniques - Traditional methods of rice processing and modern concepts of rice processing	Different types of rice in Indian market; Visualization of different rice samples produced in the market and discussion; Traditional method of rice processing. Conventional methods of rice processing Single steam parboiling Double steam parboiling Modern methods of rice processing Hot soaking - Improved hot soaking method			
Total hours for this sub-module			2	2	6
2.	Traditional rice processing machinery - Huller machines - Modified huller machines - Semi modern rice mill and machinery; Modern Rice Mills and Rice machinery Precleaners - Destoners - Different type of Huller / Sheller machines - Different Paddy Separators Different Polishers - Broken separator - Silky polisher - Destoner - Colour sortersi -	Traditional method of rice processing using Huller machine Milling of raw paddy in semi modern rice mill Milling of parboiled paddy in semi modern rice mill; Laboratory milling study Calculation of milling yield Milling of raw paddy in modern rice mill Milling of parboiled paddy in modern rice mill			

	Bagging unit				
	Total hours for this sub-module		2	2	6
3.	Parboiling vessels and machinery used in parboiling section – Boiler - Parboiling vessel – Dryer - Drying method; Assessment of Paddy/ Rice Quality	Parboiling of paddy at mill level Mild parboiled rice; Parboiling of paddy at mill level; Fully parboiled rice; Assessment of drying time and drying at mill yard. Assessment of drying time and drying in dryer; Assessment of physical parameters, Assessment of paddy for FAQ standard, Assessment of rice for FAQ standard, Assessment of Rice cooking quality, Assessment of Rice cooking quality			
	Total hours for this sub-module		2	2	6
4.	Storage and packaging of Paddy/Rice, Prevention of high moisture paddy; Potential traditional processing techniques and By-product utilization	Storage of paddy/Rice Prevention of high moisture paddy Gelatinization properties; Preparation of ethnic food products, puffing, flaking, parching and roasting. By product utilization. Estimation of moisture and oil content in rice bran			
	Total hours for this sub-module		2	2	6
5.	Value added products from rice – traditional foods, extruded products, health drinks, convenient food products; Maintenance of Rice Milling Machines and Safety measures	Preparation ready to eat and ready to cook extruder products and drinks, bakery products; Problem shooting areas in rice mill, Safety measures and visit to industries			
	Total hours for this sub-module		2	2	6
Total Contact Hours Individually for Theory, Demonstration and Practical			10	10	30
Grand Total of Contact Hours			50		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description of Tools	Quantity
1.	Hand winnower - Plastic	4
2.	Cloth (For cloth bags)	4 meters
3.	Nylon bags	4 meters
4.	Trays	4
5.	Spoons	8
6.	Lab chappals	16
7.	Mini - Lab Sheller	2
8.	Mini - Lab polisher	2
9.	Lab broken separator	1
10.	Lens	2
11.	Crack detector	1

12.	L,B measurement wooden board	4
13.	Dial caliper	2
14.	Paddy – Soaking vessels – Plastic	4
15.	Parboiling coffee filter like vessels (upto 2Kg cap.) with lid (SS)	2
16.	Vessel – for saturation test –(SS)	2
17.	Cooking vessels – for gruel loss (dia.~ 1feet, with provision for placing six 250 ml. beakers simultaneously) (SS).	2
18.	Rice cooking vessel (Suitable to place a stand of 15 test tubes simultaneously) (SS).	2
19.	Vessel for elongation test (SS) (Boiling and cooling)	2 + 2
20.	Fabrication of wire meshes (Gruel loss test and Elongation test)	24 Nos.
21.	Fabrication of stands to hold wire meshes (Gruel loss test and Elongation test)	4
22.	Wire gauge – to hold samples, and sample holding containers (SS)	20
23.	Hawkins pressure cooker 1 Lit.	1 No.
25.	Hawkins pressure cooker 2 Lit.	1 No.
26.	Stainless steel plates	2 nos
27.	Moisture box	25 nos.
28.	Heat sealing machine	1
29.	Single burner stove	2
30.	Induction stove	1
31.	Instructor chair and table	1
32.	Dual desk	10
33.	Work table for grain testing and quality tests	2
34.	Stools	16
35.	Discussion table	1
36.	Tool cabinet	1
37.	Trainees locker with space for 16 members	1
38.	First aid box	1
39.	Book shelf	1
40.	Storage rack – mesh cupboard	1

S.No.	Description of Equipments	Quantity
1.	Weighing balance (Cap. 200g and 5 Kg) – each two	2+2
2.	Moisture meter	4
3.	Oven	1
4.	Lab Sheller	1
5.	Lab polisher	1
6.	Oil extractor	1
7.	Sand bath	2
8.	Vortex mixer	2
9.	DigitalTemperature probes - 1meter, 30 cm, 60 cm length	Each 2
10.	Sieve sets	1 set
11.	Hot water bath with temperature control	2
12.	Cold water bath.	1

S.No.	Description of Glasswares and Chemicals	Quantity
1.	Flat bottom oil flasks	18
2.	Oil Extraction set (condenser and extractor)	1set each
3.	Thimbles	18
4.	Standard flask 1 Lit	4
5.	Standard flask 500 ml	4
6.	Standard flask 250 ml	4
7.	Standard flask 100 ml	20
8.	Standard flask 50 ml	10
9.	Beaker 1000 ml	4
10.	Beaker 500 ml	4
11.	Beaker 250 ml	20
12.	Beaker 100 ml	20
13.	Cooking Test tubes (50ml – graduated for each ml) (flat bottom)	25
14.	Boiling tubes – round bottom (50 ml)	25
15.	Test tubes 25 ml (round bottom without rim)	25
16.	Conical Flask (100 ml)	25
17.	Measuring jar 10ml, 25ml, 50ml,100ml – each 10	4x10
18.	Measuring jar 250ml, 500ml, 1000lit – each 2	3x2
19.	Funnel Ø 2.5 cm; Funnel Ø 7.5 cm	Each 20
20.	Conical Flask (250 ml)	10
21.	Petri Plates – Inner 9.5 cm	25
22.	Petri Plates - Inner 13 cm	10
23.	What man no 1 Filter paper	6 boxes
24.	Desiccators	2
25.	Burette: 25ml	4
26.	Crucible	10
27.	Wash bottles	4
28.	Bunsen burners	4
29.	Gas stove (Single burner)	2
30.	Induction stove	1
	List of Chemicals	
1.	Sodium Hydroxide	
2.	Sodium Chloride	
3.	Potassium hydroxide	
4.	Xanthene	
5.	HCL, H ₂ SO ₄ , and other chemicals as per need.	

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room** : 1000 square feet
b. Demonstration & Practical Class Room : 2000 square feet

11. Power requirement : 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor : ME (Food Process Engineering)
M.Tech (Food Science & Technology)

MODULE – 26

1.	Title of the Module	:	Manufacturing of Extruded Products
2.	Sector	:	Food Processing
3.	Code	:	SDT 26
4.	Entry Qualification	:	Minimum 12 th Standard/ ITI
5.	Minimum Age	:	18 yrs.
6.	Terminal Competency	:	After completion of this course the participant would be able to: a) Work on single/twin screw extruder b) Study about Extrusion cooking, preconditioning of raw material, types of extruders and operating parameters c) Different types of extruded products and their processing.
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Extrusion - Definition - Introduction to extruders and their principles - Extruders in the food industry - History and uses of extruders in the food industry; Process characteristics of the twin screw extruder - feeding, screw design, screw speed, screw configurations, die design Ingredients used in extrusion cooking - Pre-conditioning of raw materials used in extrusion process, Pre-conditioning operations and benefits of pre-conditioning - Rheological properties of cereals during extrusion	Extruder operation - Study of extruder process; Study on expanded and formed products; Study on utilization of different cereals in development of extruded product			
Total hours for this sub-module			1	1	3
2.	Structure of cereal grains -Wheat - Endosperm, Bran layer, germ, pericarp, seed coat, aleurone layer. Corn hull, germ, endosperm, tip cap. Rice - hull, germ, aleurone layer. Barley -sorghum - pearl millet; Selection of extruder - Introduction and terminology -	Processing of Cereal based and Breakfast cereal products – I; Processing of Cereal based and Breakfast cereal products - II			

	Function and advantages of extruder technology -General design features - Single-screw extruder - Twin-screw extruder; Single- vs. twin-screw extruder				
	Total hours for this sub-module		1	1	3
3.	Key control points in meeting product requirements; Effect of extrusion on nutritional quality - Introduction - Macronutrients - Vitamins - Minerals - Non-nutrient healthful components of foods	Characterization of extruded products; Physical and nutritional quality of extruded products; Study of factors affecting extrusion cooking - moisture content, diameter, temperature, pressure, screw speed, time			
	Total hours for this sub-module		1	1	3
4.	Specific Extruded products - Expanded, Puffed, Formed, Pasta, macroni - Snack foods of dairy origin - Meat based snack foods; Breakfast cereals - Introduction, The range of products, Key process issues of the product range, Main unit operations and technologies. Snack foods - Introduction, Formed dough products - potato, Half-product or pellet snacks, Directly expanded snacks, Co-extruded snacks. Baby foods - Introduction, Traditional batch processing, Extrusion system for baby foods, Market for baby foods	Development of pasta products Nutritional factors affecting the quality of product; Packaging of cereal products Packaging equipments			
	Total hours for this sub-module		1	1	3
5.	Macroni-method of manufacture, Noodles, Types of noodles, raw materials. Pasta technology - raw materials, process and equipment, different shapes and styles - packaging technology; Quality control for extruded products and FSSAI standard	Trouble shooting in extrusion process; Extruded products manufacturing industry visit			
	Total hours for this sub-module		1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description of tools & equipments	Quantity
1	Hand operated moisture meter	2
2	Weighing Balance	5
3	Measuring glass	5 sets
4	Different types of Dies	Assorted
5	Segmented/non segmented screws	Assorted
6	Apron	50
7	Hand gloves	50
8	Cap	50
9	Single / twin screw Extruder	1
10	Ribbon blender	2
11	Cooling conveyor	1
12	Post extrusion dryer	2
13	Pneumatic conveyor	1
14	Flaking machine	1
15	Drum coater	1
16	Water bath	1
17	Moisture meter	1
18	Tray drier	1
19	Hammer mill	1
20	Vernier caliper 15 cm 0.01 mm LC	5
21	Screw gauge/micrometer 0.001 mm LC	1
22	Centrifuge	1
23	Texture analyser	1
24	Kjeldahl digestion and distillation apparatus	1
25	SS containers for collection and storage of materials	-
26	Packing machine	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room** : 1000 square feet
b. Demonstration & Practical Class Room : 2000 square feet

- 11. Power requirement** : 3 phase connection
Stand-by power supply (Power GenSet)

- 12. Qualifications of Instructor** : ME (Food Process Engineering)
M.Tech (Food Science & Technology)

13. Suggested Readings

Text Books

- 1) Richardson P. *Thermal Technologies in Food Processing*. Wood head Publishers, Cambridge
- 2) Guy R. *Extrusion Cooking, Technologies and Applications*. Wood head Publishing Limited, Abington, Cambridge.
- 3) Fast R.B. and Caldwell E.F. *Breakfast Cereals and How they are made*.(2000) American Association of Cereal Chemists., St. Paul, Minnesota.

- 4) Frame N.D. *The Technology of Extrusion Cooking*. (1994) Blackie Academic & Professional, New York.
- 5) Harper J.M. *Extrusion of Foods*. Vol. 1&2 (1991) CRC Press, Inc; Boca Raton, Florida.
- 6) O'Connor C. *Extrusion Technology for the Food Industry*. (1987) Elsevier Applied Science, New York

MODULE – 27

1.	Title of the Module	:	Processing and Value Addition of Spices & Condiments
2.	Sector	:	Spice processing
3.	Code	:	SDT 27
4.	Entry Qualification	:	Minimum 8 th Standard
5.	Minimum Age	:	18 yrs
6.	Terminal Competency	:	After completion of this training the participant will be able to: a) Jobs in spices & plantation crop processing industries, Production executive, Quality assurance executive, Machine operators, maintenance executives, Quality testing – lab assistant
7.	Duration (in Hrs)	:	1 week (25 Contact hours)

8. Module Contents

S. No.	Theory	Practical	Contact Hours		
			T	D	P
1.	Spices, Condiments - Definition, production, importance, classification of spices; Spice processing scenario in India; Harvesting time and methods of harvest for individual spices; Major and Minor spices (anise seed, basil, bay leaves, capsicum spice, caraway seed, cardamom, celery seed, cinnamon and cassia, cloves, coriander, cumin, dill seed, dill weed, fennel seed, fenugreek); Major and Minor spices (ginger, mace, nutmeg, marjoram, mustard seed, oregano, parsley, pepper - white and black, rosemary, rosemary, saffron, sage, savory, tarragon, thyme, turmeric); Spice processing - Pre-processing of spices and condiments; Importance of post harvest management; Major losses occurring during post harvest period; Methods to minimize the losses	Identifying important spices, condiments. Classification based on the morphology (seed spice, flower/buds, bulbs, stem /bark, leaves); Major classification ; Minor classification ; Ensuring the maturity indices of Spice and condiment; Chemical composition of spices and condiments; Procurement and pre-processing of spices. - Spice cleaning; Spice reconditioning; Spice grinding; Post processing treatment			

		Total hours for this sub-module	1	1	3
2.	Processing of individual spices - Performance evaluation of inclined belt separator, spiral separator, vibratory type grader, rotary type grader; Performance evaluation of white pepper peeler cum washer, pepper threshers, abrasive type white pepper polisher, pepper cleaner cum grader, Performance evaluation of turmeric boiler, turmeric polisher; Performance evaluation of chilli seed extractor, cardamom garbling machinery; Drying of spices - Different types of dryers used in spice drying; Working principle and operation; Quality comparison with traditional methods; Drying characteristics of spices in dryers	Unit operations involved in processing of Seasoning Blends - Celery Salt, Garlic Salt, Onion salt; Chilly powder, curry powder ; Curry powder, pickling spice, poultry seasoning, Pumpkin pie spices, apple pie spices and oriental five spice blend; Drying characteristics of spices - Drying of spices in thin layer dryers, rotary dryer; Drying of spices in cabinet dryer; Drying of spices in fluidized bed dryer; Drying of spices in spouted bed dryer			
		Total hours for this sub-module	1	1	3
3.	Suitable spice grinders and Grinding of all spices; Principle, method of spice grinding; Machinery used for spice grinding; Energy involved in grinding; Recent developments in spice grinding; Unit operations involved in processing other Seasoning- Overview of the industry; Overview of formulating; Specific product formulations; Spices and seasoning trends for the new millennium; Spice extractives - Spice volatile oils ; Spice Oleoresins; Use of spice extractives ; Replacement of spices with oils & oleoresins	Working with different machinery for spice grinding - Hammer mill; Pin mill; Attrition mill; Ball mill; Different types of Seasonings and its formulation; Meat seasoning; Snack seasoning; Sauces and gravies; New flavor trends, ethnic flavours; Different extraction techniques; Extraction of essential oils ; Extraction of oleoresin; Method of extraction; Spice alternative products (oil/oleoresins)			
		Total hours for this sub-module	1	1	3
4.	Quality issues dealing with spices - Quality analysis of spices and their derivatives; Sampling and sample preparation; Spice-Specific tests; Recommended levels for individual components in each product	Quality analysis of spices and value added products from spices - Estimation of volatile oil; Estimation of starch; Estimation of total ash and acid insoluble ash; Estimation of moisture			
		Total hours for this sub-module	1	1	3

5.	Quality standards and specification for spices and its products - Naturally occurring toxicants; Antioxidant action of spice compounds; Health benefits of spice compounds; Antimicrobial action of spices; Spices packaging and storage recommendation for marketing; Seasoning blend duplication; Background information for seasoning formulation; Seasoning blends	Microbiological methods; Estimation of crude fibre; Packaging requirements and Safe storage requirements for whole spices and blends ; Packaging - Spice blends / seasonings; Packaging - Whole spice; Safe storage - whole spices & seasoning blends	5		
Total hours for this sub-module			1	1	3
Total Contact Hours Individually for Theory, Demonstration and Practical			5	5	15
Grand Total of Contact Hours			25		

T- Theory, D- Demonstration, P- Practical

9. Lists of Tools and Equipments for a Batch

S.No.	Description	Quantity
2.	Pepper thresher	1
3.	Inclined belt separator	1
4.	Spiral separator	1
5.	Vibratory type grader	1
6.	Rotary type grader	1
7.	White pepper peeler cum washer	1
8.	Abrasive type white pepper polisher	1
9.	Turmeric boiler	1
10.	Turmeric polisher	1
11.	Cardamom garbler	1
12.	Pepper cleaner cum grader	1
13.	Chilli seed extractor	1
14.	Tray Dryer	1
15.	Fluidized bed dryer	1
16.	Rotary dryer	1
17.	Spouted bed dryer	1
18.	Hammer mill	1
19.	Attrition mill	1
20.	Pin mill	1
21.	Ball mill	1
22.	Vacuum Packaging	1
23.	Gunny bag Stitching machine	1
24.	Soxhlet apparatus	1
25.	Ginger Polisher	1

10. Space Required for Conducting the Module (in square feet):

- a. Theory Class Room : 500 sq. ft.
- b. Demonstration & Practical Class Room : 1600 sq.ft.

11. Power requirement

: 3 phase connection
Stand-by power supply (Power GenSet)

12. Qualifications of Instructor

: M.Sc. M.Tech (Food Science & Technology)
M.Sc. (Food Science & Nutrition)

13. Suggested Readings**Text Books**

- 1) Pandey, P. H. 2002. Post Harvest Engineering of Horticultural Crops through Objectives. Saroj Prakasam, Allahabad.
- 2) Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest Technology. Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi. PP. 514.
- 3) ASTA, 1997. Official analytical methods of the American Spice Trade Association, Fourth Edition.
- 4) Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins. 1981. Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1: 605.
- 5) Pruthi, J.S. 1980. Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA. pp. 1-450. .
- 6) Pruthi, J.S. 2001. Minor Spices of India – Crop Management and Post Harvest Technology.
- 7) Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi.PP. 782.
- 8) Sivetz, M, and Desrosier, N.W. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport,Connecticut. First edition.
- 9) Handbook of Herbs and Spices : Volume 3 Vol. 3 by K. V. Peter (2006, Hardcover) : K. V. Peter (2006)
- 10) Spices: Vol.05. Horticulture Science Series By N.Mini Raj and K.V.Peter

Journals

- 1) Journal of spices and plantation crops
- 2) Indian J. Arecanut, Spices & Medicinal Plants
- 3) Journal of spices and aromatic crops
- 4) Spice India

E- Reference

- 1) www.indianspices.com
- 2) www.coconutboard.gov.in
- 3) www.tide-india.org/projects/06diffusion-arecanut-processing.html
- 4) <http://www.fao.org/docrep/v5030e/V5030E00.htm>
- 5) <http://www.sspindia.com/fruits-and-vegetable-equipment.html>