

DETAILED LECTURE OUTLINES

(as per V Deans' Committee Recommendations)

B. Tech. (Food Technology)

2016

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FOREWORD

Government of India has supported Agricultural Research and Education through successive five year plans. The human resources development through agricultural education has been primarily responsible for the green revolution in agriculture. Food industry is one of the fast growing industry, which makes value addition to the agriculture and allied products. To meet the demands of food industry in India, technological interventions to add value addition and to preserve the processed foods like meat, poultry, marine products, milk and bakery products properly and to market in a profitable way to the satisfaction of the consumers are needed. This is possible through adoption of food processing, food engineering and food safety and quality assurance principles and practices. To address the problems like shortage of man power, plant operations, storage and marketing skills and value addition to different processed food products are considered while preparing the course curriculum. The university is serving the state with about 90 outgoing food technology graduates every year, who are the main human resource in food industry sector. In order to improve and standardize the agricultural education and to meet the present challenges, Indian Council of Agricultural Research has revised the under graduate course syllabi of B. Tech. (Food Technology) Degree Programme, duly including certain changes to the various course curriculum keeping in mind more employment opportunities for passed out graduates students and also for getting P.G admissions through all India basis.

I hope that, this revised course curriculum will be very useful and beneficial to the under graduates in gaining the competence for entrepreneurship, in building confidence, skill and acquire indigenous technical knowledge of the locality and thereby preparing the pass out graduates for self-employment and will play the key role in overall personality development.

Dr. D. Bhaskara Rao, Dean of Agricultural Engineering and Technology and his faculty and all others involved in developing the course curriculum for the under graduate course - B. Tech. (Food Technology) to be implemented from 2016-17 onwards deserves all appreciation for their effort in bringing out the course catalogue in the form of a book.

Date: 30.12.2016

Place: Guntur


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(B. RAJSEKHAR)

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PREFACE

Bachelor of Technology in Food Technology is a four year (8 semesters) under graduate course in Food Technology Discipline. Syllabus of Food Technology as prescribed by V Deans' Committee recommendations, comprises of various departments, namely Food Processing Technology, Food Process Engineering, Food Safety and Quality Assurance, Food Business Management, Food Plant Operations (Student READY Courses), Basic Engineering & Basic Sciences and Humanities with total credit load of 181.

Students of Food Technology have a bright career in quality control departments, food industries, packaging industries, distilleries, soft drink factories, rice mills etc. Food technologist can also work in research laboratories and in the production industry to develop new products, test current ones and control the quality of food. Major food processing companies in which they are given job opportunities include Cadbury India Ltd., Agro-tech foods, Pepsico, MTR foods Ltd., Dabour India Ltd., Amul, Parle products Pvt. Ltd., ITC Ltd., Britannia Industries Ltd., Nestle India Pvt. Ltd., Coca – cola India etc.

The V Deans' committee recommended syllabus curriculum has been thoroughly reviewed, discussed and modified so as to improve the students intelligence, good observation power, awareness about scientific and technical developments etc., which a good food technologist suppose to possess.

I express my profound gratitude to Sri B. Rajsekhar, IAS, Hon'ble Vice-Chancellor, Acharya N. G. Ranga Agricultural University and Dr. T. V. Satyanarayana, Registrar, Acharya N. G. Ranga Agricultural University for encouragement in preparing this course catalogue.

(D. BHASKARA RAO)

Date: 30.12.2016

Place: Guntur

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&

All the Teachers of Faculty of Agricultural Engineering & Technology

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**YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF CREDITS AMONG
DIFFERENT DEPARTMENTS**

S. No.	Department	First Year		Second Year		Third Year		Final Year		Credit Hours		
		I	II	I	II	I	II	I	II	Theory	Practical	Total
1	Food Processing Technology	<u>111</u> 2+1 <u>112</u> 1+1	-	<u>211</u> 2+1 <u>212</u> 2+1	<u>213</u> 2+1 <u>214</u> 2+1 <u>215</u> 2+1	<u>311</u> 2+1 <u>312</u> 2+1	<u>313</u> 2+1 <u>314</u> 2+1 <u>315</u> 1+1	<u>411</u> 2+1	-	24	13	37
2	Food Process Engineering	-	<u>121</u> 2+1 <u>122</u> 2+1	<u>221</u> 2+1 <u>222</u> 2+1	<u>223</u> 2+1 <u>224</u> 2+1	<u>321</u> 2+1 <u>322</u> 2+1	<u>323</u> <u>2+1</u>	<u>421</u> 2+1	-	20	10	30
3	Food Safety and Quality Assurance	<u>131</u> 2+1 <u>132</u> 2+1	<u>133</u> 2+1	<u>231</u> 2+1 <u>232</u> 2+1	<u>233</u> 2+1 <u>234</u> 2+1	<u>331</u> 1+2 <u>332</u> 2+0	<u>333</u> 1+1 <u>334</u> 1+1	-	-	19	11	30
4	Food Business Management	-	-	-	<u>241</u> 2+0	<u>341</u> 2+0 <u>342</u> 1+2	<u>343</u> 1+1 <u>344</u> 2+1	<u>441</u> 1+1	-	9	5	14
5	Food Plant Operations	-	-	-	-	<u>351</u> 0+1	<u>352</u> 0+3	<u>451</u> 0+7 <u>452</u> 0+7	<u>453</u> 0+2 <u>454</u> 0+20	0	40	40
6	Basic Engineering	<u>161</u> 0+2 <u>162</u> 2+1 <u>163</u> 1+1	<u>164</u> 1+2 <u>165</u> 2+1 <u>166</u> 2+1	-	-	-	-	-	-	8	8	16
7	Basic Sciences and Humanities	<u>171</u> 1+1 <u>172</u> 1+1	<u>173</u> 1+1 <u>174</u> 2+1	<u>271</u> 2+1 <u>272</u> 1+1	-	-	-	-	-	8	6	14
8	Physical Education (Non-Credit)	<u>101</u> 0+1	<u>102</u> 0+1	-	-	-	-	-	-	0	2	2
Total		22 12+10	23 14+9	23 15+8	23 16+7	23 14+9	23 12+11	22 5+17	22 0+22	88	93	181

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
Faculty of Agricultural Engineering & Technology
B. Tech. (Food Technology)

Department-wise Distribution of Credit Load

S. No.	Name of Department	Credits
1	Food Processing Technology	37 (24+13)
2	Food Process Engineering	30 (20+10)
3	Food Safety and Quality Assurance	30 (19+11)
4	Food Business Management	14 (09+05)
5	Food Plant Operations (Student READY Courses)	40 (00+40)
6	Basic Engineering	16 (08+08)
7	Basic Sciences and Humanities	14 (08+06)
8	<i>Physical Education (Non Credit Course)</i>	<i>02 (00+02)</i>
Total		181 (88+93)

Department-wise Distribution of Courses

S. No.	Course No.	Title of the Course	Credits
Food Processing Technology (1)			
1	FDPT 111	Fundamentals of Food Processing	3 (2+1)
2	FDPT 112	Processing Technology of Liquid Milk	2 (1+1)
3	FDPT 211	Processing Technology of Cereals	3 (2+1)
4	FDPT 212	Processing Technology of Legumes and Oilseeds	3 (2+1)
5	FDPT 213	Processing Technology of Dairy Products	3 (2+1)
6	FDPT 214	Processing of Spices and Plantation Crops	3 (2+1)
7	FDPT 215	Processing Technology of Fruits and Vegetables	3 (2+1)
8	FDPT 311	Processing of Meat and Poultry Products	3 (2+1)
9	FDPT 312	Bakery, Confectionery and Snack Products	3 (2+1)
10	FDPT 313	Food Packaging Technology and Equipment	3 (2+1)
11	FDPT 314	Processing of Fish and Marine Products	3 (2+1)
12	FDPT 315	Sensory Evaluation of Food Products	2 (1+1)
13	FDPT 411	Processing Technology of Beverages	3 (2+1)
Total			37 (24+13)

Food Process Engineering (2)

1	FDPE 121	Food Thermodynamics	3 (2+1)
2	FDPE 122	Post Harvest Engineering	3 (2+1)
3	FDPE 221	Heat and Mass Transfer in Food Processing	3 (2+1)
4	FDPE 222	Unit Operations of Food Processing-I	3 (2+1)
5	FDPE 223	Unit Operations of Food Processing-II	3 (2+1)
6	FDPE 224	Food Refrigeration and Cold Chain	3 (2+1)
7	FDPE 321	Food Process Equipment Design	3 (2+1)
8	FDPE 322	Food Storage Engineering	3 (2+1)
9	FDPE 323	Instrumentation and Process Control in Food Industry	3 (2+1)
10	FDPE 421	Food Plant Layout and Utilities	3 (2+1)
Total			30 (20+10)

Food Safety and Quality Assurance (3)

1	FSQA 131	General Microbiology	3 (2+1)
2	FSQA 132	Food Biochemistry and Nutrition	3 (2+1)

3	FSQA 133	Food Microbiology	3 (2+1)
4	FSQA 231	Industrial Microbiology	3 (2+1)
5	FSQA 232	Food Chemistry of Macronutrients	3 (2+1)
6	FSQA 233	Food Chemistry of Micronutrients	3 (2+1)
7	FSQA 234	Food Biotechnology	3 (2+1)
8	FSQA 331	Instrumental Techniques in Food Analysis	3 (1+2)
9	FSQA 332	Food Quality, Safety Standards and Certification	2 (2+0)
10	FSQA 333	Food Additives and Preservatives	2 (1+1)
11	FSQA 334	Food Plant Sanitation	2 (1+1)
Total			30 (19+11)
Food Business Management (4)			
1	FDBM 241	Business Management and Economics	2 (2+0)
2	FDBM 341	Marketing Management and International Trade	2 (2+0)
3	FDBM 342	ICT Applications in Food Industry	3 (1+2)
4	FDBM 343	Project Preparation and Management	2 (1+1)
5	FDBM 344	Entrepreneurship Development	3 (2+1)
6	FDBM 441	Communication and Soft Skills Development	2 (1+1)
Total			14 (9+5)
Food Plant Operations (5)			
1	FDPO 351	Student READY - Seminar	1 (0+1)
2	FDPO 352	Student READY - Research Project	3 (0+3)
3	FDPO 451	Student READY - Experiential Learning Programme -I	7 (0+7)
4	FDPO 452	Student READY - Experiential Learning Programme-II	7 (0+7)
5	FDPO 453	Student READY - Industrial Tour	2 (0+2)
6	FDPO 454	Student READY - Internship/In-Plant Training	20 (0+20)
Total			40 (0+40)
Basic Engineering (6)			
1	FDBE 161	Engineering Drawing and Graphics	2 (0+2)
2	FDBE 162	Electrical Engineering	3 (2+1)
3	FDBE 163	Workshop Technology	2 (1+1)
4	FDBE 164	Computer Programming and Data Structures	3 (1+2)
5	FDBE 165	Basic Electronics Engineering	3 (2+1)
6	FDBE 166	Fluid Mechanics	3 (2+1)
Total			16 (8+8)
Basic Sciences and Humanities (7)			
1	FBSH 171	Engineering Mathematics-I	2 (1+1)
2	FBSH 172	Environmental Science and Disaster Management	2 (1+1)
3	FBSH 173	English Language	2 (1+1)
4	FBSH 174	Engineering Mathematics-II	3 (2+1)
5	FBSH 271	Crop Production Technology	3 (2+1)
6	FBSH 272	Statistical Methods and Numerical Analysis	2 (1+1)
Total			14 (8+6)
Physical Education (Non-Credit Courses of Co-Curricular Activities)			
1	COCA 101	Physical Education and Yoga practices	1 (0+1)
2	COCA 102	NSS	1 (0+1)
Total			2 (0+2)
Grand Total of Credit Hours			181 (88+93)

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
Faculty of Agricultural Engineering & Technology
B. Tech. (Food Technology) Degree

YEAR-WISE & SEMESTER WISE DISTRIBUTION OF COURSES
I YEAR I SEMESTER

Course title	Credit hours
FDPT 111 Fundamentals of Food Processing	3 (2+1)
FDPT 112 Processing Technology of Liquid Milk	2 (1+1)
FSQA 131 General Microbiology	3 (2+1)
FSQA 132 Food Biochemistry and Nutrition	3 (2+1)
FDBE 161 Engineering Drawing and Graphics	2 (0+2)
FDBE 162 Electrical Engineering	3 (2+1)
FDBE 163 Workshop Technology	2 (1+1)
FBSH 171 Engineering Mathematics-I	2 (1+1)
FBSH 172 Environmental Science and Disaster Management	2 (1+1)
COCA 101 Physical Education and Yoga practices (Non-Credit Course)	1 (0+1)*
	22 (12+10)

I YEAR II SEMESTER

Course title	Credit hours
FDPE 121 Food Thermodynamics	3 (2+1)
FDPE 122 Post Harvest Engineering	3 (2+1)
FSQA 133 Food Microbiology	3 (2+1)
FDBE 164 Computer Programming and Data Structures	3 (1+2)
FDBE 165 Basic Electronics Engineering	3 (2+1)
FDBE 166 Fluid Mechanics	3 (2+1)
FBSH 173 English Language	2 (1+1)
FBSH 174 Engineering Mathematics-II	3 (2+1)
COCA 102 NSS (Non-Credit Course)	1 (0+1)*
	23 (14+9)

II YEAR I SEMESTER

Course title	Credit hours
FDPT 211 Processing Technology of Cereals	3 (2+1)
FDPT 212 Processing Technology of Legumes and Oilseeds	3 (2+1)
FDPE 221 Heat and Mass Transfer in Food Processing	3 (2+1)
FDPE 222 Unit Operations of Food Processing-I	3 (2+1)
FSQA 231 Industrial Microbiology	3 (2+1)
FSQA 232 Food Chemistry of Macronutrients	3 (2+1)
FBSH 271 Crop Production Technology	3 (2+1)
FBSH 272 Statistical Methods and Numerical Analysis	2 (1+1)
	23 (15+8)

II YEAR II SEMESTER

Course title	Credit hours
FDPT 213 Processing Technology of Dairy Products	3 (2+1)
FDPT 214 Processing of Spices and Plantation Crops	3 (2+1)
FDPT 215 Processing Technology of Fruits and Vegetables	3 (2+1)
FDPE 223 Unit Operations of Food Processing-II	3 (2+1)

FDPE 224	Food Refrigeration and Cold Chain	3 (2+1)
FSQA 233	Food Chemistry of Micronutrients	3 (2+1)
FSQA 234	Food Biotechnology	3 (2+1)
FDBM 241	Business Management and Economics	2 (2+0)
		23 (16+7)

III YEAR I SEMESTER

Course title	Credit hours	
FDPT 311	Processing of Meat and Poultry Products	3 (2+1)
FDPT 312	Bakery, Confectionery and Snack Products	3 (2+1)
FDPE 321	Food Process Equipment Design	3 (2+1)
FDPE 322	Food Storage Engineering	3 (2+1)
FSQA 331	Instrumental Techniques in Food Analysis	3 (1+2)
FSQA 332	Food Quality, Safety Standards and Certification	2 (2+0)
FDBM 341	Marketing Management and International Trade	2 (2+0)
FDBM 342	ICT Applications in Food Industry	3 (1+2)
FDPO 351	Student READY - Seminar	1 (0+1)
		23 (14+9)

III YEAR II SEMESTER

Course title	Credit hours	
FDPT 313	Food Packaging Technology and Equipment	3 (2+1)
FDPT 314	Processing of Fish and Marine Products	3 (2+1)
FDPT 315	Sensory Evaluation of Food Products	2 (1+1)
FDPE 323	Instrumentation and Process Control in Food Industry	3 (2+1)
FSQA 333	Food Additives and Preservatives	2 (1+1)
FSQA 334	Food Plant Sanitation	2 (1+1)
FDBM 343	Project Preparation and Management	2 (1+1)
FDBM 344	Entrepreneurship Development	3 (2+1)
FDPO 352	Student READY - Research Project	3 (0+3)
		23 (12+11)

IV YEAR I SEMESTER

Course title	Credit hours	
FDPT 411	Processing Technology of Beverages	3 (2+1)
FDPE 421	Food Plant Layout and Utilities	3 (2+1)
FDBM 441	Communication and Soft Skills Development	2 (1+1)
FDPO 451	Student READY - Experiential Learning Programme - I	7 (0+7)
FDPO 452	Student READY - Experiential Learning Programme – II	7 (0+7)
		22 (5+17)

IV YEAR II SEMESTER

Course title	Credit hours	
FDPO 453	Student READY - Industrial Tour	2 (0+2)
FDPO 454	Student READY - Internship/In-Plant Training	20 (0+20)
		22 (0+22)
Grand Total of Credit Hours		181 (88+93)

* Non gradial courses

Department of Food Processing Technology

FDPT 111

Fundamentals of Food Processing

3 (2+1)

Course outlines

Theory

Sources, types and perishability of foods; Causes and types of food spoilage, concept of shelf-life; Scope and benefit of food preservation; Methods of food preservation; Preservation by salt and sugar: Principle, method and effect on food quality. Preservation by heat treatment: Principle and equipment for blanching, canning, pasteurization, sterilization; Preservation by use of low temperature: Principle, methods, equipment; Preservation by drying, dehydration and concentration: Principle, methods, equipment; Preservation by irradiation: Principle, methods, equipment; Preservation by chemicals- antioxidants, mould inhibitors, antibodies, acidulants, etc.; Preservation by fermentation: Principles, methods, equipment; Non thermal preservation processes: Principles, equipment – Pulsed electric field and pulsed intense light, ultrasound, dielectric heating, ohmic and infrared heating, high pressure processing, microwave processing, etc.; Quality tests and shelf-life of preserved foods; Nutritional changes and degradation during food processing.

Practical

Demonstration of various perishable food items and degree of spoilage; Blanching of selected food items; Preservation of food by heat treatment- pasteurization; Preservation of food by high concentration of sugar: Jam; Preservation of food by using salt: Pickle; Preservation of food by using acidulants, i.e. pickling by acid, vinegar or acetic acid; Preservation of food by using chemical preservatives; Preservation of bread, cake using mold inhibitors; Drying of fruit slices: Pineapple slices, apple slices in cabinet drier; Drying of green leafy vegetables; Drying of mango/other pulp by foam-mat drying; Drying of semisolid foods using roller dryers; Drying of foods using freeze-drying process; Demonstration of preserving foods under cold vs. freezing process; Processing of foods using fermentation technique, i.e. preparation of sauerkraut; Study on effect of high pressure on microbe; Study on effect of pulse electric field on food.

Lecture

Theory

- 1 Sources, types and perishability of foods – principles of food science and technology – introduction – definitions of food, food science and technology, food classification – basic four, basic five (ICMR), basic seven– perishables – semi perishables and non perishables
- 2 Causes and types of food spoilage- definition of food spoilage, causes, types- micro biological – bio-chemical, physical and enzymatic spoilage (bio-chemical spoilage) – spoilage by insects, parasites and rodents – mechanical spoilage, physical spoilage and chemical spoilage

- 4 Concept of shelf life – factors affecting shelf life- date marking- determination of best before date
- 5 Scope and benefit of food preservation – methods of food preservation - general principles of food preservation – physical methods – chemical methods – fermentation – other methods
- 6 Preservation of food by salt - principle, method- dry curing and brining; effect on food
- 7 Preservation of food by sugar – principle, methods- syrups and concentration of syrups; effect on food
- 8 Methods of processing and their effect on food quality – different processing methods- thermal and non-thermal methods – advantages and disadvantages
- 9 Preservation by heat treatment – thermal processing – types, blanching – methods - equipments-advantages and disadvantages
- 10 Canning- steps in canning- syruping, brining- canning for acidic and non-acidic foods – type of equipment used for canning – effect on food- advantages and disadvantages
- 11 Pasteurization- method, types, type of equipment, effect on food- advantages and disadvantages
- 12 Sterilization- method, type of equipment, effect on food- advantages and disadvantages
- 13 Preservation by use of low temperature storage –concept and method- various changes occurring during low temperature storage in food
- 14 Methods of food freezing – quick fast freezing and slow freezing- effect of freezing and thawing in food- advantages and disadvantages
- 15 Preservation by drying / dehydration – concept of drying - moisture content expression – types of moisture definition – bound moisture – unbound moisture – free moisture - difference between drying and dehydration – methods- sun drying; mechanical dehydration – direct heated driers and indirect heated driers
- 16 Cabinet driers, tunnel drier drum drier, fluidized bed drier, spray drier, foam mat drying, and vacuum drying
- 17 Factors affecting dehydration; changes/effects in constituents of food materials – shrinkage, case hardening – thermo-plasticity – reconstitution properties; advantages and disadvantages
- 18 Preservation by concentration – methods of concentration – film evaporators – falling evaporators – flash evaporator – freeze concentration – ultra filtration and reverse osmosis- effect on food – advantages and disadvantages
- 19 Preservation by radiation – food irradiation –forms of energy – ionizing radiation and non-ionizing energy – units of radiation –method and equipment
- 20 Applications of irradiation-effects of radiation – direct and indirect effects- irradiation doses for treating various foods – advantages and disadvantages

- 21 Preservation by chemicals – types and their mechanism of preservation – class I preservatives – class II preservative – mould inhibitors – parabens – epoxides – benzoic acid – propionic acid
- 22 Preservation by antioxidants, acidulants, antibiotics, acidulates, sulphites and nitrates-effects on food
- 23 Preservation by fermentation – principle, method, equipment-applications-some industrial fermentation in food industries
- 24 Preservation by fermentation – principle, method, equipment-applications-Some industrial fermentation in food industries
- 25 Non-thermal preservation: pulsed electric field processing- principle, method, equipment, applications and effect on food - advantages and disadvantages
- 26 Pulsed intense light- principle, method, equipment, applications effect on food - advantages and disadvantages
- 27 Ultrasound processing- principle, method, equipment, applications effect on food - advantages and disadvantages
- 28 Dielectric and infrared heating- principle, method, equipment, applications and effect on food - advantages and disadvantages
- 29 Ohmic heating- principle, method, equipment, applications and effect on food - advantages and disadvantages
- 30 High pressure processing - principle, method, equipment, applications effect on food - advantages and disadvantages
- 31 Microwave heating- principle, method, equipment, applications effect on food - advantages and disadvantages
- 32 Assessment of shelf life of processed foods- methods for determining shelf life- designing shelf life study- monitoring- prediction and establishment; nutritional changes – physical and chemical changes leading to nutrient loss and degradation and availability in food due to food processing

Practical

- 1 Demonstration of various perishable food items and degree of spoilage
- 2 Blanching of food items and preservation of food by pasteurization
- 3 Preservation food by using sterilization temperatures
- 4 Preservation of food by high concentration of sugar- Jam
- 5 Preservation of food by using salt – pickle
- 6 Preservation of food by using acidulants/acid- vinegar
- 7 Preservation of food by using chemical preservatives
- 8 Preservation of bread/ cake using mold inhibitors
- 9 Drying of fruit slices and green leafy vegetables using cabinet drier- pineapple, apple
- 10 Drying of mango pulp using foam mat drying

- 11 Drying of semisolid food using roller drying
- 12 Drying of foods using freeze drying
- 13 Demonstration of preserving foods under cold vs freezing process
- 14 Processing of foods using fermentation- sauerkraut
- 15 Study on effect of high pressure processing and pulsed electric field on food
- 16 Practical Examination

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FDPT 112

Processing Technology of Liquid Milk

2 (1+1)

Course outlines

Theory

Historical development of dairy in India; Production and utilization of milk; Composition and properties of milk and colostrum; Liquid milk collection, preservation, processing, packaging and storage - standardized milk, skim milk, sterilized milk, reconstituted milk, recombined milk, flavoured milk, fermented milk, acidophilous milk, etc.; Effect of thermal treatment on milk constituents; Cream: definition, classification, manufacture of different types of cream, processing of cream; Fermented milk products: Processing, manufacture, storage and packaging of acidophilus

milk, cultured buttermilk and other fermented milk; Bio-chemical changes occurring during manufacture of fermented milks; Factors affecting these changes and effects of these changes on the quality of finished products; Adulterations in milk and its detection; Quality defects in milk - causes and prevention, liquid milk collection, processing, packaging and storage systems and equipment - bulk milk coolers, milk chilling units, milk reception equipment, milk tanks/silos, pasteurizers, sterilizers, centrifuges, clarifiers, filtration units, homogenizers, packaging and filling machines, CIP units, etc.; Hygienic design concepts, sanitary pipes and fittings, corrosion process and their control.

Practical

Platform tests of raw milk (clot on boiling (COB) test, alcohol test); Determination of physical properties of milk; Determination of proximate composition and biochemical properties of milk; Determination of microbiological properties of milk; Detection of adulterants in milk; Identification and demonstration of liquid milk processing equipment, pipes and fittings; Preparing standardized milk as per requirement; Separation of fat from milk; Pasteurization and homogenization of milk; Packaging of liquid milk; Preparation of curd and yogurt, Visit to chilling centre and dairy plant.

Lecture

Theory

- 1 Historical development of dairy in India; production and utilization of milk and statistics of Indian milk production
- 2 Composition of different cattle milk and properties of milk and colostrum-physical, chemical and thermal
- 3 Liquid milk collection, preservation, processing, packaging and storage
- 4 Types of milk-standardized milk, skim milk, sterilized milk, reconstituted milk, recombined milk, flavoured milk, fermented milk, acidophilous milk and other kinds prevailing in market
- 5 Effect of thermal treatment on milk constituents with special concentration on SNF and fat
- 6 Cream: definition, classification, manufacture of different types of cream and processing of cream
- 7 Fermented milk products: processing, manufacture, storage and packaging of acidophilus milk, cultured buttermilk and other fermented milk
- 8 Biochemical changes occurring during manufacture of fermented milk
- 9 Factors affecting biochemical changes of fermented milk and effects of these changes on the quality of finished products
- 10 Adulterations in milk and its detection by chemical and non-chemical means
- 11 Quality defects in milk - causes and prevention
- 12 Equipments used in liquid milk collection, processing, packaging and storage systems
- 13 Bulk milk coolers, milk chilling units design and operation
- 14 Milk reception equipment, milk tanks/silos, pasteurizers, sterilizers and centrifuges

- 15 Clarifiers, filtration units, homogenizers, packaging and filling machines and CIP techniques
- 16 Hygienic design concepts, sanitary pipes and fittings, corrosion process and control

Practical

- 1 Clot on boiling (COB) test, alcohol test of raw milk
- 2 Determination of physical properties of milk-specific gravity and viscosity
- 3 Determination of proximate composition and biochemical properties of milk
- 4 Determination of proximate composition and biochemical properties of milk
- 5 Determination of microbiological properties of milk
- 6 Determination of microbiological properties of milk
- 7 Visit to chilling centre
- 8 Detection of adulterants in milk
- 9 Demonstration of liquid milk processing equipment, pipes and fittings
- 10 Preparation of standardized milk as per requirement
- 11 Separation of fat from milk
- 12 Pasteurization and homogenization of milk
- 13 Packaging techniques of liquid milk
- 14 Preparation of curd and yogurt
- 15 Visit to dairy plant
- 16 Practical Examination

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FDPT 211

Processing Technology of Cereals

3 (2+1)

Course outlines

Theory

Present status and future prospects of cereals and millets; Morphology, physico-chemical properties of cereals, major and minor millets; Chemical composition and nutritive value; Paddy processing and rice milling: Conventional milling, modern milling, milling operations, milling

machines, milling efficiency; Quality characteristics influencing final milled product; Parboiling; Rice bran stabilization and its methods; Wheat milling: Break system, purification system and reduction system; extraction rate and its effect on flour composition; quality characteristics of flour and their suitability for baking; Corn milling: Dry and wet milling of corn, starch and gluten separation, milling fractions and modified starches; Barley: Malting and milling; Oat/Rye: Processing, milling; Sorghum: Milling, malting, pearling; Millets (Pearl millet, finger millet): Processing of millets for food uses; Secondary and tertiary processing of cereals and millets; By-product processing of cereals and millets; Processing of infant foods from cereals and millets; Breakfast cereal foods: Flaked, puffed, expanded, extruded and shredded.

Practical

Morphological characteristics of cereals; Physical properties of cereals; Chemical properties of cereals; Parboiling of paddy; Cooking quality of rice; Milling of rice; Conditioning and milling of wheat; Production of sorghum flakes; Production of popcorn, flaked rice, puffed rice, noodles; Preparation of sorghum malt; Determination of gelatinization temperature by visco-amylograph; Processing of value added products from millets; Visit to cereal processing unit.

Lecture

Theory

- 1 Present status and future prospects of cereals and millets – current trends in area, production and yield
- 2 Morphology: taxonomic details of cereals and millets - structure and composition of cereal grains – wheat, corn, rice, barley, oat, rye and sorghum
- 3 Physico-chemical properties of cereals, major and minor millets: physical properties – 1000 grain weight, sphericity, roundness, bulk density, kernel density, porosity, coefficient of friction and angle of repose
- 4 Chemical properties – carbohydrates, proteins and amino acids, lipids, nucleic acids, enzymes, pigments, organic acids, polyphenols, tannins, flavouring principles and vitamins
- 5 Chemical composition and nutritive value of cereals and millets
- 6 Paddy processing and rice milling: conventional milling, modern milling and milling operations
- 7 Milling machines: traditional rice milling machinery – hand pounding equipment, single huller, battery of hullers, sheller-cum-huller mill, sheller mill and engleberg huller
- 8 Modern rice milling machinery – paddy cleaner, destoner, thickness grader, paddy husker and husk aspirator, paddy separator, abrasion type and friction type polishers, pressure-type, moisture conditioner, indented cylinder grader and color sorter
- 9 Milling efficiency: determination of milling efficiency – solving numerical on milling efficiency

- 10 Quality characteristics influencing final milled product – factors that affect rice out turn during milling
- 11 Parboiling: principle - physico-chemical changes during parboiling – steps in parboiling – effect of parboiling on milling, nutritional and cooking quality of rice
- 12 Advantages and disadvantages of parboiling – methods of parboiling – traditional methods and improved methods
- 13 Rice bran stabilization and its methods
- 14 Wheat milling : break system, purification system and reduction system - wheat quality and grading
- 15 Wheat reception and storage, preparation of wheat for milling, the milling process and working principal of milling equipment
- 16 Flour collection and treatment, generating final products and their handling
- 17 Soft wheat milling – durum wheat milling - wet milling of wheat – uses of vital wheat gluten bread, gluten flour
- 18 Extraction rate of flour and its effect on flour composition
- 19 Quality characteristics of flour and their suitability for baking – flour grades – treatments of wheat flour – flours for various purposes: bread flour, biscuit flour, cake flour, flour from steamed wheat and export quality of flour
- 20 Corn milling: dry milling of corn – cleaning, tempering/conditioning, corn dehulling and de-germination with Beall, roller milling and impacting or entoleting
- 21 Wet milling of corn - cleaning, steeping, germ separation, fiber separation and starch refinement
- 22 Starch and gluten separation - milling fractions and modified starches
- 23 Barley malting: steeping, germination, kilning and ageing – uses of malt - brewing process - beer and sake production – distilling – production of whisky
- 24 Barley milling: cleaning, conditioning, blocking, pearling and bleaching
- 25 Oat processing: milling – traditional (dry–shelling) and modern (green shelling) processes - grading, stabilization, kiln-drying, shelling and cut groats
- 26 Rye processing, milling - cleaning, conditioning, break rolls, husk aspiration, reduction rolls and rye flour
- 27 Sorghum: milling, malting, pearling - dry milling and wet milling of sorghum – products of dry and wet milling - uses of sorghum malt
- 28 Millets (pearl millet, finger millet): processing of millets for food uses
- 29 Secondary and tertiary products processing of cereals and millets: barley flour, oat flour, white groats, wheat semolina, rice flour, rice starch, parched rice, rice crackers and pasta (noodles)
- 30 Byproducts processing of cereals and millets: wheat bran, wheat germ, rice husk, rice Bran, broken rice, rice pollards and oat bran
- 31 Processing of infant foods from cereals and millets: pre-cooked rice cereal, extrusion-cooked baby foods, formulated baby foods, puffed rice cake and rice krispies

- 32 Breakfast cereal foods: flaked, puffed, expanded, extruded and shredded – flaked rice, extruded rice, shredded rice, oat flake, barley flake, corn flake, sorghum flake, oven - puffed rice, gun puffed rice, puffed wheat, puffed corn, puffed sorghum, directly expanded snacks, quick cooking pasta, pre-cooked pasta, porridge from oats and other cereals, puffing by extrusion, shredded wheat and grape nuts

Practical

- 1 Study of morphological characteristics of cereals
- 2 Determination of physical properties of cereals
- 3 Determination of chemical properties of cereals
- 4 Experiment on parboiling of paddy
- 5 Study on cooking quality of rice
- 6 Study on milling of rice
- 7 Study on conditioning and milling of wheat
- 8 Experiment on production of sorghum flakes
- 9 Experiment on production of popcorn
- 10 Experiment on production of flaked rice and puffed rice
- 11 Experiment on production of noodles
- 12 Experiment on preparation of sorghum malt
- 13 Determination of gelatinization temperature by viscoamylograph
- 14 Processing of value added products from millets
- 15 Visit to cereal processing unit
- 16 Practical Examination

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FDPT 212 Processing Technology of Legumes and Oilseeds 3 (2+1)

Course outlines

Theory

Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds; Chemical composition, nutritional value and anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti-nutritional compounds; Pulse milling: Home scale, cottage scale and modern milling methods, machines, milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in dhal milling industry; Nutritional changes during soaking and sprouting of pulses; Cooking quality of dhal, methods, factors affecting cooking of dhal; Quick cooking dhal, instant dhal; Soybean milk processing and value addition; Fermented products of legumes; Oil seed milling: Ghanis, hydraulic presses, expellers, solvent extraction methods, machines, milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in oil milling industry; Desolventization; Refining of oils: Degumming, neutralization, bleaching, filtration, deodorization, their principles and process controls; Hydrogenation of oils; New technologies in oilseed processing; Utilization of oil seed meals for different food uses: High protein products like protein concentrates and isolates; By-products of pulse and oil milling and their value addition.

Practical

Determination of physical properties of legumes and oil seeds; Determination of proximate composition of selected pulses and oilseeds; Determination of nutritional quality of selected pulses and oilseeds; Study of mini dhal mill; Study of mini oil mill; Preconditioning of pulses before milling; Preconditioning of oilseeds before milling; Removal of anti-nutritional compounds from selected pulses and oilseeds; Laboratory milling of selected pulses and its quality evaluation; Laboratory milling of selected oilseeds and its quality evaluation; Laboratory refining of selected oils; Laboratory hydrogenation of selected oils; Study of cooking quality of dhal; Processing of composite legume mix and preparation of value added products; Visit to commercial dhal mills and oil mills.

Lecture

Theory

- 1 Present status and future prospects of legumes and oilseeds – current trends in area, production and yield – technology mission on oilseeds and pulses

- 2 Morphology of legumes and oilseeds -taxonomic details of legumes and oilseeds
- 3 Classification and types of legumes and oilseeds
- 4 Chemical composition and nutritive value of legumes and oilseeds
- 5 Anti-nutritional compounds in legumes and oilseeds - protease inhibitors, lectins/haemagglutinins, goitrogens, saponins, phenolic compounds, oxalates, phytates, cyanogens, antivitamins, allergenic factors, flatulence factors, aflatoxins and cyanogenic glycosides
- 6 Methods of removal of anti-nutritional compounds – dehulling, soaking, roasting/parching, germination, boiling, pressure cooking, fermentation, extrusion and parboiling
- 7 Pulses milling: home scale, cottage scale and modern milling methods – wet milling and dry milling – milling of pigeon pea, chickpea, black gram, green gram, peas and lentil - developments in pre-milling treatment
- 8 Machines: home scale - pestle and mortar or hand driven disk mills (chakki)
- 9 Machines: cottage scale - motorized plate mill, under runner disk sheller, horizontal flour mill and hullers
- 10 Machines: commercial scale – emery coated roller machines, CFTRI modern dhal mill, CFTRI mini dhal mill, CFTRI hand operated pulse dehusker, tangential abrasive disc dehuller
- 11 Milling quality - determination of pulse milling quality
- 12 Milling efficiency - determination of pulse milling efficiency
- 13 Factors affecting milling quality and quantity: seed characteristics that affect milling – nature of seed coat, physical characteristics of grains, effect of varietal differences on dehulling quality
- 14 Problems in dhal milling industry
- 15 Nutritional changes during soaking and sprouting of pulses
- 16 Cooking quality of dhal, methods and factors affecting cooking of dhal
- 17 Quick cooking dhal - instant dhal
- 18 Soybean milk processing and value addition - soy paneer (tofu) - texturized vegetable protein, soy sauce, tempeh, natto and miso
- 19 Fermented products of legumes – idli, dosa, dhokla, khaman, dawadawa, iru, papads, ugba, badias
- 20 Oil seed milling: sources of oilseeds - annual oilseed crops, perennial oilseed crops and minor oilseeds – characteristics of oils – utilization of various oils
- 21 Oil seed milling: oilseed harvesting and handling – drying – storage - grading - pre-treatments – cleaning – dehulling – size reduction – flaking – conditioning/heat treatment
- 22 Oil seed milling: ghanis, hydraulic presses, expellers - mechanical screw press – principle and structural design - disadvantages of expeller- oil clarification - extrusion expeller

- 23 Solvent extraction methods: principle - solvent extractor – batch type and continuous type - distillation and solvent recovery
- 24 Solvent extraction methods: extraction of oils from groundnut, rapeseed/mustard, safflower, sunflower and sesame
- 25 Solvent extraction methods: extraction of oils from soybean, cotton lentils, oil palm, coconut and rice bran
- 26 Machines, milling quality, milling efficiency, factors affecting milling quality and quantity - problems in oil milling industry
- 27 Desolventization; refining of oils: degumming, neutralization, bleaching, Filtration, deodourisation, their principles and process controls - caustic refining – miscella refining – physical refining - winterization
- 28 Hydrogenation of oils: catalyst - hydrogenation process – shortenings – margarines – vanaspati – salad oils – salad dressings
- 29 New technologies in oilseed processing: super critical fluid extraction - membrane processing
- 30 Utilization of oil seed meals for different food uses: oilseed extraction – oilcakes in food products – fabricated foods – simple mixes – quality of oilseed meals – quality of cake – feed uses of oilseed meals – low fat and high protein products
- 31 High protein products like protein concentrates and isolates – oilseed based food products
- 32 Byproducts of pulse, oil milling and their value addition: pulse dehulled flour, pulse byproduct flour, hull and cotyledon fibers, isoflavones and bioactive compounds

Practical

- 1 Determination of physical properties of legumes and oilseeds
- 2 Determination of proximate composition of selected pulses and oilseeds
- 3 Determination of nutritional quality of selected pulses and oilseeds
- 4 Study of mini dhal mill
- 5 Study of mini oil mill
- 6 Study on preconditioning of pulses before milling
- 7 Study on preconditioning of oilseeds before milling
- 8 Study on removal of anti-nutritional compounds from selected pulses and oilseeds
- 9 Laboratory milling of selected pulses and its quality evaluation
- 10 Laboratory milling of selected oilseeds and its quality evaluation
- 11 Laboratory refining of selected oils
- 12 Laboratory hydrogenation of selected oils
- 13 Study of cooking quality of dhal
- 14 Processing of composite legume mix and preparation of value added products
- 15 Visit to commercial dhal mill and oil mill
- 16 Practical Examination

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FDPT 213

Processing Technology of Dairy Products

3 (2+1)

Course outlines

Theory

Classification of dairy products; Butter: Definition, composition; processing and production steps, overrun, butter making machines, quality testing of table butter, butter- defects, causes and their prevention, packaging and storage; Butter oil and ghee: Definition, composition, processing, equipment, quality tests; Paneer and Cheese: Definition, composition, types, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage; Ice cream and frozen desserts: Definition, composition, types, processing steps and flow diagram, equipment, quality testing, defects causes and prevention, packaging and storage. Condensed and Dried milk: Definition, composition, role of milk constituents in condensed milk, manufacture of condensed milk, types of standards for dried milk, manufacture of SMP and WMP using roller and spray drying, instantization, recent developments in drying, quality testing, defects, causes and prevention, packaging and storage; Traditional Indian Dairy Products: Definitions, compositions, processing, packaging, storage, equipment and quality testing; By- products of dairy industry and their utilization.

Practical

Processing technology of butter/ table butter, Processing technology of ghee, Preparation of paneer; Processing technology of selected type of cheese; Processing technology of ice-cream and selected frozen desserts; Processing technology of condensed milk; Processing technology of milk powder; Processing technology of selected Indian dairy products; Determination of selected quality parameters of selected dairy products; Visit to dairy plant.

Lecture

Theory

- 1 Introduction to dairy products- classification-Western and Indian dairy products-acid coagulated and enzyme coagulated products- heat coagulated products-fermented products-dehydrated products-byproducts of dairy processing
- 2 Butter- definition- composition- theory of churning- processing and production steps
- 3 Overrun- different butter making processes and equipment
- 4 Quality testing of table butter-defects in butter making- causes and their prevention-packaging and storage
- 5 Butter oil- definition- composition- processing- equipment-quality tests
- 6 Ghee- definition- composition- processing- equipment- quality tests
- 7 Paneer- definition, composition, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage
- 8 Cheese- definition, composition, types, processing steps, process flow diagram, equipment
- 9 Cottage cheese- composition, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage
- 10 Cheddar cheese- composition, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage
- 11 Ice cream and frozen desserts- definition, composition, types, processing steps and flow diagram
- 12 Ice cream processing equipment, continuous freezer and hardening tunnels
- 13 Overrun, quality testing, defects, causes, prevention, packaging and storage
- 14 Condensed milk-definition, composition, role of milk constituents in condensed milk and manufacture of condensed milk
- 15 Evaporated milk-manufacture, storage-defects, causes, prevention, packaging and storage
- 16 Dried milk- definition, composition, role of milk constituents and manufacture of dried milks
- 17 Types of standards for dried milk, manufacture of SMP and WMP using roller drying
- 18 Spray drying system-principles and operational parameters
- 19 Spray drying of SMP, WMP and instantization
- 20 Recent developments in drying, quality testing, defects, causes, prevention, packaging and storage
- 21 Dried milk products- cream powder-cheese powder-malted milk powder-infant milk food
- 22 Traditional Indian dairy products- definitions and compositions
- 23 Manufacture of chhana- processing, packaging, storage, equipment and quality testing
- 24 Manufacture of khoa- processing, packaging, storage, equipment and quality testing

- 25 Manufacture of srikhand-processing, packaging, storage, equipment and quality testing
- 26 Manufacture of Indian dairy sweets- kheer, rabri, kulfi and lassi
- 27 Manufacture of chana based sweets such as sandesh and rasogolla- khoa based sweets such as kalakhand and gulabjamun
- 28 Byproducts of dairy industry and their utilization-definition-classification- composition-principles and methods of utilization
- 29 Manufacturing of byproducts such as industrial and edible casein- defects-uses
- 30 Utilization of whey and its products, manufacture of whey protein concentrates and whey powder
- 31 Manufacture of lactose, flow diagram and uses
- 32 Packaging of milk products, types and requirements

Practical

- 1 Process technology of butter
- 2 Process technology of ghee
- 3 Process technology of channa
- 4 Process technology of paneer
- 5 Process technology of cottage cheese/soft cheese
- 6 Ice cream mix calculations
- 7 Manufacture of ice cream
- 8 Process technology of condensed milk
- 9 Process technology of milk powder
- 10 Process technology of rasagolla
- 11 Process technology of sandesh
- 12 Process technology of khoa
- 13 Process technology of kalakhand
- 14 Determination of selected quality parameters of selected dairy products
- 15 Visit to dairy plant and enumeration of different commercial dairy products
- 16 Practical Examination

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FDPT 214

Processing of Spices and Plantation Crops

3 (2+1)

Course outlines

Theory

Production and processing scenario of spice, flavour and plantation crops and its scope; Major spices: Post harvest technology, composition; processed products of spices: Ginger, chilli, turmeric, onion and garlic, pepper, cardamom. Minor spices: Herbs, leaves and spartan seasonings and their processing and utilization; All spice, Annie seed, sweet basil; Caraway seed, cassia, cinnamon; Clove, coriander, cumin, dill seed; Fennel seed, nutmeg, mace, mint marjoram. Rosemary, saffron, sage; Savory, thyme, ajowan; Asafetida, curry leaves; Post harvest technology for Tea, coffee, cocoa; Vanilla and annatto processing; Post harvest technology and processing of areca nut, cashew nut, oil palm; Flavours of minor spices; Flavour of major spices; Spice oil and oleoresins: Extraction techniques; Standard specification of spices; Functional packaging of spices and spice products; By-products of plantation crops and spices.

Practical

Identification and characterization of flavouring compounds of spices; Essential oil determination; Extraction of oil from clove, pepper, cardamom, chilli; Extraction of oleoresins: Turmeric, ginger, pepper, clove; Peperine estimation in pepper oleoresin; Steam distillation of spices; Determination of curcumin content in turmeric; Chemical analysis of spices: Moisture, Essential oil, specific gravity, refractive index, acid value; Study of standard specification of spices; Packaging study of spices; Preparation of curry powder; Visit to spice industry.

Lecture

Theory

- 1 Production and processing scenario of spice and its scope – introduction, history of spices, condiments, production trends, scope of spices processing
- 2 Flavor and plantation crops and its scope – flavoring compounds, definition of plantation crops, commercial value of plantation crops
- 3 Major spices: post harvest technology, composition - classification of spices and condiments, post harvest techniques and cryogenic grinding

- 4 Processed product of spices: ginger - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration.
- 5 Chilli - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration.
- 6 Turmeric - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 7 Onion - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 8 Garlic - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 9 Pepper - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 10 Cardamom - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 11 Minor spices: herbs, leaves and spartan seasonings, processing and utilization
- 12 All spice, annie seed, sweet basil - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 13 Caraway seed, cassia and cinnamon - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 14 Clove and coriander - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 15 Cumin and dill seed - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 16 Nutmeg, mace and fennel seed - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration.
- 17 Mint, marjoram and rosemary - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 18 Saffron, sage and savory - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 19 Thyme, ajowan and curry leaves - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 20 Asafetida - introduction, harvesting, post harvest technology, treatments, processing into marketable products and adulteration
- 21 Post harvest technology of tea – introduction, harvesting, composition, types, fermentation, processing and adulteration
- 22 Coffee – introduction, harvesting, post harvest technology, marketable products and adulteration.
- 23 Cocoa – introduction, harvesting, post harvest technology, marketable products and adulteration.

- 24 Vanilla and annatto processing- introduction, harvesting, post harvest technology, marketable products and adulteration.
- 25 Post harvest technology and processing of areca nut - introduction, harvesting, post harvest technology, marketable products and adulteration.
- 26 Cashew nut- introduction, harvesting, post harvest technology, marketable products and adulteration.
- 27 Oil palm - introduction, harvesting, post harvest technology, marketable products and adulteration.
- 28 Flavors of minor spices; flavor of major spices
- 29 Spice oil and oleoresins: extraction techniques – distillation, solvent extractions, cryogenic extractions and supercritical carbon dioxide extraction.
- 30 Standard specification of spices –FSSAI, ESA, ASTA
- 31 Functional packaging of spices and spice products
- 32 Byproducts of plantation crops and spices

Practical

- 1 Identification and characterization of flavouring compounds of spices; extraction essential oil
- 2 Extraction of oil from clove and pepper
- 3 Extraction of oil from cardamom
- 4 Extraction of oil from chili
- 5 Extraction of oleoresins: turmeric
- 6 Extraction of oleoresins: ginger
- 7 Extraction of oleoresins: pepper and clove
- 8 Piperine estimation in pepper
- 9 Steam distillation of spices
- 10 Determination of curcumin content in turmeric
- 11 Chemical analysis of spices: moisture and essential oil
- 12 Chemical analysis of spices: specific gravity, refractive Index and acid value
- 13 Study of standards and specification of spices
- 14 Preparation of curry powder
- 15 Visit to spice industry
- 16 Practical Examination

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FDPT 215 Processing Technology of Fruits and Vegetables 3 (2+1)

Course outlines

Theory

Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India; Overview of principles and preservation methods of fruits and vegetables; Supply chain of fresh fruits and vegetables; Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables; Minimal processing of fruits and vegetables; Blanching operations and equipment; Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products; FSSAI specifications and preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc.; Processing and equipment for above products; FSSAI specifications; Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and marmalades, candies, Preparation, preservation and machines for manufacture of chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, leather, dehydrated, wafers and papads, soup powders; Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products.

Practical

Primary processing of selected fruits and vegetables; Canning of Mango/Guava/ Papaya; Preparation of jam from selected fruits; Preparation of jelly from selected fruits; Preparation of fruit marmalade; Preparation of RTS; Preparation of squash; Preparation of syrup; Preparation of raisins, dried fig and dried banana; Preparation of anardana; Preparation of papain; Preparation of pickles; Preparation of dried ginger; Preparation of dried onion and garlic; Preparation of banana and potato wafers; Preparation of dehydrated leafy vegetables; Visit to fruits and vegetables pack house, canning plant, vegetable dehydration plant.

Lecture

Theory

- 1 Production and processing scenario of fruits and vegetables in India and world; scope of fruit and vegetable processing industry in India

- 2 Overview of principles and preservation methods of fruits and vegetables-Drying/dehydration-types-pretreatments-factors affecting quality- reconstitution- rehydration ratio
- 3 Low temperature storage- cold storage- freezing-types- changes during storage; concentration methods for fruit and vegetable products
- 4 Chemical preservation- different chemicals used in processing of fruits and vegetables- preservation by sulphur dioxide and sodium benzoate- safe limits of usage
- 5 Application of irradiation and hurdle concept in fruit and vegetable processing
- 6 Intermediate moisture foods in fruit and vegetable processing
- 7 Supply chain of fresh fruits and vegetables- introduction, objective and scope of supply chain- supply chain cluster and model- methodology- factors affecting fruit and vegetable supply chain
- 8 Primary processing and pack house handling of fruits and vegetables- operations of primary processing –need for pack house- dumping- presorting- washing and cleaning-sizing and grading
- 9 Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables- equipment used for the above operations
- 10 Minimal processing of fruits and vegetables-concept of minimal processing- using vacuum cooling, cold storage and MAP
- 11 Emerging technologies in minimal processing of fruits and vegetables- high pressure processing, pulsed electric field and ultrasonication
- 12 Blanching operations and equipment-types of blanching and equipment used; pretreatments used in blanching
- 13 Canning: definition, processing steps, equipment, cans and containers
- 14 Canning: definition, processing steps, equipment, cans and containers
- 15 Canning: quality assurance and defects in canned products
- 16 Process technology for preservation of juices
- 17 Process technology for squashes and syrups
- 18 Process technology for sherbets, nectars, cordials
- 19 Processing and equipment for squashes, syrups, sherbets, nectars and cordials
- 20 FSSAI specifications and standards for various processed fruits and vegetables
- 21 Process technology and machines for manufacture of crystallized fruits and preserves
- 22 Process technology and machines for manufacture of jam
- 23 Process technology and machines for manufacture of jelly and marmalades
- 24 Process technology and machines for manufacture of candies
- 25 Process technology and machines for manufacture of chutney and pickles
- 26 Process technology and machines for manufacture of sauce, puree, paste and ketchup
- 27 Process technology and machines for manufacture of toffee, cheese and leather
- 28 Process technology and machines for manufacture of dehydrated wafers and papads
- 29 Process technology and machines for manufacture of soup powders

- 30 Production of pectin- sources, types of pectins - low methoxy, high methoxypectins and their role in fruit processing; method of extraction
- 31 Production of vinegar- different methods of production of vinegar- Orleans slow method- quick generator method – defects
- 32 Commercial processing technology of selected fruits and vegetables for production of various value added processed products

Practical

- 1 Primary processing of selected fruits and vegetables
- 2 Canning of Mango/Guava/ Papaya
- 3 Process technology of jam from selected fruits
- 4 Process technology of jelly from selected fruits
- 5 Process technology of fruit marmalade
- 6 Process technology of RTS
- 7 Process technology of squash
- 8 Process technology of syrup
- 9 Process technology of raisins, dried fig and dried banana
- 10 Process technology of papain
- 11 Process technology of pickles
- 12 Process technology of dried ginger, dried onion and garlic
- 13 Process technology of banana and potato wafers
- 14 Process technology of dehydrated leafy vegetables
- 15 Visit to fruit or vegetable processing unit
- 16 Practical Examination

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FDPT 311

Processing of Meat and Poultry Products

3 (2+1)

Course outlines

Theory

Sources and importance of meat and poultry; Status of Meat and poultry industry in India; Pre-slaughter operations and slaughtering operations for animals and poultry; Evaluation of animal carcasses; Factors affecting post-mortem changes, properties and shelf life of meat; Mechanical deboning, grading and aging; Eating and cooking quality of meat; Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives; Meat tenderization; Meat emulsions; Meat cutting and handling; Processing technology and equipment for manufacture of smoked meat and its quality evaluation; Processing technology, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation; Processing technology and equipment for manufacture of meat sausages and their quality evaluation; Abattoir design and layout; Eggs: Structure, composition, quality characteristics, processing, preservation of eggs; Processing and preservation of poultry meat and chicken patties; Meat plant sanitation and safety; By-products of meat, poultry and eggs and their utilization; Safety standards in meat industry: HACCP/ FSSAI/Kosher/Halal.

Practical

Pre-slaughter operations of meat animals and poultry birds; Slaughtering and dressing of meat animals; Study of post-mortem changes; Meat cutting and handling; Preservation of meat by freezing; Preservation of meat by curing and pickling; Preservation of meat by dehydration; Evaluation of quality and grading of eggs; Preservation of shell eggs; Processing technology of value added poultry meat products; Value added egg products; Visit to abattoir.

Lecture

Theory

- 1 Sources, importance of meat and poultry – types of meat animals- classes of meat based on source

- 2 Status of meat and poultry industry in India
- 3 Pre-slaughter operations and slaughtering operations for animals and poultry: pre-slaughter operations – ante-mortem inspection of meat animals
- 4 Pre-slaughter operations and slaughtering operations for animals and poultry: slaughtering operations for animals and poultry – scientific and ritual methods of slaughter
- 5 Pre-slaughter operations and slaughtering operations for animals and poultry: dressing of carcasses- sheep, swine and buffalo
- 6 Evaluation of animal carcasses- sheep, buffalo, swine carcasses and grading
- 7 Factors affecting post-mortem changes- rigor mortis, properties and shelf life of meat
- 8 Mechanical deboning- mechanism and equipment used for deboning
- 9 Grading and ageing of meat – USDA grades – ageing – effect of ageing on myofibrillar proteins
- 10 Eating and cooking quality of meat- meat quality parameters – color, WHC, marbling, ante-mortem factors, connective tissue- palatability factors
- 11 Preservation of meat by chilling and freezing – equipment used
- 12 Preservation of meat by pickling and curing-methods of curing- impact of curing on meat structure- effect of curing on meat color
- 13 Preservation of meat by cooking and smoking – dry heat and moist heat techniques- smoke house- conventional smoking- liquid smokes
- 14 Preservation of meat by dehydration, radiation, chemical and biological preservatives
- 15 Meat tenderization – physical/ mechanical and chemical methods of tenderization
- 16 Meat emulsions – emulsification of meat- bowl chopper –stability of emulsion- factors affecting stability of meat emulsion
- 17 Meat cutting and handling – cuts of sheep and buffalo
- 18 Meat cutting and handling – cuts of swine and poultry
- 19 Processing technology and equipment used for manufacture of smoked meat and its quality evaluation
- 20 Processing technology and equipment used for manufacture of dehydrated meat products and their quality evaluation
- 21 Processing technology and equipment used for manufacture of meat sausages and quality evaluation
- 22 Abattoir design and layout – types of abattoirs, facilities required and various sections in an abattoir and their significance
- 23 Eggs: structure, composition – structural components of an egg and their functions- egg white proteins and egg yolk composition
- 24 Quality characteristics – candling of eggs – albumen index, yolk index, haugh's unit-grading of eggs
- 25 Processing – processing of liquid egg – pasteurization – dehydration – albumen flakes – white powders – yolk powders

- 26 Preservation – freezing of eggs and egg products
- 27 Preservation of eggs – shell eggs – oil coating, thermo stabilization, water glass and lime immersions
- 28 Processing and preservation of poultry meat and chicken patties
- 29 Meat plant sanitation and safety
- 30 Byproducts of meat, poultry, eggs and their utilization
- 31 Safety standards in meat industry: HACCP- elements of HACCP; implementation of HACCP in meat processing plant
- 32 Safety standards in meat industry: HACCP/FSSAI/Kosher/Halal

Practical

- 1 Pre-slaughter operations of meat animals and poultry birds
- 2 Slaughtering and dressing of meat animals- sheep
- 3 Slaughtering and dressing of meat animals- poultry
- 4 Study of post-mortem changes
- 5 Meat cutting and handling- sheep, buffalo and pig
- 6 Meat cutting and handling- poultry
- 7 Preservation of meat by freezing
- 8 Preservation of meat by curing and pickling
- 9 Preservation of meat by dehydration
- 10 Evaluation of quality and grading of eggs
- 11 Preservation of shell eggs
- 12 Process technology of value added poultry meat products- emulsion based products
- 13 Process technology of value added poultry meat products- restructured products
- 14 Value added egg products- egg powders
- 15 Visit to an abattoir
- 16 Practical Examination

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FDPT 312

Bakery, Confectionery and Snack Products

3 (2+1)

Course outlines

Theory

Bakery products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Product quality characteristics, defects, causes and corrective measures; Snack foods: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Snack food seasonings; Breakfast cereals, macaroni products and malts: Specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing.

Practical

Identifications and composition of various ingredients for snacks, bakery and confectionery products; Flours, their classifications and characterization; Processing technology, packaging and quality evaluation of selected snack items; Processing technology, packaging and quality evaluation of selected bakery items; Processing technology, packaging and quality evaluation of selected confectionery items; Processing technology, packaging and quality evaluation of selected chocolates; Processing technology of traditional Indian confection. Visit to bakery, confectionery and snack units (industry).

Lecture

Theory

- 1 Bakery products – history, present trends, nutritional facts
- 2 Bakery products: types – biscuits, crackers, breads, cakes, pastries
- 3 Bakery products specifications– Indian and International specifications

- 4 Bakery product compositions and ingredients – flour, sugar, yeast and milk
- 5 Bakery product compositions and ingredients – leavening agents, colors, setting material and flavors
- 6 Formulations and processing of bakery product: biscuits – crackers, soda crackers cookies and equipment
- 7 Formulations and processing of bakery product: cakes –methods in cake making, types of cakes and equipment
- 8 Formulations and processing of bakery product: breads – methods of bread making and equipment
- 9 Equipment, packaging and storage of bakery products – materials used for packaging and storage conditions
- 10 Quality testing of bakery product: physical, chemical and microbial qualities of bakery products
- 11 Confectionery and chocolate products – history, types and present trends
- 12 Confectionery and chocolate products specifications – Indian and International specifications
- 13 Confectionery and chocolate products: compositions and ingredients used in confectionery – sugars, syrups and aerating agents
- 14 Confectionery and chocolate products: compositions and ingredients used in confectionery – confectionery fats, gelatinizing agents, starches, flavors and colors
- 15 Formulations and processing of traditional confectionery and hard boiled sweets
- 16 Formulations and processing of aerated confectionery and creams
- 17 Formulations and processing of granulated confectionery, sugar panning tablets and lozenges
- 18 Formulations and processing of crystallized confectionery and chewing gums
- 19 Equipment used in Bakeryconfectionery manufacturing
- 20 Packaging and storage of confectionery products – materials used for packaging, storage conditions
- 21 Quality testing of confectionery products – physical, chemical and microbial qualities of confectionery products
- 22 Product quality characteristics, defects, causes and corrective measures of confectionery products
- 23 Chocolate making: compositions and ingredients – cocoa processing, emulsifiers and others
- 24 Formulations and processing of chocolates – dark and white chocolate processing
- 25 Equipment used in chocolate manufacturing
- 26 Packaging and storage of chocolates- materials used for packaging and storage conditions
- 27 Quality testing of chocolates – physical, chemical and microbial qualities of chocolate products

- 28 Snack foods: types, specifications, composition, ingredients, formulations, processing and snack food seasonings
- 29 Equipment, packaging, storage and quality testing
- 30 Breakfast cereals – flaked, extruded, oven puffed, gun puffed, shredded, other formulations and processing of breakfast cereals
- 31 Equipments used in manufacturing of breakfast cereals – mixers, feeders, extruders, dryers and fryers
- 32 Packaging and storage of breakfast cereals, quality testing of breakfast cereals – product quality, physical, chemical and microbial

Practical

- 1 Identification and composition of various ingredients for snacks
- 2 Identification and composition of various ingredients for bakery
- 3 Identification and composition of various ingredients for confectionery product
- 4 Flours, classifications and characterization I
- 5 Flours, classifications and characterization II
- 6 Processing technology and packaging of selected snack items
- 7 Quality evaluation of selected snack items
- 8 Processing technology and packaging of selected bakery items
- 9 Quality evaluation of selected bakery items
- 10 Processing technology and packaging of selected confectionery items
- 11 Quality evaluation of selected confectionery items
- 12 Processing technology and packaging of selected chocolate items
- 13 Quality evaluation of selected chocolate items
- 14 Processing technology of traditional Indian confectionery
- 15 Visit to bakery/confectionery/snack units
- 16 Practical Examination

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FDPT 313

Food Packaging Technology and Equipment

3 (2+1)

Course outlines

Theory

Packaging situations in World, India; Need of packaging; Package requirements, package functions; Package materials: Classification of packages, paper as package material, its manufacture, types, advantages of corrugated and paper board boxes, etc.; Glass as package material, manufacture, advantages, disadvantages; Metal (Aluminium/tin/SS) as package material-manufacture, advantages, disadvantages, plastic as package material, classification of polymers, properties of each plastics, uses of each plastics; Lamination: Moulding-Injection, blow, extrusion; Coating on paper and films; Aseptic packaging: Need, advantages, process, comparison of conventional and aseptic packaging, system of aseptic packaging and materials used in aseptic packaging; Permeability: Theoretical considerations, permeability of gases and vapours; Permeability of multilayer materials; Permeability in relation to packaging requirement of foods; Transport properties of barriers; Simulations of product: Package environment interaction; Packaging of specific foods, mechanical and functional tests on package.

Practical

Classification of various packages based on material and rigidity; Measurement of thickness of paper, paper boards; Measurement of basic weight and grammage of paper and paperboards; Measurement of water absorption of paper, paper boards; Measurement of bursting strength of paper, paper boards; Measurement of tear resistance of papers; Measurement of puncture resistance of paper and paperboard; Measurement of tensile strength of paper, paper boards; Measurement of grease resistance of papers; Determination of gas and water transmission rate of package films; Determination of laquer integrity test; Drop test, Box compression test; Identification of plastic films; Determination of seal integrity, ink adhesion; packaging practices followed for

packing fruits and vegetables; Shelf life calculations for food products; Head space analysis of packaged food; Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine.

Lecture

Theory

- 1 Packaging situations in world, India; need of packaging and package requirements
- 2 Package functions; levels of packaging; package materials- classification of packages
- 3 Paper as package material, its manufacture – pulp – mechanical pulp – chemical pulping
- 4 Alkaline process – soda process – sulphate process – sulphite process – semi chemical pulping – digestion
- 5 Bleaching - beating and refining - paper making - converting - calendaring – strength additives - sizing agents
- 6 Types of paper - kraft paper - bleached paper - grease proof paper – glassine paper - vegetable parchment waxed paper
- 7 Paper boards - paper board grades - folding cartons - beverage cartons - molded pulp containers – advantages of corrugated and paper board boxes, etc.
- 8 Printing and varnishing - die cutting and creasing - gluing and sealing
- 9 Glass as package material, properties of glass – mechanical, thermal and optical
- 10 Glass manufacture – melting, blow and blow press, narrow neck press and blow processes
- 11 Cold and hot treatment of glass, inspection of glass bottles- advantages, disadvantages of glass; food container closures
- 12 Metal (Aluminum/ tin/ SS) as package material manufacture - manufacture of tin plate - tin plating
- 13 Manufacture of aluminum containers - advantages and disadvantages
- 14 Container making processes - end manufacture - three piece can manufacture – welded side seams -soldered side seams - double seaming - two piece can manufacture
- 15 Drawn and ironed cans – drawn and redrawn cans - protective and decorative coatings - aluminum foils and containers - tube - retort pouch
- 16 Plastic as package material, classification of polymers, properties of each plastics, uses of each plastics
- 17 Lamination: molding-injection, blow, extrusion; coating on paper and films
- 18 Aseptic packaging: need, advantages, process, comparison of conventional and aseptic packaging
- 19 System of aseptic packaging and materials used in aseptic packaging
- 20 Permeability: theoretical considerations, permeability of gases and vapors; permeability of multilayer materials; permeability in relation to packaging requirement of foods
- 21 Transport properties of barriers; simulations of product
- 22 Mechanical and functional tests on packaging material
- 23 Edible and bio-based food packaging material

- 24 Modified atmospheric packaging
- 25 Active and intelligent packaging
- 26 Package environment interaction; packaging of specific foods
- 27 Packaging of flesh foods
- 28 Packaging of dairy products
- 29 Packaging of cereal, snack and confectionery
- 30 Packaging of fruits and vegetables
- 31 Packaging of beverages
- 32 Packaging laws and regulations

Practical

- 1 Classification of various packages based on material and rigidity and packaging practices followed for packing fruits and vegetables
- 2 Measurement of thickness, basic weight and grammage of paper and paperboards
- 3 Measurement of water absorption of paper and paper boards (Cobb test)
- 4 Measurement of bursting strength of paper and paper boards
- 5 Measurement of tear resistance of papers
- 6 Measurement of puncture resistance of paper and paperboard
- 7 Measurement of tensile strength of paper and paper boards
- 8 Measurement of grease resistance of papers
- 9 Determination of gas and water transmission rate of package films
- 10 Determination of lacquer integrity test
- 11 Drop test for packed food items and box compression test
- 12 Determination of seal integrity and ink adhesion
- 13 Shelf life calculations for food products and packaging practices followed for fruits and vegetables
- 14 Head space analysis of packaged food
- 15 Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine
- 16 Practical Examination

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Course outlines

Theory

Fisheries resources, global and Indian scenamrio; Types of fish and other marine products; Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical; Relationship between chilling and storage life, MAP, general aspects of fish freezing, changes in quality during chilled and frozen storage; Principles of canning, effect of heat processing on fish, storage of canned fish, pre-process operations, post-process operations, cannery operations for specific canned products; Fish products: Introduction, fish muscle proteins, surimi process, traditional and modern surimi-production lines, quality of surimi products, comparison of surimi and fish mince products; Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysates (FPH); Processing technology protocols of indigenous products: Fish sauce and paste. Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging; Oxygen absorbents and CO₂ generators, ethanol vapour generation, hurdle barrier concept, value added fish products, packaging; Sea food quality assurance, HACCP, EU hygienic regulations and ISO 9000 standards; New kinds of quality and safety problems emerging in sea food processing and preservation.

Practical

Study of anatomy and dressing of fish; Study of anatomy and dressing of prawn and other marine products; Identification of different types of fish - Selection and grading; Identification of different types of prawn and other marine products - Selection and grading; Quality evaluation of fish; Preparation of sun dried and salt cured fish, fish sauce; Chilling and freezing of fish; Preparations of fish protein concentrate; Preparation of fish meal; Preparation of marine fish oils and various fish products; Utilization of fish by-products; Preparation of marine algal products; Preservation of fish: Drying, pickling; Preservation of marine products using fermentation process; Preparation of value added sea products: Cutlets, bullets, wafers; Processing of fish oils; Canning methods for marine fishery products; Estimation of TVB and TMA; Determination of iodine value; Protein estimation by Folin-Lowrey's method; Visit to fish and prawn processing industry.

Lecture

Theory

- 1 Fisheries resources, global and Indian scenario
- 2 Types of fish and other marine products
- 3 Classification of fish (fresh water and marine)
- 4 Composition of fish: biochemical composition of fish - prawn/shrimp and marine fishes - proximate composition; nutritive value of fish flesh - prawn and marine foods
- 5 Characteristics of fresh fish

- 6 Spoilage of fish- microbiological: spoilage indices of fish - factors affecting spoilage of fish
- 7 Spoilage of fish- physiological: post-mortem changes in fish and quality assessment
- 8 Spoilage of fish- biochemical: enzymatic changes
- 9 Relationship between chilling and storage life
- 10 MAP: application of modified atmosphere packaging for fish and marine products
- 11 General aspects of fish freezing: factors affecting - freezing time of fish – individually quick freezing of shrimps, slow freezing methods - equipment required-types - direct and indirect systems
- 12 IQF of shrimps: changes in quality during chilled and frozen storage
- 13 Principles of canning and effect of heat processing on fish
- 14 Storage of canned fish, pre-process operations and post-process operations
- 15 Cannery operations for specific canned products
- 16 Fish products: introduction, fish muscle proteins, surimi process, traditional and modern surimi production lines
- 17 Quality of surimi products, comparison of surimi and fish mince products
- 18 Fish Protein Concentrates (FPC)
- 19 Fish Protein Extracts (FPE)
- 20 Fish Protein Hydrolysates (FPH)
- 21 Processing technology protocols of indigenous products: fish sauce
- 22 Processing technology of indigenous products: fish paste
- 23 Novel methods: novel methods in fish processing industry
- 24 Low dose irradiation
- 25 High pressure treatment
- 26 MAP, vacuum packaging and gas packaging
- 27 Oxygen absorbents, CO₂ generators and ethanol vapour generation
- 28 Hurdle barrier concept: definition of hurdle technology and different hurdles that can be employed in fish processing industry
- 29 Value added fish products
- 30 Packaging: packaging of fish and marine products
- 31 Sea food quality assurance, HACCP, EU hygienic regulations and ISO: 9000 standards
- 32 New kinds of quality and safety problems emerging in sea food processing and preservation

Practical

- 1 Study of anatomy and dressing of fish
- 2 Study of anatomy and dressing of prawn and other marine products
- 3 Identification of different types of fish - selection and grading

- 4 Identification of different types of prawn and other marine products - selection and grading
- 5 Quality evaluation of fish, chilling and freezing of fish
- 6 Processing technology of sun dried and salt cured fish, fish sauce
- 7 Processing technology of fish protein concentrate and preparation of fish meal
- 8 Processing technology of marine fish oils and various fish products
- 9 Utilization of fish byproducts and preparation of marine algal products
- 10 Preservation of fish: drying, pickling; preservation of marine products using fermentation process
- 11 Processing technology of value added sea products: cutlets, bullets, wafers; processing of fish oils
- 12 Canning methods for marine fishery products
- 13 Estimation of TVB and TMA
- 14 Determination of iodine value and protein estimation by Folin-Lowrey's method
- 15 Visit to fish and prawn processing industry
- 16 Practical Examination

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FDPT 315

Sensory Evaluation of Food Products

2 (1+1)

Course outlines

Theory

Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation. Principles of good practice: the sensory testing environment, test protocol

considerations, Basic principles: Senses and sensory perception, Physiology of sensory organs, Classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses. Discrimination Tests, Procedure: Types of tests – difference tests (Paired comparison, duo-trio, triangle) ranking, scoring, Hedonic scale and descriptive tests. Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements; Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests; Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control.

Practical

Determination of threshold value for basic tastes; Odour recognition, difference (PC, Duo-trio, triangle); Determination of threshold value for various odours; Selection of judging panel; Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests; Descriptive analysis methodology; Sensory evaluation of various food products using different scales, score cards and tests; Texture profile methodology; Estimation of color; Relationship between objective and subjective methods; Designing a sensory laboratory.

Lecture

Theory

- 1 Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects
- 2 Factors affecting food acceptance
- 3 Terminology related to sensory evaluation
- 4 Principles of good practice: the sensory testing environment and test protocol considerations
- 5 Basic principles: senses and sensory perception in relation to vision, touch, odour, taste and flavour
- 6 Physiology of sensory organs – mechanism of perception – texture perception and measurement
- 7 Classification of tastes and odours - threshold value, factors affecting senses, visual, auditory, tactile and other responses
- 8 Discrimination tests and procedures: types of tests – difference tests (paired comparison, duo-trio, triangle) ranking, scoring and hedonic scale
- 9 Descriptive tests - current practices and application of descriptive methods- flavour profile and dilution flavour profile
- 10 Descriptive tests - quantitative descriptive analysis-ordinal scales, category scales, line scales, free choice profiling and time intensity scaling

- 11 Panel selection, screening and training of judges
- 12 Requirements of sensory evaluation, sampling procedures and factors influencing sensory measurements
- 13 Consumer research: affective tests - objectives and methods-subjects-types of acceptance testing
- 14 Types of questionnaires, development of questionnaires, comparison of laboratory testing, consumers studies and limitations
- 15 Interrelationship between sensory properties of food products, various instrumental and physico-chemical tests
- 16 Quality evaluations - application of sensory testing: sensory evaluation in food product development and sensory evaluation in quality control

Practical

- 1 Determination of threshold value for basic tastes - sweetness
- 2 Determination of threshold value for basic tastes- saltiness
- 3 Odour recognition test
- 4 Difference (PC, duo-trio, triangle) tests
- 5 Determination of threshold value for various odours
- 6 Selection of judging panel
- 7 Training of judges for recognition of certain common flavour and texture defects using different types of sensory tests- hedonic rating
- 8 Training of judges for recognition of certain common flavour and texture defects using different types of sensory tests- numerical scoring
- 9 Training of judges for recognition of certain common flavour and texture defects using different types of sensory tests- composite scoring
- 10 Descriptive analysis methodology- flavour profile and dilution flavor profile methods
- 11 Sensory evaluation of various food products using different scales, score cards and tests-line scaling method
- 12 Texture profile methodology
- 13 Estimation of color
- 14 Relationship between objective and subjective methods
- 15 Designing a sensory laboratory
- 16 Practical Examination

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FDPT 411

Processing Technology of Beverages

3 (2+1)

Course outlines

Theory

History and importance of beverages and status of beverage industry; Processing of beverages: Packaged drinking water, juice based beverages, synthetic beverages, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based beverages, alcoholic beverages, fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc.; FSSAI specifications for beverages; Ingredients, manufacturing and packaging processes and equipment for different beverages; Water treatment and quality of process water; Sweeteners, colorants, acidulants, clouding and clarifying and flavouring agents for beverages; Carbon dioxide and carbonation; Quality tests and control in beverages; Miscellaneous beverages: Coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups.

Practical

Quality analysis of raw water; Determination of density and viscosity of caramel; Determination of colours in soft drinks by wool technique; Preparation of iced and flavoured tea; Preparation of carbonated and non-carbonated beverages; Determination of caffeine in beverages; Determination of brix value, gas content, pH and acidity of beverages; Quality analysis of tea and coffee; Preparation of miscellaneous beverages; Visit to carbonation unit; Visit to mineral water plant.

Lecture

Theory

- 1 History and importance of beverages – evolution and economic importance
- 2 Status of beverage industry – past, present and future trends and marketing status
- 3 Processing of beverages - classification, process overview and hazard analysis
- 4 Packaged drinking water – processing, specifications and equipment
- 5 Juice based beverages – types, processing, unit operations and health benefits

- 6 Synthetic beverages – types and processing
- 7 Still and carbonated beverages - types and processing
- 8 Low-calorie and dry beverages – introduction to zero and low calorie beverages
- 9 Isotonic and sports drinks – definition of isotonic beverage, types of sports drinks, purpose of drink, nutrition, formulation and examples
- 10 Dairy based beverages – milk drinks, buttermilk, drinkable yogurts, shakes and flavored milk drinks
- 11 Alcoholic beverages – fermentation process -beer, cider, wine and spirits
- 12 Fruit beverages - juice, squash, cordial, nectar, syrups and carbonated beverages
- 13 Specialty beverages – types and functional beverages
- 14 Tea and coffee – types, flavored tea, processing, brewing of coffee and instant coffee
- 15 Cocoa and spices based beverages – chocolate drinks and spiced beverages
- 16 Plant extracts based beverages – herbal beverages, green tea, herbal tea, detoxifying drinks, nectars and syrups
- 17 FSSAI specifications for beverages
- 18 Ingredients used in beverage making
- 19 Manufacturing of various non-alcoholic beverages
- 20 Manufacturing of various alcoholic beverages
- 21 Packaging processes of beverages
- 22 Equipment for different beverages
- 23 Water treatment and quality of process water
- 24 Sweeteners used in beverages – natural, bulk and artificial sweeteners
- 25 Colorants and acidulants used in beverages – natural and synthetic colors, acid regulators
- 26 Clouding and clarifying used in beverages - natural and synthetic
- 27 Flavoring agents for beverages
- 28 Carbon dioxide infusion and carbonation
- 29 Quality tests and control in beverages
- 30 Miscellaneous beverages: coconut water and sweet toddy
- 31 Processing of sugar cane juice and coconut milk
- 32 Processing of flavored syrups

Practical

- 1 Quality analysis of raw water
- 2 Determination of density and viscosity of caramel
- 3 Determination of colours in soft drinks by wool technique
- 4 Preparation of iced tea
- 5 Preparation of flavoured tea
- 6 Preparation of carbonated beverages
- 7 Preparation of non carbonated beverages

- 8 Determination of caffeine in beverages
- 9 Determination of brix value and gas content of beverages
- 10 Determination of pH and acidity of beverages
- 11 Quality analysis of tea
- 12 Quality analysis of coffee
- 13 Preparation of miscellaneous beverages – coconut milk
- 14 Visit to packaged water plant
- 15 Visit to carbonation unit
- 16 Practical Examination

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1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
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3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
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Department of Food Process Engineering

FDPE 121

Food Thermodynamics

3 (2+1)

Course outlines

Theory

Basic concepts: definitions, approaches, thermodynamic systems, thermodynamic properties and equilibrium, state of a system, state diagram, path and process, different modes of work, Zeroth law of thermodynamics, concept of temperature, heat; First law of thermodynamics: Energy, enthalpy, specific heats, applications of first law, steady and unsteady flow analysis; Second law of thermodynamics: Kelvin-Planck and Clausius statements, reversible and irreversible processes, thermodynamic temperature scale, entropy, availability and irreversibility; Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behaviour of simple compressible substances, phase rule; Thermodynamic cycles: Carnot vapor power cycle, ideal Rankine cycle, Rankine Reheat cycle, air standard Otto cycle, air standard Diesel cycle, air-standard Brayton cycle, vapor-compression refrigeration cycle; Psychrometry: thermodynamic properties of moist air, perfect gas relationship, absolute humidity, relative humidity, percentage humidity, humid volume, total heat, enthalpy, dry bulb temperature, wet bulb temperature, dew point temperature, adiabatic processes, wet bulb depression, humid heat, specific volume, heating, cooling, dehumidifying, sorption isotherms, three stages of water, phase diagram for water, vapour pressure temperature curve for water, heat requirement for vaporization, measurement of humidity; Boilers and steam generation; Properties of steam: Wet, dry saturated, superheated steam, use of steam tables.

Practical

Determination of dryness fraction of steam. Determination of state of air using psychrometric chart and hygrometer; Use of psychrometric chart during drying process/humidification process; Tutorials on psychrometric chart; Demonstration of equilibrium sorption isotherms; Use of psychrometric chart during drying process/humidification process; Visit to food plant with steam utilization.

Lecture

Theory

- 1 Basic concepts: definitions, approaches, thermodynamic systems
- 2 Thermodynamic properties – processes and cycles
- 3 Homogeneous and heterogeneous systems and thermodynamic equilibrium
- 4 Zeroth law of thermodynamics, concept of temperature and heat
- 5 Quasi-static process, pure substance and thermostatics
- 6 State of a system, state diagram, path and process, different modes of work
- 7 First law of thermodynamics: energy, enthalpy and specific heats

- 8 Applications of first law, steady and unsteady flow analysis
- 9 Second law of thermodynamics: Kelvin-Planck
- 10 Clausius statements, reversible and irreversible processes
- 11 Thermodynamic temperature scale, entropy, availability and irreversibility of energy
- 12 Properties of Pure Substances: Thermodynamic properties of pure substances in solid
- 13 Thermodynamic properties of pure substances in liquid and vapor phases
- 14 P-V-T behaviour of simple compressible substances, phase rule
- 15 Thermodynamic cycles: Carnot vapor power cycle
- 16 Ideal Rankine cycle, Rankine reheat cycle
- 17 Air standard Otto cycle, air standard Diesel cycle
- 18 Air-standard Brayton cycle
- 19 Vapor-compression refrigeration cycle
- 20 Psychrometry: thermodynamic properties of moist air
- 21 Perfect gas relationship, absolute humidity
- 22 Relative humidity, percentage humidity
- 23 Humid volume, total heat, enthalpy, dry bulb temperature
- 24 Wet bulb temperature, dew point temperature
- 25 Adiabatic processes, wet bulb depression, humid heat
- 26 Specific volume, heating, cooling, dehumidifying
- 27 Sorption isotherms, three stages of water, phase diagram for water
- 28 Vapour pressure temperature curve for water
- 29 Heat requirement for vaporization, measurement of humidity
- 30 Properties of steam: wet, dry saturated and superheated steam
- 31 Properties of steam: Wet, dry saturated and superheated steam
- 32 Use of steam tables

Practical

- 1 Study of domestic refrigerator & identification of parts
- 2 Study of air conditioner & identification of parts
- 3 Determination of dryness fraction of steam
- 4 Determination of state of air using psychrometric chart and hygrometer
- 5 Determination of state of air using psychrometric chart and hygrometer
- 6 Use of psychrometric chart during drying process/humidification process
- 7 Tutorials on psychrometric chart
- 8 Study and identification of different parts of boiler
- 9 Demonstration of equilibrium sorption isotherms
- 10 Demonstration of equilibrium sorption isotherms
- 11 Use of psychrometric chart during drying process/humidification process
- 12 Use of psychrometric chart during drying process/humidification process

- 13 Visit to food plant with steam utilization
- 14 Tutorials on steam tables
- 15 Tutorial based on pressure-enthalpy diagram
- 16 Practical Examination

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2. P. K. Nag. 2005. Engineering Thermodynamics, 3rd Ed. Tata-McGraw-Hill Education, New Delhi.
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FDPE 122

Post Harvest Engineering

3 (2+1)

Course outlines

Theory

Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Water activity, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture; Post Harvest Handling operations; Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Peeling; Sorting and grading: Sorting, grading, methods of grading; Grading-Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance; Separation: Magnetic separator, destoners, electrostatic separators, pneumatic separator; Decorticating and shelling: Principles of working, design and constructional details, operating parameters, maintenance, etc. of various decorticators/dehullers/shellers, description of groundnut decorticators, maize shellers, etc.; Grain drying theory, grain dryers; Liquid dryers: Drum dryer, spray dryer and foam-mat drier; Parboiling: process, changes during parboiling, parboiling methods, advantages and disadvantages of parboiling with respect to milling, nutritional and cooking quality of grain, significance of glass transition temperature; Milling: milling, polishing, grinding, milling equipment, dehuskers,

polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, machine efficiency and power requirement; Materials handling: Introduction to different conveying equipment used for handling of grains, fruits and vegetables; Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection; Belt conveyor: Principle, characteristics, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain; Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors; Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Pneumatic conveying system: Capacity and power requirement, types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.

Practical

Study of cleaners for grains; Study of washers for fruits and vegetables; Study of graders for grains; Study of graders for fruits and vegetables; Study of decorticators; Study of a maize/sunflower sheller; Study of crop dryers; Study of a RF/MW/tray dryer; Study of hot air dryer and modeling drying kinetics; Study of vacuum dryer and modeling drying kinetics; Study of working principle of spray dryer and spray drying process; Study of drum dryer and liquid food dehydration using drum drying; Study of fluidized bed dryer and drying process; Study of foam-mat dryer; Study of rice milling machines; Study of pulse milling machines; Study of different components of flour mill; Study of different materials handling equipment.

Lecture

Theory

- 1 Overview of post harvest technology, concept and science; production and post harvest losses of durables and perishables
- 2 Reasons for post harvest losses and importance of loss reduction to mitigate food demand; engineering approach in reduction of post harvest losses
- 3 Concept of water activity, water binding and its effect on enzymatic, non-enzymatic reactions, microbial action and food texture
- 4 Control of water activity and moisture by various processing principles
- 5 Post harvest handling operations; cleaning of grains and types of cleaners
- 6 Types of screens- rotary screens, vibrating screens- working principles, design parameters cleaning efficiency, care and maintenance
- 7 Post harvest handling operations; cleaning- washing of fruits and vegetables, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance

- 8 Peeling, sorting and grading, methods of grading; grading- size grading, color grading, specific gravity grading
- 9 Screening equipment for grading of fruits and vegetables, grading efficiency, care and maintenance
- 10 Separation- magnetic separator, de-stoners, electrostatic separators, pneumatic separator working principles, efficiency, care and maintenance
- 11 Decorticating and shelling: principles of working, design and constructional details, operating parameters, care and maintenance
- 12 Description of groundnut decorticators, maize shellers, sunflower shellers, castor decorticator, principles of working, design and constructional details, operating parameters, care and maintenance
- 13 Grain drying theory, grain dryers, principle of drying- constant rate and falling rate drying period, EMC
- 14 Grain drying theory, grain dryers; liquid dryers: drum dryer, spray dryer and foam-mat drier
- 15 Parboiling: process, changes during parboiling, parboiling methods, advantages and disadvantages of parboiling
- 16 Parboiling with respect to milling, nutritional and cooking quality of grain, significance of glass transition temperature
- 17 Milling, polishing, grinding, milling equipment, de-huskers, polishers (abrasion, friction, water jet)
- 18 Flour milling machines, grinders, cutting machines-principles of working, design and constructional details, operating parameters, care and maintenance
- 19 Pulse milling machines, principles of working, design, constructional details, operating parameters, care and maintenance
- 20 Pulse milling machines, principles of working, design, constructional details, operating parameters, care and maintenance
- 21 Oil expellers, principles of working, design, machine efficiency, power requirement, operating parameters, care and maintenance
- 22 Oil expellers, principles of working, design, machine efficiency and power requirement, operating parameters, care and maintenance
- 23 Materials handling: introduction to different conveying equipment used for handling of grains, fruits and vegetables
- 24 Scope and importance of material handling devices; study of different material handling systems: classification, principles of operation, selection of conveyor system
- 25 Belt conveyor: principle, characteristics, relationship between belt speed and width, capacity
- 26 Belt conveyor: Inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper

- 27 Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain
- 28 Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors
- 29 Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity
- 30 Bucket elevator: speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types
- 31 Pneumatic conveying system: capacity and power requirement, types, air/product separators
- 32 Gravity conveyor design considerations, capacity and power requirement

Practical

- 1 Study of cleaners for grains
- 2 Study of washers for fruits and vegetables
- 3 Study of graders for grains, fruits and vegetables
- 4 Study of groundnut and castor decorticators
- 5 Study of a maize/sunflower sheller
- 6 Study of crop dryers
- 7 Study of a RF/MW/tray dryer
- 8 Study of hot air dryer and modeling drying kinetics
- 9 Study of vacuum dryer and modeling drying kinetics
- 10 Study of drum dryer, foam-mat dryer and liquid food dehydration
- 11 Study of fluidized bed dryer and drying process
- 12 Study of rice milling machines
- 13 Study of pulse milling machines
- 14 Study of different components of flour mill
- 15 Study of different materials handling equipment
- 16 Practical Examination

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FDPE 221

Heat and Mass Transfer in Food Processing

3 (2+1)

Course outlines

Theory

Basic heat transfer processes, heat transfer coefficients, properties related to heat transfer; One-dimensional steady state conduction: Theory of heat conduction, Fourier's law and its derivation, Concept of electrical analogy and its application for thermal circuits, heat transfer through composite walls and insulated pipelines; One-dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation, development of equations of temperature distribution with different boundary conditions; Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (fins) of uniform area of cross-section and with Equation of temperature distribution with different boundary conditions; Effectiveness and efficiency of the fins; Introduction to unsteady state heat conduction: System with negligible internal resistance and in various geometries; Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer; Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heat transfer to flowing fluids; Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors; Introduction to condensing and boiling heat transfer: Film- and drop-wise condensation, effect of non-condensable gases, boiling heat transfer; Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design; Application of different types of heat exchangers in dairy and food industry; Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolar diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry.

Practical

Heat transfer analysis during conduction and convection; Study on various types of heat exchangers used in food industry; Preparation and calibration of thermocouples; Determination of thermal conductivity of different food products; Study of working principle and constructional details of plate heat exchanger; Study of working principle and constructional details of shell and tube heat exchanger. Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry; Studies on heat transfer through extended surfaces; Studies on temperature distribution and heat transfer in HTST pasteurizer.

Lecture

Theory

- 1 Basic heat transfer processes-conduction, convection and radiation
- 2 Heat transfer co-efficient and properties related to heat transfer
- 3 One-dimensional steady state conduction
- 4 Theory of heat conduction, Fourier's law and its derivation
- 5 Concept of electrical analogy and comparison with conduction through composite slab
- 6 Heat transfer through composite walls and insulated pipelines-critical thickness of insulation
- 7 One-dimensional steady state heat conduction with heat generation
- 8 Heat flow through slab, hollow sphere and cylinder with linear heat transfer
- 9 Uniform/non-uniform heat generation in different solid
- 10 Development of equations of temperature distribution with different boundary conditions
- 11 Steady-state heat conduction with heat dissipation to environment
- 12 Introduction to extended surfaces (fins) of uniform area of cross-section and with equation of temperature distribution with different boundary conditions
- 13 Effectiveness, efficiency of fins and errors in measurement of temperature in a thermocouple well
- 14 Introduction to unsteady state heat conduction
- 15 System with negligible internal resistance in various geometries
- 16 Convection: forced and free convection
- 17 Use of dimensional analysis for correlating variables affecting convection heat transfer
- 18 Concept of Nusselt number, Prandtl number, Reynolds number and Grashoff number
- 19 Important empirical relations used for determination of heat transfer coefficient- Heislar's charts and calculations
- 20 Empirical relations used for determination heat transfer in flowing fluids
- 21 Radiation: heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces
- 22 Determination of shape factors in radiation heat transfer

- 23 Introduction to condensing and boiling heat transfer: film and drop-wise condensation
- 24 Effect of non-condensable gases and boiling heat transfer
- 25 Heat exchangers: general discussion, fouling factors and jacketed kettles
- 26 LMTD, parallel and counter flow heat exchangers
- 27 Shell and tube and plate heat exchangers
- 28 Heat exchanger design; application of different types of heat exchangers in dairy and food industry, heat exchanger effectiveness and NTU analysis
- 29 Mass transfer: Fick's law of diffusion
- 30 Steady state diffusion of gases and liquids through solids
- 31 Equi-molar diffusion and isothermal evaporation of water into air
- 32 Mass transfer coefficient, application of mass transfer in dairy and food industry

Practical

- 1 Heat transfer analysis during conduction
- 2 Heat transfer analysis during convection
- 3 Study on various types of heat exchangers used in food industry
- 4 Study on various types of heat exchangers used in food industry
- 5 Preparation and calibration of thermocouples
- 6 Determination of thermal conductivity of different food products
- 7 Study of working principle and constructional details of plate heat exchanger
- 8 Study of working principle and constructional details of shell and tube heat exchanger
- 9 Determination of overall heat transfer coefficient of shell and tube used in food industry
- 10 Determination of overall heat transfer coefficient of plate heat exchanger used in food industry
- 11 Determination of overall heat transfer coefficient of jacketed kettle used in food industry
- 12 Studies on heat transfer through extended surfaces
- 13 Studies on temperature distribution in HTST pasteurizer
- 14 Studies on heat transfer in HTST pasteurizer
- 15 Tutorials on heat exchangers
- 16 Practical Examination

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FDPE 222

Unit Operations of Food Processing-I

3 (2+1)

Course outlines

Theory

Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping); Mixing: theory of solid mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquid mixing; Mixing equipment: Mixers for low or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids; Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machines; Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids; Membrane separation: General considerations, materials for membrane construction, ultra-filtration, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and micro filtration.

Practical

Determination of fineness modulus and uniformity index; Determination of mixing index of a feed mixer; Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law. Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of centrifugal separator; Study of freeze dryer and freeze drying process; Study on

osmosis in fruits; Determination of solid gain and moisture loss during osmosis; Study of reverse osmosis process; Study of ultra filtration/membrane separation process.

Lecture

Theory

- 1 Engineering properties of food material- physical, thermal and aerodynamic properties
- 2 Engineering properties of food material- mechanical, optical and electro-magnetic properties
- 3 Size reduction- benefits, classification, determination and designation of the fineness of ground material
- 4 Sieve/screen analysis, principle and mechanisms of comminution of food
- 5 Rittinger's, Kick's and Bond's equations to determine energy requirement
- 6 Work index and energy utilization
- 7 Size reduction equipment- principal types and crushers (jaw and gyratory crushers)
- 8 Smooth roll mills, hammer mills and impactors
- 9 Attrition mills, buhr mills and tumbling mills
- 10 Ultrafine grinders and fluid jet pulverizer
- 11 Colloid mill and cutting machines (slicing, dicing, shredding and pulping)
- 12 Mixing: theory of solid mixing, criteria of mixer effectiveness, mixing indices and rate of mixing
- 13 Theory of liquid mixing and power requirement for liquid mixing
- 14 Mixing equipment-mixers for low or medium viscosity liquids (paddle agitators and impeller agitators)
- 15 Powder-liquid contacting devices and other mixers
- 16 Mixers for high viscosity liquids and pastes
- 17 Mixers for dry powders and particulate solids
- 18 Mechanical separations- theory; centrifugation- liquid-liquid centrifugation
- 19 Liquid-solid centrifugation, clarifiers, desludging and decanting machines
- 20 Filtration-theory of filtration, rate of filtration, pressure drop during filtration and applications
- 21 Constant rate filtration, constant pressure filtration and derivation of equation
- 22 Filtration equipment- plate, frame filter press and rotary filters
- 23 Centrifugal filters, vacuum filters, air filters and filter aids
- 24 Membrane separation-definition, general considerations, membrane configurations and materials for membrane construction
- 25 Microfiltration-equipment and applications
- 26 Ultra filtration, processing variables and applications of ultra filtration in food processing
- 27 Membrane fouling, causes, concentration, polarization and mitigation

- 28 Reverse osmosis, mode of operation and applications
- 29 Demineralization by electro-dialysis, principles and equipment
- 30 Gel filtration, principles, types and equipment
- 31 Ion exchange, principles and equipment
- 32 Per-evaporation, principles and equipment

Practical

- 1 Determination of fineness modulus and uniformity index
- 2 Determination of mixing index
- 3 Power requirement in size reduction of grains using Rittinger's law, Kick's law and Bond's law
- 4 Tutorials on power requirement in size reduction
- 5 Tutorials on power requirement in size reduction
- 6 Performance evaluation of hammer mill
- 7 Performance evaluation of attrition mill
- 8 Study of centrifugal separator
- 9 Study of freeze dryer and freeze drying process
- 10 Study on osmosis in fruits
- 11 Determination of solid gain and moisture loss during osmosis
- 12 Study of reverse osmosis process
- 13 Study of ultra filtration/membrane separation process
- 14 Tutorials on membrane separation processes
- 15 Visit to grinding/flour mill
- 16 Practical Examination

References

1. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
2. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles, 4th Ed. Prentice-Hall, NY, USA.
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FDPE 223

Unit Operations of Food Processing-II

3 (2+1)

Course outlines

Theory

Evaporation: Principles of evaporation, mass and energy balance, factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Dühring

plot; Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation; Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation; Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapor recompression systems; Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices; Food freezing: Introduction, freezing point curve for food and water, freezing points of common food materials, Principles of food freezing, freezing time calculation by using Plank's equation; Freezing systems; Direct contact systems, air blast immersion; Changes in foods; Frozen food properties; freezing time, factors influencing freezing time, freezing/thawing time; Freeze concentration: Principles, process, methods; Frozen food storage: Quality changes in foods during frozen storage; Freeze drying: Heat mass transfer during freeze drying, equipment and practice. Expression and Extraction: liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction, continuous multistage counter current extraction; Leaching: process, preparation of solids, rate of leaching, types of equipment, equilibrium relations; Crystallization and dissolution: Theory and principles, kinetics, applications in food industry, equipment for crystallization; Distillation: Principles, vapor-liquid equilibrium, continuous flow distillation, batch/differential distillation, fractional distillation, steam distillation, distillation of wines and spirits; Baking: Principles, baked foods, baking equipment; Roasting: Principles of roasting, roasting equipment; Frying: theory and principles, shallow or contact frying and deep fat frying, heat and mass transfer in frying, frying equipment; Puffing: Puffing methods, puffing equipment; Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating equipment, vat, tubular heat exchanger, plate heat exchanger; Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipment; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package; Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification.

Practical

Study of working principle open pan and vacuum evaporator; Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of sterilizer; Design problems on freezers; Numerical problem on thermo bacteriology (D, Z and F); Study of freezers; Freezing of foods by different methods; Determination of freezing time of a food material; Effect of sample particle size and time on solvent extraction process; Effect of temperature on crystallization rate of sugar; Study of blancher, pasteurizers, fryers, homogenizers, irradiators; Determination of oil uptake by the food product during frying; Study on qualitative changes in the fried food product; Visit sugar processing industry.

Lecture

Theory

- 1 Evaporation- principles of evaporation, mass and energy balance
- 2 Factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Duhring plot)
- 3 Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation
- 4 Evaporation equipment- natural circulation evaporators, horizontal/vertical short tube evaporators
- 5 Evaporation equipment -natural circulation with external calandria, long tube, forced circulation evaporators
- 6 Evaporator ancillary plant, design of evaporation systems
- 7 Single effect and multiple effect evaporators
- 8 Feeding methods of multiple effect evaporation systems, feed preheating, vapor recompression systems, fouling of evaporators and heat exchangers
- 9 Recompression, heat and mass recovery and vacuum creating devices
- 10 Food freezing-introduction, freezing point curve for food and water, freezing points of common food materials
- 11 Principles of food freezing, freezing time calculation by using Plank's equation
- 12 Freezing systems- direct contact systems, air blast immersion and changes in foods
- 13 Frozen food properties-freezing time, factors influencing freezing time, freezing/thawing time
- 14 Freeze concentration-principles, process, methods; frozen food storage- quality changes in foods during frozen storage
- 15 Freeze drying- heat and mass transfer during freeze drying, equipment and practice
- 16 Expression and extraction-liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction
- 17 Expression and extraction of liquid- continuous multistage counter current extraction
- 18 Leaching- process, preparation of solids, rate of leaching, types of equipment, equilibrium relations
- 19 Crystallization and dissolution- theory, principles, kinetics, applications in food industry and equipment for crystallization
- 20 Distillation- principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation
- 21 Distillation- fractional distillation, steam distillation, distillation of wines and spirits
- 22 Baking- principle, baked foods, baking equipment
- 23 Roasting- principle of roasting, roasting equipment

- 24 Frying-theory, principles, shallow or contact frying, deep fat frying, heat and mass transfer in frying and frying equipment
- 25 Puffing- puffing methods and puffing equipment
- 26 Pasteurization- purpose, microorganisms, their reaction to temperature and other influences
- 27 Pasteurization- methods of heating, design, mode of operation of heating equipment- vat, tubular heat exchanger and plate heat exchanger
- 28 Sterilization- principle, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipment
- 29 UHT sterilization, in the package sterilization, temperature and pressure patterns
- 30 Equipment for sterilizing goods in the package
- 31 Aseptic processing- principle, analysis of thermal resilience, duration mathematics of conduction heating
- 32 Blanching- principle and equipment; homogenization and emulsification

Practical

- 1 Study of working principle of open pan and vacuum evaporator
- 2 Study of single effect evaporator and estimation of heat and mass balance during concentration of liquid foods
- 3 Study of multiple effect evaporator and estimation of heat and mass balance during concentration of liquid foods
- 4 Study of multiple effect evaporator and estimation of heat and mass balance during concentration of liquid foods
- 5 Study of sterilizer equipment and design problems on freezers
- 6 Numerical problem on thermo bacteriology (D, Z and F values)
- 7 Study of freezers and freezing of foods by different methods
- 8 Design problems on freezers
- 9 Effect of sample particle size and time on solvent extraction process
- 10 Effect of temperature on crystallization rate of sugar
- 11 Study of blancher and pasteurizers
- 12 Study of fryers, homogenizers and irradiators
- 13 Determination of oil uptake by the food product during frying
- 14 Study on qualitative changes in the fried food product
- 15 Visit to sugar processing industry
- 16 Practical Examination

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FDPE 224

Food Refrigeration and Cold Chain

3 (2+1)

Course outlines

Theory

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures; Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry Vs wet compression, throttling Vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling; Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable

properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve; Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display; Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc.

Practical

Study of vapour compression refrigeration system; Determination of COP of vapour compression refrigeration system; Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems; Study of refrigerants, their properties and charts; Study of direct and indirect contact freezing equipment for foods; Study of spray freezing process for foods; Study of food cold storage; Estimation of refrigeration load for cold storage; Estimation of refrigeration load for meat and poultry products; Study of refrigeration system of dairy plant; Estimation of refrigeration load for ice-cream; Study of cooling system for bakery and estimation of refrigeration loads; Estimation of refrigeration load during chocolate enrobing process; Study of refrigerated van; Study of deep freezing and thawing of foods; Study of refrigerated display of foods and estimation of cooling load.

Lecture

Theory

- 1 Principles of refrigeration: definition, background, second law of thermodynamics, unit of refrigeration capacity and coefficient of performance
- 2 Production of low temperatures: expansion of a liquid with flashing, reversible/irreversible adiabatic expansion of a gas/real gas
- 3 Thermoelectric cooling and adiabatic demagnetization
- 4 Air refrigerators working on reverse Carnot cycle-Carnot cycle, reversed Carnot cycle
- 5 Selection of operating temperatures: air refrigerators working on Bell Coleman cycle
- 6 Reversed Brayton or Joule or Bell Coleman cycle
- 7 Analysis of gas cycle, polytropic and multistage compression
- 8 Vapour refrigeration: vapor as a refrigerant in reversed Carnot cycle with p-v and t-s diagrams and limitations of reversed Carnot cycle

- 9 Vapour compression system: modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs wet compression, throttling vs isentropic expansion)
- 10 Representation of vapor compression cycle on pressure-enthalpy diagram
- 11 Super heating and sub cooling
- 12 Liquid-vapour regenerative heat exchanger for vapour compression system
- 13 Effect of suction vapour super heat and liquid sub cooling
- 14 Actual vapour compression cycle, vapour-absorption refrigeration system: process and calculations
- 15 Maximum coefficient of performance of a heat operated refrigerating machine
- 16 Common refrigerants and properties
- 17 Classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical
- 18 Azeotropes, components of vapour compression refrigeration system, evaporator and compressor
- 19 Condenser and expansion valve
- 20 Process of ice manufacturing, principles and systems of ice production
- 21 Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation and quality of ice
- 22 Cold storage - cold store, design of cold storage for different categories of food resources, size and shape
- 23 Construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fittings
- 24 Evaporators, automated cold stores and security of operations
- 25 Refrigerated transport: handling, distribution, cold chain, refrigerated product handling, order picking, refrigerated vans and refrigerated display
- 26 Air-conditioning - meaning, factors affecting comfort air-conditioning, classification and sensible heat factor
- 27 Industrial air-conditioning, problems on sensible heat factor
- 28 Winter/summer/year round air-conditioning, unitary air-conditioning systems
- 29 Central air-conditioning, physiological principles in air-conditioning
- 30 Air distribution and duct design methods; design of complete air-conditioning systems
- 31 Humidifiers and dehumidifiers
- 32 Cooling load calculations - load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration and peak load

Practical

- 1 Study of vapour compression refrigeration system
- 2 Determination of COP of vapour compression refrigeration system
- 3 Study of various types of compressors and condensers
- 4 Study of expansion valves and evaporative coils used in refrigeration systems

- 5 Study of refrigerants, properties and charts
- 6 Study of direct and indirect contact freezing equipment for foods
- 7 Study of spray freezing process for foods
- 8 Study of food cold storage, estimation of refrigeration load for cold storage
- 9 Estimation of refrigeration load for meat and poultry products
- 10 Study of refrigeration system of dairy plant-industrial visit
- 11 Estimation of refrigeration load for ice-cream
- 12 Study of cooling system for bakery and estimation of refrigeration loads
- 13 Estimation of refrigeration load during chocolate enrobing process
- 14 Study of refrigerated van
- 15 Study of deep freezing and thawing of foods
- 16 Practical Examination

References

1. William C. Whitman, William M. Johnson, John A. Tomczyk and Eugene Silberstein. 2009. Refrigeration & Air Conditioning Technology, 6th Ed. Delmar, Cengage Learning, NY, USA.
2. C. P. Arora. 2000. Refrigeration and Air Conditioning, 2nd Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
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FDPE 321

Food Process Equipment Design

3 (2+1)

Course outlines

Theory

Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes; Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations; Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories; Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort; Design of evaporators and crystallizers: Design of single effect and multiple effect evaporators and its components; Design of rising film and falling film evaporators and feeding arrangements for evaporators; Design of crystalliser and

entrainment separator; Design of agitators and separators: Design of agitators and baffles; Design of agitation system components and drive for agitation; Design of centrifuge separator; Design of equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems; Design of freezing equipment: Design of ice-ream freezers and refrigerated display system; Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer; Design of conveyors and elevators: Design of belt, chain and screw conveyor, design of bucket elevator and pneumatic conveyor; Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder; Design of fermenters: Design of fermenter vessel, design problems; Hazards and safety considerations: Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices.

Practical

Design of pressure vessel; Design of shell and tube heat exchangers and plate heat exchanger; Design of sterilizers and retort; Design of single and multiple effect evaporators; Design of rising film and falling film evaporator; Design of crystallizer; Design of tray dryer; Design of fluidized bed dryer; Design of spray dryer; Design of vacuum dryer; Design of microwave dryer; Design of belt and chain conveyor; Design of screw conveyor; Design of bucket elevator and pneumatic conveyor; Design of twin screw extruder; Design of fermenter.

Lecture

Theory

- 1 Materials and properties: materials for fabrication, mechanical properties- ductility and hardness
- 2 Corrosion, protective coatings, corrosion prevention linings equipment
- 3 Choice of materials and material codes
- 4 Design considerations: stresses created due to static and dynamic loads and combined stresses
- 5 Design stresses, theories of failure and safety factor
- 6 Temperature effects, radiation effects, effects of fabrication method and economic considerations
- 7 Design of pressure and storage vessels: operating conditions, design conditions and stress
- 8 Design of shell and its component, stresses from local load, thermal gradient, mountings and accessories
- 9 Design of heat exchangers: design of shell and tube heat exchanger
- 10 Design of plate heat exchanger
- 11 Design of scraped surface heat exchanger, sterilizer and retort
- 12 Design of evaporators and crystallizers: design of single effect and multiple effect evaporators and its components
- 13 Design of rising film and falling film evaporators and feeding arrangements for evaporators
- 14 Design of crystallizer and entrainment separator

- 15 Design of agitators and separators: design of agitators and baffles
- 16 Design of agitation system components and drive for agitation
- 17 Design of centrifugal separator; design of equipment components-shafts, pulleys and bearings
- 18 Design of belts and springs
- 19 Design of drives and speed reduction systems
- 20 Design of freezing equipment - design of ice-cream freezers and refrigerated display system
- 21 Design of dryers: design of tray dryer and tunnel dryer
- 22 Design of fluidized dryer and spray dryer
- 23 Design of vacuum dryer, freeze dryer and microwave dryer
- 24 Design of conveyors and elevators: belt, chain and screw conveyor
- 25 Design of bucket elevator and pneumatic conveyor
- 26 Design of extruders – cold and hot extruder
- 27 Design of screw and barrel
- 28 Design of twin screw extruder
- 29 Design of fermentors – design of fermentor vessel and design problems
- 30 Hazards and safety considerations: hazards in process industries and analysis of hazards
- 31 Safety measures in equipment design
- 32 Pressure relief devices

Practical

- 1 Design of pressure vessel
- 2 Design of shell and tube heat exchangers
- 3 Design of plate heat exchanger
- 4 Design of sterilizers and retort
- 5 Design of single and multiple effect evaporator
- 6 Design of rising film and falling film evaporator
- 7 Design of crystallizer
- 8 Design of tray dryer and fluidized bed dryer
- 9 Design of spray dryer and cyclone separator
- 10 Design of vacuum dryer and microwave dryer
- 11 Design of belt and chain conveyor
- 12 Design of screw conveyor
- 13 Design of bucket elevator and pneumatic conveyor
- 14 Design of twin screw extruder and fermentor
- 15 Visit to food industry
- 16 Practical Examination

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FDPE 322

Food Storage Engineering

3 (2+1)

Course outlines

Theory

Storage: Importance of scientific storage systems, post harvest physiology of semi-perishables and perishables, climacteric and non climacteric fruits, respiration, senescence, ripening, changes during ripening, ethylene bio-synthesis; Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control; Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos; Storage of grains: respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation; Aeration and stored grain management: purposes of aeration, aeration theory, aeration system design, aeration system operation; Storage pests and control: Damage due to storage insects and pests, its control, seed coating, fumigations, etc.; Damage caused by rodents and its control; Storage of perishables: cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage; Design of storage structures: Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, BIS specifications, functional, structural and thermal design of cold stores.

Practical

Visits to traditional storage structures; Layout design, sizing, capacity and drawing of traditional storage structures; Measurement of respiration of fruits/grains in the laboratory; Study on fumigation; Visits to FCI godowns; Design of grain godowns for particular capacity and commodity; Drawing and layout of grain godown for particular commodity and capacity; Visits to cold storage; Design of cold storage for particular capacity and commodity; Drawing and layout of cold storage for particular commodity and capacity; Visits to CA storage; Design of CA storage for particular capacity and commodity; Drawing and layout of CA storage for particular commodity and capacity; Visits to evaporative cooling system for storage; Storage study in the MAP.

Lecture

Theory

- 1 Storage: definition, importance of scientific storage systems
- 2 Post harvest physiology of semi perishables and perishables
- 3 Post harvest physiology of climacteric and non climacteric fruits
- 4 Studies on respiration, ripening, senescence, changes during ripening, ethylene biosynthesis in perishables
- 5 Introduction to damages – direct damage and indirect damage
- 6 Causes of spoilage in storage (moisture, temperature, humidity)
- 7 Causes of spoilage in storage (respiration loss, heat of respiration, sprouting)
- 8 Destructive agents (rodents, birds, insects)
- 9 Sources of infestation and control
- 10 Storage structures – traditional storage structures and improved storage structures
- 11 Storage structures – modern storage structures
- 12 Farm silos – horizontal silos, tower silos- size and capacity of silos
- 13 Farm silos – pit silos, trench silos- size and capacity of silos
- 14 Storage of grains – respiration of grains
- 15 Moisture and temperature changes in stored grains
- 16 Conditioning of environment inside storage through ventilation
- 17 Introduction to aeration and stored grain management
- 18 Purposes of aeration, aeration theory, aeration system design and aeration system operation
- 19 Storage pests and control
- 20 Damage due to storage insects and pests, control-seed coating and fumigations
- 21 Damage caused by rodents and its control
- 22 Storage of perishables – cold storage, controlled and modified atmospheric storage
- 23 Storage of perishables – hypobaric storage, evaporative cooling storage
- 24 Conditions for storage of perishable products

- 25 Control of temperature and relative humidity inside storage
- 26 Design of storage structures – functional and structural design of grain storage structures
- 27 Design of storage structures – pressure theories, pressure distribution in the bin
- 28 Design of storage structures- grain storage loads, pressure and capacities
- 29 Design of storage structures- pressure and capacities
- 30 Design of storage structures-warehouse and silos
- 31 BIS specifications of warehouses, silos and cold storage units
- 32 Functional, structural and thermal design of cold stores

Practical

- 1 Visit to traditional storage structures
- 2 Layout design, sizing, capacity and drawing of traditional storage structures
- 3 Measurement of respiration of fruits/grains in laboratory
- 4 Studies on fumigation
- 5 Visit to FCI godowns
- 6 Design of grain godowns for particular capacity and commodity
- 7 Drawing and layout of grain godown for particular commodity and capacity
- 8 Visit to cold storage
- 9 Design of cold storage for particular capacity and commodity
- 10 Drawing and layout of cold storage for particular commodity and capacity
- 11 Visits to CA storage
- 12 Design of CA storage for particular capacity and commodity
- 13 Drawing and layout of CA storage for particular commodity and capacity
- 14 Visit to evaporative cooling system used in storage
- 15 Storage studies on MAP
- 16 Practical Examination

References

1. P. H. Pandey. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana.
2. Myer Kutz. 2007. Handbook of Farm, Dairy, and Food Machinery. William Andrew, Inc., Norwich, NY, USA.
3. A. M. Michael and T. P. Ojha. 2004. Principal of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi.
4. L. W. Newbaver and H. B. Walker. 2003. Farm Buildings Design. Prentice-Hall Inc., New Jersey, USA.
5. J. Whitaker. 2002. Agricultural Buildings and Structures. Reston Publishing Home, Reston, Virginia, USA.
6. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
7. C. W. Hall. 1980. Drying and Storage of Agricultural Crops. The AVI Publishing Company, Inc., Westport, Connecticut, USA.

Course outlines**Theory**

Introduction, definitions, characteristics of instruments, static and dynamic characteristics; Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers; Pressure and pressure scales, manometers, pressure elements differential pressure; Liquid level measurement, different methods of liquid level measurement; Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering; Weight measurement: Mechanical scale, electronic tank scale, conveyor scale; Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors, automatic valves; Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems; Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware; Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis; Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices; Controllers and indicators: Temperature control, electronic controllers, flow ratio control, atmosphere control, timers and indicators, food sorting and grading control, discrete controllers, adaptive and intelligent controllers; Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.

Practical

Study on instrumentation symbols; Determination of relative humidity by wet and dry bulb thermometer; Measurement of wind velocity by anemometer; Measurement of intensity of sun shine by sunshine recorders; Study of characteristics of pressure transducers, real-time study of pressure transducers characteristics with PC, characteristics of IC temperature sensor, characteristics of platinum RTD, temperature controlled alarm system; Study of water level to current conversion; Study of characteristics of capacitive transducer.

Lecture**Theory**

- 1 Introduction, definitions and characteristics of instruments
- 2 Static and dynamic characteristics -performance characteristics - static and dynamic performance characteristics – accuracy - precision - resolution - threshold - static sensitivity – deflection factor
- 3 Linearity, range and span, hysteresis, dead band, backlash and drift
- 4 Errors in performance parameters: types of errors, systematic or cumulative errors, accidental or random errors and miscellaneous type of gross errors

- 5 Calibration - classification of calibration – primary, secondary, direct and routine
- 6 Temperature and temperature scales; various types of thermometers - bimetallic thermometers – glass thermometers and pressure gauge thermometers
- 7 Thermocouples; Seebeck and Thomson effects -laws of thermo-electricity- law of intermediate temperatures- law of Intermediate metals – thermocouple materials
- 8 Resistance thermometers and pyrometers
- 9 Pressure and pressure scales- gauge pressure, absolute pressure, differential pressure, vacuum – units of pressure - pressure scales - conversion of units- types of pressure measurement devices and manometers
- 10 Pressure elements differential pressure elastic pressure elements
- 11 Pressure sensitive primary devices: some of the commonly used force summing devices
- 12 Bourdon tubes, diaphragms and bellows
- 13 Liquid level measurement and different methods of liquid level measurement
- 14 Flow measurement: kinds of flow, rate of flow, total flow differential pressure meters - orifice meter
- 15 Variable area meters – venturi meter
- 16 Food flow metering: weight measurement - mechanical scale, electronic tank scale, conveyor scale
- 17 Measurement of moisture content, specific gravity, measurement of humidity and measurement of viscosity
- 18 Measurement of turbidity, color, measurement of density, brix and pH
- 19 Enzyme sensors and automatic valves
- 20 Transmission: pneumatic and electrical
- 21 Control elements, control actions, pneumatic and electrical control systems
- 22 Process control: definition, simple system analysis, dynamic behaviour of simple process and Laplace transform
- 23 Process control hardware: frequency response analysis, frequency response characteristics
- 24 Bode diagram, Nyquist plots and stability analysis
- 25 Transducers: classification, self-generating transducers and variable parameter type
- 26 Digital, actuating and controlling devices
- 27 Controllers and indicators: temperature control and electronic controllers
- 28 Flow ratio control and atmosphere control
- 29 Timers and indicators, food sorting and grading control
- 30 Discrete controllers, adaptive and intelligent controllers
- 31 Computer-based monitoring and control: importance, hardware features of data acquisition and control computer
- 32 Signal interfacing and examples in food processing

Practical

- 1 Study on instrumentation symbols
- 2 Determination of relative humidity by wet and dry bulb thermometer
- 3 Measurement of wind velocity by anemometer
- 4 Measurement of intensity of sun shine by sunshine recorders
- 5 Study of characteristics of pressure transducers
- 6 Real-time study of pressure transducers characteristics with PC
- 7 Determination of characteristics of IC temperature sensor
- 8 Determination of characteristics of platinum RTD
- 9 Study of temperature controlled alarm system
- 10 Study of water level to current conversion
- 11 Study of characteristics of capacitive transducer
- 12 Determination of linearity of LVDT
- 13 Determination of Sensitivity of LVDT
- 14 Calibration of rotameter
- 15 Calibration of digital balance
- 16 Practical Examination

References

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
2. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA.
3. Curtis D. Johnson. 2003. Process Control Instrumentation Technology, 7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
4. D. V. S. Murty. 2004. Transducers and Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

FDPE 421

Food Plant Layout and Utilities

3 (2+1)

Course outlines

Theory

Overall design of food processing plant; Plant location, levels of plant location; Problems and general design considerations (technical, economic, legal, safety and hygiene); Industrial buildings and grounds; Classification of dairy and food plants, farm level collection and chilling center; Space requirement; Preparation of a plant layout: Plant layout problem, importance, objectives, classical types of layouts; Evaluation of plant layout; Advantages of good layout; Organizing for plant layout, data forms; Development and presentation of layout: Development

of the pilot layout, constructing the detailed layout - Functional design: Setting of different sections in a plant, layout installations; Quantitative analysis for plant layout: Engineering economy; Linear programming; Network analysis, PERT and CPM, inventory management, layout of effluent treatment plant; Common problems in plant layout and process scheduling; Equipment selection and capacity determination, arrangement of process, and service equipment; Estimation of services and utilities; Office layout, line balancing, flexibility; Practical layouts; Common materials of construction of food plant, buildings; Maintenance of food Plant buildings, illumination and ventilation, cleaning and sanitization, painting and colour coding, fly and insect control; Feasibility study: Steps involved in feasibility study, collection of the information, information flow diagrams, preparation of feasibility report; Plant location: Factors affecting plant location, their interaction with plant location, location theory models for evaluation of alternate locations; Plant size: Economic plant size, factors affecting the plant size (technical and economical), raw material availability, market demand, competition in the market, return on investment, etc.; Procedures for estimation of economic plant size (breakeven analysis and optimization), estimation of volume of production for each product; Process design: Product specifications, least cost mix of raw materials, process design, process selection considering technical, economic and social aspects; Process planning and scheduling, flow sheeting, flow diagrams and process flow charts including their design and computer aided development of flow charts; Selection of equipment: Considerations involved in equipment selection, economic analysis of equipment alternatives using optimization techniques and cash flows, economic decision on spare equipment; Plant layout: Types of layouts, considerations involved in planning an efficient layout, preparation and development of layout, evaluation of alternate layouts, use of computers in development and evaluation of layouts, equipment symbols, flow sheet symbols, electric symbols, graphic symbols for piping systems, standards for space requirement and dimensions, distances between critical plant areas and for different plant facilities; Planning and design of service facilities and plant surroundings: Requirements of the steam, refrigeration, water, electricity, waste disposal, lighting, ventilation, drainage, CIP system, dust removal, fire protection, etc.; Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring; Planning of offices, laboratories, lockers and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses, etc.; Workers safety and health aspects: Falling hazards and safeguards, electric hazards, heat exposure, dust protection, noise control, protection against chemicals, fire safety, fumes, moist conditions, personnel hygiene, sanitary requirements and standards, insect, rodent and bird control; Building and building materials: Requirements in respect of building type, wall, ceiling and floor construction, building height and building materials; Utilities and services – Introduction: Classification of various utilities and services in food industry; Water use in food processing industry: Water supply system: Operational aspects of pumps, piping system for fresh water, chilled water, etc., fittings and control, water requirement for cleaning and processing, water quality, water purification and softening; Water use in food processing: Different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization, water loadings per unit mass of raw material; Water conservation: Water and waste water management, economic use of water, water filtration and recirculation; Steam uses in food industry: Temperature, pressure and quantity of steam required in various food

processing operations; Steam generation system: Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system, heat loss from boiler system, boiler design consideration; Energy conservation technologies for steam generation system, energy saving through optimal design and operation of boiler, energy recovery from flue gas, energy recovery from blow down water, maintenance of boiler; Steam distribution system: Components of steam distribution, heat loss and energy efficiency of a steam distribution system; Energy conservation technologies for steam distribution system: Steam trap maintenance, condensate recovery, repairing of steam leaks, insulation improvements; Economical analysis of energy efficiency improvement, cogeneration; Electric energy uses in food industry: Power and Electrical system: Types of electrical loads, electric loads, sources of energy losses in power and electrical systems, low power factor, improper motor load, poor control; Power management for demand control, power factor improvement, replacement with high efficiency motors, replacement with electronic adjustable motors; Energy conservation in heat exchangers.

Practical

Preparation of project report. Preparation of feasibility report; Layout of food storage wares and go-downs; Layout and design of cold storage; Layout of preprocessing house; Layout of milk and milk product plants; Low shelf-life product plant; Bakery and related product plant; Fruits processing plants; Vegetable processing plants; Layout of multi- product and composite food plants; Evaluation of given layout; Waste treatment and management of food plant; Study of operational aspects of water supply system and measures to conserve water in food processing plant; Study of sizing and maintenance of various pumps used in food industry; Estimation of water requirement in food processing plant; Study of waste disposal and management process in the food processing plants; Study of different types piping layout, fittings and control and process of regular checkups and maintenance; Study of different types of steam and distribution systems and its maintenance; Study of different types steam distribution systems, its maintenance and safety measures.

Lecture

Theory

- 1 Overall design of food processing plant: plant location and levels of plant location
- 2 Problems and general design considerations (technical, economic, legal, safety and hygiene)
- 3 Space requirement: preparation of a plant layout: plant layout problem, importance, objectives and classical types of layouts
- 4 Advantages of good layout: organizing for plant layout and data forms
- 5 Development and presentation of layout: development of the pilot layout, constructing the detailed layout - functional design: setting of different sections in a plant and layout installations
- 6 Quantitative analysis for plant layout – subjective, quantitative, semi- quantitative techniques, equal weights method and weight-cum-rating methods

- 7 Composite measure methods and location Break-even-analysis
- 8 Engineering economy- methods of economic evaluation of engineering alternatives – undiscounted cash flow methods – payback period method – discounted cash flow method – net present value, equivalent annual rate of return methods – cost-benefit analysis and social costs
- 9 Linear programming – salient features – formulation of linear programming model – advantages and limitations
- 10 Layout of effluent treatment plant: common problems in plant layout and process scheduling
- 11 Equipment selection, capacity determination, arrangement of process and service equipment
- 12 Practical layouts: common materials of construction of food plant and buildings
- 13 Cleaning, sanitization, painting and color coding
- 14 Feasibility study: steps involved in feasibility study, collection of the information, information flow diagrams and preparation of feasibility report
- 15 Plant location: factors affecting plant location, their interaction with plant location and location theory models for evaluation of alternate locations
- 16 Plant size: economic plant size and factors affecting the plant size (technical and economical)
- 17 Raw material availability, market demand, competition in the market and return on investment
- 18 Procedures for estimation of economic plant size (breakeven analysis and optimization) and estimation of volume of production for each product
- 19 Process design: product specifications, least cost mix of raw materials, process design, process selection considering technical, economic and social aspects
- 20 Process planning and scheduling, flow sheeting, flow diagrams and process flow charts including their design and computer aided development of flow charts
- 21 Selection of equipment: considerations involved in equipment selection, economic analysis of equipment alternatives using optimization techniques, cash flows and economic decision on spare equipment
- 22 Plant layout: types of layouts, considerations involved in planning an efficient layout, preparation of layout, evaluation of alternate layouts, use of computers in development and evaluation of layouts
- 23 Equipment symbols, flow sheet symbols, electric symbols, graphic symbols for piping systems, standards for space requirement and dimensions, distances between critical plant areas and for different plant facilities

- 24 Planning and design of service facilities and plant surroundings: requirements of the steam, refrigeration, water, electricity, waste disposal, lighting, ventilation, drainage, CIP system, dust removal and fire protection
- 25 Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe coloring: planning of offices, laboratories, lockers, toilet facilities, canteen, parking lots, roads, loading docks, garage, repair and maintenance shop and ware houses
- 26 Workers safety and health aspects: falling hazards and safeguards, electric hazards, heat exposure, dust protection, noise control, protection against chemicals, fire safety, fumes and moist conditions
- 27 Personnel hygiene, sanitary requirements and standards - insect, rodent and bird control; building and building materials: requirements in respect of building type, wall, ceiling, floor construction, building height and building materials
- 28 Utilities and services – water use in food processing industry: water supply system, operational aspects of pumps, piping system for fresh water and chilled water
- 29 Fittings and control, water requirement for cleaning and processing, water purification and softening; water use in food processing: different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization and water loadings per unit mass of raw material
- 30 Steam uses in food industry: temperature, pressure and quantity of steam required in various food processing operations; steam generation system: components of a boiler system and fuels used in boilers
- 31 Steam distribution system: components of steam distribution, heat loss and energy efficiency of a steam distribution system; energy conservation technologies for steam distribution system
- 32 Electric energy uses in food industry: power and electrical system - types of electrical loads, sources of energy losses in power and electrical systems, low power factor, improper motor load, poor control; power management for demand control, power factor improvement, replacement with high efficiency motors, replacement with electronic adjustable motors and energy conservation in heat exchangers

Practical

- 1 Preparation of project report
- 2 Preparation of feasibility report
- 3 Layout of food storage wares and godowns
- 4 Layout and design of cold storage
- 5 Layout of milk and milk product plants and low shelf-life product plant
- 6 Layout of bakery and related product plant

- 7 Layout of fruit and vegetable processing plants
- 8 Layout of multi-product and composite food plants
- 9 Evaluation of given layout
- 10 Waste treatment and management of food plant
- 11 Estimation of water requirement in food processing plant and study of sizing
- 12 Study of waste disposal and management process in the food processing plants
- 13 Study of different types piping layout, fittings, control, process of regular checkups and maintenance
- 14 Study of different types steam distribution systems, maintenance and safety measures
- 15 Visit to food industry to study the plant layout
- 16 Practical Examination

References

1. Tufail Ahmad. 2003. Dairy Plant Engineering and Management. KitabMahal, Allahabad.
2. Max S. Peters and Klas D. Timmerhaus.1991. Plant Design and Economics for Chemical Engineers, 4th. Ed. McGraw-Hill, Inc., New York.
3. Ed Bausbacher and Roger Hunt. 1993. Process Plant Layout and Piping Design. P.T.R. Prentice-Hall, Inc., New Jersey.
4. Willia D. Baasel.1989. Preliminary Chemical Engineering Plant Design, 2nd Ed.. Elsevier, New York.

Department of Food Safety and Quality Assurance

FSQA 131

General Microbiology

3 (2+1)

Course outlines

Theory

Evolution and scope of microbiology; History of microbiology; Microbial classification, nomenclature and identification; Taxonomic groups; General methods of classifying bacteria; Microscopy and microscopes: Principles, simple and compound microscopes, phase contrast, dark field, ultra violet, fluorescent, electron microscope (SEM and TEM), applications, smears and staining; General structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, protoplasm, endoplasmic reticulum, lysosome, golgi apparatus, centriole, cilia, flagellum, storage bodies and ribosomes, chloroplasts, mitochondria and nucleus; Morphology and fine structure of bacteria: Cultivation of bacteria, nutritional requirements; Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites; Bacteriological media, growth of bacteria, growth kinetics, quantitative measurement of bacterial growth; Reproduction of bacteria; Introduction to fungi, cultivation of fungi, general characteristics; Introduction to yeast, algae and protozoa and virus, general characteristics; Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport. Control of microorganisms: Physical agents and chemical agents, chemotherapeutic agents and chemotherapy; Characteristics of antibiotics; Mode of action of antibiotics; Pure culture techniques: Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections; Applied and environmental microbiology: Definitions and scope of industrial and environmental microbiology, microbiology of water and waste water, air, soil and industrial microbiology. Industrial uses of bacteria, yeasts and molds.

Practical

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.

Lecture

Theory

- 1 Evolution and scope of microbiology, Haeckel's Kingdom protista, prokaryotic and eukaryotic protest and Whittaker's five kingdom concept
- 2 History of microbiology, contributions of different scientists to the microbiology and germ theory of diseases

- 3 Microbial classification, nomenclature and identification; taxonomic groups; general methods of classifying bacteria
- 4 Microscopy and microscopes: principles, simple and compound microscopes, phase contrast, dark field and ultra violet microscopy
- 5 Fluorescent microscopy, electron microscope (SEM and TEM), applications, smears and staining
- 6 General structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, protoplasm, endoplasmic reticulum, lysosome, golgi apparatus, centriole, cilia, flagellum, storage bodies, ribosomes, chloroplasts, mitochondria and nucleus
- 7 Morphology and fine structure of bacteria, size, shape, arrangement and bacterial structures- flagella, pili, capsule, sheaths and stalks
- 8 Cultivation of bacteria, nutritional requirements; nutritional classification of bacteria; phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites
- 9 Bacteriological media, types of media and physical conditions required for growth
- 10 Growth of bacteria, synchronous growth and continuous culture
- 11 Growth kinetics, quantitative measurement of bacterial growth, direct microscopic count electronic enumeration of cell numbers, plate count method and membrane filter count
- 12 Turbidimetric methods, determination of nitrogen content, determination of dry weight of cells
- 13 Reproduction of bacteria- Binary fission, budding
- 14 Introduction to fungi, asexual and sexual reproduction of fungi, cultivation of fungi and mushrooms cultivation
- 15 Introduction to yeast: morphological and cultural characteristics
- 16 Introduction to algae: morphology, reproduction and rickettsia
- 17 Introduction to protozoa : morphology and reproduction
- 18 Introduction to viruses: morphology and structure (morphological groups of phages) and phage structure
- 19 Replication of bacterial viruses, lysogeny, food borne viruses (hepatitis, gastroenteritis and polio viruses)
- 20 Nutrient transport phenomenon: passive diffusion, facilitated diffusion; group translocation and active transport
- 21 Control/destruction of microorganisms by physical agents-high temperature, thermal death time and decimal reduction time
- 22 Control of microorganisms by low temperatures, desiccation, radiations, bacteriological filters
- 23 Control of microorganisms by chemical agents, characteristics of an ideal antimicrobial chemical agent
- 24 Alcohols, halogens, heavy metals and their compounds, dyes, quaternary ammonium compounds, detergents, aldehydes and gases as agents
- 25 Control of microorganisms by antibiotics, characteristics of antibiotics

- 26 Mode of action of antibiotics, chemotherapeutic agents and chemotherapy
- 27 Antifungal, antiviral, chemotherapeutic agents, antitumor antibiotics and synthetic chemotherapeutic agents
- 28 Pure culture techniques: methods of isolation of pure cultures
- 29 Maintenance and preservation of pure cultures: culture collections
- 30 Applied and environmental microbiology: definitions and scope of industrial and environmental microbiology
- 31 Microbiology of water and waste water, air, soil and industrial microbiology
- 32 Industrial uses of bacteria, yeasts and molds

Practical

- 1 Experiment on microscopy
- 2 Experiment on micrometry
- 3 Cleaning and sterilization of glassware and acquainting with equipment used in microbiology laboratory
- 4 Preparation of nutrient agar media and techniques of inoculation
- 5 Staining methods – study on monochrome staining
- 6 Study on gram staining- negative staining
- 7 Study on capsule-staining
- 8 Study on flagella staining
- 9 Study on endospore staining
- 10 Pure culture techniques (streak plate)
- 11 Pure culture techniques (pour plate/spread plate)
- 12 Identification procedures (morphology and cultural characteristics).
- 13 Growth characteristics of bacteria: determination of microbial numbers, direct plate count and generation time
- 14 Growth characteristics of fungi - cultivation of mushrooms
- 15 Study of factors influencing growth: pH, temperature, growth curves for bacteria
- 16 Practical Examination

References

1. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 2014. Microbiology: An Introduction, 12th Ed. Prentice-Hall, NY, USA.
2. Johanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2013. Prescott's Microbiology, 9th Ed. McGraw-Hill Higher Education, NY, USA
3. Michael J. Pelczar Jr., E. C. S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.

Course outlines

Theory

Biochemistry and its scope, cellular biochemistry; Carbohydrates: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism; Metabolism of carbohydrates: Biological role of carbohydrates, glycolysis and respiration, production of ATP, brief description of electron transport chain, oxidative and substrate phosphorylation; Proteins: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism; Metabolism of proteins: Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle; Lipids: Occurrence, classification and structure, physicochemical and metabolic functions, metabolism; Metabolism of lipids: Biological role of lipids, breakdown of triglycerides and phospholipids, β -oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids; Nucleic acids: Properties, structure and metabolism; Vitamins and minerals: Chemistry and metabolic functions; Enzymes: Introduction to enzymes, coenzymes, regulation of enzymatic activity, enzyme kinetics, inhibition effects of pH, allosteric enzymes, derivation of Michaelis-Menten equation, chemical nature and nomenclature, classification, sources and properties, mechanism of action, coenzyme and prosthetic groups; Concepts and content of nutrition: Metabolic function of nutrients; Water and energy balance, water intake and losses, basal metabolism; Formulation of diets, classification of balanced diet, preparation of balanced diet for various groups; Recommended dietary allowances for various age groups; Malnutrition; Assessment of nutritional status; Food fad and faddism; Potentially toxic substance in human food; Functions of food; Basic food groups; nutrients supplied by food; Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Minerals: Functions, sources, factors affecting absorption of minerals, absorption promoters, absorption inhibitors, effect of deficiency; Vitamins and hormones: Classification, functions, sources, effects of deficiency, fat soluble vitamins, water soluble vitamin; Relationship between vitamins and hormones in terms of their biological role.

Practical

Preparation of various solutions and buffers; Qualitative and quantitative determination of carbohydrates; Qualitative and quantitative determination of amino acids; Qualitative and quantitative determination of proteins; Qualitative and quantitative determination of lipids; Qualitative and quantitative determination of vitamins; Isolation of enzymes from various sources; Measurement of energy using bomb calorimeter; Determination of pKa of acid; Determination of pI for casein; Estimation of sugars by Anthrone method; Estimation of protein by Lowry method; Estimation of amino acid using Biuret reaction.

Lecture

Theory

- 1 Biochemistry and its scope, cellular biochemistry
- 2 Carbohydrates: occurrence, classification and structures
- 3 Physicochemical properties and metabolic functions
- 4 Metabolism; metabolism of carbohydrates: biological role of carbohydrates
- 5 Glycolysis and respiration, production of ATP
- 6 Brief description of electron transport chain, oxidative and substrate phosphorylation
- 7 Proteins: occurrence, classification and structures
- 8 Physicochemical properties, metabolic functions and metabolism
- 9 Metabolism of proteins: breakdown of proteins, transamination, deamination and decarboxylation
- 10 Nitrogen fixation: types of nitrogen fixation
- 11 Urea cycle, regulation of urea cycle
- 12 Lipids: occurrence, classification and structures
- 13 Physicochemical properties and metabolic functions and metabolism
- 14 Metabolism of lipids: biological role of lipids
- 15 Breakdown of triglycerides and phospholipids
- 16 β -oxidation of long chain fatty acids, ketosis
- 17 Biosynthesis of fatty acids, triglycerides and phospholipids
- 18 Nucleic acids: properties, structure and metabolism
- 19 Vitamins: chemistry and metabolic functions
- 20 Minerals: chemistry and metabolic functions
- 21 Enzymes: introduction to enzymes, coenzymes and regulation of enzymatic activity
- 22 Enzyme kinetics, inhibition effects of pH and allosteric enzymes
- 23 Derivation of Michaelis-Menten equation
- 24 Chemical nature and nomenclature, classification, sources, properties, mechanism of action, coenzyme and prosthetic groups
- 25 Concepts and content of nutrition: metabolic function of nutrients; water and energy balance, water intake and losses
- 26 Basal metabolism; formulation of diets, classification of balanced diet, preparation of balanced diet for various groups; recommended dietary allowances for various age groups
- 27 Malnutrition; assessment of nutritional status; food fad and faddism; potentially toxic substance in human food; functions of food
- 28 Basic food groups; nutrients supplied by food
- 29 Nutrients: sources, functions, digestion, absorption, assimilation, transport of carbohydrates, proteins and fats in human beings
- 30 Minerals: functions, sources, factors affecting absorption of minerals, absorption promoters, absorption inhibitors, effect of deficiency

- 31 Vitamins and hormones: classification, functions, sources, effects of deficiency and fat soluble vitamins
- 32 Water soluble vitamin: relationship between vitamins and hormones in terms of biological role

Practical

- 1 Preparation of various solutions and buffers
- 2 Qualitative and quantitative determination of carbohydrates
- 3 Qualitative and quantitative determination of carbohydrates
- 4 Qualitative and quantitative determination of amino acids – TLC, electrophoresis and biuret reaction
- 5 Qualitative and quantitative determination of amino acids – TLC, electrophoresis and biuret reaction
- 6 Qualitative and quantitative determination of proteins
- 7 Qualitative and quantitative determination of lipids
- 8 Qualitative and quantitative determination of vitamins – Vitamin-C (Dye method)
- 9 Isolation of enzymes from various sources
- 10 Measurement of energy using bomb calorimeter
- 11 Determination of p_ka of acid
- 12 Determination of pI for casein
- 13 Estimation of sugars by Anthrone method
- 14 Estimation of protein by Lowry method
- 15 Estimation of iron, phosphorous, calcium and β-carotene
- 16 Practical Examination

References

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. *Wardlaw's Perspectives in Nutrition: A Functional Approach*. McGraw-Hill, Inc., NY, USA.
2. David L. Nelson and Michael M. Cox. 2012. *Lehninger Principles of Biochemistry*, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. *Biochemistry*, 4th Ed. John Wiley and Sons, Inc., NY, USA.
4. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. *Handbook of Nutrition and Food*, 2nd Ed. CRC Press, Boca Raton, FL, USA.
5. Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley and Sons, Inc., NY, USA.
6. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer and Gregory J. Gatto, Jr. 2002. *Biochemistry*, 7th Ed. W.H. Freeman and Company, NY, USA.

Course outlines

Theory

Importance and significance of microbes in food science; Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods; Intrinsic factors; pH, water activity, nutrients etc., Extrinsic factors: Relative humidity, temperature, gaseous atmosphere; Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances; Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods; Microbiology of milk and milk products; Microbiology of fruits and vegetables, Microbiology of cereal and cereal products, Microbiology of meat and meat products, Microbiology of fish and other sea foods; Microbiology of poultry and eggs: Microbiology of sugar and sugar products; Microbiology of salts and spices, Microbiology of canned foods, Shelf-life: Calculation of shelf-life, Shelf-life requirements, deteriorative reactions, accelerated testing; Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products; Microbial toxins: Bacterial toxins, fungal toxins, algal toxins and mushroom toxins; Food borne intoxications and infections types of food involved, toxicity and symptoms, chemical properties, environmental conditions; Food borne viruses: Polio, hepatitis A & E, noro viruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms, chemical properties, environmental conditions.

Practical

Isolation of bacteria and molds from foods; Microbial examination of cereal and cereal products: Identification, isolation and confirmation; Microbial examination of vegetable and fruits: Identification, isolation and confirmation; Microbial examination of meat and meat products: Identification, isolation and confirmation; Microbial examination of fish and other sea foods: Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification, isolation and confirmation; Microbial examination of milk and milk products: Identification, isolation and confirmation; Microbial examination of sugar, salts and spices: Microbial examination of canned products: Identification, isolation and confirmation; Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus); Thermal death time determination; Detection of Salmonella from food sample; Detection of coliforms from water by MPN method; Detection of Staphylococcus aureus from food sample.

Lecture

Theory

- 1 Importance and significance of microbes in food science
- 2 Microbial spoilage of foods, cause of spoilage

- 3 Classification of foods by ease of spoilage
- 4 Factors affecting growth and survival of microorganisms in foods, intrinsic factors - pH, water activity and nutrients
- 5 Factors affecting growth and survival of microorganisms in foods, intrinsic factors - buffering capacity, redox potential (Eh), inhibitory substances and biological structures
- 6 Extrinsic factors: relative humidity, temperature, gaseous atmosphere; chemical changes caused by microorganisms
- 7 Changes in nitrogenous organic compounds, non-nitrogenous organic compounds
- 8 Changes in organic acids, other compounds, lipids, pectic substances
- 9 Contamination of foods- sources of contamination, genera of bacteria, maintenance of anaerobic condition
- 10 Contamination of foods- sources of contamination, genera of bacteria, maintenance of anaerobic condition
- 11 Asepsis, removal of microorganisms
- 12 Intermediate moisture foods; microbiology of milk and milk products
- 13 Microbiology of fruits and vegetables
- 14 Microbiology of fruits and vegetables
- 15 Microbiology of cereal and cereal products
- 16 Microbiology of meat and meat products
- 17 Microbiology of fish and other sea foods
- 18 Microbiology of fish and other sea foods
- 19 Microbiology of poultry and eggs
- 20 Microbiology of poultry and eggs
- 21 Microbiology of sugar and sugar products
- 22 Microbiology of salts and spices
- 23 Microbiology of canned foods
- 24 Shelf life: calculation of shelf life, shelf life requirements
- 25 Deteriorative reactions, accelerated testing
- 26 Simulations of product: package environment interaction
- 27 Shelf life simulation for moisture, oxygen and light sensitive products
- 28 Food borne intoxications and infections types of food involved, toxicity and symptoms
- 29 Chemical properties, environmental conditions
- 30 Food borne viruses: polio, hepatitis A & E
- 31 Noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms, chemical properties, environmental conditions
- 32 Noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms, chemical properties and environmental conditions

Practical

- 1 Isolation of bacteria and molds from foods
- 2 Isolation of bacteria and molds from foods
- 3 Microbial examination of cereal and cereal products: identification, isolation and confirmation
- 4 Microbial examination of vegetable and fruits: identification, isolation and confirmation
- 5 Microbial examination of meat and meat products: identification, isolation and confirmation
- 6 Microbial examination of fish and other sea foods: identification, isolation and confirmation
- 7 Microbial examination of eggs and poultry: identification, isolation and confirmation
- 8 Microbial examination of milk and milk products: Identification, isolation and confirmation
- 9 Microbial examination of sugar salts and spices: identification, isolation and confirmation
- 10 Microbial examination of canned products: identification, isolation and confirmation
- 11 Determination and enumeration of pathogenic and indicator organisms in foods (coliform/enterococcus)
- 12 Determination and enumeration of pathogenic and indicator organisms in foods (coliform/enterococcus); thermal death time determination
- 13 Detection of salmonella from food sample
- 14 Detection of coliforms from water by MPN method
- 15 Detection of *Staphylococcus aureus* from food sample
- 16 Practical Examination

References

1. Carl Vanderzant and Don F. Splittsoesev. 1992. *Compendium of Methods for the Microbial Examination of Foods*, 3rd Ed. APHA Publishers, Washington DC, USA.
2. Frazer, Math and Deibel. 1959. *Laboratory Manual for Food Microbiology*, Burgers Publishers – Minnesota, USA.
3. George J. Banwart. 1989. *Basic Food Microbiology*, 2nd Ed. Chapman & Hall, New York, USA.
4. James M. Jay. 2000. *Modern Food Microbiology*, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
5. Martin R. Adams and Maurice O. Moss. 2008. *Food Microbiology*, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK.
6. William C. Frazier and & Dennis C. Westhoff. 1987. *Food Microbiology*, 4th Ed. Tata McGraw-Hill Education, New Delhi.

Course outlines

Theory

History of industrial microbiology; Primary and secondary metabolites produced by the microorganisms; Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work; Fermentation media, Industrial sterilization; Definition, thermal death time, media heat sterilization, advantages of continuous sterilization, design of sterilization, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts; Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals. Types of fermenters, Types of fermentations; Industrially important secondary metabolites; and microorganisms involved; Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects; Bacteriocins; Nisin: Production of microbial enzymes; Downstream processing; Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery.

Practical

Isolation and screening of citric acid/ amylase/ protease /antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid, Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid; Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colors; Production, purification and estimation of beer/ ethanol; Production, purification and assay of fungal amylases/proteases/Lipase; Production and assay of nisin from lactic acid bacteria; Single cell protein production; Starter activity of Baker's yeast Mushroom production.

Lecture

Theory

- 1 History of industrial microbiology
- 2 Primary and secondary metabolites produced by the microorganisms
- 3 Screening of microorganisms: primary screening - isolation of desired and interested microorganisms - secondary screening - yield potential of microbes - both qualitative and quantitative approach
- 4 Preservation of microorganisms and organizations involved in microbial culture collection
- 5 Fermentation media: characteristics of an ideal production medium, raw materials as media, precursors and inducers, repressors and antifoams
- 6 Industrial sterilization; definition, thermal death time and media heat sterilization
- 7 Advantages of continuous sterilization, design of sterilizing equipment, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts

- 8 Fermentor: components of fermentor, parts of fermentor, peripheral parts and accessories, additional accessories and peripherals
- 9 Types of fermentors: stirred tank fermentors - packed bed fermentors - fluidized bed fermentors - bubble column fermentor - air lift fermentor - cylindrical fermentors – flocculated cell culture fermentor
- 10 Types of fermentors: multi phase bioreactors - trickling bed bioreactors - tubular fermentor-mechanically agitated stirred tank reactors, deep jet fermentor, cyclone column fermentor, novel see saw bioreactor, Stirred Tank Fermentor
- 11 Types of fermentation: solid state fermentation-submerged fermentation – factors affecting submerged culture - batch fermentation - fed batch fermentation - sub batch fermentation
- 12 Types of fermentations: continuous fermentation - multiple fermentations - multistage fermentations
- 13 Industrially important secondary metabolites and microorganisms involved: production of organic acids - citric acid, lactic acid, itaconic acid, acetic acid - fermentation conditions - inoculum preparation – carbon and nitrogen source - trace elements - pH and temperature - aeration and agitation, yield, recovery and uses of organic acids
- 14 Industrially important secondary metabolites and microorganisms involved: gluconic acid, kojic acid, gallic acid - fermentation conditions - inoculum preparation – carbon and nitrogen source - trace elements - pH and temperature – aeration, agitation, yield, recovery and uses of organic acids
- 15 Industrially important secondary metabolites and microorganisms: production of antibiotics - screening of antibiotic producers - β - lactam antibiotics – penicillin - chemical nature and biosynthesis – commercial production - inoculum - media - fermentation process - temperature - aeration - pH - biomass production – recovery, purification and uses of antibiotics
- 16 Probiotics: importance, role in fermented foods, organisms involved, beneficial effects
- 17 Bacteriocin: classification, biosynthesis, factors affecting bacteriocin action, physical and chemical properties, stability of bacteriocin, factors influencing bacteriocin production
- 18 Bacteriocin: assay of bacteriocin, recovery and purification of bacteriocin, applications of bacteriocin
- 19 Nisin production: metabolism - fermentation conditions – inoculum preparation - carbon and nitrogen source - trace elements - pH and temperature requirement - recovery and purification
- 20 Production of microbial enzymes: solid state fermentation - fermentors - medium - advantages and disadvantages - submerged fermentation - steps of enzyme production - factors affecting submerged culture
- 21 Production of microbial enzymes: production of amylases, proteases, pectinases, cellulases - commercial production - inoculum - media - fermentation process - temperature - aeration - pH - biomass production - recovery and purification

- 22 Production of microbial enzymes: extraction of enzymes - physical disruption method - chemical treatment method - purification of enzyme - removal of nucleic acids and cell debris - preliminary purification - final purification – applications
- 23 Downstream processing; cell disruption methods: mechanical disruption methods and non-mechanical disruption methods; extraction; purification; concentration; product recovery – methods of product recovery – centrifugation
- 24 Biocolours - carotenoids - lycopene - angkak- production - using fungi - *Monascus purpureus*- history and traditional uses - morphology - fermentation conditions - pigment of *M. purpureus* - health benefits -toxicology - safe consumption
- 25 Microbial polysaccharides - bacterial polysaccharides - localization and description - xanthan - pullulan - curdlan - exopolysaccharides from lactic acid bacteria - dextran – from extremophilic bacteria
- 26 Fungal polysaccharides - cell wall polysaccharides - lichen cell wall polysaccharides - fungal exopolysaccharides - production of polysaccharides - culture techniques and fermentation parameters - agitation - pH - aeration - culture medium - solid state fermentation
- 27 Applications of polysaccharides - polysaccharides as food additives – pharmaceutical applications - oligosaccharides derivatives
- 28 Production of amino acids – historical developments - manufacturing methods – extractive isolation - chemical synthesis - enzymatic catalysis - fermentative production - L glutamic acid - L lysine - uses and applications
- 29 Production of vitamins - general aspects - nomenclature and classification - vitamin B complex - vitamin B12 - vitamin B2 - production of these vitamins - production by fermentation of *Ashbya gossypii* - vitamin C
- 30 Production of SCP - single cell protein advantages - source of SCP - production of bacterial biomass - production using waste - starchy waste - from algae - nutritive value of SCP - consumption of SCP - uses of SCP
- 31 Baker’s yeast - development and history - vienna process - production of yeast -nutrient materials - concentration of sugar - aeration - temperature - pH - molasses ammonia process - yeast from sulphite liquor - food and fodder yeast
- 32 Mushroom production – history – types of mushroom – edible mushroom – spawn production – cultivation

Practical

- 1 Isolation and screening of citric acid producing microbes
- 2 Isolation and screening of amylase producing microbes
- 3 Isolation and screening of protease producing microbes
- 4 Isolation and screening of antibiotic producing microbes

- 5 Production of citric acid/lactic acid/ acetic acid
- 6 Purification of citric acid/lactic acid/ acetic acid and estimation of citric acid/lactic acid/ acetic acid
- 7 Standardization of physical factors for higher yields of citric acid
- 8 Isolation and identification of cultures producing bio-colors
- 9 Production, purification and estimation of ethanol in beer and wine
- 10 Production, purification and assay of fungal amylases
- 11 Production, purification and assay of fungal proteases
- 12 Production, purification and assay of fungal lipase
- 13 Production and assay of nisin from lactic acid bacteria
- 14 Single cell protein production – yeast & mushrooms
- 15 Starter activity of baker's yeast/mushroom production
- 16 Practical Examination

References

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2. Dennis E. Briggs, Chris A. Boulton, Peter A, Brookes and Roger Stevens. 2004. Brewing Science and Practice. Woodhead Publishing Ltd. Cambridge, England.
3. G. Reed. 2004. Prescott & Dunn's Industrial Microbiology, 4th Ed. AVI Publishers, Connecticut, USA.
4. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA.
5. L. E. Casida Jr. 1968. Industrial Microbiology. New Age International Publishers, New Delhi.

FSQA 232

Food Chemistry of Macronutrients

3 (2+1)

Course outlines

Theory

Nature Scope and development of food chemistry; Moisture in foods, role and type of water in foods, functional properties of water, water activity and sorption isotherm, molecular mobility and foods stability; Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulsions); Rheology of diphase systems; Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates; Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic

modification of protein; Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants; Changes during food processing treatment of drying and dehydration, irradiation, freezing, fermentation, canning, restoration, enrichment, fortification and supplementation of foods.

Practical

Determination of moisture content of foods using different methods; Studies of sorption isotherms of different foods; Swelling and solubility characteristics of starches; Rheological properties of food systems; Determination of crude proteins by micro-Kjeldhal method; Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.; Isolation of egg and milk protein; Preparation of protein isolate and concentrate of proteins; Determination of acid value, saponification value and iodine number of fat/oil; Assay of amylases, papain and lipases.

Lecture

Theory

- 1 Nature, scope and development of food chemistry
- 2 Moisture in foods, role and type of water in foods
- 3 Functional properties of water - water activity
- 4 Moisture sorption isotherm
- 5 Molecular mobility and food stability
- 6 Dispersed systems of foods: foods as dispersed systems – characterization of dispersion
- 7 Physicochemical aspects of food dispersion system - sol
- 8 Physicochemical aspects of food dispersion system – gel – food gels
- 9 Physicochemical aspects of food dispersion system - emulsion and foam
- 10 Rheology of diphase systems
- 11 Carbohydrates: changes of carbohydrates on cooking
- 12 Modification of carbohydrates
- 13 Dietary fibers and carbohydrates digestibility
- 14 Enzymatic and chemical reactions of carbohydrates
- 15 Enzymatic and chemical reactions of carbohydrates
- 16 Proteins in foods: plant proteins, milk proteins and egg proteins
- 17 Processing induced, physical, chemical and nutritional changes in protein: changes in nutritional quality and formation of toxic compounds
- 18 Processing induced, physical, chemical and nutritional changes in protein: changes in functional properties of proteins

- 19 Chemical modification of proteins: alkylation-acylation-phosphorylation-sulfitolysis and esterification
- 20 Enzymatic modification of protein: enzymatic hydrolysis- pepsin reaction – protein cross linking
- 21 Lipids in foods : role and use of lipids/fat; crystallization and consistency of lipids
- 22 Chemical aspects of lipids: lipolysis, auto-oxidation and thermal decomposition
- 23 Chemistry of frying technology of fat and oil
- 24 Oil processing: technology of edible fat and oils- rendering, pressing and solvent extraction
- 25 Oil processing: refining- hydrogenations and interesterification
- 26 Safety use of oils and fats in food formulation
- 27 Enzymatic and chemical reactions of fats
- 28 Rancidity and types: chemical deterioration of lipids- hydrolytic reactions; mechanism of lipid oxidation – pro-oxidants - formation of lipid oxidation decomposition products
- 29 Detection techniques and chemical aspects of lipids: tests for rancidity
- 30 Antioxidants : definition- antioxidant activity- antioxidants in foods- natural and synthetic antioxidants
- 31 Changes during food processing treatment of drying, dehydration, irradiation, freezing, fermentation and canning
- 32 Restoration, enrichment, fortification and supplementation of foods

Practical

- 1 Determination of moisture content of foods using different methods (direct & indirect)
- 2 Studies of sorption isotherms of different foods
- 3 Swelling and solubility characteristics of starches
- 4 Rheological properties of food systems
- 5 Determination of crude proteins by micro-Kjeldhal method
- 6 Determination of essential amino acids – lysine
- 7 Determination of essential amino acids - tryptophan
- 8 Determination of essential amino acids – methionine
- 9 Isolation of egg and milk protein
- 10 Preparation of protein isolate and concentrate of proteins
- 11 Determination of acid value of fat/oil
- 12 Determination of saponification value of fat/oil
- 13 Determination of iodine number of fat/oil
- 14 Assay of amylases
- 15 Assay of papain and lipase
- 16 Practical Examination

References

1. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.
2. H. D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemistry, 4th Ed. Springer-Verlag Berlin Heidelberg.
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4. Lillian Hoagland Meyer. 1974. Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA.

FSQA 233

Food Chemistry of Micronutrients

3 (2+1)

Course outlines

Theory

Chemistry of food flavour; Philosophy and definitions of flavour, flavourmatics/flavouring compounds, sensory assessment of flavour, technology for flavour retention; Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs; Food colorants; Regulatory use of dyes; Colour losses during thermal processing; Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors. Enzymes in food industry: Carbohydrases, protease, lipase; Modification of food using enzymes: Role of endogenous enzymes in food quality, enzymes use as processing aid and ingredients

Practical

Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations); Estimation of calcium; Determination of phosphorus; Determination of iron; Estimation of magnesium; Estimation of tannins and phytic acid from food; Determination of vitamin A (Total carotenoids); Determination of ascorbic acid by dye method; Determination of thiamin and riboflavin; Determination of food colors; Assessment of hydrocolloids as food additives; Assessment of various pectinases from fruits and vegetables.

Lecture

Theory

1. Chemistry of food flavour, philosophy, definitions of flavor, methods for flavor analysis, taste and other saporous substances – sweet taste substances, bitter, salty, sour and umami taste substances, flavor modifiers, astringency, pungency and cooling substances
2. Flavourmatics/flavouring compounds in vegetables: fruits and spice flavors, flavor volatiles - lactic acid, ethanol fermentation, fats and oils, meat foods and milk; sensory assessment of flavor and technology for flavor retention

- 3 Pigments in animal: heme pigments - haemoglobin, myoglobin, cured meat pigments, stability of meat pigments
- 4 Pigments in plants kingdom: chlorophyll - structure of chlorophyll and its derivatives, physical characteristics, alterations of chlorophyll
- 5 Carotenoids: structure of carotenoids, occurrence, distribution and physical properties
- 6 Carotenoids: extraction, analysis, chemical properties and stability during processing
- 7 Phenolic and flavonoids; anthocyanins, flavonoids and other phenols - anthocyanins - structure - color and stability of anthocyanins-factors affecting stability of anthocyanins - structural transformation and pH – temperature Proanthocyanidins – tannins, quinoids and xanthenes
- 8 Betalains – structure, physical properties and chemical properties; effect of processing on pigment behavior, technology for retention of natural colors of food stuffs
- 9 Food colorants: introduction, classification of colorants, regulatory use of regulatory dyes- regulatory aspects, properties of certified dyes and use of certified colors
- 10 Color losses during thermal processing of chlorophyll, loss of green color during thermal processing - different technologies of green color preservation - acid neutralization to retain chlorophyll, high temperature short time processing, enzymatic conversion to chlorophyllides, commercial application of metalo complex, regreening of thermal processing
- 11 Vitamins -requirements, allowances, toxicity, enrichment, restoration, fortification, losses of vitamins, optimization and retention of vitamins
- 12 Vitamin- A &D: Structure, general properties, stability, mechanism of degradation and bioavailability
- 13 Vitamin–E & K: structure, general properties, stability, mechanism of degradation and bioavailability
- 14 Water soluble vitamins : ascorbic acid – structure, general properties, stability, mechanism of degradation and bioavailability
- 15 Thiamin: structure, general properties, stability, mechanism of degradation and bioavailability
- 16 Riboflavin: structure, general properties, stability, mechanism of degradation and bioavailability
- 17 Niacin: structure, general properties and bioavailability
- 18 Vitaminm-B6 : structure, general properties, stability, mechanism of degradation and bioavailability
- 19 Folate: structure, general properties, stability, mechanism of degradation and bioavailability
- 20 Biotin: structure, general properties, stability, mechanism of degradation and bioavailability
- 21 Vitamin –B12; structure, general properties, stability, mechanism of degradation, bioavailability, analytical methods; toxicity of vitamins and retention of vitamins
- 22 Principles of mineral chemistry - nutritional aspects of minerals, mineral composition of foods, chemical and functional properties of minerals in foods

- 23 Minerals: types of macro minerals, sources, requirements, allowances, enrichment, restorations and fortifications
- 24 Losses of macro minerals during processing, optimization, retention of minerals and bioavailability of macro minerals
- 25 Toxicity of macro minerals
- 26 Minerals: types of micro minerals, sources, requirements, allowances, enrichment, restorations and fortifications
- 27 Losses of micro minerals during processing
- 28 Optimization, retention of minerals and bioavailability of micro minerals
- 29 Toxicity of micro minerals
- 30 Chemistry of anti-nutritional factors in foods - saponin, phytic acid, hemagglutinins or lectins
- 31 Enzymes in food industry: carbohydrases, proteasase and lipases
- 32 Modification of food using enzymes: role of endogenous enzymes in food quality, color, texture, flavor and aroma changes in foods

Practical

- 1 Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations)
- 2 Estimation of calcium
- 3 Determination of phosphorus
- 4 Determination of iron
- 5 Estimation of magnesium
- 6 Estimation of tannins
- 7 Estimation of phytic acid from food
- 8 Determination of vitamin A (total carotenoids)
- 9 Determination of ascorbic acid by dye method
- 10 Determination of thiamin
- 11 Determination of riboflavin
- 12 Determination of food colors class (natural colors)
- 13 Determination of food colors (artificial colors)
- 14 Assessment of hydrocolloids as food additives
- 15 Assessment of various pectinases from fruits and vegetables
- 16 Practical Examination

References

1. H. D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemistry, 4th Ed. Springer-Verlag Berlin Heidelberg.
2. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA

Course outlines

Theory

Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses; DNA replication: Replication fork, DNA polymerases, other enzymes and proteins required for DNA replication, origin of replication, replication of circular DNA molecule; Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes; Promoter enzymes; Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction); Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombinant DNA, introduction of recombinant DNA into host cell, identification and selection of cells containing cloned genes; Biosensors: Classification, application in food industry; Application of biotechnology in food: Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries; Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labeling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004.

Practical

Study of auxotroph; Micro-propagation through tissue culture; Strain improvement through U.V. mutation for lactose utilization; Chemical mutagenesis using chemical mutagens (Ethidium bromide); Determination of survival curves using physical and chemical mutagens; Isolation and analysis of chromosomal/genomic DNA from *E. coli* and *Bacillus cereus*; Separation of protoplast using cellulytic enzymes; Production of biomass from fruit and vegetable waste; Introduction of ELISA/Southern blot/DNA finger printing, etc.; Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by *Pseudomonas* spp.

Lecture

Theory

- 1 Chemical nature of the genetic material: DNA as genetic material –Griffith experiment, Hershey and chase experiment - RNA as genetic material.
- 2 Chemical nature of the genetic material: structural elements of nucleic acids - sugar – anionic group - nitrogenous bases - purines - pyrimidine's - nucleosides - nucleotides – phosphoric acid - ATP - GTP - CTP - UTP - TTP

- 3 Properties and functions of the genetic material: primary conformation of DNA - secondary conformation of DNA - Watson and Crick model-types of DNA- A, B, Z - tertiary conformation of DNA - higher level of chromatin structure- denaturation and re-naturation
- 4 Organization of the genetic material in bacteria, eukaryotes and viruses: packaging of DNA into chromatin – protein components of chromatin, histones, non histone proteins, nucleosome organization – solenoid model, Dangler-Sting model
- 5 DNA replication: replication fork, DNA polymerases, other enzymes and proteins required for DNA replication, origin of replication, replication of circular DNA molecule
- 6 Transcription in prokaryotes and eukaryotes
- 7 Translation in prokaryotes and eukaryotes
- 8 RNA synthesis, types of RNA and genetic code
- 9 Mutation and DNA repair
- 10 Mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair)
- 11 Transposable elements, plasmids, types of plasmids
- 12 Genetic recombination in bacteria: Holiday model, site specific recombination
- 13 Genetic recombination in bacteria: transformation, transduction, conjugation
- 14 Regulation of gene expression in prokaryotes: induction- repression - LAC operon- model -promoter - operator- structural genes - lac Z gene - lac Y gene - lac A gene – regulation of LAC operon - negative regulation - positive regulation.
- 15 Expression of foreign genes: transformation - calcium chloride mediated - calcium phosphate mediated - microinjection - liposome mediated gene transfer - electrophoration; promoter enzymes
- 16 Recombinant DNA technology: selection of DNA - selection of suitable vehicle – cloning vector - selection of suitable enzyme - introduction of rDNA - screening of host cells - selection based on antibiotic resistance - complementation of nutritional defects - assay of biological activity - immunochemical method- colony hybridization –expression of target gene in the host cell
- 17 Restriction enzymes – nomenclature of enzymes - three letter code - molecular scissors - nature of cutting ends - blunt ends - sticky ends – isoschi-zomers- recognition sites - star activity – neoschi-zomers - cleavage - mechanism of action – applications of restriction enzymes
- 18 Cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA)
- 19 Cloning of specific gene and their identification (Southern blotting, polymerase chain reaction)
- 20 Gene cloning: production of identical cells, isolation and purification of insert DNA

- 21 Isolation of vector DNA, construction of recombinant DNA, introduction of recombinant DNA into host cell
- 22 Identification and selection of cells containing cloned genes: selection based on antibiotic resistance - complementation of nutritional defects - assay of biological activity – immunochemical method - colony hybridization
- 23 Biosensors: definition, bioreceptors, transducers, signal processing, classification, application in food industry
- 24 Application of biotechnology in food
- 25 Immobilization of enzymes: arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface and aggregation
- 26 Immobilization of enzymes: entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films and microencapsulation
- 27 Immobilization of enzymes: large scale cell immobilization, uses and applications in industries
- 28 Ethical issues concerning GM foods: testing for GMOs and current guidelines for production
- 29 Ethical issues concerning GM foods: release and movement of GMOs, labeling, traceability, trade related aspects, bio-safety, risk assessment and risk management
- 30 Ethical issues concerning GM foods: public perception of GM foods
- 31 Ethical issues concerning GM foods: IPR – history of IPR in India, intellectual property, protection and intellectual property rights, international harmonization of patent laws, properties of biotechnological inventions, choice of IPR protection, management of IPR, benefits from IPR and problems from IPR
- 32 Ethical issues concerning GM foods: GMO Act 2004

Practical

- 1 Study of auxotroph
- 2 Micro-propagation through tissue culture
- 3 Strain improvement through U.V. mutation for lactose utilization
- 4 Chemical mutagenesis using chemical mutagens (Ethidium bromide)
- 5 Determination of survival curves using physical mutagens
- 6 Determination of survival curves using chemical mutagens
- 7 Isolation and analysis of chromosomal/genomic DNA from *E. coli*
- 8 Isolation and analysis of chromosomal/genomic DNA from *Bacillus cereus*
- 9 Separation of protoplast using cellulytic enzymes
- 10 Separation of protoplast using cellulytic enzymes
- 11 Production of biomass from fruit waste

- 12 Production of biomass from vegetable waste
- 13 Introduction of ELISA/Southern blot/DNA finger printing
- 14 Agarose gel electrophoresis of plasmid DNA
- 15 Pesticide degradation by Pseudomonasspp
- 16 Practical Examination

References

1. B. D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
2. Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene-Tech Books, New Delhi.
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4. Oliver Brandenburg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea Sonnino 2011. Introduction to Molecular Biology and Genetic Engineering. FAO, Rome, Italy.
5. S. B. Primrose and R. M. Twyman. 2006. Principles of Gene Manipulation and Genomics, 7th Ed. Blackwell Publishing, Victoria, Australia.
6. Ashok Agarwal and Pradeep Parihar. 2005. Industrial Microbiology: Fundamentals and Applications. Agrobios India, Jodhpur.

FSQA 331

Instrumental Techniques in Food Analysis

3 (1+2)

Course outlines

Theory

Concepts of food analysis; Rules and regulations of food analysis; Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foods; Methods of analysis: Proximate constituents, moisture, adulterations, minerals analysis; Principles and methodology involved in analytical techniques: ion selective electrodes, spectroscopy, ultraviolet visible, fluorescence, infrared spectro, atomic absorption and emission, mass spectroscopy, nuclear magnetic resonance and electron spin resonance; Chromatography: Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method, gas-liquid, high performance liquid chromatography; Separation techniques: Dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation, iso-electric focusing, isotopic techniques, manometric techniques; Immuno assay techniques in food analysis; Evaluation of analytical data: Accuracy and precision, statistical significance, co-relations regression, result interpretation; Instrumentation and sensors for the food industry; Food compositional analysis using near infra-red absorption technology: Principles of measurement, instrumentation, applications in the food industry, power of process monitoring and trending, practical considerations for implementing on-line measurement, practical aspects of infra-red remote thermometry, radiation thermometers,

measurement principles, practical situations, miscellaneous techniques; In-line and off-line FTIR measurements, food applications, calibration and general aspects of routine use; Rapid microbiological methods: Overview, Conductance/impedance techniques for microbial assay; chemo-sensors, biosensors, immune sensors; Electronic noses and tongues: Sensors for food flavour and freshness, electronic noses, tongues and testers; Introduction to flavour assessment, modelling the human nose, electronic nose, electronic tongue, marker chemical approach, Chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, ions, gases and volatiles, amperometric, potentiometric and thermometric biosensors; Acoustic sensors, optical immune-sensors; Fluorescence sensor systems; Novel sensing receptors, sensor arrays, commercial biosensors.

Practical

Sampling plan; Sample collection and preparation for analysis; Sensory evaluation of products; Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products; Quality evaluation of food products for color and taste of marketed products; Analysis of heavy metals using atomic absorption spectrophotometer; Estimation of physico acid using spectrophotometer; Separation of amino acids by two-dimensional paper chromatography; Identification of sugars in fruit juice using TLC; Separation of pralines by ion-exchange chromatography; Molecular weight determination using sephadox-gel; Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques; Quantitative determination of sugars and fatty acid profile by GLE; Quantitative make-up of water and fat soluble vitamins using HPLC; Separation of sugars by paper chromatography; Analysis of wheat flour; Analysis of foods for pesticide and drug residues; Study of colorimetry and spectrophotometry; Spectrophotometric method of total chlorophyll (A & B).

Lecture

Theory

- 1 Concepts of food analysis; rules and regulations of food analysis; principles and methodology involved in analysis of foods: rheological analysis, textural profile analysis of foods
- 2 Methods of analysis: proximate constituents, moisture, adulterations, minerals analysis; principles and methodology involved in analytical techniques: ion selective electrodes, spectroscopy, ultraviolet visible, fluorescence and infrared spectroscopy
- 3 Atomic absorption, emission and mass spectroscopy; nuclear magnetic resonance and electron spin resonance spectroscopy
- 4 Chromatography: adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method, gas-liquid, high performance liquid chromatography
- 5 Separation techniques: dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation
- 6 Iso-electric focusing, isotopic techniques, manometric techniques; Immuno assay techniques in food analysis

- 7 Evaluation of analytical data: accuracy and precision, statistical significance, co-relations regression, result interpretation.
- 8 Instrumentation and sensors for the food industry; food compositional analysis using near infra-red absorption technology
- 9 Principles of measurement, instrumentation, applications in the food industry, power of process monitoring and trending, practical considerations for implementing on-line measurement and practical aspects of infra-red remote thermometry
- 10 Radiation thermometers, measurement principles, practical situations, miscellaneous techniques; In-line and off-line FTIR measurements, food applications, calibration and general aspects of routine use, rapid microbiological methods: overview
- 11 Conductance/impedance techniques for microbial assay; chemo-sensors, biosensors and immune-sensors
- 12 Electronic noses and tongues: sensors for food flavor and freshness, electronic noses, tongues and tasters
- 13 Introduction to flavor assessment, modeling the human nose, electronic nose, electronic tongue and marker chemical approach
- 14 Chemically sensitive semiconductor devices: solid-state sensors for pH, acidity, ions, gases and volatiles, amperometric, potentiometric and thermometric biosensors
- 15 Acoustic sensors, optical immune-sensors and fluorescence sensor systems
- 16 Novel sensing receptors, sensor arrays and commercial biosensors

Practical

- 1 Sampling plan; sample collection and preparation for analysis
- 2 Sensory evaluation of products
- 3 Quality evaluation of raw materials: fruits
- 4 Quality evaluation of raw materials: vegetables
- 5 Quality evaluation of raw materials: cereals
- 6 Quality evaluation of raw materials: dairy products
- 7 Quality evaluation of raw materials: dairy products
- 8 Quality evaluation of raw materials: meat
- 9 Quality evaluation of raw materials: poultry products
- 10 Quality evaluation of food products for color and taste of marketed products
- 11 Quality evaluation of food products for color and taste of marketed products
- 12 Analysis of heavy metals using atomic absorption spectrophotometer
- 13 Analysis of heavy metals using atomic absorption spectrophotometer
- 14 Analysis of heavy metals using atomic absorption spectrophotometer
- 15 Estimation of phytic acid using spectrophotometer
- 16 Separation of amino acids by two-dimensional paper chromatography

- 17 Identification of sugars in fruit juice using TLC
- 18 Separation of proteins by ion-exchange chromatography
- 19 Molecular weight determination using sephadox-gel
- 20 Identification of organic acids by paper electrophoresis
- 21 Gel-electrophoresis for analytic techniques
- 22 Quantitative determination of sugars and fatty acid profile by GLC
- 23 Quantitative make-up of water and fat soluble vitamins using HPLC
- 24 Separation of sugars by paper chromatography
- 25 Analysis of wheat flour
- 26 Analysis of wheat flour
- 27 Analysis of wheat flour
- 28 Analysis of foods for pesticide and drug residues
- 29 Study of colorimetry and spectrophotometry
- 30 Spectrophotometric method of total chlorophyll (a & b)
- 31 Spectrophotometric method of total chlorophyll (a & b)
- 32 Practical Examination

References

1. S. Suzanne Nieisen. 2010. Food Analysis Laboratory Manual, 2nd Ed. Springer, NY, USA.
2. SemihÖtles. 2009. Handbook of Food Analysis Instruments. CRC Press, Boca Raton, FL, USA.
3. Da-Wen Sun. 2008. Modern Techniques for Food Authentication. Elsevier Inc., Burlington, MA, USA.
4. S. Suzanne Nieisen. 2003. Food Analysis, 3rd Ed. Kluwer Academic, New York, USA.

FSQA 332 Food Quality, Safety Standards and Certification 2 (2+0)

Course outlines

Theory

Food quality: Definition and its role in food industry; Quality attributes, classification; Color and gloss: Definition, different colors, color measurement by spectrophotometer, Muncell color system and Lovibond tintometer; role in food qualities. Role of viscosity and consistency in food quality; Physical properties: Size and shape, weight, volume, weight volume ratio, length, width, diameter, symmetry, curvature, area; Defects, classification. Genetic-physiological defects: Structural, off color, character; Entomological defects: Holes, scars, lesions, off coloring, curled aves, pathological defects; Mechanical defects, extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by

floatation, elution, electronic sorting and internal defects; Flavour: Definition and its role in food quality; Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes; Odour: Definition, classification, neutral-mechanisms, olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction; Visual, auditory, tactile and other senses, vision, audition, oral perception other than taste; Factors influencing sensory measurements: Attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation; Correlation of sensory and instrumental analysis; Laboratory quality measurement: Types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests, directional difference tests, classification of difference tests, two-sample tests, three-sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures; Consumer measurement: Factors influencing acceptance and preference, objectives of consumer preference studies, information obtained from consumer study, factors influencing results from consumer surveys, methods of approach, development of the questionnaire, types of questionnaires, serving procedures; Comparison of laboratory panels with consumer panels; Limitations of consumer survey; Quality of raw materials: Physical, chemical and microbial quality; Quality of products during processing and after processing: Color, taste, texture, flavour, appearance; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. Quality inspection, quality control; Quality management and quality assurance: Total quality management, good manufacturing practices, good agricultural practices, good laboratory practices; Quality management systems, QSS; Quality circles, SQC; ISO system. HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors; Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.

Lecture

Theory

- 1 Food quality: definition and role in food industry; quality attributes and classification
- 2 Color and gloss: definition, different colors, color measurement by spectrophotometer, Munsell color system and Lovibond tintometer; role in food quality
- 3 Role of viscosity/consistency in food quality
- 4 Defects, classification, genetic – physiological defects: structural, off color, character; entomological defects- holes, scars, lesions, off coloring, curled aves and pathological defects
- 5 Mechanical defects, extraneous or foreign material defects; measurement of defects: improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects

- 6 Flavour: definition and its role in food quality, taste: classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes and interaction of tastes
- 7 Odour: definition, classification, neutral-mechanisms, olfactory abnormalities, odor testing, techniques, thresholds, odor intensities and olfaction
- 8 Visual, auditory, tactile, oral perception other than taste and other senses
- 9 Factors influencing sensory measurements: attitudinal factors, motivation, psychological errors in judgment, relation between stimulus and perception adaptation
- 10 Correlation of sensory and instrumental analysis
- 11 Laboratory quality measurement: types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests and directional difference tests
- 12 Classification of difference tests, two – sample tests, three-sample tests, multisampling tests, comparison of procedures, ranking and scoring
- 13 Hedonic scaling, dilution procedures, descriptive sensory analysis, contour method and other procedures
- 14 Consumer measurement: factors influencing acceptance and preference, objectives of consumer preference studies and information obtained from consumer study
- 15 Factors influencing results from consumer surveys, methods of approach, development of the questionnaire, types of questionnaires and serving procedures
- 16 Comparison of laboratory panels with consumer panels: limitations of consumer survey
- 17 Quality of raw materials: physical, chemical and microbial quality – pesticide residues and toxicity, heavy metal poisoning and control
- 18 Quality of products during processing and after processing: color, taste, texture, flavor and appearance
- 19 Factors influencing the food quality: soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products
- 20 Recording and reporting of quality- quality checks, monitoring operations, corrective measures and report sending
- 21 Quality inspection and quality control: objectives of quality control, types of inspection services in quality control, fundamentals for quality control programme and sequence of operation in quality control
- 22 Quality management and quality assurance: total quality management- principles of TQM, implementation of TQM and hurdles to implement TQM
- 23 Good agricultural practices (GAP), good manufacturing practices (GMP), good laboratory practices (GLP) and good hygiene practices (GHP)
- 24 Quality management systems- QSS- Quality Standard System-QS9000
- 25 Quality circles- introduction, definition, objectives, concept, training, process of operation, advantages and limitations
- 26 SQC- Statistical Quality Control: definition, variation in quality, types of variation, causes, specifications, control limits, control charts for variables – X bar and R- bar charts

- 27 ISO system- ISO: 9000 certification series, ISO: 22000-2005 – role and benefits
- 28 HACCP: principles, implementation and maintenance of records
- 29 Plan documentation and types of records; auditing: surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors
- 30 Certification, certification procedures, certifying bodies, accrediting bodies – FSSAI, list of quality accreditation bodies and criteria of accreditation in India
- 31 Certification, certification procedures, certifying bodies and accrediting bodies
- 32 International bodies- Codex Alimentarius Commission, USDA, FDA and IFS- role in safeguarding quality

References

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

FSQA 333

Food Additives and Preservatives

2 (1+1)

Course outlines

Theory

Intentional and unintentional food additives, their toxicology and safety evaluation; Naturally occurring food additives; Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial), pigments and their importance and utilization as food color; processing of natural and artificial food colorants; Food preservatives and their chemical action. Role and mode of action of salts, chelating agents, stabilizers and thickeners; Humectants/ polyhydric alcohol, anti-caking agent, firming agent, flour bleaching and maturing agents, antioxidants, nutritional and non-nutritional sweeteners; Production of enzymes, leavening agents, fat substitutes, flavor and taste enhancers in food processing; Acidity regulators; Emulsifiers.

Practical

Evaluation of GRAS aspect of food additives; Estimation of chemical preservatives by TLC (organic and inorganic); Identification of food colour by TLC (organic and inorganic); Quantitative estimation of added dyes; Isolation and identification of naturally occurring food pigments by paper and TLC; Role and mode of action of chelating agent in fruit juice; Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream); Role and mode of clarifying agent in fruit juices; Role and mode of antioxidant in frozen fish; Role of leaving agent in baked food product; Preservation of coconut shreds using humectants.

Lecture

Theory

- 1 Intentional and unintentional food additives: introduction to food additives – role/functions of food additives in food processing - classification : intentional and unintentional food additives
- 2 Toxicology and safety evaluation of food additives - beneficial effects and harmful effects of food additives – categories of food additives under generally recognized as safe (GRAS) - tolerance levels and toxic levels in foods – ADI and LD50 values of food additives; naturally occurring food additives – applications in food processing
- 3 Food colors and dyes: regulatory aspects of dyes- permitted, non-permitted and provisionally listed colors, dyes and lakes; safe doses and toxic effects; food colors: natural and artificial - pigments, dyes and lakes -their sources, importance and utilization; processing of natural and artificial food colorants
- 4 Food preservatives and their chemical action – class I and class II preservatives - chemical action on foods and human system- safe doses/permitted levels of usage in food and toxic effects; role and mode of action of salts –types of salts-properties and role in food processing - permitted levels of usage and toxic effects
- 5 Chelating agents – definition of chelation –types of chelators - alpha acids, properties and mechanism of action – synergism with anti-oxidants- permitted levels of usage and toxic effects
- 6 Stabilizers and thickeners – definition - algal polysaccharides, plant based gums, cellulose derivatives, gelatin, pectin and modified starches – properties, applications and permitted levels in processed foods
- 7 Humectants/Polyhydric alcohols and anti-caking agents – definition, functions, their mechanism of action in food products, permitted levels and toxic effects
- 8 Firming agents - definition, functions, mechanism of action in food products, permitted levels and toxic effects
- 9 Flour bleaching and maturing agents - definition, types of bleaching and maturing agents in bread industry, functions, their mechanism of action in food products, permitted levels and toxic effects
- 10 Anti-oxidants - definition, types of antioxidants (natural and synthetic) - functions, mechanism of action in food products, permitted levels and toxic effects
- 11 Nutritional and non-nutritional sweeteners - definition, types of nutritional and non-nutritional sweeteners (natural and synthetic) - functions, role, mechanism of action in food products, permitted levels and toxic effects
- 12 Production of enzymes – enzymes, sources, production of enzymes and applications in food processing
- 13 Leavening agents – definition, types of leavening agents – natural and chemical leavening agents – baking powders and classification of baking powders based on acid component and mode of action - permitted levels and toxic effects

- 14 Fat substitutes- definition, types, functions, sources, production of fat substitutes, role and mechanism of action in processed foods
- 15 Flavour and taste enhancers - definition, types, sources, mechanism of action and application in processed foods - permitted levels and toxic effects; acidity regulators – acids, bases and buffers used in processed foods - permitted levels and toxic effects
- 16 Emulsifiers - definition, classification, properties, mechanism of action and applications-surface activity in O/W and W/O systems – HLB value and critical micellar concentration and their significance in defining the role of emulsifiers and permitted levels and toxic effects

Practical

- 1 Evaluation of GRAS aspect of food additives
- 2 Estimation of chemical preservatives by TLC (organic)
- 3 Estimation of chemical preservatives by TLC (In organic)
- 4 Identification of food color by TLC (organic)
- 5 Identification of food color by TLC (inorganic)
- 6 Quantitative estimation of added dyes
- 7 Isolation and identification of naturally occurring food pigments by paper chromatography
- 8 Isolation and identification of naturally occurring food pigments by TLC
- 9 Demonstration of role and mode of action of chelating agent in fruit juice
- 10 Demonstration of role and mode of action of stabilizer and thickener in frozen dairy products (ice cream)
- 11 Demonstration of role and mode of action of stabilizer and thickener in frozen dairy products (ice cream)
- 12 Demonstration of role and mode of action of clarifying agent in fruit juices
- 13 Demonstration of role and mode of action of antioxidant in frozen fish
- 14 Demonstration of role of leavening agent in baked food product
- 15 Preservation of coconut shreds using humectants
- 16 Practical Examination

References

1. H. D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemistry. 4th Edition. Springer-Verlag, Berlin, Heidelberg.
2. S. N. Mahindru. 2008. Food Additives: Characteristics, Detection and Estimation. Aph Publishing Corporation, New Delhi.
3. S. S. Deshpande. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland

Course outlines

Theory

Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices, sanitation; Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures, role of pest management in bio-security; Relationship of microorganisms to sanitation, allergens, allergen control; Food contamination, protection against contamination; Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions; Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal, liquid waste disposal; Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management; Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations, pest control design; Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials, cleaning of low-moisture food manufacturing plants; Dairy processing plant sanitation: Role of pathogens, sanitary construction considerations, soil characteristics in dairy plants, sanitation principles, cleaning equipment; Meat and poultry plant sanitation: Role of sanitation, sanitation principles, cleaning compounds for meat and poultry plants, sanitizers for meat and poultry plants, sanitation practices, sanitation procedures; Sea food plant sanitation: Sanitary construction considerations, contamination sources, sanitation principles, recovery of by-products; Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures, evaluation of sanitation effectiveness; Beverage plant sanitation: Mycology of beverage manufacture, sanitation principles, non-alcoholic beverage plant sanitation, brewery sanitation, winery sanitation, distillery sanitation;

Practical

Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand); Determination of hardness of water; Good Manufacturing Practices (GMPs) and personal hygiene; Sewage treatment: Primary, secondary, tertiary and quaternary; Aerobic and anaerobic sludge treatment; Lab demonstration on state of water; Study of CIP plant; Isolation and identification of Actinomycetes; Enrichment and isolation of cellulose degrading bacteria; Biodegradation of phenol compounds; Bacteriological examination of water: Coliform MPN test; Sampling of airborne microorganisms; Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines.

Lecture

Theory

- 1 Good manufacturing practices – current good manufacturing practices- standard operating procedures, good laboratory practices – sanitation –sanitation in the food industry-sanitation laws, regulations and guidelines
- 2 Establishment of sanitary practices – potential risks of food borne bioterrorism, bioterrorism protection measures – role of pest management in bio-security
- 3 Relationship of microorganisms to sanitation: relationship of microorganisms to food sanitation, causes of microbial growth, effect of microorganisms on spoilage
- 4 Relationship of microorganisms to sanitation: microbial destruction, growth control and load determination –the relationship of allergens to sanitation – allergen control
- 5 Food contamination –protection against contamination– personal hygiene and sanitary food handling: role of HACCP in sanitation – principles – organization, implementation and maintenance
- 6 Quality assurance for sanitation: role of total quality management – quality assurance for effective sanitation and organization for quality assurance
- 7 Cleaning compounds – characteristics – classification – selection – handling and storage precautions
- 8 Sanitizers - sanitizing methods - sanitation equipment: cleaning equipment and sanitizing equipment- waste product handling: solid waste disposal and liquid waste disposal
- 9 Pest control: insect infestation- cockroaches- insect destruction- rodents and birds- use of pesticides and integrated pest management
- 10 Sanitary design and construction for food processing: site selection, site preparation, building construction considerations, processing and design considerations - pest control design
- 11 Low-moisture food manufacturing and storage sanitation: sanitary construction considerations, receipt and storage of raw materials- cleaning of low-moisture food manufacturing plants
- 12 Dairy processing plant sanitation: role of pathogens, sanitary construction considerations - soil characteristics in dairy plants- sanitation principles - cleaning equipment
- 13 Meat and poultry plant sanitation: role of sanitation, sanitation principles, cleaning compounds for meat and poultry plants- sanitizers for meat and poultry plants, sanitation practices and sanitation procedures
- 14 Sea food plant sanitation: sanitary construction considerations - contamination sources - sanitation principles - recovery of byproducts
- 15 Fruit and vegetable processing plant sanitation: contamination sources - sanitary construction considerations- cleaning considerations- cleaning of processing plants- cleaners and sanitizers- cleaning procedures- evaluation of sanitation effectiveness

- 16 Beverage plant sanitation: mycology of beverage manufacture, sanitation principles- non-alcoholic beverage plant sanitation- brewery sanitation - winery sanitation - distillery sanitation

Practical

- 1 Estimation of BOD (Biological Oxygen Demand)
- 2 Estimation of COD (Chemical Oxygen Demand)
- 3 Determination of hardness of water
- 4 Good Manufacturing Practices (GMPs) and personal hygiene
- 5 Sewage treatment: primary, secondary, tertiary and quaternary
- 6 Aerobic and anaerobic sludge treatment
- 7 Lab demonstration on state of water - study of CIP of plant
- 8 Isolation and identification of actinomycetes
- 9 Enrichment and isolation of cellulose degrading bacteria
- 10 Biodegradation of phenol compounds
- 11 Bacteriological examination of water: coliform
- 12 Bacteriological examination of water: MPN test
- 13 Sampling of airborne microorganisms
- 14 Sampling of surfaces - equipment and physical plant
- 15 Aerosol sampling and measurement guidelines
- 16 Practical Examination

References

1. Michael M. Cramer. 2013. Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press, Boca Raton, FL, USA.
2. Ralph Mitchell and Ji-Dong Gu. 2010. Environmental Microbiology, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Norman G. Marriott and Robert B. Gravani. 2006. Principles of Food Sanitation, 5th Ed. Springer Science+Business Media, Inc., NY, USA.
4. I. L. Pepper and C. P. Gerba. 2005. Environmental Microbiology: Laboratory Manual, 2nd Ed. Elsevier Academic Press, Amsterdam.
5. Y. H. Hui, Bernard L. Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong and Phil Ventresca. 2003. Food Plant Sanitation. Marcel Dekker, Inc., NY, USA.

Department of Food Business Management

FDBM 241

Business Management and Economics

2 (2+0)

Course outlines

Theory

Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling; Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid; Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity; Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation; Theory of production: Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis; Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.

Lecture

Theory

- 1 Definitions and management principles
- 2 Scientific principles
- 3 Administrative principles
- 4 Functions of management: planning, organizing, staffing, directing and controlling
- 5 Maslow's hierarchy of needs theory
- 6 Organizational structures
- 7 Principles of organization
- 8 Types of organization: formal, informal, line, line and staff, matrix and hybrid
- 9 Human resource management: definition, importance and objectives
- 10 Process, source of recruitment and process of selection
- 11 Introduction to economics: definitions
- 12 Nature, scope, difference between microeconomics and macroeconomics
- 13 Theory of demand and supply
- 14 Elasticity of demand
- 15 Price and income elasticity
- 16 Markets: types of markets

- 17 Characteristics of markets
- 18 National income: GDP
- 19 National income :GNP & NNP
- 20 Disposable personal income, per capita income
- 21 Inflation
- 22 Theory of production
- 23 Production function and factors of production
- 24 Law of variable proportions and law of returns to scale
- 25 Short run, long run cost, fixed cost and variable cost
- 26 Total cost, average cost, marginal cost and opportunity cost
- 27 Break even analysis
- 28 Finance accounting – concepts, double entry system and ledger
- 29 Cost accounting and finance management: definition, importance and scope
- 30 Financial statement - balance Sheet
- 31 Financial statement - profit and loss account
- 32 Corporate social responsibility: importance and business ethics

References

1. L. M. Prasad. 2001. Principles and Practices of Management, 9th Ed. S. Chand & Sons, New Delhi.
2. Koontz Harold. 2008. Principles of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
3. P. C. Thomas. 2008. Managerial Economics, 9th Ed. Kalyani Publishers.
4. K. K. Dewett and M. H. Navalur. 2006. Modern Economic Theory. S. Chand & Sons, New Delhi.
5. P. Subba Rao. 2010. Human Resource Management. Himalaya Publications.
6. S. P. Jain. 2012. Financial Accounting. Kalyani Publications, Ludhiana.

FDBM 341 Marketing Management and International Trade 2 (2+0)

Course outlines

Theory

Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behaviour: micro- and macro-environments; Marketing research and marketing information systems; Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process; Product policy and planning: Product-mix, product line, product life cycle; New product development process; Product brand, packaging,

services decisions; Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions; Advertising: Objectives, budget and advertising message, media planning, personal selling, publicity, sales promotion; World consumption of food: Patterns and types of food consumption across the globe; Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels; WTO and world trade agreements related to food business, export trends and prospects of food products in India; Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.

Lecture

Theory

- 1 Marketing: concept, functions and scope
- 2 Marketing management process
- 3 Concepts of marketing-mix
- 4 Elements of marketing-mix
- 5 Market structure
- 6 Consumer buying behavior
- 7 Micro and macro-environments
- 8 Marketing research and marketing information systems
- 9 Market measurement
- 10 Market forecasting
- 11 Market segmentation, targeting and positioning
- 12 Allocation and marketing resources
- 13 Marketing planning process
- 14 Components of product system
- 15 Product-mix and product line
- 16 Product life cycle
- 17 New product development process
- 18 Product brand, packaging services and decisions
- 19 Marketing channel decisions; retailing, wholesaling and distribution
- 20 Pricing decisions
- 21 Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry
- 22 Physical distribution – channels levels and channel functions
- 23 Advertising: objectives and budget
- 24 Advertising message and media planning
- 25 Sales promotion

- 26 Personal selling, publicity
- 27 World consumption of food: patterns and types of food consumption across the globe
- 28 Salient features of international marketing
- 29 International marketing environment, deciding which and how to enter international market
- 30 WTO and world trade agreements related to food business
- 31 Composition and direction of Indian exports and imports, export trends and prospects of food products in India
- 32 Government institutions related to International food trade: APEDA, tea board, spices board, MOFPI etc.

References

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy, MithileshwarJha. 2013. Marketing Management: A South Asian Perspective, 14th Ed. Pearson Education.
2. William J. Stanton. 1984. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
3. C. N. Sontakki. 2001. Marketing Management. Kalyani Publishers, New Delhi.
4. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. 2015. International Business, 15th Ed., Pearson Education, USA.
5. Aswathappa. 2010. International Business. Tata McGraw-Hill Education, New Delhi.
6. Fransis Cherunilam. 2010. International Business: Text and Cases, 5th Ed. PHI Learning, New Delhi.

FDBM 342

ICT Applications in Food Industry

3 (1+2)

Course outlines

Theory

Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems; Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver; Web hosting and webpage design; file transfer protocol (FTP), on-line food process control from centralized server system in processing plant; Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger, MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations, user defined functions, programming using MATLAB; debugging MATLAB programs, applications to simulations; Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots; Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox; Introduction to

computational fluid dynamics (CFD), governing equations of fluid dynamics; Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations; Physical boundary conditions, discretization; Applications of CFD in food and beverage industry; Introduction to CFD software, GAMBIT and FLUENT software; LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette; Components of a LabVIEW application: Creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW; LabVIEW typical programs: Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette, creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O; LabVIEW results: Displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.

Practical

Introduction to various features in spreadsheet; Solving problems using functions in spreadsheets; Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack; Solution of problems on regression analysis using Analysis Tool pack in spreadsheet; Solution of problems on optimization using solver package in spreadsheet; Introduction to MATLAB; Writing code using MATLAB programming; Solution of problems using Curve Fitting Toolbox in MATLAB; Solution of problems using Fuzzy Logic Toolbox in MATLAB; Solution of problems using Neural Network Toolbox in MATLAB; Solution of problems using Image Processing Toolbox in MATLAB; Introduction to GAMBIT software; Creation of geometry for laminar flow through pipe using GAMBIT; Introduction to FLUENT software; Import of geometry and application of boundary conditions; Solution of problems on laminar flow using FLUENT; Introduction to LabVIEW and NI-DAQ.

Lecture

Theory

- 1 Importance of computerization in food industry; operating environments and information systems for various types of food industries
- 2 Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware; software and protocols
- 3 Landlines, local area network systems and modems
- 4 Spreadsheet applications: data interpretation, solving problems, preparation of charts; use of macros to solve engineering problems
- 5 Use of add-ins, use of solver; web hosting and webpage design
- 6 File transfer protocol (FTP), on-line food process control from centralized server system in processing plant
- 7 Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger; MATLAB help system, problem solving methodologies, numeric, cell and arrays
- 8 Matrix operations, user defined functions, programming using MATLAB; debugging MATLAB programs; applications to simulations; plotting and model building in MATLAB,

- X-Y plotting functions, subplots and overlay plots
- 9 Special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots
 - 10 Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox; neural network toolbox, image processing toolbox and statistical toolbox
 - 11 Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics; models of flow; substantial derivative, divergence of velocity, continuity, momentum and energy equations
 - 12 Physical boundary conditions, discretization; applications of CFD in food and beverage industry; introduction to CFD software, GAMBIT and FLUENT software
 - 13 Lab VIEW – Lab VIEW environment: getting data into computer, data acquisition devices; components of a Lab VIEW application: creating a VI, data Flow execution
 - 14 NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette; debugging techniques
 - 15 Additional help, context help, tips for working in Lab VIEW, Lab VIEW typical programs: loops, while loop, for loop, functions and sub Vis.; types of functions, searching the functions palette, creating custom sub Vis.
 - 16 Decision making and file I/O, case structure, select (if statement), file I/O; Lab VIEW results: displaying data on front panel; controls and indicators, graphs, charts, arrays, loop timing, signal processing, textual math and math script

Practical

- 1 Acquainting of various features in spreadsheets
- 2 Solving problems using functions in spreadsheets
- 3 Use of Add-Ins in spread sheet & Statistical data analysis using Analysis Tool pack
- 4 Solution of problems on regression analysis using Analysis Tool pack in spreadsheet
- 5 Solution of problems on regression analysis using Analysis Tool pack in spreadsheet
- 6 Solution of problems on optimization using solver package in spreadsheet
- 7 Solution of problems on optimization using solver package in spreadsheet
- 8 Acquainting to MATLAB software
- 9 Writing code using MATLAB programming
- 10 Solution of problems using Curve Fitting
- 11 Solution of problems using Curve Fitting
- 12 Toolbox in MATLAB
- 13 Solution of problems using Fuzzy Logic Toolbox in MATLAB
- 14 Solution of problems using Fuzzy Logic Toolbox in MATLAB
- 15 Solution of problems using Neural Network Toolbox in MATLAB
- 16 Solution of problems using Neural Network Toolbox in MATLAB
- 17 Solution of problems using Image Processing Toolbox in MATLAB

- 18 Solution of problems using Image Processing Toolbox in MATLAB
- 19 Acquainting to GAMBIT software
- 20 Acquainting to GAMBIT software
- 21 Creation of geometry for laminar flow through pipe using GAMBIT
- 22 Creation of geometry for laminar flow through pipe using GAMBIT
- 23 Acquainting to FLUENT software
- 24 Acquainting to FLUENT software
- 25 Import of geometry
- 26 Application of boundary conditions
- 27 Application of boundary conditions
- 28 Solution of problems on laminar flow using FLUENT
- 29 Solution of problems on laminar flow using FLUENT
- 30 Introduction to Lab VIEW
- 31 Introduction to NI-DAQ
- 32 Practical Examination

References

1. R. Paul Singh. 2014. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis. Academic Press, London.
2. William J. Palm III. 2011. Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA.
3. Da-Wen Sun. 2007. Computational Fluid Dynamics in Food Processing. CRC Press, Boca Raton, FL, USA.
4. Nigel Chapman and Jenny Chapman. 2006. Web Design: A Complete Introduction. John Wiley & Sons, USA.
5. National Instruments Corporation. 2005. Introduction to LabVIEW: 3-Hour Hands-On. NI, Austin, Texas.
6. David Bailey and Edwin Wright. 2003. Practical SCADA for Industry. Elsevier, Burlington, MA

FDBM 343

Project Preparation and Management

2 (1+1)

Course outlines

Theory

Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management; Project life cycle; Project selection: Project identification and screening, project appraisal, project charter, project proposal,

project scope, statement of work; Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT; Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation; Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis; Project completion and future directions: Project completion and review; Project management: Recent trends and future directions; Computers in project management.

Practical

Data collection from market on various projects on food processing. Writing work break down structure for different projects. Solving various problems using an assignment model and job sequencing. Drawing network charts for different projects. Formulation of CPM scheduling for a specific project. Formulation of PERT scheduling for a specific project. Calculation of project cost and break even analysis for a specific food product enterprise. SWOT analysis of a specific enterprise.

Lecture

Theory

- 1 Overview of project management: functions and viewpoints of management and evolution of project management
- 2 Forms and environment of project management
- 3 Project life cycle
- 4 Project identification and screening
- 5 Project feasibility analysis – market feasibility, financial feasibility, economic feasibility, technical feasibility, commercial feasibility, environmental feasibility, project risk analysis.
- 6 Project appraisal/evolution techniques – undiscounted cash flows
- 7 Project appraisal/evolution techniques – discounted cash flows
- 8 Project planning and scheduling: work breakdown structure, planning and scheduling of activity networks
- 9 Network scheduling, precedence diagrams, critical path method, program evaluation, review technique, assumptions in PERT modeling, decision CPM and GERT
- 10 Time-cost trade-offs resource considerations in projects, resource profiles, leveling and limited resource allocation
- 11 Project implementation, monitoring and control: project management process and role of project manager, team building and leadership in project

- 12 Organizational and behavioral issues in project management
- 13 Project monitoring and control
- 14 PERT/cost method and earned value analysis
- 15 Project completion and future directions: project completion and review
- 16 Project management: recent trends and future directions; computers in project management

Practical

- 1 Identifying the primary characteristics of a project
- 2 Studying various parts of project life cycle: output, outcome and impact
- 3 Study on the project life cycle related to food industry
- 4 Studying the various tools for project management
- 5 Project evaluation techniques- undiscounted cash flows and discounted cash flows
- 6 Problems on PERT analysis-1
- 7 Problems on PERT analysis-2
- 8 Problems on PERT analysis-3
- 9 Study on critical path of a project
- 10 Study on risk assessment matrix by logical framework analysis
- 11 Study on work breakdown structure
- 12 Study and drawing of Gantt chart-1
- 13 Study and drawing of Gantt chart-1
- 14 Project network- construction and analysis
- 15 Preparation of a project report
- 16 Practical Examination

References

1. R. Panneerselvam. 2004. Operations Research, 2nd Ed. International Book House, Mumbai.
3. John M. Nicholas. 2000. Project Management for Business and Technology – Principles and Practices. Pearson Prentice Hall, USA.
4. Harold Kerzner. 2013. Project Management – A System Approach to Planning, Scheduling, and Controlling, John Wiley & Sons, USA.
5. Prasanna Chandra. 2014. Projects – Planning, Analysis, Selection, Financing, Implementation, and Review. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
6. P. Gopalakrishnan and V. E. Rama Moorthy. 2014. Textbook of Project Management. Macmillan.

Course outlines**Theory**

Entrepreneurship: Importance and growth, characteristics and qualities of entrepreneur, role of entrepreneurship, ethics and social responsibilities; Entrepreneurship development: Assessing overall business environment in the Indian economy; Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs; Globalization and the emerging business/entrepreneurial environment; Concept of entrepreneurship, entrepreneurial and managerial characteristics, managing an enterprise, motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow up, managing competition, entrepreneurship development programs, SWOT analysis, generation, incubation and commercialization of ideas and innovations; Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur; Entrepreneurial motivation; Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth; Project feasibility study: Post planning of project, project planning and control; New venture management; Creativity. Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs)/SSIs; Export and import policies relevant to food processing sector; Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export; Social responsibility of business.

Practical

Visit to public enterprise; Visit to private enterprise; Visit to agro-processing/food business centres; SWOT analysis of public enterprises; SWOT analysis of private enterprises; Project proposals as entrepreneur – individual and group; Presentation of project proposals in the class.

Lecture**Theory**

- 1 Entrepreneurship: importance and growth
- 2 Characteristics of entrepreneur
- 3 Qualities of entrepreneur
- 4 Role of entrepreneur
- 5 Ethics and social responsibilities of entrepreneurship
- 6 Entrepreneurship development: assessing overall business environment in the Indian economy
- 7 Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs

- 8 Globalization and the emerging business/entrepreneurial environment
- 9 Concept of entrepreneurship
- 10 Entrepreneurial and managerial characteristics
- 11 Managing an enterprise, motivation and entrepreneurship development
- 12 Importance of planning, monitoring, evaluation, follow up, managing competition and entrepreneurship development programs
- 13 SWOT Analysis
- 14 Generation, incubation and commercialization of ideas and innovations
- 15 Women entrepreneurship-role and importance
- 16 Problems of women entrepreneurship
- 17 Corporate entrepreneurship- role and mobility of entrepreneur
- 18 Entrepreneurial motivation
- 19 Planning and evaluation of projects
- 20 Growth of firm, project identification and selection
- 21 Factors inducing growth
- 22 Project feasibility study: post planning of project, project planning and control
- 23 New venture management and creativity
- 24 Government schemes and incentives for promotion of entrepreneurship
- 25 Government policy on small and medium enterprises (smes)/ssis
- 26 Export and import policies relevant to food processing sector
- 27 Venture capital
- 28 Contract farming and joint ventures
- 29 Public-private partnerships
- 30 Overview of food industry inputs
- 31 Characteristics of Indian food processing industries and export
- 32 Social entrepreneurship opportunities

Practical

- 1 Visit To Public Enterprise
- 2 Visit To Public Enterprise
- 3 Visit To Private Enterprise
- 4 Visit To Private Enterprise
- 5 Visit To Agro-Processing/Food Business Centers
- 6 Visit To Agro-Processing/Food Business Centers

- 7 SWOT Analysis of Public Enterprises
- 8 SWOT Analysis of Private Enterprises
- 9 Study of sick Agro-processing/Food business enterprise
- 10 Case study and analysis of entrepreneurial failure due to environmental factors
- 11 Case study and analysis of social responsibilities of a business
- 12 Project proposals as entrepreneur – individual and group
- 13 Project proposals as entrepreneur – individual and group
- 14 Presentation of project proposals in the class
- 15 Presentation of project proposals in the class
- 16 Practical Examination

References

1. C. B. Gupta and N. P. Srinivasan. 2012. Entrepreneurship Development. S. Chand & Sons, New Delhi.
2. Anil Kumar, S., Poornima, S. C., Mini, K., Abraham and Jayashree, K. 2003. Entrepreneurship Development. New Age International Publishers, New Delhi.
3. Gupta, C. B. 2001. Management: Theory and Practice. Sultan Chand & Sons, New Delhi.
4. Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi.
5. Hisrich R. D. & Peters MP. 2002. Entrepreneurship. Tata McGraw Hill, New Delhi.
6. Kaplan J. M. 2003. Patterns of Entrepreneurship. John Wiley & Sons, New Delhi.
7. Nandan H, 2007. Fundamentals of Entrepreneurship Management. Prentice Hall, New Delhi.

FDBM 441

Communication and Soft Skills Development

2 (1+1)

Course outlines

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Lecture

Theory

- 1 Structural and functional grammar – tenses active voice and passive; direct and indirect speech agreement of the verb with subject
- 2 Articles preposition, parts of speech and agreement of the verb with subject
- 3 Communication – meaning and process of communication, verbal and non-verbal communication.
- 4 Listening and note taking – developing listening skills
- 5 Spoken English – vowels, consonants, monophthongs, diphthongs and triphthongs
- 6 Stress intonation phonetic transcription
- 7 Writing skills – the style, importance of professional writing, choice of words and phrases, clichés, jargons, foreign words and phrases
- 8 Oral presentation skills – oral presentation by students, articulation and delivery – evaluation sheet for oral presentation – structure of oral presentation
- 9 Field diary and lab record – by students
- 10 Reading and comprehension of general articles and using different types of reading skill
- 11 Precise writing – summarizing, abstracting
- 12 Individual and group presentation
- 13 Impromptu presentation – impromptu speaking
- 14 Public speaking
- 15 Group discussion
- 16 Organizing seminars and conferences – checklist for organizing workshops

Practical

- 1 Structural and functional grammar – tenses, active and passive voice, direct and indirect speech, agreement of the verb with subject and practice
- 2 Articles preposition, parts of speech and agreement of the verb with subject and practice
- 3 Communication – meaning and process of communication, verbal and non-verbal communication and practice
- 4 Listening and note taking – developing listening skills

- 5 Spoken English – Vowels, Consonants, Monophthongs, Diphthongs, Triphthongs and practice
- 6 Stress intonation and phonetic transcription
- 7 Writing skills – the style, importance of professional writing, choice of words and phrases, clichés, jargons, foreign words, phrases and practice
- 8 Oral presentation skills – oral presentation by students, articulation and delivery – evaluation sheet for oral presentation – structure of oral presentation and practice
- 9 Field diary and lab record – by students
- 10 Reading and comprehension of general articles by using different types of reading skills and practice
- 11 Precise writing – summarizing, abstracting and practice
- 12 Individual and group presentation and practice
- 13 Impromptu presentation – impromptu speaking practice
- 14 Public speaking and group discussion practice
- 15 Organizing seminars and conferences – checklist for organizing workshops and practice
- 16 Practical Examination

References

1. N. K. Agarwala. 1983. Better English Grammar and Composition.
2. Balasubramanian T. 1989. A Text Book of Phonetics for Indian, Orient Longman, New Delhi.
3. Krishna Mohan and Meerab Banarjee 1990. Developing Communication Skills, Macmillan Indian Ltd., New Delhi.
4. Krishna Swamy, VR 1979. Strengthen – your writing, Orient Longman, New Delhi.
5. Krishna Swamy, N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd., Madras.

Student has to undergo “Student READY - Experiential Learning” with a credit load of (0+14) credit hours through relevant pilot plants for processing of various commodities, preferably on campus. This shall include development of detailed project report on setting up of enterprise in the selected areas of product manufacture and evaluation of the module. The experiential learning is intended to build practical skills and entrepreneurship attributes among the students with an aim to deal with work situations and for better employability and self-employment.

Concept

The word 'experiential' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, bring in innovation or some other transfer of skills or knowledge. Experiential Learning is a business curriculum-related endeavor which is interactive.

Experiential Learning (EL) is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities move participants to explore and discover their own potential. Both activities and facilitation play a critical role in enhancing team performance.

Objectives

Experiential Learning (EL) provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of EL are:

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

Duration

The experiential learning programme will be offered in the final year. As the programme is enterprise oriented, students and faculty are expected to attend the activities of the enterprise even on institutional holidays with total commitment, and without any time limit or restriction of working hours for ELP. The Experiential Learning Programme shall be run for full year by making two groups and rotating activities of the final year in two groups.

Student has to undergo “Student READY - In-plant training” of one semester duration with a credit load of (0+20) credit hours at relevant food processing industry, machinery manufacturer, marketing or other agencies. The in-plant training is intended to expose the students to an environment in which they are expected to be associated in their future career. The students will be required to have hands-on-experience in one or more commercial establishment

Technology and globalization are ushering an era of unprecedented change. The need and pressure for change and innovation is immense. To enrich the practical knowledge of the students, in-plant training shall be mandatory in the last semester for a period of up to 10 weeks. In this training, students will have to study a problem in industrial perspective and submit the reports to the university. Such in-plant trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-Plant training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in right way through this type of industrial attachment mode.

OBJECTIVES

- To expose the students
- To Industrial environment, which cannot be simulated in the University.
- To familiarize the students with various Materials, Machines, Processes, Products and their applications along with relevant aspects of shop management.
- To make the students understand the psychology of the workers, and approach to problems along with the practices followed at factory
- To make the students understand the scope, functions and job responsibility-ties in various departments of an organization.
- Exposure to various aspects of entrepreneurship during the programme period.

Department of Basic Engineering

FD BE 161

Engineering Drawing and Graphics

2 (0+2)

Course outlines

Practical

Introduction of drawing scales; Scales; Representation factor; Reduced scale, enlarged scale, full scale; Principles of orthographic projections; Reference planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids: Change of position method, alteration of ground lines; Section of solids and interpenetration of solid-surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids; Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components; Preparation of sectional drawings of simple machine parts; Drawing of riveted joints and thread fasteners; Demonstration on computer graphics and computer aided drafting use of standard software; Sectional drawings of engineering machines; Computer graphics for food engineering applications; Interpretation of sectional views of food equipment and components; Practice in the use of basic and drawing commands on AutoCAD; Generating simple 2-D drawings with dimensioning using AutoCAD; Small Projects using CAD/CAM.

Practical

- 1 Introduction to drawing tools and practice on English alphabets drawings in different font style
- 2 Introduction to drawing scales-representation factor- reduced scale-enlarged scale-full scale and its usage in engineering drawing
- 3 Scales- plain scales, diagonal scales, isometric scales and their application in engineering drawing
- 4 Introduction to planes, views, plan, elevation and orthographic projections
- 5 Projection of points, description by using drawing lines and alphabets
- 6 Projection of lines inclined to simple planes and both the planes
- 7 Projection of planes and oblique planes
- 8 Introduction to solids, types of solids- drawings on solids
- 9 Section of solids and interpenetration of solid-surfaces
- 10 Projection of solids with reference to two planes
- 11 Introduction to developments- development of solids of flat faces
- 12 Development of solids- cylinders, pyramids, cones and frustum
- 13 Introduction to isometric scale- projection of simple geometric planes in isometric scale
- 14 Projection of solids in isometric scale-I

- 15 Projection of solids in isometric scale-II
- 16 Projection of solids in plane views from isometric scale-I
- 17 Projection of solids in plane views from isometric scale-II
- 18 Projections of solids (change of position method, alteration of ground lines)-I
- 19 Projections of solids (change of position method, alteration of ground lines)-II
- 20 Preparation of manual drawings with dimensions from models
- 21 Preparation of manual drawings with dimensions from isometric drawings of machine components
- 22 Preparation of sectional drawings of simple machine parts
- 23 Drawing of riveted joints and thread fasteners
- 24 Introduction to computer interface in engineering drawing and software
- 25 Demonstration on computer graphics and computer aided drafting
- 26 Exercise on sectional drawings of engineering machines using computer aided design
- 27 Exercise on drawing of food processing equipment using computer aided design
- 28 Interpretation of sectional views of food equipment and components
- 29 Practice on the use of basic drawing commands on AutoCAD
- 30 Generating simple 2-D drawings of machine surfaces with dimensioning using AutoCAD
- 31 Small projects of food processing equipment design and plant layout using CAD/CAM
- 32 Practical Examination

References

1. Ibrahim Zeid. 2004. Mastering CAD/CAM. McGraw-Hill Book Co., NY, USA.
2. Kunwoo Lee. 1999. Principles of CAD/CAM/CAE Systems. Prentice-Hall, USA.
3. N. D. Bhat and V. M. Panchal. 1995. Machine Drawing. Charotar Publishing House, Anand.
4. N. D. Bhat. 1995. Elementary Engineering Drawing. Charotar Publishing House, Anand.

FD BE 162

Electrical Engineering

3 (2+1)

Course outlines

Theory

AC Fundamentals: Definitions of cycle, frequency, time period, amplitude, Peak value, RMS value, Average value, Electro motive force; Magnetic circuits, composite magnetic circuits, hysteresis and eddy currents; Phase relations and vector representation, AC through resistance, inductance and capacitance, A.C. series and parallel circuits, Simple R-L, R-C and R-L-C circuits, 3 Phase Systems: Star and Delta connections, Relationship between line and phase voltages and

currents in Star and Delta connections, various methods of single and three phase power measurement. Transformer : Principle of working, construction of single phase transformer, emf equation, Phasor diagrams, Ideal transformer, transformer on no load, Transformer under load, Equivalent circuits, Transformer losses, efficiency, Regulation, Open and short circuit test. Single phase induction motor: double field revolving theory, magnetic leakage, core types, shell type transformer characteristics, phase split, shaded pole motors. Poly-phase induction motor: Construction, operation, equivalent circuit, production of rotating field, effect of rotor resistance, torque equation, starting and speed control methods, D.C. Machine (generator and motor): Types, Construction and Operation, EMF equation, armature reaction, commutation of D.C. generator and their characteristics, D.C. Motors, their starting, speed controls and characteristics. Electric Power Economics, Maximum demand charge, Load factor, power factor and power factor improvement, Measuring Equipment's: Classification, Characteristics of different electrical measuring systems and equipment's, Electrical Wiring, system of wiring, domestic wiring installation, industrial electrification, protection devices, earthing, use of multi-meter, Circuit protection devices, fuses, AC generators, alternators, principle of operation, types of rotors, emf equation, ELCB & relays.

Practical

Study of voltage resonance in L.C.R. circuits at constant frequency: (a) Star connection study of voltage and current relation. (b) Delta connection study of voltage and current relation. Measurement of Power in 3 phase circuit by wattmeter and energy meter: (a) for balanced loads, (b) for unbalanced loads. Polarity test, no-load test, efficiency and regulation test of single-phase transformer, Starting of induction motors by; (a) D.O.L. (b) Manual star delta (c) Automatic star delta starts. Starting of slip ring induction motors by normal and automatic rotor resistance starters. Test on 3 phase induction motor- determination of efficiency, line current, speed slip and power factor at various outputs. Determination of relation between the induced armature voltage and speed of separately excited D.C. generator. Magnetization characteristics of D.C. generator. Study the starter connection and starting reversing and adjusting speed of a D.C. motor. Problems on Industrial Electrification. Study of various circuit protection devices. Study of various measuring instruments.

Lecture

Theory

- 1 AC fundamentals:- definitions of cycle, frequency, time period, amplitude, average value and rms value
- 2 AC through inductance, resistance, capacitance, L-R circuit and R-C circuit
- 3 L-C-R circuit series and parallel resonant circuits
- 4 Electro motive force, magneto motive force, reluctance, magnetic circuit, composite magnetic circuit, magnetic hysteresis and area of hysteresis loop
- 5 Steinmetz law for hysteresis loss, eddy current loss, Steinmetz formula for eddy current loss

- 6 Three phase system:- star, delta connections, relation between line voltage and phase voltage, line current and phase current in star connected system
- 7 Relation between line voltage and phase voltage, line current and phase current in delta connected system
- 8 Measurement of single phase power using induction watt meter, measurement of three phase power using single watt meter
- 9 Measurement of three phase power using three watt meter method and two watt meter method
- 10 Transformer: working principle and construction of single phase transformer, emf equation of transformer
- 11 Ideal transformer characteristics and phasor diagram, transformer on no load and transformer under load
- 12 Transformer losses, efficiency, regulation, open circuit test and short circuit test
- 13 Magnetic leakage, core type, shell type transformers and difference between core and shell type transformers
- 14 DC generator: working principle, construction, field system, armature, commutator and other accessories
- 15 DC armature winding, lap winding, wave winding, terms used in armature winding
- 16 Emf equation of DC generator, armature reaction, demagnetizing and cross magnetizing ampere turn
- 17 Methods of compensating armature reactions, commutation, resistance commutation and emf commutation
- 18 Characteristics of DC generator: separately excited, shunt, series and compound generator
- 19 DC motor : working principle, value of back emf, voltage equation, torque equation of DC motor, armature torque and shaft torque
- 20 Types of DC motor: separately excited, shunt, series, compound motor and starting of DC motor
- 21 Speed control of DC motor: voltage control, armature control, field control of series motor, armature control and field control of shunt motor
- 22 Single phase induction motor, double field revolving theory
- 23 Phase split shaded pole motors
- 24 Poly phase induction motor: principle of operation, production of rotating magnetic field
- 25 Torque equation, equivalent circuit, squirrel cage rotor and phase wound rotor
- 26 Effect of rotor resistance, slip, speed control of induction motors
- 27 Starting of induction motors: DOL starter, auto transformer starter and star delta starter
- 28 AC generator: principle of operation, construction and salient pole type rotor

- 29 Smooth cylindrical type rotor, emf equation
- 30 Electric power economics:- maximum demand charge, load factor, power factor and power factor improvement
- 31 Electrical wiring systems, system of wiring used for domestic installations and electrical wiring and electrification
- 32 Earthing, use of multi-meter, fuses- materials used for fuse wire, various types of fuses, relays, MCB, ELCB, earthing, necessity of earthing and use of multi-meter

Practical

- 1 Study of voltage resonance in L.C.R. circuits at constant frequency
- 2 Study of voltage and current relation of star and delta connections
- 3 Measurement of power in 3-phase circuits for balance loads and unbalanced loads by wattmeter and energy meters
- 4 Polarity test, no load test, efficiency and regulation test of single phase
- 5 To study the construction details of the DC machine and to draw sketches of different components
- 6 Starting of induction motor by D.O.L starters
- 7 Starting of induction motor by manual star-delta and automatic star-delta starter
- 8 Starting of induction motor by manual auto-transformer
- 9 Starting of slip-ring induction motor by normal and automatic rotor starters
- 10 Test on 3-phase induction motor, determination of efficiency and speed
- 11 Determination of power factor, slip, line current at various outputs of 3-phase induction motor
- 12 To determine the relation between the induced armature voltage and speed of separately excited DC generator
- 13 Magnetization characteristic of DC generator
- 14 Study the starter connection and starting, reversing and adjusting speed of a DC motor
- 15 Study of various measuring instruments and various circuit protection devices
- 16 Practical Examination

References

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3. Anwani M. L. 1997. Basic Electrical Engineering, Dhampat Rai & Co (Pvt.) Ltd, New Delhi.

Course outlines**Theory**

Introduction to basic materials: Ferrous and non-ferrous materials and important engineering materials such as timber, abrasive materials, silica, ceramics, glasses, graphite, diamond, plastic polymers and composite materials, their properties and applications; Introduction and classification of workshop tools; Safety measures in workshop; Indian Factory Acts on safety; Measuring and Gauging: Basic measuring instruments and gauges; Heat treatment processes: Introduction to hardening, tempering, annealing, normalizing, etc.; Welding: Introduction, types of welding, types of electrodes, types of flames, types of welding joints, edge preparation, welding techniques and equipments; Gas welding and gas cutting, arc welding; Introduction to soldering and brazing and their uses; Estimation of welding and soldering cost; Smithing and forging: Introduction to different tools and their uses; Different forging operations, defects of forging; Brief ideas about power hacksaw, etc.; Carpentry: Introduction to various carpentry tools and materials; Type of woods and their characteristics, brief ideas about band saw, wooden lathe circular saw, wood planner, etc.; Machinery: Introduction to various workshop machines (1) Lathe, (2) Milling machine, (3) Shaper and planner, (4) Drilling and boring machine, (5) Grinder and (6) CNC machines; Length of cut, feed, depth of cut, RPM, cutting speed, time, time allowances; Estimation of machining time for different lathe operations; Estimation of machining time for casting, shaping, slotting and planning operations, work holding and tool holding devices; Sheet-metal: Introduction, different operations, sheet metal joints; Allowances for sheet metal, operations and joints, estimate of cost.

Practical

Identification of different materials of manufacture; Demonstration of different measuring instruments and measurement technique; Identification of various hand tools; Demonstration of various power tools and machine tools; Simple exercises in filing, fitting, chipping, hack sawing, chiseling, tapping, etc.; Introduction to welding machine, processes, tools, their use and precautions; Simple exercises on arc welding; Simple exercises in gas welding; Demonstration of various casting processes and equipments, tools and their use; Exercises on mould making using one piece pattern and two piece pattern; Demonstration of mould making using sweep pattern and match plate pattern; Simple exercises on turning: Step turning, taper turning, knurling, drilling and threading; Introduction to shaper and planner machine and preparations of various jobs on them; Introduction to drilling machines and preparation of a related jobs; Demonstration of other important operations and preparation of additional jobs.

Lecture

Theory

- 1 Introduction to workshop, safety measures in workshop; Indian Factory Acts on safety
- 2 Introduction to basic materials: ferrous and non-ferrous materials-timber, abrasive materials, silica, ceramics, glasses, graphite, diamond, plastic polymers and composite materials; their properties and applications
- 3 Introduction and classification of simple tools used in fitting shop
- 4 Heat treatment processes-hardening, tempering, annealing, normalizing and case hardening
- 5 Welding-types of welding, types of electrodes, flux and usage, arc welding, types of welding joints, edge preparation, welding techniques and equipment
- 6 Gas welding and gas cutting, types of flame, introduction to soldering and brazing and uses
- 7 Estimation of welding and soldering cost on prevailing market price
- 8 Smithy and forging- introduction to different tools of smithy and forging and their uses and mechanized tools
- 9 Elaboration of different forging operations, defects of forging and power operated hacksaw
- 10 Introduction carpentry tools- type of woods and their characteristics, classification of saws, chisels, gauging tools and planes
- 11 Introduction to lathe machine-components-different operations performed in lathe machine
- 12 Introduction to threading-tapping-sequence in tapping-dieing- measurements of threads
- 13 Introduction to drilling machine- components- adjustment in measurements: introduction to milling machine and grinding machine- components- adjustment in measurements
- 14 Introduction to planer and shaper- length of cut, feed, depth of cut, RPM, cutting speed, time, time allowances and usage of CNC in workshop machines
- 15 Estimation of machining time for casting, shaping, slotting and planning operations, work holding and tool holding devices on prevailing market price
- 16 Introduction to metal sheets-different operations, sheet metal joints; allowances for sheet metal, operations and joints, estimation of cost

Practical

- 1 Introduction to workshop and demonstration of personnel safety precautions and identification of different material of manufacture
- 2 Demonstration of different tools of carpentry and fitting shop and study of specifications
- 3 Practice on carpentry joints
- 4 Practice on carpentry joints
- 5 Practice on metal joints in fitting shop

- 6 Demonstration of arc welding and practice on any three types of metal joints
- 7 Demonstration of gas welding, precaution and practice on any three types of metal joints
- 8 Practice on various casting processes, equipment, tools and their use
- 9 Demonstration of drilling and milling machine and operational setup for predefined measurement
- 10 Demonstration of planer, shaper and slotter, operational setup for predefined measurement
- 11 Practice on metal sheet work with any three shape formation
- 12 Introduction to smithy and forging tools and simple piece works on metal job
- 13 Demonstration of lathe machine with different operations performed by lathe
- 14 Demonstration of tapping and dieing
- 15 Introduction to CNC machine and operational demonstration
- 16 Practical Examination

References

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2. W. A. J. Chapman. 1989. Workshop Technology, Parts I and II. Arnold Publishers (India) Pvt. Ltd., New Delhi.
3. S. K. Hazra Choudari and S. K. Bose. 1982. Elements of Workshop Technology, Vols. I and II. Media Promoters and Publishers Pvt. Ltd., Mumbai.

FDDBE 164 Computer Programming and Data Structures 3 (1+2)

Course outlines

Theory

Introduction and historical background: Review of computer technology; Processor, memory, secondary storage, display devices and other peripheral devices; Basic computer organization, future trends; Brief review of present-day applications, programming; Introduction to systems software, applications software and programming language; Algorithms and flow-charts: Input-processing-output model of a computer program; Role of the compiler and the integrated development environment; Introduction to C: Structure of a C program, simple data types, declarations, operators and expressions; The assignment statement; Library functions; Control Structures: Conditional and iterative execution of statements; Importance of documentation; Nesting of control structures and the use of indentation to indicate nesting levels; Labels and the “go to” statement; Arrays; Single and multi-dimensional arrays: Character strings and string functions; Functions: Scope rules; Argument passing by reference and by value; Storage classes; Use of function prototypes; Structures, unions and user-defined types; Operations on files: Concept of standard input and output files; Formatting of data on input and output; Use of

include files; Introduction to high level languages; Primary data types and user defined data types, variables, typecasting, operators, building and evaluating expressions, standard library functions, managing input and output, decision making, branching, looping, arrays, user defined functions, passing arguments and returning values, recursion, scope and visibility of a variable, string functions, structures and union, pointers, stacks, push/pop operations, queues, insertion and deletion operations, linked lists.

Practical

Familiarizing with Turbo C IDE; Building an executable version of C program; Debugging a C program; Developing and executing simple programs; Creating programs using decision making statements such as if, go to and switch; Developing program using loop statements while, do and for; Using nested control structures; Familiarizing with one and two dimensional arrays; Using string functions; Developing structures and union; Creating user defined functions; Using local, global and external variables; Using pointers; Implementing stacks; Implementing push/pop functions; Creating queues; Developing linked lists in C language; Insertion/deletion in data structures.

Lecture

Theory

- 1 Introduction to a computer – history, generations, parts of computer (peripheral devices-processor, memory, secondary memories, display devices)
- 2 Basic computer organization – ALU, control unit, CPU, latest technologies and applications of computers
- 3 Introduction to software and its types – system software, application software, programming languages and its types – high level, low level programming languages
- 4 Flowchart and its symbols – input-processing-output model of a computer program, algorithm role of compiler & integrated development environment: TURBO 'C'/ Turbo C++
- 5 Introduction to C, steps in learning 'C' – character set, identifiers, keywords, data types: predefined and user-defined data types
- 6 Steps in learning 'C' – constants, variables and its types, escape sequences, typecasting: implicit typecasting and explicit typecasting
- 7 Steps in learning 'C' – header files (include files), operators, expressions: building and evaluating expressions
- 8 Steps in learning 'C' – standard library functions: managing input & output functions- (formatted input/ output functions and unformatted input/ output functions)
- 9 Branching – decision making/control statements- conditional control statements: if, if-else, multiple if else, nested if-else, switch unconditional control statements: break, go-to, lable, continue

- 10 Looping – loop/iterative statements: while, do – while, for.; scope and visibility of variables
- 11 Functions – user defining a function - defining and declaring function (i.e., use of function prototype)
- 12 Types of user defined functions, parameter/argument passing mechanisms-call-by-value, call-by-reference and recursion
- 13 Arrays, types of arrays – single, two, multi dimensional arrays
- 14 Character functions, string library functions, storage classes: auto, extern, static, register storage classes
- 15 Pointers, structures, unions, files and its input/output operations: opening, reading - writing (formatting data on input/output Files) and closing a files
- 16 Introduction to a data structures and types

Practical

- 1 Familiarizing with Turbo C/C++ IDE: introduction to a ‘C’ compiler & its purpose to execute ‘C’ programs
- 2 Building an executable version of a ‘C’ program – (basic structure of ‘C’ program)
- 3 To know the purpose of debugging a ‘C’ program – (step by step execution of ‘C’ program)
- 4 Developing and executing ‘C’ programs – (Ex: arithmetic operations on numbers)
- 5 Developing and executing ‘C’ programs – (to perform some mathematical & logical operations)
- 6 Developing and executing ‘C’ programs – (by using conditional operator)
- 7 Developing and executing ‘C’ programs – (by using decision making/ control statements: if, if-else)
- 8 Developing and executing ‘C’ programs – (by using decision making/ control statements: multiple if-else)
- 9 Developing and executing ‘C’ programs – (by using decision making/ control statements: nested if-else)
- 10 Developing and executing ‘C’ programs – (by using decision making/ control statements: switch)
- 11 Developing and executing ‘C’ programs – (by using decision making/ control statements: break, continue)
- 12 Developing and executing ‘C’ programs – (by using decision making/ control statements: continue)
- 13 Developing and executing ‘C’ programs – (by using decision making/ control statements: go-to)

- 14 Developing and executing 'C' programs – (by using loop statements/ iteration statements: while)
- 15 Developing and executing 'C' programs – (by using loop statements/ iteration statements: do-while)
- 16 Developing and executing 'C' programs – (by using loop statements/ iteration statements: for)
- 17 Developing and executing 'C' programs – (by using input/output library functions: unformatted input library functions)
- 18 Developing and executing 'C' programs – (by using input/output library functions: unformatted output library functions)
- 19 Developing and executing 'C' programs – (by using user defined functions: function without arguments and without return statement)
- 20 Developing and executing 'C' programs – (by using user defined functions: function without arguments and with return statement)
- 21 Developing and executing 'C' programs – (by using user defined functions: function with arguments and without return statement)
- 22 Developing and executing 'C' programs – (by using user defined functions: function with arguments and without statement)
- 23 Developing and executing 'C' programs – (by using parameter passing mechanisms: call-by-value, call-by-reference)
- 24 Developing and executing 'C' programs – (by using local, global, external variables)
- 25 Developing and executing 'C' programs – (by using recursion)
- 26 Developing and executing 'C' programs – (by using arrays: single double dimensional arrays)
- 27 Developing and executing 'C' programs – (by using arrays: two/multi dimensional arrays)
- 28 Developing and executing 'C' programs – (by using a string library functions)
- 29 Developing and executing 'C' programs – (by using pointers, structures, unions)
- 30 Developing and executing 'C' programs – (implementing a linked lists)
- 31 Developing and executing 'C' programs – (implementing a stack, queue)
- 32 Practical Examination

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3. Yashwant Kanetkar, 2016. Let Us C, 13th Edition. BPB Publications, New Delhi.
4. Mark Allen Weiss. 2013. Data Structures and Algorithm Analysis in C/C++. Pearson Education, New Delhi.
5. R. Paul Singh. 2014. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis. Academic Press, London.
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10. David Bailey and Edwin Wright. 2003. Practical SCADA for Industry. Elsevier, Burlington, MA.

FDDBE 165

Basic Electronics Engineering

3 (2+1)

Course outlines

Theory

Semiconductors, P-n junction, V-I characteristics of P-n junction, diode as a circuit element, rectifier, clipper, clamper, voltage multiplier, filter circuits; Diode circuits for OR and AND (both positive and negative logic) bipolar junction transistor: Transistor connections (CB, CE, CC), operating point, classification (A, B and C) of amplifier, transistor biasing, various biasing methods (fixed, self, potential divider); Coupling of amplifiers, h-parameter model of a transistor, analysis of small signal, CE amplifier, phase shift oscillator, feed back in amplifiers, oscillators- Hartley oscillator, analysis of differential amplifier using transistor, ideal OP-AMP characteristics, linear and non-linear applications of OP-AMP integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), Zener diode voltage regulator, regulated DC power supply, transistor series regulator, current limiting, OP-AMP voltage regulators; Basic theorem of Boolean algebra; Combinational logic circuits (basic gates, SOP rule and K-map, binary ladder D/A converter of displacement, temperature, velocity, force and generalized instrumentation, measurement of pressure using potentiometer, resistance thermometer, thermocouples.

Practical

Study of diode characteristics; Study of triode characteristics; Study of Zener diode; Study of V-I characteristics of P-n junction diode; Study of RC coupled amplifier; Study of RC phase shift oscillator; Study of full wave rectifier; Verification of logic gates; Determination of energy

gap in a junction diode; Study of transistor characteristics in CE configuration; Study of OP-Amp IC 741 as differential amplifier; Study of half wave rectifier; Study of OP-AMP IC 741 as a active rectifier; Study of transistor characteristics; Study of temperature characteristics of resistor; Study of diode as clipper and clamper.

Lecture

Theory

- 1 Semiconductors, P-n junction, V-I characteristics of P-n Junction, diode as a circuit element
- 2 Rectifier: efficiency and ripple factor of half wave rectifier (derivation)
- 3 Rectifier: efficiency and ripple factor of full wave rectifier (derivation)
- 4 Clipper circuits: positive clipping circuit, biased clipping circuit, combination clipping circuit
- 5 Clamper circuits: positive clamper and negative clamper circuits
- 6 Fitter circuits: series induction filter, ripple factor, regulation output voltage
- 7 Fitter circuits: shunt capacitor filter, ripple factor and regulation
- 8 Pi filter, voltage multiplier
- 9 Diode circuits for OR and AND gates with truth table
- 10 Bipolar junction transistor, operating point, transistor load line analysis
- 11 Transistor connections: (CB) common base connection, expression for collector current, and characteristics
- 12 Transistor connections: (CE) common emitter connection, relation between β and α and characteristics
- 13 Transistor connections: (CC) common collector connection, relation between β and α , collector current
- 14 Classification of amplifiers, class A, class B, class C amplifiers
- 15 Feedback in amplifiers, principle, positive feedback, advantages of negative feedback, reasons for negative feedback
- 16 Transistor biasing: stability factor, thermal run way, base resistor method
- 17 Various biasing methods, biasing with feedback resistor voltage divider bias
- 18 Coupling of amplifiers: gain, frequency response, decibel gain, band width - R-C coupled amplifier, operation, advantages, disadvantages
- 19 Transformer coupled amplifier, direct coupled amplifier operation, advantages disadvantages and applications
- 20 H-Parameter model of a transistor, analysis of small signal
- 21 CE Amplifier: current gain voltage gain and power gain

- 22 Phase shift oscillator: oscillators principle, frequency and condition of maintenance of oscillations, draw backs
- 23 Hartly oscillator, circuit arrangement working, frequency, condition for maintenance of oscillations
- 24 Analysis differential amplifier using transistor ideal OP-AMP – characteristics of an, operational amplifier stages
- 25 Linear and Non linear applications of OP-AMP as integrator, Active rectifiers, comparator
- 26 OP-AMP as differentiator, differential, instrumentation amplifier and oscillator
- 27 Zener diode voltage regulator, regulated DC power supply, voltage regulation, minimum load resistance
- 28 Transistor series voltage regulator, current limiting, OP-AMP as voltage regulator
- 29 Basic theorem of Boolean Algebra - combinational logic circuits (OR laws, AND laws, NOT laws, commutative law, associative law distributive laws absorptive laws)
- 30 Sum of products form (SOP), Karnaugh – map (K-map), binary ladder (D/A) converter
- 31 Instrumentation - measurement of displacement temperature, velocity force and generalized instrumentation
- 32 Measurement of pressure using potentiometer, thermocouples and resistance thermometer

Practical

- 1 To study the diode characteristics and triode characteristics
- 2 To study the zener diode characteristics
- 3 To study V-I characteristics of p-n junction diode
- 4 To study the RC coupled amplifier
- 5 To study the RC phase shift oscillator
- 6 To study full wave rectifier
- 7 Verification of logic gates
- 8 Determine the energy gap in a junction diode
- 9 To study transistor characteristics in CE configurations
- 10 To study a OP-AMP IC 741 as differential amplifier
- 11 To study half wave rectifier
- 12 To study a OP-AMP IC 741 as a active rectifier
- 13 Study of transistor characteristics
- 14 Study of temperature characteristics of resistor
- 15 Study of diode as clipper and clamper
- 16 Practical Examination

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5. Gupta Sanjeev, Sonthosh Gupta. 2012. Electronic Devices and Circuits. Danapath Rai Publications, New Delhi.
6. Rajendra Prasad. 2009. Electronic Measurements and Instrumentation. Khanna Publications, New Delhi.

FD BE 166

Fluid Mechanics

3 (2+1)

Course outlines

Theory

Units and dimensions; Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid; Pressure on vertical rectangular surfaces; Flow behavior of viscous fluids; Compressible and non-compressible fluids; Surface tension, capillarity; Pressure measuring devices: Simple, differential, micro-, inclined manometer, mechanical gauges, piezometer; Floating bodies: Archimedes principle, stability of floating bodies; Equilibrium of floating bodies, metacentric height; Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation; Bernoulli's theorem and its applications; Navier-Stokes equations in cylindrical co-ordinates, boundary conditions; Simple application of Navier-Stokes equation: Laminar flow between two straight parallel boundaries; Flow past through the immersed solids, packed and fluidized beds; Flow through pipes: Loss of head, determination of pipe diameter; Determination of discharge, friction factor, critical velocity; Flow through orifices, mouthpieces, notches and weirs; Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe; External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter; Water level point gauge, hook gauge; Dimensional analysis: Buckingham's theorem application to fluid flow phenomena, Froude Number, Reynolds number, Weber number and hydraulic similitude; Turbines and pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump; Centrifugal pumps: Pumps in series and parallel, basic equations applied to centrifugal pump, loss of head due to changed discharge, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps, Submersible pumps; Reciprocating pumps: Working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water, gear pump; Pressure variation, work efficiency; Pressure requirements for viscous fluids to lift them to different heights and selection of pumps; Open channel hydraulics: Classification of open channel and definitions, most economical sections of regular cross-sections; Specific energy concept-critical depth, energy diagrams; Velocity and pressure profiles in open channels; Hydraulic jumps-types.

Practical

Study of different tools and fittings; Study on flow rate versus pressure drop with U-tube manometer; Verification of Bernoulli's theorem; Determination of discharge co-efficient for ventury, orifice, V-notch; Verification of emptying time formula for a tank; Determination of critical Reynold's number by Reynold's apparatus; Study of reciprocating, centrifugal and gear pump; Calibration of rotameter; Study of different types of valves; Study of pumps for viscous fluid; Floating bodies, liquid flow, venture meter, orifice, weir, flow through pipes.

Lecture

Theory

- 1 Fluids; definitions; classification; units and dimensions
- 2 Properties of fluids; static pressure of liquids: hydraulic pressure, absolute, gauge pressure and pressure head of a liquid
- 3 Pressure on vertical rectangular surfaces
- 4 Flow behavior of viscous foods; compressible and non-compressible fluids; surface tension and capillarity
- 5 Pressure measuring devices: simple, differential, micro, inclined manometer and piezometer
- 6 Mechanical gauges; Bourdon's tube pressure gauge; diaphragm pressure gauge; dead weight pressure gauge
- 7 Floating bodies: Archimedes principle, stability of floating bodies; equilibrium of floating bodies
- 8 Buoyancy of flotation; metacentric height
- 9 Fluid flow: classification, steady, uniform, non-uniform, laminar, turbulent and continuity equation
- 10 Bernoulli's theorem and its applications in venture meter, pitot tube and orifice meter
- 11 Rota meter; water level point gauge and hook gauge
- 12 Navier-Stokes equations in cylindrical co-ordinates, boundary conditions; simple application of Navier-Stokes equation
- 13 Laminar flow between two straight parallel boundaries; flow past through the immersed solids, packed and fluidized beds
- 14 Flow through simple pipes; loss of head in pipes; determination of pipe diameter and discharge; friction factor
- 15 Flow through orifices (measurement of discharge); types of orifices; jet of water; vena contracta, hydraulic coefficients; experimental method for hydraulic coefficients; discharge through rectangular orifice
- 16 Flow through orifices (measurement of discharge); time of emptying a square; rectangular or circular tank through an orifice at its bottom; time of emptying a hemispherical tank through an orifice at its bottom

- 17 Time of emptying a circular horizontal tank through an orifice at its bottom; time of emptying a tank of variable cross-section through an orifice
- 18 Flow through mouthpieces; types of mouthpieces; loss of head of a liquid flowing in a pipe; discharge through a mouth piece
- 19 Flow over notches; types of notches; discharge over a rectangular notch; triangular notch; stepped notch, time of emptying a tank over rectangular notch; triangular notch
- 20 Flow through weirs; types of weirs; discharge over a rectangular weir
- 21 Dimensional analysis; Buckingham's theorem application to fluid flow phenomena
- 22 Types of similarities; dimensionless numbers: Froude Number, Reynolds number, Weber number and hydraulic similitude
- 23 Open channel hydraulics; classification of open channel and definitions
- 24 Manning's formula for discharge through an open channel
- 25 Channels of most economical cross sections; conditions for maximum discharge through a channel of rectangular section; trapezoidal section; circular section
- 26 Specific energy concept; specific energy of flowing fluid; specific energy diagram; critical depth; types of flows; critical velocity
- 27 Velocity and pressure profiles in open channels
- 28 Hydraulic jump; types of hydraulic jumps; depth of hydraulic jump; loss of head due to hydraulic jump
- 29 Turbines and pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump; centrifugal pumps: pumps in series and parallel, basic equations applied to centrifugal pump, submersible pumps and reciprocating pumps
- 30 Loss of head due to changed discharge, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps
- 31 Working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water and gear pump
- 32 Pressure variation, work efficiency; pressure requirements for viscous fluids to lift them to different heights and selection of pumps

Practical

- 1 Study of different tools and fittings
- 2 Study on flow rate versus pressure drop with U-tube manometer
- 3 Verification of Bernoulli's theorem
- 4 Determination of discharge co-efficient for venturimeter
- 5 Determination of discharge co-efficient for orifice
- 6 Determination of discharge co-efficient for V-notch

- 7 Determination of discharge co-efficient for rectangular weir
- 8 Determination of discharge co-efficient for trapezoidal weir
- 9 Determination of head losses in pipes
- 10 Determination of critical Reynolds's number by Reynolds apparatus
- 11 Study of reciprocating, centrifugal and gear pump
- 12 Calibration of rotameter
- 13 Study of different types of valves
- 14 Study of pumps for viscous fluid
- 15 Floating bodies and liquid flow
- 16 Practical Examination

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Department of Basic Sciences and Humanities

FBSH 171

Engineering Mathematics-I

2 (1+1)

Course outlines

Theory

Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordan method to find inverse of a matrix, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms; Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form; Curvature, asymptotes, tracing of curves, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, error evaluation, maxima and minima; Integral calculus: Reduction formulae, rectification of standard curves, volumes and surfaces of revolution of curves, double and triple integrals, change of order of integration, gamma and beta functions, application of double and triple integrals to find area and volume.

Practical

Problems on rank of matrix by reduction to normal form; Problems on Gauss-Jordan method to find inverse of a matrix; Problems on solution of linear equations: Problems on Cayley-Hamilton theorem; Problems on orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms; Problems on Taylor's and Maclaurin's expansions; Problems on curvature, asymptotes, tracing of curves; Problems on partial differentiation; Problems on homogeneous function and Euler's theorem; Problems on total derivatives and derivative of an implicit function; Problems on change of variables, Jacobians, error evaluation; Problems on maxima and minima; Problems on volumes and surfaces of revolution of curves, double and triple integrals; Problems on change of order of integration; Problems on application of double and triple integrals.

Lecture

Theory

- 1 Matrices: definition of matrix and types of matrices, elementary transformations
- 2 Rank of a matrix, finding rank of a matrix by reducing to echelon form
- 3 Finding rank of a matrix by reducing to normal form
- 4 Gauss-Jordan method to find inverse of a matrix
- 5 System of linear equations (homogeneous and non homogeneous system of equations) consistency and solution of linear equations
- 6 Cayley-Hamilton theorem
- 7 Differential calculus: Taylor's and Maclaurin's expansions

- 8 Curvature
- 9 Function of two or more independent variables and partial differentiation
- 10 Homogeneous functions and Euler's theorem
- 11 Derivative of an implicit function
- 12 Maxima and minima
- 13 Integral calculus: reduction formulae, rectification of standard curves
- 14 Volumes and surfaces of revolution of curves
- 15 Double and triple integrals, change of order of integration
- 16 Application of double and triple integrals to find area and volume

Practical

- 1 Problems on elementary transformations
- 2 Problems on finding rank of a matrix by reducing to normal form
- 3 Problems on Gauss-Jordan method to find inverse of a matrix
- 4 Problems on system of linear equations
- 5 Problems on Cayley-Hamilton theorem
- 6 Problems on Taylor's and Maclaurin's expansions
- 7 Problems on asymptotes and tracing of curves
- 8 Problems on homogeneous functions and Euler's theorem
- 9 Problems on derivative of an implicit function
- 10 Problems on maxima and minima
- 11 Problems on reduction formulae and rectification of standard curves
- 12 Problems on volumes and surfaces of revolution of curves
- 13 Problems on double and triple integrals
- 14 Problems on change of order of integration
- 15 Problems on application of double and triple integrals to find area and volume
- 16 Practical Examination

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Course outlines

Theory

Environment, ecology and ecosystem: Definition and inter-relationships amongst and between them, components of environment, relationship between different components; Man-environment relationship; Impact of technology on the environment; Environmental degradation; Ecology and ecosystems: Introduction; Ecology: Objectives and classification, concepts of an ecosystem structure and function of ecosystem; Components of ecosystem: Producers, consumers, decomposers; Biodiversity; Bio-geo-chemical cycles: Hydrological cycle, carbon cycle, oxygen cycle, nitrogen cycle, sulfur cycle; Energy flow in eco-system; Food chains: Grazing, detritus, food webs; Ecological pyramids; Major ecosystems: Forest ecosystem, Grassland ecosystem, desert ecosystem, aquatic ecosystem, estuarine ecosystem; Population and natural resources: Development of habitation patterns and environmental factors governing human settlement; Population and pollution, reasons for overpopulation, population growth, demographic projections and population structures, production of food; Renewable and non-renewable resources: Renewable resources, non-renewable resources, destruction versus conservation; Water resources: Water resources, Indian scenario; Water sources: Surface and ground water sources, uses and overuses of water resources, problems due to overexploitation of water resources; Forest resources: Indian scenario; Importance of forests - ecologically and economically, uses of forest products, forest types; Deforestations: Causes and effects, forest degradation in India; Energy resources: Indian scenario, conventional energy sources and its problems; Non-conventional energy sources: Advantages and its limitations, problems due to overexploitation of energy resources. Environmental pollution - Water pollution: Introduction, water quality standards, sources of water pollution, classification of water pollutants, effects of water pollutants, eutrophication; Air pollution: Composition of air, structure of atmosphere, ambient air quality standards, classification of air pollutants, sources of common air pollutants like SPM, SO₂, NO_x, natural and anthropogenic sources, effects of common air pollutants; Land and noise pollution: Introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution, effects of noise pollution; Radioactive pollution; Food processing industry waste and its management; Management of urban waste water; Recycling of organic waste; Recycling of factory effluent; Control of environmental pollution through law; Composting of biological waste; Sewage, uses of water disposal effluent treatment; Current environmental global issues: Global warming and green houses effects, acid rain, depletion of ozone layer. Disaster Management: Natural disasters and nature of disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, climatic change. Sea level rise. Man-made disasters-Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. Disaster management-effect to migrate natural disaster at national and global level. International strategy for disaster reduction. Concept of disaster management, national disaster management framework, financial arrangements; role of NGOs, community based organizations and media. Central, state, district and local administration; Armed forces in disaster response; police and other organizations.

Practical

Environment and its analysis; Water quality parameters; Estimation of total, volatile and fixed solids in polluted water; Estimation of total dissolved solids in polluted water; Collection of sample for pollution study; Determination of pH/acidity/alkalinity from sample; Estimation of dissolved oxygen; Estimation of BOD; Estimation of COD; Estimation of nitrates; Estimation of phosphates; Estimation of pollutant elements; Estimation of heavy/toxic elements; Estimation of lead /mercury; Visit to industrial sewage disposal unit.

Lecture

Theory

- 1 Environment: definition, scope, importance, components, relationship between different components; man- environment relationship; impact of technology on the environment and environmental degradation
- 2 Ecology and ecosystems: ecology: objectives and classification, concepts of an ecosystem structure and function of ecosystem; components of ecosystem and biodiversity; food chains, food webs and ecological pyramid
- 3 Bio-geo-chemical cycles and energy flow in eco-system
- 4 Major ecosystems: characteristic features, structure and functions of different ecosystems
- 5 Population and natural resources-habitation patterns and environmental factors governing human settlement- population and pollution- demographic projections and population structures and production of food
- 6 Renewable and non-renewable resources: types - destruction versus conservation
- 7 Water resources: Indian scenario, sources, uses and overuses- problems due to overexploitation of water resources- dams - its advantages and disadvantages
- 8 Forest resources: Indian scenario; importance of forests - ecologically and economically, uses of forest products, forest types; deforestations: causes and effects, forest degradation in India
- 9 Energy resources: Indian scenario, conventional energy sources and its problems, Non-conventional energy sources: advantages and its limitations, problems due to overexploitation of energy resources
- 10 Environmental pollution - water pollution: introduction, water quality standards, sources of water pollution, classification of water pollutants, effects of water pollutants, eutrophication
- 11 Air pollution: composition of air, structure of atmosphere, ambient air quality standards, classification of air pollutants, sources and effects of common air pollutants
- 12 Land and noise pollution: introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution, effects of noise pollution; radioactive pollution
- 13 Food processing industry waste and its management, management of waste water, organic waste, factory effluents, composting of biological waste, sewage - uses of water disposal effluent treatment

- 14 Control of environmental pollution through law - various acts, current environmental global issues: global warming and green house effects, acid rain and depletion of ozone layer
- 15 Disaster management: natural and nature of disasters, types and effects; geological, mountain area, wind and water related disasters and manmade disasters
- 16 Disaster management-effect to migrate natural disaster, national, global level and International strategy for disaster reduction; roles and responsibilities of different agencies and government

Practical

- 1 Environment and its analysis and collection of sample for pollution study
- 2 Water quality parameters: determination of pH
- 3 Estimation of total, volatile and fixed solids in polluted water
- 4 Estimation of total dissolved solids in polluted water/ effluent sample
- 5 Determination of electrical conductivity of given water (polluted) sample
- 6 Estimation of hardness of polluted water
- 7 Determination of acidity/ alkalinity of sample
- 8 Estimation of dissolved oxygen
- 9 Estimation of BOD
- 10 Estimation of COD
- 11 Estimation of nitrates
- 12 Estimation of phosphate
- 13 Estimation of pollutant toxic elements
- 14 Estimation of lead/ mercury
- 15 Visit to industrial sewage treatment and disposal unit
- 16 Practical Examination

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2. Husain Majid. 2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management (online book)
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4. Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.

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10. Climate change. 1995. Adaptation and mitigation of climate change-Scientific Technical Analysis Cambridge University Press, Cambridge.
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FBSH 173

English Language

2 (1+1)

Course outlines

Theory

Introduction: Importance of language and communication skills in the engineering profession; Spoken and conversational English: Main features, agreement, disagreement, likes, dislikes and enquiries; Debate and discussion. Basic sentence patterns in English: Agreement between subject and verb; Proper use of pronouns, adjectives and adverbs; Proper use of phrases and clauses; Some basic rules of composition; Concept of register; development of vocabulary; Reference skills: Dictionary, thesaurus, indexing, contents, glossary; Reading of selected texts and discussions; Vocabulary building tasks; Note-taking and note-making, linkage, development of paragraphs; Cohesion, coherence and style.

Practical

Grammar tenses; Voice-change; Direct/indirect narration; Prepositions and determiners; Word-formation with parts of speech; Types of sentences; Elementary knowledge of English sound with word-stress, intonation pattern; Composition, letter, application, summary and report writing.

Lecture

Theory

- 1 Introduction: importance of language and communication skills in the engineering profession
- 2 Spoken and conversational English main features, agreement, disagreement, likes dislikes and enquiries

- 3 Debate and discussion
- 4 Basic sentence patterns in English
- 5 Agreement between subject and verb
- 6 Proper use of pronouns
- 7 Adjectives and adverbs
- 8 Proper use of phrases and clauses
- 9 Some basic rule of composition
- 10 Concept of register
- 11 Development of vocabulary
- 12 References skills; dictionary, thesaurus, indexing, contents and glossary
- 13 Reading of selected texts and discussions
- 14 Vocabulary building tasks
- 15 Note – taking & Note – making, linkage, development of paragraphs
- 16 Cohesion, coherence and style

Practical

- 1 Grammar – tenses
- 2 Tenses practice
- 3 Voice change
- 4 Active voice and passive voice practice
- 5 Prepositions and determines
- 6 Prepositions practice
- 7 Direct and indirect narration
- 8 Direct and indirect speech practice
- 9 Word formation with parts of speech
- 10 Types of sentences
- 11 Elementary knowledge of English sound with word stress
- 12 Intonation pattern
- 13 Composition, application and different types of letters practice
- 14 Summary and report writing
- 15 Report writing practice
- 16 Practical Examination

References

1. Alice Oshima and Ann Hogue. 1998. Writing Academic English. Addison Wesley Longman, White Plains, NY, USA.
2. N. Krishnaswamy and T. Sriraman. 1995. Current English for Colleges. Macmillan India Ltd., Chennai.

Course outlines

Theory

Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del , Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations; Line, surface and volume integrals; Ordinary differential equations: Definition, order, degree of differential equation, Formation differential equation, Solving differential equation by Variables separable method, Solution of Homogeneous, Non- Homogeneous, linear, Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, Fourier series: periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, harmonic analysis; Partial differential equations: Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations.

Practical

Problems on differentiation of vectors, gradient, divergence and curl of a vector point function; Problems on line, surface and volume integrals ;Problems on equations reducible to exact form by integrating factors, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations; Problems on Fourier series, functions having arbitrary period, half range series; Problems on Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations.

Lecture

Theory

- 1 Vector calculus: differentiation of vectors, scalar and vector point functions
- 2 Vector differential operator del , gradient of a scalar point function
- 3 Divergence of a vector point function and their physical interpretations
- 4 Curl of a vector point function and their physical interpretations
- 5 Line integrals
- 6 Surface and volume integrals
- 7 Ordinary differential equations: definition, order, degree of differential equation
- 8 Formation differential equation
- 9 Solving differential equation by variables separable method
- 10 Solution of homogeneous differential equation

- 11 Non- homogeneous
- 12 Solution of linear differential equation, Bernoulli's differential equations
- 13 Solution of exact differential equation
- 14 Differential equations reducible to exact form by integrating factors
- 15 Equations of first order and higher degree, Clairaut's equation
- 16 Differential equations of higher orders
- 17 Methods of finding complimentary functions
- 18 Methods of finding particular integrals
- 19 Method of variation of parameters
- 20 Cauchy's and Legendre's linear equations
- 21 Simultaneous linear differential equations with constant coefficients
- 22 Fourier series: periodic functions, Fourier series, Euler's formulae Dirichlet's conditions
- 23 Fourier series of functions having period $2p$
- 24 Fourier series of functions having arbitrary period $2L$
- 25 Fourier series of even and odd functions
- 26 Fourier series of half range series
- 27 Harmonic analysis partial differential equations: formation of partial differential equations
- 28 Partial differential equations: formation of partial differential equations by eliminating arbitrary constants
- 29 Formation of partial differential equations by eliminating arbitrary functions
- 30 Solution of Lagrange's linear equation
- 31 Solutions of higher order linear partial differential equations with constant coefficients
- 32 Solution of non-linear partial differential equations

Practical

- 1 Problems on differentiation of vectors, gradient of a scalar point function
- 2 Problems on divergence and curl of a vector point function
- 3 Problems on line integral, surface and volume integrals
- 4 Problems on equations reducible to exact form by integrating factors
- 5 Problems on methods of finding complementary functions
- 6 Problems on methods of finding particular integrals
- 7 Problems on method of variation of parameters
- 8 Problems on Cauchy's and Legendre's linear equations
- 9 Problems on Fourier series functions having period $2p$
- 10 Problems on Fourier series functions having arbitrary period $2L$
- 11 Problems on half range series
- 12 Problems on formation of partial differential equations
- 13 Problems on Lagrange's linear equation
- 14 Problems on higher order linear partial differential equations with constant coefficients
- 15 Problems on solution of non-linear partial differential equations
- 16 Practical Examination

References

1. B. V. Ramana. 2008. Engineering Mathematics. Tata McGraw-Hill Book Co., New Delhi.
2. M. D. Raisinghania. 2005. Ordinary & Partial Differential Equation. S. Chand and Co. Ltd., New Delhi.
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4. Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

FBSH 271

Crop Production Technology

3 (2+1)

Course outlines

Theory

Classification of crops; Effect of different weather parameters on crop growth and development; Principles of tillage; Soil-water-plant relationship, crop rotation, cropping systems, relay cropping and mixed cropping; Crop production technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc.; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology for major pulse crops viz., pigeon pea, cowpea, gram, green gram, black gram, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology for major spices and cash crops viz., cumin, coriander, funnel, ginger, garlic, sugarcane, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Horticulture: Scope of horticultural crops. Soil and climatic requirements for fruits and vegetables, nursery raising and management; Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc.: Major varieties, time of transplanting, spacing, inter-culturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology for major vegetable crops viz., potato, onion, tomato, chilli and other greens and leafy vegetables: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Practical

Examination of soil profile in the field; Introduction to different equipment utilized in a weather observatory; Identification of seed of different agricultural crops and their varieties; Study of seed viability and germination test; Identification of different weeds and methods of their control; Use of different inter-culturing equipment; Study of water requirement of different

crops; Fertilizer application methods and equipment; Judging maturity time for harvesting of crop; Identification and description of important fruit and vegetable crops; Preparation of nursery; Study of different garden tools; Practices of pruning and training in some important fruit crops.

Lecture

Theory

- 1 Classification of crops
- 2 Effect of different weather parameters on crop growth and development
- 3 Principles of tillage
- 4 Soil-water-plant relationship, crop rotation, cropping systems, relay cropping and mixed cropping
- 5 Major cereal crops: Paddy- major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 6 Major cereal crops: Wheat
- 7 Major cereal crops: Maize
- 8 Major cereal crops: Pearl millet and Sorghum
- 9 Major oilseed crops: Groundnut- major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 10 Major oilseed crops: Sesame
- 11 Major oilseed crops: Rapeseed and mustard
- 12 Major oilseed crops: Castor and Niger
- 13 Major oilseed crops: Sunflower and safflower
- 14 Major pulse crops: Green gram and black gram -major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 15 Major pulse crops: Pigeon pea and cow pea
- 16 fiber crops: Agave- major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 17 Fiber crops: Jute
- 18 Major spices and cash crops: Sugarcane- major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 19 Major spices and cash crops: Cumin and coriander
- 20 Major spices and cash crops: Ginger
- 21 Major spices and cash crops: Garlic and Funnel
- 22 Horticulture: scope of horticultural crops, soil and climatic requirements for fruits and vegetables, nursery raising and management

- 23 Major fruit crops: Mango - major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 24 Major fruit crops: Jackfruit and banana
- 25 Major fruit crops: Sapota and aonla
- 26 Major fruit crops: Pomegranate and guava
- 27 Major fruit crops: Orange and lime
- 28 Major fruit crops: Papaya and custard apple
- 29 Major vegetable crops: Potato - major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production
- 30 Major vegetable crops: Eggplant and onion
- 31 Major vegetable crops: Tomato and chili
- 32 Major vegetable crops: other green and leafy vegetables

Practical

- 1 Examination of soil profile in the field
- 2 Introduction to different equipment used in a weather observatory
- 3 Identification of propagating material of different agricultural crops and their varieties
- 4 Identification of propagating material of different agricultural crops and their varieties
- 5 Study of seed viability and germination test
- 6 Identification of different weeds and methods of their control
- 7 Use of different inter-culturing equipment
- 8 Study of water requirement of different crops
- 9 Fertilizer application methods and equipment
- 10 Judging maturity time for harvesting of crop
- 11 Identification and description of important fruit and vegetable crops
- 12 Identification and description of important fruit and vegetable crops
- 13 Preparation of nursery
- 14 Study of different garden tools
- 15 Practice of pruning and training in some important fruit crops
- 16 Practical Examination

References

1. S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
2. T. Yellamanda Reddy and G. H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. S. S. Singh. Principles and Practices of Agronomy. 1985. Kalyani Publishers, Ludhiana.

Course outlines**Theory**

Statistical methods: Measures of central tendency, Measures of dispersion, Data types, Normal distribution and properties, testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table, correlation, regression, testing of significance of correlation and regression, multiple linear regression, ANOVA, one-way and two-way classifications; Experimental designs: Basic designs, completely randomized design (CRD) - Layout and analysis with equal and unequal number of observations, randomized block design (RBD) - Layout and analysis; Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method.

Practical

Problems on one sample, two sample Z-tests when population S.D. is known and unknown; Problems on one sample, two sample and paired t-test; Chi-square test – 2×2 and $m \times n$; Contingency table and F-test; Calculation of correlation coefficient and its testing; Fitting of simple linear regressions; Fitting of multiple regression equations; ANOVA: One way/two way. Problems on Newton's forward and backward interpolation formula for equal intervals; Problems on trapezoidal rule; Problems on Simpson's $1/3$ and $3/8$ rules; Problems on solution of ordinary differential equations of first order and second orders by Runge-Kutta method; Problems on Euler's method.

Lecture**Theory**

- 1 Statistical methods: measures of central tendency, measures of dispersion
- 2 Data types, normal distribution and properties
- 3 Testing of hypothesis, concepts, testing of significance based on Z-test
- 4 Testing of significance based on t-test and f-test
- 5 Chi-square test and contingency table
- 6 Correlation
- 7 Regression, multiple linear regression
- 8 ANOVA, one-way and two-way classifications
- 9 Experimental designs: completely randomized design (CRD) - layout and analysis with equal and unequal number of observations
- 10 Randomized block design (RBD) - layout and analysis
- 11 Numerical analysis: finite differences of various difference operators and their relationships and factorial notation

- 12 Interpolation with equal intervals, Newton's forward and backward interpolation formulae
- 13 Numerical integration: numerical integration by trapezoidal rule
- 14 Numerical integration by Simpson's and Weddle's rules
- 15 Numerical solution of ordinary differential equations by Picard's method and Taylor's series method
- 16 Euler's method, modified Euler's method and Runge-Kutta method

Practical

- 1 Problems on measures of central tendency, measures of dispersion
- 2 Problems on one sample, two sample Z-tests when population S.D. is known and unknown
- 3 Problems on one sample, two sample and paired t-test and f-test
- 4 Problems on Chi-square test
- 5 Problems on Chi-square test – 2×2 and $m \times n$ contingency table
- 6 Problems on calculation of correlation coefficient and its testing
- 7 Problems on fitting of simple linear regression equations
- 8 Problems on fitting of multiple regression equations
- 9 Problems on ANOVA one way classification, layout and analysis of completely randomized design (CRD)
- 10 Problems on ANOVA two way classification, layout and analysis of randomized block design (RBD)
- 11 Problems on Newton's forward and backward interpolation formula for equal intervals
- 12 Problems on trapezoidal rule, Simpson's and Weddle's rules
- 13 Problems on numerical solution of ordinary differential equations by Picard's method and Taylor's series method.
- 14 Problems on solution of ordinary differential equations by modified Euler's method
- 15 Problems on solution of first order and second orders differential equations by Runge-Kutta method
- 16 Practical Examination

References

1. S. R. S. Chandel. A Hand book of Agricultural Statistics. Achal Prakashan Mandir, Kanpur.
2. S. C. Gupta and V. K. Kapoor. 2014. Fundamental Applied Statistics. S. Chand & Sons, New Delhi.
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Department of Physical Education
Non-Credit Courses of Co-Curricular Activities

COCA 101

Physical Education and Yoga Practices

1(0+1)

Practical

Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance; Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification; Theories of learning; Exercises for good posture; Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance; Test and measurement in physical education: Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; Circuit training, interval training, far trek training, pressure training and resistance training; Importance of Asanas, free hand exercises and yoga; Recreation: Definition, agencies promoting recreation, camping and re-recreation; Governance of sports in India; Organization of tournaments; National and international events; Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events.

Lecture

Practical

- 1 Introduction of physical education – objectives - development and importance
- 2 Study of physical training and health
- 3 Acquainting with exercises of good posture
- 4 Study of exercises to develop physical fitness and growth
- 5 Flexibility – components – speed – strength – endurance
- 6 Power - agility – co-ordination and balance
- 7 Test and measurement in physical education – physical fitness and motor fitness test
- 8 Study on first aid and how to prevent sports and games injuries
- 9 Study of weight training – aerobic and non-aerobic exercises
- 10 Circuit training – interval training – far trek training
- 11 Skills of the leadership qualities in physical education
- 12 Importance of Asanas – free exercises and yoga
- 13 Recreation – promoting recreation – camping and re-recreation
- 14 Organization of tournaments – inter class – Inter collegiate- South zone - National and International events
- 15 Drawing of fixtures – rules and regulations – coaching
- 16 Fundamental skill development of major games – coaching and techniques in development of athletic events

- Note: 1) Compulsory Uniform: half pants, Tee shirts, shoes and socks of white color (Girls with white Tee shirt and track pants)
- 2) The games mentioned in the practical may be inter-changed depending on the season and facilities

COCA 102

NSS

1 (0+1)

Course outlines

NSS

Orientation of students towards national problems; Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy, socio-economic structure of Indian society, population and five year plans; Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition; Right to information act.

Aims and objectives of NSS :NSS logo, motto etc. Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, Village adoption.

Lecture

Practical

- 1 Orientation of students towards National problems; campus cleaning
- 2 To aware of fundamental rights; campus cleaning
- 3 Introduction and importance of NSS; campus cleaning
- 4 Study of activities for improving the social status of women; campus cleaning
- 5 To aware of socio – economic structure of Indian society; campus cleaning
- 6 To aware of population and five year plans; campus cleaning
- 7 Study of activities during the emergencies
- 8 To aware of non-formal education of rural youth ; campus cleaning
- 9 Study of educational culture; campus cleaning
- 10 To undergo first aid training; campus cleaning
- 11 Study of consumer awareness; campus cleaning
- 12 Study of activities directed by the central & state government; campus cleaning
- 13 To aware of environment enrichment; campus cleaning
- 14 Study of environment conservation and health; campus cleaning
- 15 Study of family welfare and nutrition; campus cleaning
- 16 To aware of Right to Information Act; campus cleaning