CATALOGUE OF

UNDERGRADUATE COURSE

B. Tech. (Food Technology)

2016

ANGRAU

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

Lam, Guntur - 522 034

Meeting on finalization of undergraduate
B. Tech. (Food Technology) course curricula as per
the recommendations of the ICAR V Deans' committee

DETAILED LECTURE OUTLINES

(as per V Deans' Committee Recommendations)
B. Tech. (Food Technology)
2016

Chief Editor

Dr. K. Yella Reddy

Dean of Agricultural Engineering & Technology

Dr. D. Bhaskara Rao

Former Dean of Agricultural Engineering & Technology

Editors

Dr. S. Vishnu Vardhan

Associate Professor & Technical Officer

Dr. M. Raghubabu

Professor (Retired)

Er. K. Rajesh

Assistant Professor

Er. A.D. Srikanth T

Assistant Professor

ANGRAU

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

Lam, Guntur – 522 034

May, 2022

No. of copies: 500

Laser Typeset and Printed at

Ritunestham Press
Guntur.
Ritunestham Press,
Pulladigunta, Guntur. Ph.: 0863-2286288
ritunesthampress@gmail.com

Dr. A. Vishnu Vardhan Reddy
Vice-Chancellor

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
Administrative Office : Lam, Guntur – 522 034
A.P. India
http://www.angrau.ac.in
Tel: 91-0863-2347011 (O)
Email: vicechancellor@angrau.ac.in

ANGRAU

FOREWORD

Food processing sector has enormous significance for India's development because of vital linkages and synergies, it promotes between two pillars of our economy i.e. industry and agriculture. Indian food processing industry accounts for 32% of country's total food market, one of the largest industries in India. It contributes around 8.80 and 8.39% of Gross Value Added (GVA) in manufacturing and agriculture sectors respectively.

Food Technology is the science that compact with all techniques and activities involved in preserving, processing and manufacturing the food stuff. Technical interventions are required to add value to processed foods such as meat, poultry, marine products, milk, and bakery items, as well as to sell them profitably to the satisfaction of consumers without compromising in quality as well.

Government of India has supported Agricultural Research and Education through successive five-year plans. ANGRAU works with ICAR in a partnership mode in line with recommendations of V Dean's Committee and has contributed significantly in developing first rate human resource in Food Technology education at under graduation level. The university is serving the state with about 110 outgoing food technology graduates every year, who are the main human resource in food industry sector.

The course syllabus is a tool that serves as a road map for the class and aligns the students with the teacher's goals. The syllabus is crucial in executing effective and quality learning that meets the demands of farmers and industry by setting the tone and detailing the course structure.I hope that this revised course curriculum will be very useful and beneficial to undergraduates in gaining entrepreneurship skills, developing confidence, skill, and acquiring indigenous technical knowledge of the area, and thus preparing pass out graduates for self-employment, as well as playing a key role in overall personality development.

The Faculty of Agricultural Engineering& Technology deserve all appreciation for their effort in development of this revised course curriculum for the under graduate course – B. Tech (Food Technology) for bringing sustainability and profitability in agricultural production systems.

A. Vishnu Vardhan Reddy
Vice-Chancellor

Dr. K. Yella Reddy
Dean of Agri. Engineering & Technology

Acharya N. G. Ranga Agricultural University
Administrative Office, Lam,
Guntur - 522 034. AP.
Email : deanaet@angrau.ac.in
Phone:0863-2347006
Cell: 7093403883

ANGRAU

PREFACE

Bachelor of Technology in Food Technology is a scientific branch that deals with the techniques involved in production, processing, preservation, packaging, labeling, quality management, and distribution of food products. Techniques and processes for converting raw materials into food are also included in this field. Making food that is both healthy and palatable requires much research. All dimensions of food technology demand professionals with sound scientific knowledge, which fully imparted by their undergraduate programme.

The present course curriculum is reviewed and designed as per V Dean's Committee Recommendations by updating and augmenting to achieve quality and need based Food Technology Education. The course structure of 'Fluid Mechanics' subject has been thoroughly discussed and modified according to the needs of students of Food Technology course to make them professionals and helps in competing in competitive exams like GATE, ICAR and ASRB. The course syllabus provides great insight in contextualizing academic aspects of challenges and provides opportunities for enhancing employability and entrepreneurship capabilities of graduates.I wish that from the contemplated temples of quality education in Food processing, qualified human resource is generated that will work on reducing produce losses, value addition, quality food processing, new product development, maintaining plant and processing.

The faculty of Agricultural Engineering &Technology express profound gratitude to the former Hon'ble Vice- Chancellors and Dr. A. Vishnuvardhan Reddy, Hon'ble Vice-Chancellor, Acharya N G Ranga Agricultural University for their constant support and encouragement.

Dr. K. Yella Reddy
Dean of Agri. Engineering & Technology

CONTRIBUTORS

Dr. D. Bhaskara Rao
Dean, Faculty of Agricultural Engineering and Technology, ANGRAU, LAM, Guntur

Dr. M. Raghu Babu
Professor (Academic) & Univ. Head (SWE), ANGRAU, LAM, Guntur

Dr. Sivala Kumar
Associate Dean & Univ. Head (APFE), College of Food Science and Technology, Bapatla

Dr. Ch. V. V. Satyanarayana
Professor & Univ. Head (Food Engineering), College of Food Science and Technology, Bapatla

Dr. B. V. S. Prasad
Professor & Univ. Head (Food Technology), College of Agricultural Engineering, Bapatla

Dr. I. Bhavani Devi
Professor & Special Officer
Institute of Agri-Business Management, SV Agril. College, Tirupathi

Dr. A. Pratap Reddy
Professor and Univ. Head (Physical Education), Agricultural College, Mahanandi

Dr. D. Daniel Smith
Associate Professor (Food Engineering), College of Food Science and Technology, Bapatla

Er. M. Sardar Baig
Assistant Professor (Food Technology), College of Food Science and Technology, Bapatla

Ms. M. Venkata Suneela
Assistant Professor (Mathematics), College of Agricultural Engineering, Bapatla

Ms. M. Kirthy Reddy
Assistant Professor (Food Technology), College of Food Science and Technology, Bapatla

Ms. R. Aruna
Assistant Professor (Food Chemistry and Nutrition), College of Food Science and Technology, Pulivendula

Er. A. D. Srikanth Tangirala
Assistant Professor (Food Engineering), College of Food Science and Technology, Pulivendula

Dr. T. V. Satyanarayana
Registrar,
ANGRAU, Lam, Guntur

Dr. A. Sivasankar
Controller of Examinations,
ANGRAU, Lam, Guntur

Dr. S. Kaleemullah
Professor (APFE) & Associate Dean,
College of Food Science and Technology, Pulivendula

Dr. P. Rambabu
Professor & Univ. Head (Agricultural Extension), Agricultural College, Bapatla

Dr. D. Vishnu Sankar Rao
Hon. Director (CCS) & Univ. Head (Agril. Economics), ANGRAU, Lam, Guntur

Dr. V. Srinivasa Rao
Professor & Univ. Head (Agril. Stat. & Mathematics), Agricultural College,
Bapatla

Dr. R. Lakshmipathy
Scientist (Microbiology),
Agril. Research Station, Amaravathi

Dr. H. V. Hema Kumar
Associate Professor & Head (Agril. Structures), College of Agricultural Engineering, Bapatla

Er. K. Rajesh
Assistant Professor (Food Engineering), College of Food Science and Technology, Bapatla

Dr. M. Srinivas Rao
Assistant Professor (Agricultural Extension), Agricultural College, Bapatla

Dr. Beera Vimala
Assistant Professor (Food & Industrial Microbiology), College of Food Science and Technology, Bapatla

Mrs. Y. Aruna Kumari
Assistant Professor (Food Technology), College of Food Science and Technology, Pulivendula

Mrs. P. Jayamma
Assistant Professor (Food and Industrial Microbiology), College of Food Science and Tech, Pulivendula

Dr. B. Sunita V. S.
Teaching Associate,
College of Food Science and Technology, Bapatla

Ms. R. Preethi Sagar
Teaching Associate,
College of Food Science and Technology, Bapatla

Mrs. B. Jayanthi
Teaching Associate,
College of Food Science and Technology, Bapatla

Mrs. D. V. Ratna Kumari
Teaching Associate,
College of Food Science and Technology, Bapatla

Mrs. K. Sowjanya
Teaching Associate,
College of Food Science and Technology, Pulivendula

Mr. K. Vinay Pramod Kumar
Teaching Associate,
College of Food Science and Technology, Pulivendula

Er. B. Krishna Kanth
Senior Research Fellow,
O/o Dean of A E & T, ANGRAU, Guntur

Mr. N. Sheshagiri Rao
Teaching Associate,
College of Agricultural Engineering, Bapatla

Ms. Mercy Florence
Teaching Associate,
Agricultural College, Bapatla

Mr. V. Anil Kumar
Teaching Associate,
College of Food Science and Technology, Bapatla

Mrs. K. Sarojini Devi
Teaching Associate,
College of Food Science and Technology, Bapatla

Mr. M. P. Raju
Teaching Associate,
College of Food Science and Technology, Pulivendula

Mr. Kumar Raja
Teaching Associate,
College of Food Science and Technology, Bapatla

&

All the Teachers of Faculty of Agricultural Engineering & Technology

INDEX

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	111 2+1 112 1+1	-	211 2+1 212 2+1	213 2+1 214 2+1 215 2+1	311 2+1 312 2+1	313 2+1 314 2+1 315 1+1	411 2+1	-	**24**	**13**	**37**
2	Food Process Engineering	-	121 2+1 122 2+1	221 2+1 222 2+1	223 2+1 224 2+1	321 2+1 322 2+1	323 2+1	421 2+1	-	**20**	**10**	**30**
3	Food Safety and Quality Assurance	131 2+1 132 2+1	133 2+1	231 2+1 232 2+1	233 2+1 234 2+1	331 1+2 332 2+0	333 1+1 334 1+1	-	-	**19**	**11**	**30**
4	Food Business Management	-	-	-	241 2+0	341 2+0 342 1+2	343 1+1 344 2+1	441 1+1	-	**9**	**5**	**14**
5	Food Plant Operations	-	-	-	-	351 0+1	352 0+3	451 0+7 452 0+7	453 0+2 454 0+20	**0**	**40**	**40**
6	Basic Engineering	161 0+2 162 2+1 163 1+1	164 1+2 165 2+1 166 2+1	-	-	-	-	-	-	**8**	**8**	**16**
7	Basic Sciences and Humanities	171 1+1 172 1+1	173 1+1 174 2+1	271 2+1 272 1+1	-	-	-	-	-	**8**	**6**	**14**
8	Physical Education (Non-Credit)	101 0+1	102 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	*Physical Education (Non Credit Course)*	*02 (00+02)*
	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

References

1. Stavros Yanniotis. 2008. Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.
2. Gaurav Tewari and Vijay K. Juneja. 2007. Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA.
3. M. Shafiur Rahman. 2007. Handbook of Food Preservation, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
5. Marcus Karel and Darvl B. Lund.2003. Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY, USA.
6. Peter Zeuthen and Leif Bùgh-Sùrensen. 2003. Food Preservation Techniques. CRC Press LLC, Boca Raton, FL, USA.
7. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
8. Norman N. Potter and Joseph H. Hotchkiss. 1995. Food Science, 5th Ed. Chapman & Hall, NY, USA.
9. Norman W. Desrosier and James N. Desrosier. 1977. The Technology of Food Preservation, 4th Ed. AVI Publishing Co., Connecticut, USA.
10. Girdhari Lal, G.S. Siddappa and G.L. Tandon. 1959. Preservation of Fruits and Vegetables. ICAR, New Delhi.

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 colustrum; 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 colustrum-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

References

1. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK.
2. Adnan Y. Tamime. 2009. Milk Processing and Quality Management. Blackwell Publishing Ltd., UK.
3. Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.
5. H.G. Kessler. 1981. Food Engineering and Dairy Technology. Verlag A. Kessler, Fraising Germany.
6. Y.H. Hui. 1993. Dairy Science and Technology Handbook, Vol. I, II and III. Wiley-VCH, USA.

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 tertiaryprocessing 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

References

1. Amalendu Chakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. Khalil Khan and Peter R. Shewry. 2009. Wheat: Chemistry and Technology, 4th Ed., AACC International, Inc., St. Paul, MN, USA.
3. Colin Wrigley. 2004. Encyclopedia of Grain Science. Academic Press, London, UK.
4. Elaine T. Champagne. 2004. Rice: Chemistry and Technology, 3rd Ed., AACC International, Inc., St. Paul, MN, USA.
5. Amalendu Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
6. Pamela J. White and Lawrence A. Johnson. 2003. Corn: Chemistry and Technology, 2nd Ed., AACC International, Inc., St. Paul, MN, USA.
7. David A. V. Dendy and Bogdan J. Dobraszczyk. 2001. Cereal and Cereal Products: Technology and Chemistry. Springer-Verlag, US.

8. N. L. Kent and A. D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.

9. Samuel A. Matz. 1991. The Chemistry and Technology of Cereals as Food and Feed, 2nd Ed. Springer Science + Business Media, NY, USA.

10. E. V. Araullo, D. B. De Padna and Graham. 1976. Rice Post-Harvest Technology. IDRC, Canada.

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, badies

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

References

1. Guriqbal Singh, Harbhajan Singh Sekhon, Jaspinder Singh Kolar and Masood Ali. 2005. Pulses. Agrotech Publishing Academy, Udaipur.
2. Chakraverty. 2008. Post-Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Frank D. Gunstone. 2008. Oils and Fats in the Food Industry. John Wiley and Sons Ltd., West Sussex, UK.
4. Fereidoon Shahidi. 2005. Bailey's Industrial Oil & Fat Products, 6th Ed., Vols. 1 to 6. John Wiley and Sons, Inc. Hoboken, New Jersey, USA.
5. Amalendu Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post-Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
6. K. M. Sahay and K. K. Singh. 2001. Unit Operations of Agricultural Processing, 2nd Ed. Vikas Publishing House Pvt. Ltd., Noida.

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

References

1. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK.
2. Adnan Y. Tamime. 2009. Milk Processing and Quality Management. Blackwell Publishing Ltd., UK.
3. Pieter Walstra, Jan T. M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.

5. H. G. Kessler. 1981. Food Engineering and Dairy Technology. Verlag A. Kessler, Fraising Germany.

6. Y. H. Hui. 1993. Dairy Science and Technology Handbook, Vol. I, II and III. Wiley-VCH, USA.

7. Aneja, R. P. Mathur, B. N. Chandan, R. C. Banerjee, A. K., 2002, Technology of Indian Milk Products: Handbook of Process Technology Modernization for Professionals Entrepreneurs and Scientists, Dairy India Yearbook

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

References

1. K. G. Shanmugavelu. 2005. Spices and Plantation Crops. Oxford & IBH Publishing Co., New Delhi.
2. J. W. Purseglave, E. G. Brown, C. L. Green and Robins. 1981. Spices,Vol. I and II. SRJ Academic Press, New Delhi.
3. J. S. Pruthi. 2001. Spices and Condiments – Major Spices of India. National Book Trust, New Delhi.

4. J. S. Pruthi. 2001. Spices and Condiments – Minor Spices of India. National Book Trust, New Delhi.

5. Kenji Hirasa and MitsuoTakemasa. 1998. Spice Science and Technology. Marcel Dekker, NY, USA.

6. H. Panda. 2010. Handbook on Spices and Condiments (Cultivation, Processing and Extraction). Asia Pacific Business Press Inc., New Delhi.

7. S. Gupta. 2007. Handbook of Spices and Packaging with Formulae. Engineers India Research Institute, New Delhi.

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

References

1. U. D. Chavan and J. V. Patil. 2013. Industrial Processing of Fruits and Vegetables. Astral International Pvt. Ltd., New Delhi.
2. S. Rajarathnam and R. S. Ramteke. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. New India Publishing Agency, New Delhi.
3. Y. H. Hui. 2006. Handbook of Fruits and Fruit Processing. Blackwell Publishing Ltd., Oxford, UK.
4. W. V. Cruess. 2004. Commercial Fruit and Vegetable Products. Agrobios India, Jodhpur.
5. Y. H. Hui, Sue Chazala, Dee M. Graham, K. D. Murrell and Wai-Kit Nip. 2004. Handbook of Vegetable Preservation and Processing. Marcel Dekker, Inc., NY, USA.
6. A. K. Thompson. 2003. Fruit and Vegetables: Harvest, Handling and Storage, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
7. Amalendu Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.

8. R. P. Srivastava and Sanjeev Kumar. 2002. Fruit & Vegetable Preservation: Principles and Practices, 3rd Ed. International Book Distribution Co., Delhi.

9. P. H. Pandey. 1997. Post Harvest Technology of Fruits and Vegetables. SarojPrakashan, Allahabad.

10. Mircea Enachescu Dauthy. 1995. Fruit and Vegetable Processing. FAO Agricultural Services Bulletin No.119. FAO of UN, Rome.

11. Girdhari Lal, G. S. Siddappa and G. L. Tandon. 1959. Preservation of Fruits and Vegetables. ICAR, New Delhi.

12. EIRI Board of Consultants and Engineers. 2008. Manufacture of Snacks, Namkeen, Papads and Potato Products. EIRI, New Delhi.

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 myofibrilar 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

References

1. Vikas Nanda. 2014. Meat, Egg and Poultry Science & Technology. I.K. International Publishing House Pvt. Ltd., New Delhi.
2. B. D. Sharma and Kinshuki Sharma. 2011. Outlines of Meat Science and Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
3. Fidel Toldrá, Y. H. Hui, IciarAstiasarán, Wai-Kit Nip, Joseph G. Sebranek, Expedito-Tadeu F. Silveira, Louise H. Stahnke, Régine Talon. 2007. Handbook of Fermented Meat and Poultry. Blackwell Publishing Professional, Ames, Iowa, USA.
4. Joseph Kerry, John Kerry and David Ledward. 2005. Meat Processing-Improving Quality.Woodhead Publishing Ltd., Cambridge, England.
5. NIIR Board of Consultants and Engineers. 2005. Preservation of Meat and Poultry. Asia Pacific Business Press, Inc., Delhi.

6. Howard J. Swatland. 2004. Meat Cuts and Muscle Foods, 2nd Ed. Nottingham Univ. Press, Nottingham.

7. B. D. Sharma. 2003. Modern Abattoir Practices and Animal Byproducts Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

8. B. D. Sharma. 1999. Meat and Meat Products Technology Including Poultry Products Technology. Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi.

9. Alan H. Varnam and Jane P. Sutherland. 1995. Meat and Meat Products: Technology, Chemistry and Microbiology. Chapman and Hall, London.

10. William J. Stadelman and Owen J. Cotterill. 1995. Egg Science and Technology, 4th Ed. Food Products Press, NY, USA.

11. R. A. Lawrie. 1985. Meat Science, 4th Ed. Pergamon Press, Oxford, UK.

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

References

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.

2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.

3. E. J. Pyler and L. A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.

4. E. J. Pyler and L. A. Gorton. 2008. Baking Science & Technology, Vol. I: Fundamentals & Ingredients, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.

5. H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.

6. John J. Kingslee. 2006. A Professional Text to Bakery and Confectionery. New Age International, New Delhi.
7. Harold Corke, Ingrid De Leyn, Nanna A. Cross, Wai-Kit Nip, Y. H. Hui. 2006. Bakery Products: Science and Technology. Blackwell Publishing Ltd., Oxford, UK.
8. Joseph Amendola and Nicole Rees. 2003. Understanding Baking: The Art and Science of Baking, 3rd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
9. Duncan Manley. 2000. Technology of Biscuits, Crackers and Cookies, 3rd Ed. Woodhead Publishing Limited, Cambridge, England.
10. N. L. Kent and A. D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
11. E. B. Jackson. 1995. Sugar Confectionery Manufacture, 2nd Ed. Springer-Verlag, US.
12. Samuel A. Matz. 1976. Snack Food Technology, 2nd Ed. AVI Publishing Co., Inc., Westport, Connecticut, USA.
13. US Wheat Associates. Baker's Handbook on Practical Baking.

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

References

1. Gordon L. Robertson. 2014. Food Packaging: Principles and Practice, 3rd Ed. CRC Press, Boca Raton, FL, USA.
2. Gordon L. Robertson. 2010. Food Packaging and Shelf Life – A Practical Guide. CRC Press, Boca Raton, FL, USA.
3. Jung H. Han. 2007. Packaging for Nonthermal Processing of Food. Blackwell Publishing Ltd., Oxford, UK.
4. Jung H. Han. 2005. Innovations in Food Packaging. 2nd Edition. Food Science & Technology International Series. Elsevier Academic Press, UK.
5. Richard Coles, Berek McDowell and Mark J. Kirwan. 2003. Food Packaging Technology. Blackwell Publishing Ltd., Oxford, UK.

FDPT 314 Processing of Fish and Marine Products 3 (2+1)

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 CO_2 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, CO_2 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

References

1. D. P. Sen. 2005. Advances in Fish Processing Technology. Allied Publishers Pvt. Ltd., Delhi.
2. Brigitte Maas-van Berkel, Brigiet van den Boogaard and Corlien Heijnen. 2004. Preservation of Fish and Meat. Agromisa Foundation, Wageningen.
3. FAO. 2003. Code of Practices of Canned Fishery products. FAO, UN, Rome.
4. Brend W. Rautenstrauss and Thomas Liehr. 2002. Fish Technology. Springer-Verlag, US.
5. G. M. Hall. 1997. Fish Processing Technology, 2nd Ed. Chapman & Hall, London, UK.
6. C. O. Chichester and H. D. Graham. 1973. Microbial safety of Fishery products. Academic Press, New York.
7. American Public Health Association. 1970. Recommended Procedures for the Bacteriological examination of Seawater and shell fish. APHA, USA.
8. George Borstorm. 1961. Fish as Food - Vol. I, II, III and IV. Academic Press, New York.
9. K. Gopakumar. 2002. View Larger Image Textbook of Fish Processing Technology. ICAR, New Delhi.
10. Charles L. Cutting. 2002. Processing and Preservation of Fish. Agro Bios, New Delhi.

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, due-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

References

1. Amerine, M. A., Pangborn, R. M. and Rossles, E. B. 1965. Principles of Sensory Evaluation of Food. Academic Press, London.

2. Early, R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.

3. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
4. Lawless, H. T. and Klein, B. P. 1991. Sensory Science Theory and Applicatons in Foods. Marcel Dekker.
5. Macrae, R., Rolonson Roles and Sadlu, M. J. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XI. Academic Press.
6. Maslowitz, H. 2000. Applied Sensory Analysis of Foods. Vols. I, II. CRC Press, Boca Raton, FL, USA.
7. Piggot, J. R. 1984. Sensory Evaluation of Foods. Elbview Applied Science Publ.
8. Potter, N. N. and Hotchkiss, J. H. 1997. Food Science. 5th Ed. CBS Publishers, Delhi.

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

References

1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
2. Y. H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
4. Amalendu Chakraverty, Arun S. Mujumdar, G. S. VijayaRaghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
5. V. K. Joshi and Ashok Pandey. 1999. Biotechnology: Food Fermentation – Microbiology, Biochemistry and Technology, Vol. II. Educational Publishers & Distributors, New Delhi.
6. Alan H. Varnam and Jane P. Sutherland. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman, London, UK.

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; Psychometry: 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 psychometric chart and hygrometer; Use of psychometric chart during drying process/ humidification process; Tutorials on psychometric chart; Demonstration of equilibrium sorption isotherms; Use of psychometric 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 Psychometry: 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 Vapourpressuretemperature 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 psychometric chart and hygrometer
5 Determination of state of air using psychometric chart and hygrometer
6 Use of psychometric chart during drying process/humidification process
7 Tutorials on psychometric 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 psychometric chart during drying process/humidification process
12 Use of psychometric 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

References

1. R. K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd., Bangalore.
2. P. K. Nag. 2005. Engineering Thermodynamics, 3rd Ed. Tata-McGraw-Hill Education, New Delhi.
3. J. M. Smith, H. C. Van Ness and M. M. Abbott. 2005. Introduction to Chemical Engineering Thermodynamics, 7th Ed. McGraw-Hill, Inc., NY, USA.
4. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
5. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
6. Donald B. Brooker, Fred W. Bakker-Arkema and Carl W. Hall. 1976. Drying Cereal Grains. The AVI Publishing Company, Inc., Connecticut, MA, USA.

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

References

1. Amalendu Chakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. Chakraverty. 2008. Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
4. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
5. K. M. Sahay and K. K. Singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.

6. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.

7. R. L. Earle. 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.

8. Carl W. Hall and Denny C. Davis. 1979. Processing Equipment for Agricultural Products. The AVI Publishing Company, Inc., Connecticut, MA, USA.

9. S. M. Henderson and R. L. Perry. 1966. Agricultural Process Engineering, 2nd Ed. The AVI Publishing Company, Inc., Connecticut, MA, USA.

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

References

1. Eduardo Cao. 2010. Heat Transfer in Process Engineering. The McGraw-Hill Companies, Inc., New York, USA.
2. J. P. Holman. 2010. Heat Transfer, 10th Ed. McGraw-Hill Book Co., Boston, USA.
3. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
4. John H. Lienhard IV and John H. Lienhard V. 2008. A Heat Transfer Textbook. Phlogiston Press, Cambrige, MA, USA.

5. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
6. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles, 4th Ed. Prentice-Hall, NY, USA.
7. J. M. Coulson, J. F. Richardson, J. R. Backhurst and J. H. Harker. 1999. Coulson & Richardson's Chemical Engineering, Vol. 1, Fluid Flow, Heat Transfer and Mass Transfer, 6th Ed. Butterworth–Heinemann, Oxford, UK.
8. M. NecatiÖzisik. 1993. Heat Conduction, 2nd Ed. John Wiley & Sons, NY, USA.
9. Robert E. Treybal. 1980. Mass Transfer Operations, 3rd Ed. McGraw-Hill Book Company, Auckland, USA.

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, 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 configurationsand 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.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
4. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed. Butterworth–Heinemann, Oxford, UK.

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

References

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.

2. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
3. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
4. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
5. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
6. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed. Butterworth–Heinemann, Oxford, UK.
7. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
8. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
9. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA.
10. Robert E. Treybal. 1980. Mass Transfer Operations, 3rd Ed. McGraw-Hill Book Company, Auckland, USA.

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, polytrophic 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.
3. W. F. Stoecker and J. W. Jones.1982. Refrigeration and Air Conditioning, 2nd Ed. McGraw-Hill Book Co., New York, USA.

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

References

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
4. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
5. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA
6. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA.
7. J. F. Richarson and D. G. Peacock. 1994. Coulson & Richardsons's Chemical Engineering, Vol. 3, Chemical & Biochemical Reactors & Process Control, 3rd Ed. Elsevier Butterworth-Heinemann, Amsterdam, The Netherlands.

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 bio-synthesis 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, Virgenia, 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.

FDPE 323 Instrumentation and Process Control in Food Industry 3 (2+1)

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.

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

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, ß-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 ß-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 pka 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 ß-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 Biochemisry, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. Biochemisry, 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, LubertStryer and Gregory J. Gatto, Jr. 2002. Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA.

FSQA 133 **Food Microbiology** **3 (2+1)**

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 aureusfrom food sample

16 Practical Examination

References

1. Carl Vanderzant and Don F. Splittsoessev. 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. Westfoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.

FSQA 231 Industrial Microbiology 3 (2+1)

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 - inoculums 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 - ß - 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 - Monascuspurpureus- 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 glutamicacid - 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 Ashbyagossypii - 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

1. Nduka Okafor. 2007. Modern Industrial Microbiology and Biotechnology. Science Publishers, Enfield, New Hampshire, USA.
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, emulations); 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- plastein 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 Chemisry, 4th Ed. Springer-Verlag Berlin Heidelberg.
3. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA.
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, proteasase, lipases; 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 xanthones

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, hemagglutenins 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 Chemisry, 4th Ed. Springer-Verlag Berlin Heidelberg.

2. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA

FSQA 234 **Food Biotechnology** **3 (2+1)**

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 recombined DNA, introduction of recombined 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 recombined DNA, introduction of recombined 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.
3. James D. Watson. 2013. Molecular Biology of the Gene, 7th Ed. Benjamin Cummings, San Francisco, USA.
4. Oliver Brandenberg, Zephaniah Dhlamini, Alessandra Sensi, KakoliGhosh 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, florescence, 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 physic 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, florescence 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 miscellar 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

FSQA 334 **Food Plant Sanitation** **2 (1+1)**

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. Willium 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 Gnatt chart-1

13 Study and drawing of Gnatt 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.

FDBM 344 Entrepreneurship Development 3 (2+1)

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.

Department of Food Plant Operations (Student READY Courses)

FDPO 351 Student READY – Seminar 1 (0+1)

Seminar

Student has to deliver "Student READY – Seminar" including preparation of synopsis, presentation and discussion by each student on current topics/interests in Food Processing Technology with weightage of (0+1) credit hours.

FDPO 352 Student READY – Research Project 3 (0+3)

Project work

Student Project is essential for students interested in higher education. Through this component, they will know how to identify research problem, experimental set up and writing report etc.

Student has to complete "Student READY –Project" with a credit load of (0+3) credit hours to undertake investigation of selected problems of special interests in Food Processing Technology to individual student. The work includes library work, field or laboratory research, recording data, analyzing data and writing of report, etc.

Student will select relevant or interested area of specialization such as Food Technology, Food Process Engineering etc., the student will prepare a research project plan and it will be presented in-front of committee appointed by the Associate Dean of the respective college. Also, for each student, one advisor will be provided, who will guide the student in completion of proposed research plan. A total of 3 credit hours will be allotted for preparation of the project and its presentation as a seminar. This exercise will prepare students interested in higher education. They will be exposed with identifications of problems in experimental setup and project preparation.

FDPO 451 Student READY – Experiential Learning Programme - I 7 (0+7)

&

FDPO 452 Student READY – Experiential Learning Programme - II 7 (0+7)

Experiential Learning

Experiential Learning helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This is step forward for earning while learning concept. Experiential Learning is major step forward for High Quality Professional Competence, Practical Work Experience in Real Life Situation to Graduates, Production Oriented Courses, Production to Consumption Project working, Facilitates producing Job Providers rather than Job Seekers and Entrepreneurial Orientation.

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 projet 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.

Attendance

The minimum attendance required for this programme is 85%. The attendance of a student will be maintained at the EL unit. The attendance particulars shall be communicated to the Chief Executive Officer (Associate Dean) by the Manager of the EL unit every week. The students will be eligible for the final evaluation of EL only when the attendance requirement is met with. Any student in the event of recording shortage of attendance has to re-register the EL when offered next by paying the assigned fee.

Students' Eligibility

To get the eligibility for registering the EL programme, the students should have completed all the courses successfully. No student should be allowed to take up the EL programme with backlog/repeat courses. The assignment/allotment of the EL programme shall be based on merit of the student at the end of 5th Semester. A separate certificate should be issued to the students after successful completion of EL course. Allotment of EL programmes amongst students to different modules should be done strictly on the basis of merit at the end of fifth semester. In this work experience, students will know exact problems of farming & suggest appropriate technology and finally useful in enhancing productivity and profitability at farmers end.

It was suggested that all Agricultural Engineering colleges should have Experiential Learning Units and in case these units are lying useless, outsourcing of these units, could be good option to generate money from them throughout the year.

FDPO 453 Student READY – Industrial Tour 2 (0+2)

Industrial Tour

Student has to undergo "Student READY - Educational/Industrial Tour" of two- three weeks to various industries within and outside the state of the university and submission of report on Industrial Tour carrying a weightage of (0+2) credit hours.

FDPO 454 Student READY – Internship/In – Plant Training 20 (0+20)

Internship/In plant Training (IPT)

In-plant training for a short period of time in relevant industry to gain the knowledge and experience of the work culture. In-plant training by reputed organization either MNC's or organized sectors provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements.

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

FDBE 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; References 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.

FDBE 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 exited, 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 exited, 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, protection 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, earthling, necessity of earthling 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 exited 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

1. Theraja & Theraja A. K. 2005. A text book of Electrical Technology - vol. II, S. Chand and Company Ltd., New Delhi.

2. Vincent Del Toro . 2000. Electrical Engineering Fundamentals, Prentice-Hall of India Pvt. Ltd., New Delhi.

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

FDBE 163 **Workshop Technology** **2 (1+1)**

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; Smithying 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 Smithying 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

1. B. S. Raghuwamsi. 1996. A Course in Workshop Technology, Vols. I and II. DhanpetRai& Sons, New Delhi.

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.

FDBE 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' complier & 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 liked lists)

31 Developing and executing ‘C’ programs – (implementing a stack, queue)

32 Practical Examination

References

1. Ashok N. Kamthane. 2011. Programming in ‘C’, 2nd Edition. Pearson Education.

2. Balagurusamy E. 1990. Programming in ‘C’. Tata McGraw Hill Publishing Co. Ltd., 12/ 4 Asaf Ali Road, New Delhi.

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.
6. William J. Palm III. 2011. Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA.
7. Da-Wen Sun. 2007.Computational Fluid Dynamics in Food Processing.CRC Press, Boca Raton, FL, USA.
8. Nigel Chapman and Jenny Chapman. 2006. Web Design: A Complete Introduction. John Wiley & Sons, USA.
9. National Instruments Corporation. 2005. Introduction to LabVIEW: 3-Hour Hands-On. NI, Austin, Texas.
10. David Bailey and Edwin Wright. 2003. Practical SCADA for Industry. Elsevier, Burlington, MA.

FDBE 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 ß and a and characteristics

13 Transistor connections: (CC) common collector connection, relation between ? and a, 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

References

1. Mehta V. K. 2008. Principles of Electronics. S. Chand and Co., New Delhi
2. A. K. Shancy. 2013. Measurement of Electronics and Electronic Instrumentation. Dhanpath Rai & Sons, Delhi.
3. Roy Chowdary, Integrated Electronics. John Wiley International.
4. Kumar Anand. Fundamentals of Digital Circuits A. PHI.
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.

FDBE 166 Fluid Mechanics for Food Processing 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 foods; Compressible and non-compressible fluids; Surface tension, capillarity; Pressure measuring devices: Simple, differential, micro-, inclined manometer, mechanical gauges, piezometer; Floating bodies: Archimedis 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 foods 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

Determination viscosity, determination of flow behavior index; Study on flow rate versus pressure drop with U-tube manometer; Verification of Bernoulli's theorem; Determination of discharge co-efficient for venturi, orifice, head losses in pipes; Determination of critical Reynold's number by Reynold's apparatus; Study of reciprocating, centrifugal and gear pump; Study of different types of valves; Study of pumps for viscous fluid;liquid flow, venture meter, orifice, 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, inclined immersed surfaces

4 Flow behavior of viscous foods; compressible and non-compressible fluids; surface tension and capillarity

5 Classification of fluids based on viscosity, Newton's law of viscosity, Newtonian & Non Newtonian fluids, Psuedoplastic, Dilatant, Plastic and Bhingam plastic fluids and their examples

6 Equations of flow of viscous liquids (Power equation, Hershel Bulkley and Casson Equations), Instrumentation for viscosity measurements (Red wood viscometer, capillary tube viscometer, rotational viscometer- concentric cylinder, cone and plate, parallel plat and single spindle type)

7 Determination of type of fluid 'n' (flow behavior index) using experimental viscosity data

8 Pressure measuring devices: simple, differential, micro, inclined manometer and piezometer

9 Mechanical gauges; Bourdon's tube pressure gauge; diaphragm pressure gauge; dead weight pressure gauge

10 Floating bodies: Archimedes principle, Buoyancy of flotation

11 Forces on a submerged body: Drag, Lift, expressions for drag & lift, Drag on a sphere and terminal velocity of a body

12 Fluid flow: Eulerian and Lagrangian description of fluids motion, concept of local and convective accelerations

13 Fluid flow classification, steady, uniform, non-uniform, laminar, turbulent and continuity equation, Reynold number

14 Types of flow lines- Path line, streak line, stream tube and streak line Concept of fluid rotation, vorticity, velocity potential, stream function and relation between velocity potential and stream function

15 Bernoulli's theorem and its applications in venture meter, pitot tube and orifice meter

16 Rota meter; water level point gauge and hook gauge

17 Viscous flow: Navier-Stokes equations simple application of Navier Stokes equation; flow of viscous fluids in a circular pipe, Flow of viscous fluid between parallel plates

18 Couette flow, loss of head due friction in viscous flow (Hazen Poisuelle's formula)

19 Fluidization, conditions for fluidization, minimum fluidization velocity, types of fluidization, expansion of fluidized beds, expansion of fluidization beds, applications, flow past through the immersed solids, packed and fluidized beds

20 Flow through simple pipes; loss of head in pipes; Darcy's formula, determination of pipe diameter and discharge; friction factor

21 Types of fittings used in pipes- bends, tees, flanges, elbows, reducers, crosses, nipples, unions, valves; Types of pipe valves - plug valve, ball valve, butterfly valve, gate valve, globe valve, needle valve, diaphragm valve, swing check valve, lift check valve, relief valve

22 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

23 Flow through orifices (measurement of discharge); time of emptying a square; rectangular or circular tank; hemi spherical; circular horizontal through an orifice at its bottom

24 Flow through mouthpieces; types of mouthpieces; loss of head of a liquid flowing in a pipe; discharge through a mouthpiece

25 Prandtl boundary layer equations- Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies

26 Open channel hydraulics; classification of open channel and definitions; Manning's formula for discharge through an open channel

27 Fans and Blowers: Fan laws, Types of fans: Propeller, axial flow and centrifugal blowers; Types- Forward curved, backward curved and straight curved centrifugal blowers, applications, Characteristic curves, selection of blowers

28 Concept of specific speed, NPSH, Design of centrifugal blower

29 Pumps: Classification- Positive and variable displacement pumps- working principles of reciprocating pumps (piston pumps, diaphragm pumps, plunger pumps), double acting pump, rotary pumps (lobe pumps, gear pump, screw pump, cam pump, peristaltic pumps)

30 Axial pumps, Centrifugal pumps, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps

31 Design of piping system, calculation of minimum diameter of pipes, Piping systems – Parallel, series piping,

32 Selection of pumps and power requirement

Practical

1 Determination of viscosity by red wood viscometer

2 Determination of viscosity by Capillary tube viscometer

3 Determination of viscosity by rotational viscometer

4 Determination of type of fluid 'n' (flow behavior index) using experimental viscosity data

5 Study on flow rate versus pressure drop with U-tube manometer

6 Verification of Bernoulli's theorem

7 Determination of discharge co-efficient for venturimeter
8 Determination of discharge co-efficient for orifice
9 Selection and design of centrifugal blower
10 Determination of pipe sizing for Newtonian fluids in laminar and turbulent flow
11 Determination of pipe sizing for non-Newtonian fluids in laminar and turbulent flow
12 Determination of head losses in pipes
13 Determination of critical Reynolds's number by Reynolds apparatus
14 Study of different types of valves
15 Study of pumps for viscous fluid
16 Practical Examination

References

1. Frank M. White. 2010. Fluid Mechanics, 7th Ed. McGraw-Hill Book Co., Inc., Boston, USA.
2. Yunus A. Çengel and John M. Cimbala. 2006. Fluid Mechanics: Fundamentals and Applications. McGraw-Hill, Inc., New York, USA.
3. Bruce R. Munson, Donald F. Young and Theodore H. Okiishi. 2002. Fundamentals of Fluid Mechanics, 4th Ed. John Wiley & Sons, Inc., New York, USA.
4. E. John Finnemore and Joseph B. Franzini. 2002. Fluid Mechanics with Engineering Applications, 10th Ed. McGraw-Hill, Inc., New York, USA.
5. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot.2002. Transport Phenomena, 2nd Ed. John Wiley & Sons, Inc., New York, USA.
6. Noel de Nevers. 1991. Fluid Mechanics for Chemical Engineers. McGraw-Hill, Inc., New York, USA.
7. Victor L. Streeter. 1962. Fluid Mechanics, 3rd Ed. McGraw-Hill Book Co., Inc., Boston, USA.
8. James F Steffe. 1996. Rheological methods in Food Process Engineering. Freeman Press, USA.
9. Albert Ibarz,and Gustavo V. Barbosa- Canovas. 2003. Unit operations in Food Engineering. CRC Press.
10. R.K Rajput. 1998. A Text book of Fluid Mechanics. S. Chand & Company Ltd., New Delhi
11. R.K Bansal. 1998. A Text book of Fluid Mechanics & Hydraulic Machines. Lakshmi Publications, New Delhi
12. P.N. Modi and S.M. Sethi. Hydraulics and Fluid Mechanics (incl. Hydraulic Machines) Standard Book House.
13. Warren L McCabe, Julian C Smith and Peter Harriot. 2002. Unit Operations in Chemical Engineering. McGraw Hill International Edition.

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-Jordon 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-Jordon method to find inverse of a matrix; Problems onsolution 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-Jordon 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-Jordon method to find inverse of a matrix

4 Problems on system of linear equations

5 Problems on Cayley-Hamilton theorem

6 Problems onTaylor'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

References

1. B. S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.

2. Shanti Narayan. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.

3. Shanti Narayan. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.

4. Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

FBSH 172 Environmental Science and Disaster Management 2 (1+1)

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, NOX, 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

References

1. Gilbert M. Masters and Wendell P. Ela. 2013. Introduction to Environmental Engineering and Science. Pearson Education Limited, NY, USA.

2. Husain Majid. 2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management (online book)

3. Suresh K. Dhameja. 2009. Environmental Engineering and Management. S. K. Kataria & Sons, New Delhi.

4. Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.

5. Sharma, R. K. and Sharma, G. 2005. Natural Disaster. APH Publishing Corporation, New Delhi.
6. Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies. BS Publishers, Hyderabad.
7. Gupta P. K. 2004. Methods in Environmental Analysis – Water. Soil and Air. Agro bios, Jodhpur.
8. Sharma J. P. 2003. Introduction to Environment Science. Lakshmi Publications, New Delhi.
9. Kaul S. N. and Ashuthosh Gautam. 2002. Water and Waste Water Analysis. Days Publishing House, Delhi.
10. Climate change. 1995. Adaptation and mitigation of climate change-Scientific Technical Analysis Cambridge University Press, Cambridge.
11. Bernard J. Nebel and Richard T. Wright. 1993. Environmental Science: The Way the World Works. Prentice-Hall Professional, New Delhi.

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 pharses 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.

FBSH 174 **Engineering Mathematics-II** **3 (2+1)**

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.
3. B. S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
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.

FBSH 272 Statistical methods and Numerical analysis 2 (1+1)

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×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×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.
3. G. Nageswara Rao. 2007. Statistics for Agricultural Sciences. BS Publications, Hyderabad.
4. Erwin Kreyszig, 2006. Advanced Engineering Mathematics, 9th Ed. John Wiley & Sons, New York, USA.
5. B. S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
6. P. P. Gupta and C. C. Malik. 1993. Calculus of Finite Differences and Numerical Analysis. Krishna Prakash Mandor, Meerut.

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.

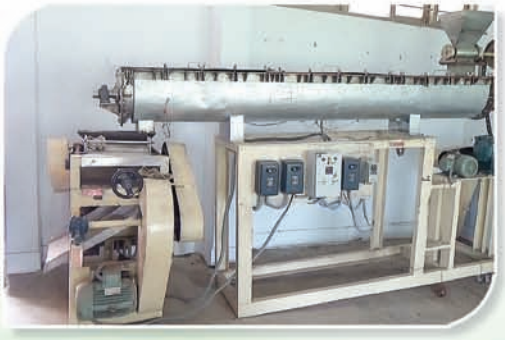
Lecture

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


INDOSAW


World Food Day
2014



Contact:

Dean of Agricultural Engineering and Technology

Acharya N. G. Ranga Agricultural University

Lam, Guntur - 522 034

Email ID : deanaet@hotmail.com

Website: www.angrau.ac.in