PONDICHERRY UNIVERSITY

Bachelor of Technology

Food Technology

REGULATIONS, CURRICULUM AND SYLLABUS

(2019- 2020)

PONDICHERRYUNIVERSITY
BACHELOR OF TECHNOLOGY PROGRAMMES

(EIGHT SEMESTERS)
REGULATIONS

1. CONDITIONS FOR ADMISSION:

(a) Candidates for admission to the first semester of the 8 semester B.Tech. Degree programme should be required to have passed:

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks(a mere pass for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semesters B.Tech programme:

The minimum qualification for admission is a pass in three year diploma or four year sandwich diploma course in engineering / technology with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in any B.Sc. course with mathematics as one of the subjects of study with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in main and ancillary subjects excluding language subjects. The list of diploma programs approved for admission for each of the degree programs is given in **Annexure A**.

2. AGE LIMIT:

The candidate should not have completed 21 years of age as on 1st July of the academic year under consideration. For Lateral Entry admission to second year of degree programme, candidates should not have completed 24 years as on 1st July of the academic year under consideration. In the case of SC/ST candidates, the age limit is relaxable by 3 years for both the cases.

3. DURATION OF PROGRAMME:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. ELIGIBILITY FOR THE AWARD OF DEGREE:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless

he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. BRANCHES OF STUDY:

Branch I   -   Civil Engineering
Branch II   -   Mechanical Engineering
Branch III   -   Electronics & Communication Engineering
Branch IV   -   Computer Science & Engineering
Branch V   -   Electrical& Electronics Engineering
Branch VI   -   Chemical Engineering
Branch VII   -   Electronics & Instrumentation Engineering
Branch VIII   -   Information Technology
Branch IX   -   Instrumentation & Control Engineering
Branch X   -   Biomedical Engineering
Branch XI   -   Food Technology

Or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. SUBJECTS OF STUDY:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. EXAMINATIONS:

The theory and practical examinations shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April / May).

(a) Theory courses for which there is a written paper of 75 marks in the university examination**.**

The Internal Assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows:

5 marks for 95% and above
4 marks for 90% and above but below 95%
3 marks for 85% and above but below 90%
2 marks for 80% and above but below 85%
1 mark for 75% and above but below 80%

A minimum of three tests are to be conducted for every theory subject and, of them two best are to be considered for computation of internal assessment marks.

(b) Practical courses for which there is a university practical examination of 50marks: Every practical subject carriesan internal assessment mark of 50 distributed as follows:

(i) Regular laboratory exercises and records – 20 marks (ii) Internal practical test-15 marks (iii) Internal viva-voce – 5 marks and (iv) Attendance – 10 marks.

The marks earmarked for attendance are to be awarded as follows: 10 marks for 95% and above

8 marks for 90% and above but below 95%

6 marks for 85% and above but below 90%

4 marks for 80% and above but below 85%

2 marks for 75% and above but below 80%

8. REQUIREMENT FOR APPEARING FOR UNIVERSITY EXAMINATION:

A candidate shall be permitted to appear for university examinations at the end of any semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonationfee as prescribed by theUniversity along with a medical certificate obtained from a medical officer not below the rank of Assistant Director)

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii)   His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. PROCEDURE FOR COMPLETING THE COURSE:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semesters for students admitted under lateral entry).

10. PASSING MINIMUM:

(i) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal Assessment plus University

examination marks) and not less than 40%of the marks in University examination.

(ii) A candidate who has been declared –Failed‖ in a particular subject may reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

The internal assessment marks obtained by the candidate shall be considered only in the first attempt for theory subjects alone. For the subsequent attempts, University examination marks will be made up to the total marks. Further the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11. AWARD OF LETTER GRADES:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Range of Total Marks	Letter Grade	Grade Points
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	F	0
Incomplete	FA	

Note: ‗F‗ denotes failure in the course. ‗FA‗ denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.

(b) The list of courses enrolled during the semester and the grades scored.

(c) The Grade Point Average (GPA) for the semester and The Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses

$$GPA = (Sum\ of(C \times GP)/Sum\ of\ C)$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA.

(e) The conversion of CGPA into percentage marks is as given below

$$\%\ Mark = (CGPA - 0.5) \times 10$$

12. AWARD OF CLASS AND RANK:

(i)   A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entrycandidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(i)   A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with DISTINCTION.

(i)   A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv)   All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

(v)   For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 8th semester in the first attempt. Rank certificates

would be issued to the first ten candidates in each branch of study.

13. PROVISION FOR WITHDRAWAL:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.

14. DISCONTINUATION OF COURSE:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 7 years, including of the period of discontinuance.

15. REVISION OF REGULATIONS AND CURRICULUM:

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when found necessary.

ANNEXURE – A

(Diploma programs for admission for B.Tech. Lateral Entry)

B.Tech courses in which admission is sought	Diploma courses eligible for admission
Civil Engineering	Civil Engineering Civil and Rural Engineering Architectural Assistantship Architecture Agricultural Engineering
Mechanical Engineering	Mechanical Engineering Automobile Engineering Agricultural Engineering Mechanical and Rural Engineering Refrigeration and Air-conditioning Agricultural Engineering & Farm Equipment Technology Metallurgy Production Engineering Machine Design & Drafting Machine tool maintenance and Repairs Printing Technology / Engineering Textile Engineering / Technology Tool Engineering
Electrical and Electronics Engineering Electronics & Communication Engineering Electronic and Instrumentation Engineering Instrumentation and Control Engineering Bio Medical Engineering	Electrical Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Instrumentation Engineering / Technology Electronics and Communication Engg. Electronics Engineering Medical Electronics Instrumentation and Control Engineering Applied Electronics
Chemical Engineering	Chemical Engineering Chemical Technology Petrochemical Technology Petroleum Engineering Ceramic Technology Plastic Engineering Paper & Pulp Technology Polymer Technology
Information Technology Computer Science & Engineering	Computer Science and Engineering Computer Technology Electrical and Electronics Engineering Electronics & Communication Engineering Electronics & Instrumentation Engineering Instrumentation Engineering / Technology
Food Technology	Biotechnology Food Technology B.Sc. Bio Science B.Sc. Bio Chemistry Chemical Technology Agriculture Engineering and Farming

Curriculum

for

B.Tech.
Food Technology

2019-2020

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO1: **Employability:** Our Graduates shall be suitably employed with professional competency and knowledge of modern tools.

- PEO2: **Higher Education:** Our Graduates shall be capable to pursue higher studies/research in the field of engineering and management.

- PEO3: **Entrepreneurship:** Our Graduates shall be prepared for a successful career by meeting ever increasing demands required by Food Technology profession and enable them to become an entrepreneur.

- PEO4: **Professional and Ethical values:** Our Graduates cultivate professional and ethical attitudes with effective communication skills, team work and multidisciplinary approach related to engineering issues.

PROGRAM OUTCOMES (POs)

Graduating students of Robotics and Automation Engineering from Pondicherry University will have the ability to:

- **PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- **PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

- **PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- **PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PONDICHERRY UNIVERSITY

B.Tech (Food Technology)

CURRICULUM

I SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T101	Mathematics – I	3	1	-	4	25	75	100
T102	Physics	4	-	-	4	25	75	100
T103	Chemistry	4	-	-	4	25	75	100
T110	Basic Civil and Mechanical Engineering	4	-	-	4	25	75	100
T111	Engineering Mechanics	3	1	-	4	25	75	100
T112	Communicative English	4	-	-	4	25	75	100
	Practical							
P104	Physics Laboratory	-	-	3	2	50	50	100
P105	Chemistry Laboratory	-	-	3	2	50	50	100
P106	Workshop Practice	-	-	3	2	50	50	100
	Total	22	2	9	30	300	600	900

II SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T107	Mathematics – II	3	1	-	4	25	75	100
T108	Material Science	4	-	-	4	25	75	100
T109	Environmental Science	4	-	-	4	25	75	100
T104	Basic Electrical and Electronics Engineering	3	1	-	4	25	75	100
T105	Engineering Thermodynamics	3	1	-	4	25	75	100
T106	Computer Programming	3	1	-	4	25	75	100
	Practical							
P101	Computer Programming Laboratory	-	-	3	2	50	50	100
P102	Engineering Graphics	2	-	3	2	50	50	100
P103	Basic Electrical and Electronics Laboratory	-	-	3	2	50	50	100
P107	NSS / NCC *	-	-	-	-	-	-	-
	Total	22	4	9	30	300	600	900

* To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation

III SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
FT T31	Fourier Series and Partial Differential Equations	3	1	-	4	25	75	100
FT T32	Introduction to Food Processing	4	-	-	4	25	75	100
FT T33	Food Process Calculations	3	1	-	4	25	75	100
FT T34	Food Microbiology	4	-	-	4	25	75	100
FT T35	Principles of Fluid Mechanics	4	-	-	4	25	75	100
FT T36	Food Chemistry	4	-	-	4	25	75	100
	Practical							
FT P31	Food Microbiology Laboratory	-	-	3	2	50	50	100
FT P32	Food Chemistry Laboratory	-	-	3	2	50	50	100
FT P33	Fluid Mechanics and Machinery Laboratory	-	-	3	2	50	50	100
	Total	**23**	**1**	**9**	**30**	**300**	**600**	**900**

IV SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
FT T41	Probability and Statistics	3	1	-	4	25	75	100
FT T42	Food Analysis	3	1	-	4	25	75	100
FT T43	Fundamentals of Heat and Mass Transfer	3	1	-	4	25	75	100
FT T44	Nutritional Biochemistry	4	-	-	4	25	75	100
FT T45	Thermodynamics	4	-	-	4	25	75	100
FT T46	Unit Operations for Food Processing	4	-	-	4	25	75	100
	Practical							
FT P41	Food Analysis Laboratory	-	-	3	2	50	50	100
FT P42	Unit Operations Laboratory	-	-	3	2	50	50	100
FT P43	Nutritional Biochemistry Laboratory	-	-	3	2	50	50	100
SP P44	Physical Education *	-	-	-	-	-	-	-
	Total	**21**	**3**	**9**	**30**	**300**	**600**	**900**

* To be completed in III and IV semesters, under Pass / Fail option only and not counted for CGPA calculation.

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
FT T51	Food Additives	4	-	-	4	25	75	100
FT T52	Enzyme and Fermentation Technology	4	-	-	4	25	75	100
FT T53	Refrigeration and Cold Chain Management	4	-	-	4	25	75	100
FT T54	Food Processing and Preservation	4	-	-	4	25	75	100
	Elective I	4	-	-	4	25	75	100
	Elective II	4	-	-	4	25	75	100
	Practical							
FT P51	Food Processing and Preservation Laboratory	-	-	3	2	50	50	100
FT P52	Enzymes and Fermentation Technology Laboratory	-	-	3	2	50	50	100
HS P53	General Proficiency – I	-	-	3	1	100	-	100
	Total	**24**	**-**	**9**	**29**	**350**	**550**	**900**

VI SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
FT T61	Food Process Engineering	4	-	-	4	25	75	100
FT T62	Baking and Confectionary Technology	4	-	-	4	25	75	100
FT T63	Fruits and Vegetable Processing	4	-	-	4	25	75	100
	Elective III	4	-	-	4	25	75	100
	Elective IV	4	-	-	4	25	75	100
	Practical							
FT P61	Fruits and Vegetable Processing Laboratory	-	-	3	2	50	50	100
FT P62	Baking and Confectionary Technology Laboratory	-	-	3	2	50	50	100
HS P63	General Proficiency – II	-	-	3	1	100	-	100
	Total	**20**	**-**	**9**	**25**	**325**	**475**	**800**

VII SEMESTER

Code No.	Name of the Subjects	L	T	P	Credits	IA	UE	TM
		Periods				Marks		
	Theory							
FT T71	Dairy Process Technology	4	-	-	4	25	75	100
FT T72	Food Safety, Quality and Regulation	4	-	-	4	25	75	100
FT T73	Food Packaging Technology	4	-	-	4	25	75	100
	Elective V	4	-	-	3	25	75	100
	Elective VI	4	-	-	3	25	75	100
	Practical							
FT P71	Testing of Packaging Materials Laboratory	-	-	3	2	50	50	100
FT P72	Dairy Process Technology Laboratory			3	2	50	50	100
FT P73	Industrial Visit/Training	-	-	2	1	100	-	100
FT PW7	Project Work-I	-	-	6	4	100	-	100
	Total	**20**	**-**	**14**	**27**	**425**	**475**	**900**

VIII SEMESTER

Code No.	Name of the Subjects	L	T	P	Credits	IA	UE	TM
		Periods				Marks		
	Theory							
FT T81	Professional Ethics	2	-	-	1	100	-	100
FT T82	Process Economics And Industrial Management	4	-	-	4	25	75	100
FT T83	Meat, Fish and Poultry Processing Technology	4	-	-	4	25	75	100
	Electives VII	4	-	-	4	25	75	100
	Elective VIII	4	-	-	4	25	75	100
	Practical							
FT PW8	Project Work-II	-	-	9	8	50	50	100
	Total	**18**	**-**	**9**	**25**	**250**	**350**	**600**

TOTAL CREDITS: 226

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, II , SEMESTER V

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
FT E 01	Biology and Chemistry of Food Flavors	4	-	-	4	25	75	100
FT E 02	Pulse and Oil Seed Technology	4	-	-	4	25	75	100
FT E 03	Traditional Foods	4	-	-	4	25	75	100
FT E 04	Functional Foods and Nutraceuticals	4	-	-	4	25	75	100
FT E 05	Spices and Plantation Technology	4	-	-	4	25	75	100
FT E 06	Food Process Equipment Design	4	-	-	4	25	75	100

PROFESSIONAL ELECTIVE III, IV, SEMESTER VI

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
FT E 07	Intellectual Property Rights	4	-	-	4	25	75	100
FT E 08	Cereal Technology	4	-	-	4	25	75	100
FT E 09	Instrumentation and Process Control	4	-	-	4	25	75	100
FT E 10	Biological Spectroscopy	4	-	-	4	25	75	100
FT E 11	Fundamentals of Nanoscience	4	-	-	4	25	75	100
FT E 12	Food Plant Layout	4	-	-	4	25	75	100

PROFESSIONAL ELECTIVE V, VI, SEMESTER VII

Code No.	Name of the Subjects'pk	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
FT E 13	Specialty Foods	4	-	-	4	25	75	100
FT E 14	Beverage Technology	4	-	-	4	25	75	100
FT E 15	Milling Technology	4	-	-	4	25	75	100
FT E 16	Creativity, Innovation and New Food Product Development	4	-	-	4	25	75	100
FT E 17	Downstream Processing	4	-	-	4	25	75	100
FT E 18	Foundation Skills in Integrated Product Development	4	-	-	4	25	75	100

PROFESSIONAL ELECTIVE VII, VIII, SEMESTER VIII

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
FT E 19	Management of Food Waste	4	-	-	4	25	75	100
FT E 20	Genetic Engineering and Genetically Modified Foods	4	-	-	4	25	75	100
FT E 21	Storage Engineering	4	-	-	4	25	75	100
FT E 22	Fat and Oil Technology	4	-	-	4	25	75	100
FT E 23	Emerging Technologies in Food Processing		-	-	4	25	75	100
FT E 24	Total Quality Management	4	-	-	4	25	75	100
FT E 25	Computer Applications in Food Industry	4	-	-	4	25	75	100

SEMESTER I
T101 MATHEMATICS - I   3   1   0   4

COURSE OBJECTIVES
- To introduce and familiarize with functions of several variables and the idea of applying calculus concepts to problems in Engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes.

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Apply knowledge of mathematics to solve functions of several variables.
- Identify, formulate, and solve engineering problems like multiple integrals and their usage.
- To solve differential equations that model physical processes using effective mathematical tools

UNIT I: CALCULUS
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.
(12)

UNIT II : FUNCTIONS OF SEVERAL VARIABLES
Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor_s series for functions of two variables, Maxima and minima, Lagrange_s method of undetermined multipliers.   (12)

UNIT III : MULTIPLE INTEGRALS AND APPLICATIONS
Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).   (12)

UNIT IV : DIFFERENTIAL EQUATIONS
Exact equations, First order linear equations, Bernoulli_s equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut_s type. (12)

UNIT V: DIFFERENTIAL EQUATIONS (HIGHER ORDER)
Linear differential equations of higher order – with constant coefficients, the operator D, Euler_s linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method simple applications to electric circuits.   (12)

TEXT BOOKS:
1. Venkataraman, M. K, Engineering Mathematics (First Year), Second Edition, The National Publishing Company, Chennai 2010 (For units I, III, IV, V)
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011. (For Unit II only)

REFERENCE BOOKS:
1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2, S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi, 8th Edition.
5. Bali, N. P, and Manish Goyal, Advanced Engineering Mathematics, Lakshmi Publications, New Delhi, 2007.

T102 PHYSICS   4   0   0   4

COURSE OBJECTIVES
- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformes modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines
- To understand the concepts and applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Apply knowledge of science and engineering to understand physics and its significant contributions in the advancement of technology and invention of new products that dramatically transform modern-day society.
- Identify different areas of physics which have direct relevance and applications to different Engineering disciplines.
- Apply fundamental knowledge to understand applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

UNIT I : ACOUSTICS & NDT
Ultrasonics- Ultrasonic Waves Productions (Piezoelectric & Magnetostriction method) – Detections (Acoustic Grating). NDT application – Ultrasonic Echo method – Liquid Penetrant method Acoustics - Factors affecting Acoustic of Buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies - Sabine_s formula for Reverberation Time–Doppler effect and its application to Radars (elementary idea)   (9)

UNIT II : OPTICS
Interference-Air Wedge – Michelson_s Interferometer – Wavelength Determination – Interference Filter – Antireflection Coatings.Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism. Polarization –Basic concepts of Double Refraction - Huygens Theory of Double Refraction – Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polari meter.   (9)

UNIT III: LASERS & FIBER OPTICS
Lasers - Principles of Laser – Spontaneous and Stimulated Emissions - Einstein_s Coefficients – Population Inversion and Laser Action – Types of optical resonators(qualitative Ideas) – Types of Lasers -NdYAG, CO_2 laser, GaAs Laser – Application of Lasers. Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode)- Application to sensors and Fiber Optic communication.   (9)

UNIT IV: WAVE MECHANICS
Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrödinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box – Quantum Mechanical Tunneling – Tunnel Diode.   (9)

UNIT V: NUCLEAR ENERGY SOURCE
General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – Nuclear Reactor: Materials Used in Nuclear Reactors. – PWR – BWR – FBTR. Nuclear fusion reactions for fusion reactor – D-D and D-T reactions, Basic principles of nuclear fusion reactors.   (9)

TEXT BOOKS:
1. V Rajendran, Engineering Physics, 2nd Ed., TMH, New Delhi 2011 (For Units I to IV only)
2. Arthur Beiser, Concept of Modern Physics, 6th Ed, TMH, New Delhi 2008 (For Unit V Only)

REFERENCE BOOKS:
1. Ajay Ghatak, Optics, TMH, New Delhi, 2007.
2. Thiagarajan and Ghatak, Lasers fundamental and Application, TMH, New Delhi 2008.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006
4. K.R.Nambiar, Lasers, New Age International, New Delhi, 2008
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997
6. Avadhanulu M N Engineering Physics, Vol-I, S. Chand & Co,2009.

COURSE OBJECTIVES
➢ To know about the importance of Chemistry in Engineering domain
➢ To understand the chemistry background of industrial process
➢ To apply chemistry knowledge for engineering disciplines

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Apply knowledge of science and engineering to understand the importance of Chemistry in Engineering domain
➢ Identify different Electrochemical cells and their usage for industrial process
➢ Apply fundamental knowledge of chemistry and build an interface of theoretical concepts with industrial applications / engineering applications.

UNIT I : WATER
Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – Lime-soda process, Zeolite process and Ion exchange process. Desalination – reverse osmosis & electrodialysis.   (9)

UNIT II : POLYMERS
Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties – chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, Rubbers – vulcanization, synthetic rubber, BuNa-S, BuNa-N, silicone and butyl rubber. Conducting polymers – classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastic, moulding techniques – compression, injection, transfer and extrusion moulding.   (9)

UNIT III: ELECTROCHEMICAL CELLS
Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen calomel, Ag /AgCl & glass electrodes. Batteries - primary and secondary cells, laclanche cell, lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells - H2-O2 fuel cell.   (9)

UNIT IV: CORROSION AND ITS CONTROL
Chemical & electrochemical corrosion-Galvanic series- galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion- corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective coatings-metallic coating-tinning and galvanizing, cladding, electroplating and Anodizing.
(9)
UNIT V: PHASE RULE
Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component alloy systems - Pb-Ag, Cu-Ni and Mg-Zn systems.   (9)

TEXT BOOKS:
1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi 2010.

REFERENCE BOOKS:
1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S. Chand & Co., Ltd.

New Delhi., 2008.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001
3. P. Kannan and A. Ravi Krishnan –Engineering Chemistry‖ Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd edition. PHI Learning PVT., LTD, New Delhi, 2008.

T 110 BASIC CIVIL AND MECHANICAL ENGINEERING   4 0 0 4

COURSE OBJECTIVES
- ➢ To be able to differentiate the types of buildings according to national building code and understand building components and their functions as well as different types of roads, bridges and dams.
- ➢ To explain the concepts of thermal systems used in power plants and narrate the methods of harnessing renewable energies
- ➢ To explain the role of basic manufacturing processes and develop an intuitive understanding of underlying working principles of mechanical machines and systems.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Get an idea about construction procedure and steps involved in component design of the building.
- ➢ Understand the manufacturing processes such as casting, forming, joining, and machining
- ➢ Apply the Functions of Prime movers, working of IC engines and refrigerator Understand.

PART - A CIVIL ENGINEERING
UNIT I : BUILDINGS, BUILDING MATERIALS
Buildings-Definition-Classification according to NBC- plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick, cement, cement-mortar, concrete, steel- their properties and uses.

(10)

UNIT II: BUILDINGS AND THEIR COMPONENTS
Buildings- Various Components and their functions. Soils and their classification Foundations-Functions and types of foundations, Masonry - Function and types, Floors-Definition and types of floors, Roofs : Definition and types. **(10)**

UNIT III : BASIC INFRASTRUCTURE
Basic Infrastructure: Surveying-classification, general principles, types, uses, instruments used. Roads – types : Components, types and their advantage and disadvantage. Bridges-components and types of bridges. Dams-Purpose, types of dams. Water supply-sources and quality requirements need and principles of Rainwater harvesting. (10)

PART - B MECHANICAL ENGINEERING
UNIT IV: INTERNAL AND EXTERNAL COMBUSTION SYSTEMS
IC engines – Classification – working principles – Diesel and petrol engines: two stroke and four stroke engines. Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers)– Boiler mountings and accessories. Merits and demerits- Applications. **(10)**

UNIT V: POWER GENERATION SYSTEMS
Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear power plants – Schemes and layouts (Description Only) – Solar – Wind - Geothermal – Wave – Tidal and Oceans thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only). **(10)**

UNIT VI : MANUFACTURING PROCESS
Machines – Lathe – Drilling – Bending – Grinding Shearing (Description only) Machining Processes – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filing – Sawing – Grinding. Moulding and Metal Joining - Pattern

making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only). **(10)**

TEXT BOOKS:
1. Natarajan, K V, Basic Civil Engineering, 11th Edition, Dhanalakshmi Publications Chennai, 2011. (For Units I to III)
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI).
3.

REFERENCE BOOKS:
1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai,2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New Delhi, 2012.
3. Punmia, B.C., et. al., Surveying , Vol-I, Laxmi Publishers, New Delhi, 2012.
4. Punmia, B.C., et.al Building Construction, Laxmi Publishers, New Delhi ,2012.
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co.,1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media Promoters Publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R .A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

COURSE OBJECTIVES
- To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
- To comprehend the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
- To emphasis the concepts through solved examples

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Apply knowledge of mathematics, science and engineering to analyze the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
- Design and conduct experiment, as well as to analyze the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and analyze dynamic equilibrium equation
- Design, construct and analyze Engineering Mechanics through solved examples

UNIT I : FUNDAMENTAL OF MECHANICS

Fundamental of Mechanics: Basic Concepts Force System and Equilibrium, Definition of Force, Moment and Couple, Principle of Transmissibility, Varignon_s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.   **(12)**

UNIT II : PRACTICAL APPLICATION OF FORCE SYSTEM

Structural member: definition, Degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of Trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.   **(12)**

UNIT III: PROPERTIES OF SURFACES

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.   **(12)**

UNIT IV: KINEMATICS AND KINETICS OF PARTICLES

Equations of motion - Rectilinear motion, curvelinear motion, Relative motion, D_Alembert_s principle, work- Energy equation – Conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact.   **(12)**

UNIT V : KINEMATICS AND KINETICS OF RIGID BODIES

Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum.   **(12)**

TEXT BOOKS:

1. Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2012.

REFERENCE BOOKS:

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill,2001.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw – Hill International Edition, 1997
3. Bhavikatti,S.S and K.G.Rajashekarappa, Engineering Mechanics, New Age International (P) Ltd, New Delhi,2010.

T 112 COMMUNICATIVE ENGLISH   4 0 0 4

COURSE OBJECTIVES
- To improve the LSRW skills of I year B.Tech students
- To instill confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Apply fundamental knowledge to improve the LSRW skills of I year B.Tech students
- To enable the students to communicate with ease
- Apply basic knowledge to equip the students with the necessary skills and develop their language prowess

UNIT I : BASIC COMMUNICATION THEORY
Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills.   **(12)**

UNIT II: COMPREHENSION AND ANALYSIS
Comprehension of technical and non-technical material- Skimming, scanning, inferring- Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing.   **(12)**

UNIT III: WRITING
Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc.   **(12)**

UNIT IV: BUSINESS WRITING / CORRESPONDENCE
Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications.   **(12)**

UNIT V: ORAL COMMUNICATION
Basics of phonetics – Presentation skills – Group Discussions – Dialogue writing – Short Extempore – Debates-Role Plays-Conversation Practice.   **(12)**

TEXT BOOKS:
1. Robert J.Dixson. ,Complete Course in English, Prentice-Hall of India Pvt. New Delhi,2006

REFERENCE BOOKS
1. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005.
2. Boove, Courtland R et al., Business Communication Today. Delhi. Pearson Education ,2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles And Practice,OUP, 2007.
4. Robert J.Dixson., Everyday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi,2007.
5. Sethi,J and Kamalesh Sadanand., A Practical Course in English Pronunciation, Prentice-Hall of India Pvt. Ltd, New Delhi,2007.

COURSE OBJECTIVES

➢ To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

➢ An ability to understand, explain and use instrumental techniques for intensity pattern analysis
➢ Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power
➢ Capable of handling screw gauge, vernier caliper and travelling microscope to calculate the required parameters
➢ Acquire basic knowledge about thermal conduction and magnetic field due to a current carrying coil

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Thermal conductivity – Lee_s DISC

2. Thermal conductivity - Radial flow

3. Spectrometer – Prism or Hollow prism

4. Spectrometer – Transmission grating

5. Spectrometer - Ordinary & Extraordinary rays

6. Newton_s rings

7. Air – wedge

8. Half shade polarimeter – Determination of specific rotatory power

9. Jolly_s experiment – determination of α

10. Magnetism: i – h curve

11. Field along the axis of coil carrying current

12. Vibration magnetometer – calculation of magnetic moment & pole strength

13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination

14. Determination of optical absorption coefficient of materials using laser

15. Determination of numerical aperture of an optical fiber

16. Electrical conductivity of semiconductor – two probe / four probe method

17. Hall effect in semiconductor

P105 CHEMISTRY LABORATORY   0   0   3   2

COURSE OBJECTIVES
- ➢ To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
- ➢ The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Determination of dissolved oxygen in water.

2. Determination of total hardness of water by EDTA method.

3. Determination of carbonate and bicarbonate in water.

4. Estimation of chloride content in water.

5. Estimation of magnesium by EDTA.

6. Estimation of Acetic acid in vinegar.

7. Estimation of ferrous by permanganometry.

8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.

9. Estimation of available chlorine in bleaching powder.

10. Estimation of copper in copper sulphate solution.

11. Estimation of calcium by permanganometry.

12. Estimation of iron by colorimetry

DEMONSTRATION EXPERIMENTS (ANY TWO OF THE FOLLOWING)

1. Determination of COD of water sample.

2. Determination of lead by conductometry.

3. Percentage composition of sugar solution by viscometry

P 106   WORKSHOP PRACTICE   0   0   3   2

COURSE OBJECTIVES
  - To convey the basics of mechanical tools used in engineering
  - To establish hands on experience on the working tools
  - To develop basic joints and fittings using the hand tools
  - To establish the importance of joints and fitting in engineering applications
  - To explain the role of basic workshop in engineering
  - To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.

COURSE OUTCOMES
On successful completion of the laboratory students will be able to:
  - To acquire skills in basic engineering practice.
  - To identify the hand tools and instruments.
  - To acquire measuring skills.
  - To acquire practical skills in the trades.
  - To provides the knowledge of job materials in various shops.

I FITTING
Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle
  1. Study of tools and Machineries
  2. Symmetric fitting
  3. Acute angle fitting

II WELDING
Study of arc and gas welding equipment and tools – Edge preparation – Exercises on lap joint and V Butt joints –Demonstration of gas welding
  1. Study of arc and gas welding equipment and tools
  2. Simple lap welding (Arc)
  3. Single V butt welding (Arc)

III SHEET METAL WORK
Study of tools and Machineries – exercises on simple products like Office tray and waste collection tray
  1. Study of tools and machineries
  2. Funnel
  3. Waste collection tray

IV CARPENTRY
Study of tools and Machineries – Exercises on Lap joints and Mortise joints
  1. Study of tools and machineries
  2. Half lap joint
  3. Corner mortise joint

T 107 MATHEMATICS – II

COURSE OBJECTIVES

- ➢ To develop the use of matrix algebra techniques for practical applications and to introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.
- ➢ To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations
- ➢ To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Apply knowledge of mathematics to solve matrix algebra techniques for practical applications and Curl, Divergence and integration of vectors in vector calculus for many application problems.
- ➢ Identify, formulate, and solve engineering problems like Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations
- ➢ Apply formulae and analyze problems of Fourier transform techniques

UNIT I: MATRICES
Eigenvalues and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.   **(12)**

UNIT II: VECTOR CALCULUS
Vector Calculus: Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke_s theorem (without proof). Simple application problems. **(12)**

UNIT III: LAPLACE TRANSFORM
Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems.   **(12)**

UNIT IV: APPLICATIONS OF LAPLACE TRANSFORM
Methods for determining inverse Laplace Transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.   **(12)**

UNIT V: FOURIER TRANSFORM
Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval_s identity. **(12)**

TEXT BOOKS:

1. Venkataraman M.K, Engineering Mathematics The National Publishing Company, Chennai, 2012.
2. Kandasamy P. et al, Engineering Mathematics, Vol.2 & 3, S. Chand & Co., New Delhi.

REFERENCE BOOKS:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi,41st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010

T108 MATERIAL SCIENCE   4 0 0 4

COURSE OBJECTIVES

To understand the importance of Material Science as a subject that revolutionized modern day technologies

➢ To understand the significance of material science in the development of new materials and devices for all branches of Engineering

➢ To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Apply core concepts in Materials Science to solve engineering problems.

➢ knowledgeable of contemporary issues relevant to Materials Science and Engineering.

➢ Select materials for design and construction.

➢ Understand the importance of life-long learning.

UNIT I: CRYSTAL STRUCTURE AND DEFECTS

Crystal structure - Bravais Lattices , Crystal Systems - Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method. Lattice defects – Qualitative ideas of point, line, surface and volume defects.

(12)

UNIT II: DIELECTRIC PROPERTIES

Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field - Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications.

(12)

UNIT III: MAGNETIC PROPERTIES

Origin of atomic magnetic moment – Bohr magneton-Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording.   (12)

UNIT IV: SEMICONDUCTORS AND SUPERCONDUCTORS

Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) -temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors --Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V) Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – High Temperature Superconductors – 123 superconductor – Applications of superconductors.   **(12)**

UNIT V: ADVANCED MATERIALS

Liquid Crystals – Types – Application as Display Devices Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications,Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA Nanomaterials - Nano materials (one, Two& three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes – synthesis, Properties and applications.   **(12)**

TEXT BOOKS:

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

REFERENCE BOOKS:

1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & sons, Singapore, 2007.
4. V Raghavan , Materials Science and Engineering- A First Course, 5th Edition, Prentice Hall of India, 2008.
5. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012
6. M.N. Avadhanulu, Enginerring Physics- Volume-II, S.Chand &Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005.

T109 ENVIRONMENTAL SCIENCE   4 0 0 4

COURSE OBJECTIVES
  ➢ To know about the environment
  ➢ To understand about environmental pollution
  ➢ To apply the knowledge in understanding various environmental issues
    and problems

COURSE OUTCOMES
  On successful completion of the module students will be able to:
  ➢ Apply fundamental knowledge to understand about the environment
  ➢ Identify environmental pollution through science
  ➢ Apply basic knowledge to solve various environmental issues and problems

UNIT I: ENVIRONMENT AND ENERGY RESOURCES
Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification.Pollutants classification. Forest resources – use and over exploitation, deforestation, forest management. Water resources – use and conflicts over water, dams - benefits and problems. Mineral resources – mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources – world food problems, environmental impact of modern Agriculture – fertilizer and pesticides. Energy resources – growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development.   **(12)**

UNIT II: ECOSYSTEM & BIODIVERSITY
Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers, and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, esturine and marine) ecosystems. Biodiversity – definition, genetic species and ecosystem diversity. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species.Conservation of biodiversity – in-situ and ex-situ conservation of biodiversity.   (12)

UNIT III: AIR POLLUTION
Definition and classification. Chemical and photochemical reaction in different layers of atmosphere. Causes, sources, effects and control measures of air pollutants - oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro-fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global Warming, Ozone Depletion, Acid Rain, Sulfurous Smog and Photochemical Smog.   **(12)**

UNIT IV: WATER AND LAND POLLUTION
Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants. Causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land Pollution – Solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution.   **(12)**

UNIT V: POLLUTION CONTROL AND MONITORING
Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas

Chromatography and Conductometry. Analysis of air pollutants – NOx, COx, SOx, H2S, Hydrocarbons and particulates. **(12)**

TEXT BOOKS:

1. Raghavan Nambiar K., ‒Text Book of Environmental Studies‖ 2nd edition, Scitech Publications, India, Pvt. Ltd, Chennai, 2008.
2. A.K. De, ‒Environmental chemistry‖ 6rd edition; New age international (P) Ltd, New Delhi, 2006

REFERENCE BOOKS:

1. B.K. Sharma, ‒Environmental chemistry‖ 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S.Dara, and D.D. Mishra ‒A text book of environmental chemistry and pollution control, 5th Ed, S.Chandand Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a Sustainable Future, 10thedition, Prentice Hall, 2008
4. G. S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000

T104 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   3 1 0 4

COURSE OBJECTIVES

- ➢ To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines
- ➢ To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flipflops.
- ➢ To understand the measuring devices in electronics.
- ➢ To gain knowledge on various communication systems and network models.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- ➢ Will gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines
- ➢ Will gain basic knowledge on instruments for measurements, communication systems and network models.

PART – A - ELECTRICAL
UNIT I: DC CIRCUIT
Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law,Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits.   **(10)**

UNIT II: AC CIRCUIT
Concepts of AC circuits – rms value, average value, form and peak factors -Simple RLC series circuits – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method.   **(10)**

UNIT III :ELECTRICAL MACHINES AND POWER PLANTS:
Law of Electromagnetic induction, Fleming_s Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor(Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).Fundamentals of fuses and circuit breakers.   **(10)**

PART – B – ELECTRONICS
UNIT IV: ELECTRONIC CIRCUIT
V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.
          (10)

UNIT V: DIGITAL ELECTRONICS
Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem – Logic gates - Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers.
          (10)

UNIT VI : COMMUNICATION AND COMPUTER SYSTEMS
Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system. Network model - PAN, LAN, MAN and WAN - Circuit and packet switching – Overview of ISDN.   **(10)**

TEXT BOOKS:

1. Kothari D P and Nagrath I J , Basic Electrical Engineering , Tata McGraw Hill,2009. (For Units I to III)
2. Rajendra Prasad , ――Fundamentals of Electronic Engineering‖, Cengage learning, New Delhi, First Edition, 2011 (For Unit IV)
3. Morris Mano, ――‖Digital design‖, PHI Learning, Fourth Edition, 2008 (For Unit V)
4. Wayne Tomasi, ――-Electronic Communication Systems - Fundamentals Theory Advanced‖, Sixth Edition, Pearson Education, 2004. (For Unit VI)

REFERENCE BOOKS:

1. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004..
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, New Delhi, 1993.
3. David. A. Bell, –Electronic Devices and Circuits‖, PHI Learning Private Ltd, India, Fourth Edition, 2008
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, –Digital Principles and Applications,‖ 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, –Electronic Devices and Circuits‖ Tata McGraw Hill,2008
7. R.L. Boylestad and L. Nashelsky, –Electronic Devices and Circuit Theory‖, PHI Learning Private Limited, Ninth Edition, 2008.
8. M.S.Sukhija and T.K.Nagsarkar, ―― Basic Electrical and Electronics Engineering‖, Oxford University Press, 2012.

T105 ENGINEERING THERMODYNAMICS   3 1 0 4

COURSE OBJECTIVES
- To understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior and establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Apply knowledge of mathematics, science and engineering to understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- Design and conduct experiment, as well as to analyze and develop methodologies for predicting the system behavior and understand the importance of laws of thermodynamics applied to energy systems
- Identify and analyze role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

UNIT I: BASIC CONCEPTS AND DEFINITIONS
Energy conversion and efficiencies - System, property and state - Thermal equilibrium - Temperature - Zeroth law of Thermodynamics – P, V, and T Diagrams, - Thermodynamic Diagram.   **(12)**

UNIT II: FIRST LAW OF THERMODYNAMICS
The concept of work and adiabatic process - First law of thermodynamics - Conservation of Energy principle for closed and open systems - Calculation of work for different processes of expansion of gases.   **(12)**

UNIT III: SECOND LAW OF THERMODYNAMICS
Equilibrium and the second law - Heat engines - Kelvin-Planck statement of second law of thermodynamics - Reversible and irreversible processes - Carnot principle - Clausius inequality- Entropy.   **(12)**

UNIT IV: GAS POWER CYCLES
Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and Bryton cycles and their efficiencies.   **(12)**

UNIT V: REFRIGERATION CYCLES AND SYSTEMS
Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system - Liquefaction and solidification (only theory)   **(12)**

TEXT BOOKS:
1. Nag, P. K., ―-Engineering Thermodynamics‖, 4th edition, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi,1995

REFERENCE BOOKS:
1. Arora, C.P., ―·Thermodynamics‖, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi,1998.
2. Burghardt, M.D., ―-Engineering Thermodynamics with Applications‖, 4th edition, Harper & Row, N.Y., 1986.
3. Huang, F.F., ―-Engineering Thermodynamics‖ 2nd edition , Macmillan Publishing Co. Ltd., N.Y.,1989.
4. Cengel, Y.A. and Boles, M.A., "Thermodynamics - An Engineering Approach", 5th edition, Mc-Graw Hill, 2006
5. Wark, K., ―·Thermodynamics‖, 4th edition ,Mc Graw Hill, N.Y.,1985

T 106 COMPUTER PROGRAMMING   3 1 0 4

COURSE OBJECTIVES
 - ➢ To introduce the basics of computers and information technology and educate problem solving techniques.
 - ➢ To impart programming skills in C language.
 - ➢ To practice structured programming to solve real life problems.

COURSE OUTCOMES
   On successful completion of the module students will be able to:
 - ➢ Know concepts in problem solving
 - ➢ To do programming in C language
 - ➢ To write diversified solutions using C language
 - ➢ To know about structures, pointers and its manipulation.

UNIT I

History of Computers – Block diagram of a Computer – Components of a Computer system – Classification of computers - Hardware – Software – categories of Software – Operating System – Applications of Computers –Network Structure - Internet and its services – Intranet – Study of word processor – Preparation of worksheets.   **(12)**

UNIT II

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart - Pseudo code. Introduction to C – History of C – Importance of C - C tokens – data types – Operators and expressions – I/O functions.   **(12)**

UNIT III

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions .Storage classes – Strings – String library functions.   **(12)**

UNIT IV

Structures – Arrays and Structures – nested structures – passing structures to functions – user defined data types– Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and structures.   **(12)**

UNIT V

Files – operations on a file – Random access to files – command line arguments .Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.   **(12)**

TEXT BOOKS:

1. Balagurusamy. E, ―Programming in ANSI C‖, Tata McGraw Hill, 12th Edition, 2012

REFERENCE BOOKS:

1. Vikas Verma, ―-AWorkbook on C‖ –,Cengage Learning, Second Edition,2012
2. Ashok N Kamthane, ―-Computer Programming‖, Pearson education, Second Impression, 2008.

P 101 COMPUTER PROGRAMMING LABORATORY   0   0   3   2

COURSE OBJECTIVES
- ➢ To introduce the basics of computers and information technology and educate problem solving techniques.
- ➢ To impart programming skills in C language and gain a hands on experience of compilation and execution of _c' programs.
- ➢ To practice structured programming to solve real life problems.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
- ➢ Know concepts in problem solving
- ➢ To do programming in C language
- ➢ To write diversified solutions using C language

LIST OF EXERCISES

1. Study of OS Commands
2. Write a C program to find the Area of the triangle.
3. Write a C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a C program to read a three digit number and produce output like

    1 hundreds

    7 tens

    2 units for an input of 172.
5. Write a C program to check whether a given character is vowel or not using Switch – Case statement.
6. Write a C program to print the numbers from 1 to 10 along with their squares.
7. Write a C program to find the sum of _ _n_ numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of Local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.

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P 102 ENGINEERING GRAPHICS   **2   0   3   2**

</div>

COURSE OBJECTIVES
- ➢ To convey the basics of engineering drawing
- ➢ To explain the importance of an engineering drawing
- ➢ To teach different methods of making the drawing
- ➢ To establish the importance of projects and developments made in drawing that
- ➢ are used in real systems
- ➢ To explain the role of computer aided design _Auto Cad
- ➢ To develop an intuitive understanding of underlying significance of using these Drawings

COURSE OUTCOMES

On successful completion of this course, the student will be able to familiarize with the fundamentals and standards of Engineering graphics
- ➢ Perform freehand sketching of basic geometrical constructions and multiple   views of objects.
- ➢ Project orthographic projections of lines and plane surfaces.
- ➢ Draw projections and solids and development of surfaces.
- ➢ Visualize and to project isometric and perspective sections of simple solids.

UNIT I

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning.

UNIT II

Conic sections, Involutes, Spirals, Helix, Projection of Points, Lines and Planes Projection of Solids and Sections of Solids.

UNIT III

Development of surfaces - Intersection of surfaces (cylinder-cylinder, cylinder-cone)

UNIT IV

Isometric projections and Orthographic projections

UNIT V

Computer Aided Drafting: Introduction to Computer Aided Drafting hardware - Overview of application software - 2D drafting commands (Auto CAD) for simple shapes - Dimensioning

TEXT BOOKS:

1. Gopalakrishna K.R. and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.

REFERENCE BOOKS:
1. Bhatt N.D., Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. Venugopal K., Engineering Drawing and Grahics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004 .
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989
5. Natarajan K.V., A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & College, 1992.

P 103 BASIC ELECTRICAL AND ELECTRONICS LABORATORY   0 0 3 2

COURSE OBJECTIVES
- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications.
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- To gain a practical knowledge on the functions and application of basic logic gates and flip flops

COURSE OUTCOMES
On successful completion of the laboratory students will be able to:
- Know about basic electrical tools, applications and precautions
- Perform different types of wiring used in domestic and industrial applications
- Measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- Understand the functions and application of basic logic gates and flip flops

ELECTRICAL LAB
LIST OF EXPERIMENTS
1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring.
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters.

ELECTRONICS LAB
LIST OF EXPERIMENTS
1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)
2. Verification of Kirchoff's Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff's laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan's theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX- NOR gates and Flipflops - JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.

P 107 NSS / NCC

NCC/NSS training is compulsory for all Undergraduate students

1. The activities will include Practical/field activities/Extension lectures.
2. The activities shall be carried out outside class hours.
3. For the above activities, the student participation shall be for a minimum period of 45 hours.
4. The activities will be monitored by the respective faculty in charge and the First Year Coordinator.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years
6. Pass in this course is mandatory for the award of degree.

**FT T31   FOURIER SERIES AND PARTIAL DIFFERENTIAL   3   1   0   4
EQUATIONS**

COURSE OBJECTIVES
  ➢ To introduce the basic concepts for solving standard partial differential   equations.
  ➢ To provide the concept of Fourier series and expanding functions into Fourier series including Harmonic analysis.
  ➢ To make the students knowledgeable in the areas of Boundary Value Problems like vibrating string (wave equation), Heat equation in one and two dimensions.

COURSE OUTCOMES
On successful completion of this course, Students will be able to:
  ➢ How to solve the given standard partial differential equations.
  ➢ The physical significance of Fourier series techniques in solving one, two dimensional heat flow problems and one dimensional wave equations.

UNIT I :FOURIER SERIES
Dirichlet's conditions – General Fourier series – Periodic - Odd and Even functions – Half Range Sine Series – Half Range Cosine Series.   **(12)**

UNIT II :
Root Mean Square Value – Parseval's theorem on Fourier Coefficients - Complex form of Fourier series – Harmonic Analysis.   **(12)**

UNIT III :PARTIAL DIFFERENTIAL EQUATIONS
Formation of PDE by elimination of arbitrary constant and arbitrary function – General , Singular , particular and complete integrals - Lagrange's linear first order equation - Higher order PDE with constant coefficients of both homogeneous and non-homogeneous types.   **(12)**

UNIT IV : APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS
Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solution – Transverse vibration of an elastic string.   **(12)**

UNIT V :
Fourier series solution for one dimensional heat flow equation – Fourier series solutions for two dimensional heat flow equations under steady state condition – (Cartesian and Polar forms) (excluding proof).   **(12)**

TEXT BOOKS:
 1. Grewal B.S., –Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
 2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics forEngineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:
1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" Prentice Hall India Learning Pvt Ltd, 2003.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., –Advanced Engineering Mathematics –Tata McGraw   Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

FT T32   INTRODUCTION TO FOOD PROCESSING   4   0   0   4

COURSE OBJECTIVES
> ➢ This course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects in large scale.
> ➢ This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.
> ➢ To study the methods of handling and storage of various food raw materials.
> ➢ To be aimed at the low wastages by controlling insects, pesticides, etc. and to know the food hygiene to evade the food related hazards.

COURSE OUTCOMES
On successful completion of this course, Students will be able to:
> ➢ Be aware of the different methods applied to processing foods.
> ➢ Be able to understand the traditional and modern methods of large scale food processing.
> ➢ Know the importance of food hygiene and waste disposal.
> ➢ Understand the significance of food processing and the role of food and beverage industries in the supply of foods.

UNIT I: PROCESSING OF FOOD AND ITS IMPORTANCE
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.   (12)

UNIT II:METHODS OF FOOD HANDLING AND STORAGE
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.   (12)

UNIT III:LARGE-SCALE FOOD PROCESSING
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.   (12)

UNIT IV:FOOD WASTES IN VARIOUS PROCESSES
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.   (12)

UNIT V:FOOD HYGIENE
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals,Cleaning of equipment and premises.   (12)

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund ‒Physical Principles of Food Preservation‖. Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M ‒Food Preservation and Safety Principles and Practice‖.Surbhi Publications, 2001.
3. Sivasankar, B. ‒Food Processing & Preservation‖, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, ‒Food Processing and Preservation‖, Daya Publications, 2005.

REFERENCES:

1. Desrosier NW & James N. (2007). Technology of food preservation. AVI. Publishers
2. Fellows, P.J. (2005). Food processing technology: Principle and Practice. 2nd Ed. CRC Publishers
3. Jelen, P. (2005). Introduction to Food Processing. Prentice Hall

COURSE OBJECTIVES
 ➢ To know the basic units and fundamental calculation related with various compositions of mixture and solutions.
 ➢ To gain the knowledge on basic principles of stoichiometry for material balance and various processing for the industrial applications.
 ➢ To calculate the heat capacity and enthalpy for a system.

COURSE OUTCOMES
On successful completion of this course, Students will be able to:
 ➢ Understand the basic and fundamental calculation in food processing
 ➢ Use the stoichiometric principles for the material balance in a process industry.
 ➢ Find the energy balance and enthalpy changes for a system.

UNIT I: FOOD SCIENCE

Introduction & definition of Food Science; Palatability of food and measurement of acceptance by:I)testing ii)appearance iii)smell iv)test; General structure and composition of cereals like wheat & rice, nutritive value & various products like whole wheat flour, maida, puffed rice etc; Food additives; classification, composition and nutritive value of fruits & vegetables; Milk & milk products; Classification & properties of sugar; fats, oil & nuts; Spice & beverages & their roles.

(12)

UNIT II: Fundamental Calculations and Humidity

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.   (12)

UNIT III: STOICHIOMETRY

Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use –Data sources, Humidity and applications. Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.   (12)

UNIT IV: ENERGY BALANCE

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.   (12)

UNIT V: ENTHALPY CHANGES

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of s t a n d a r d heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction. (Use of Psychometric chart is permitted in the examination).   (12)

 TEXT BOOKS:
  1. Bhatt, B.L and Vora, S.M., "Stoichiometry", Third Edition, McGraw-Hill, New York, 2004.
  2. Gavhane, K.A "Introduction to Process Calculations" (Stoichiometery)
     NiraliPrakashan   Publications, Pune, 2009.

REFERENCES:
  1. Venkataramani, V. and Anantharaman, N., "Process Calculations" , Prentice Hall of India, New Delhi, 2011.
  2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", Eighth Edition, Prentice Hall India, New Delhi, 2015.

COURSE OBJECTIVES
- ➢ This course aims to develop the knowledge of students in the basic area of Food Microbiology.
- ➢ This is necessary for effective understanding of food processing and technology subjects as well as food safety.
- ➢ This course will enable students to appreciate the role of microbes in food spoilage, food borne infections.
- ➢ To identify the methods and techniques for the preservation of foods form the pathogens.

COURSE OUTCOMES

On successful completion of the module students will be able to:
- ➢ Be able to understand and identify the various microbes associated with foods and food groups.
- ➢ Be able to understand and identify the role of these microbes in food spoilage, food preservation.
- ➢ Understand the role of pathogens in food borne infections
- ➢ Understand the methods used to detect pathogens in foods.

UNIT I: INTRODUCTION
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.   (12)

UNIT II:CONTROL OF MICROBES IN FOODS
Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.   (12)

UNIT III:MICROBES IN FOOD FERMENTATIONS
Microbes of importance in food fermentations, – homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations – pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations -yeast fermentations - characteristics and strain selection, fungal fermentations. microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.   (12)

UNIT IV:MICROBIAL AGENTS OF FOOD BORNE ILLNESS
Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.   (12)

UNIT V: MICROBIAL EXAMINATION OF FOODS

Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulimum& Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.   (12)

TEXT BOOKS:
1. Banwart, G.J. ‒Basic Food Microbiology‖ 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. ― Food Microbiology‖. MJP Publishers, Chennai, 2007.
3. Jay, J.M. ‒Modern Food Microbiology‖. 4th Edition. CBS Publishers, 2003.
4. Adams, M.R. and M.O. Moss.‖ Food Microbiology‖. New Age International, 2002
5. Khetarpaul, Neelam. ‒Food Microbiology‖ Daya Publishing House, 2006.

REFERENCES:
1. Montville, Thomas J. and Karl R. Matthews ― Food Microbiology: An Introduction‖. ASM Press, 2005
2. Ray, Bibek and ArunBhunia. ‒Fundamental Food Microbiology‖ 4th Edition, CRC Press, 2008
3. Pawsey, R. K. ―Case Studies in Food Microbiology for Food Safety and Quality‖. The Royal Society of Chemistry, 2001.
4. Forsythe, S.J. ‒The Microbiology of Safe Food‖. Blackwell Science, 2000.
5. Doyle, Michael P. ‒Food Microbiology: Fundamentals and Frontiers‖. 2nd Edition, ASM Press, 2001.

COURSE OBJECTIVES
➢ To introduce the students to the mechanics of fluids through a thorough understanding of the   properties of the fluids, behavior of fluids under static conditions.
➢ To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
➢ The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
➢ To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
➢ Gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

UNIT I: PROPERTIES OF FLUIDS
Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mecha nical gages – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height.   (12)

UNIT II: FLUID FLOW ANALYSIS
Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational – circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube – path line– steak line – flow net – velocity potential – stream function. Principles of conservation of mass– energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.
                                                                                                                    (12)

UNIT III:FLOW MEASUREMENTS
Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter rota meter – elbow meter pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of values.   (12)

UNIT IV: OPEN CHANNEL FLOW
Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force - critical flow – computation. Flow measurement in channels – notches – rectangular, Cippollette and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.   (12)

UNIT V:DIMENSIONAL ANALYSIS & PUMPS

Dimensional analysis – concept of geometric, kinematic and dynamic similarity.Important nondimensional numbers – Reynolds, Froude, Euler, Mach and Weber. Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – Types-components – working – types of pumps and impellers – Priming-friction losses.   (12)

TEXT BOOKS:

1. Modi, P.N. and Seth S.M. ―Hydraulics and fluid mechanics‖. Standard Publishers Distributors, New Delhi,2010

2. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th ed) Tata McGraw Hill, New Delhi, 1998

REFERENCES:

1. Bansal, R.K., ―A text book of fluid mechanics and hydraulic machinery‖, Laxmi publications Pvt. Ltd., New Delhi, 2002
2. Grade, RJ.,.–Fluid mechanics through problems‖. Wiley eastern Ltd., Madras,2002
3. Jain A. K. –Fluid Mechanics‖. Khanna Publishers 1995.
4. JagadishLal,.―Hydraulic machines‖. Metropolitan book house, New Delhi, 2000
5. Michael, A.M..–Irrigation Theory and practice‖, Vikas publishing house, New Delhi, 2008

COURSE OBJECTIVES
- ➢ The course aims to develop the knowledge of students in the basic area of Food Chemistry.
- ➢ This is necessary for effective understanding of food processing and technology subjects.
- ➢ This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- ➢ Be able to understand and identify the non-nutritive components in food, naturally present.
- ➢ Understand and use effectively, food composition tables and databases.
- ➢ Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition

UNIT I: WATER AND ICE
Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam. (12)

UNIT II: CARBOHYDRATES
Monosaccharides,Oligosaccharides,Polysaccharides,Starch,Cellulose,Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber. (12)

UNIT III: LIPIDS
Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids. (12)

UNIT IV : AMINO ACIDS, PEPTIDES AND PROTEINS
Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein. (12)

UNIT V : FOOD COLORANTS: PIGMENTS IN ANIMAL AND PLANT TISSUES. FLAVORS
aste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances. (12)

TEXT BOOKS AND REFERENCES:
1. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
2. Fennema, O.R, 2006, Food Chemistry, Academic Press.
3. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekke

COURSE OBJECTIVES

> ➢ Enable students to understand the methods of isolating and characterizing various microbes associated with foods and food groups.
> ➢ Enable students to understand and use various microbiological techniques for the study of foods.
> ➢ Understand the methods used to detect pathogens in foods.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

> ➢ Able to get a basic knowledge on complete understanding of isolation, characterization of various microbes associated with foods and food groups.
> ➢ Familiarize with microbiological techniques for the study of foods.
> ➢ Better understanding of methods to detect pathogens in foods.

LIST OF EXPERIMENTS:

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media- Types and Use; Preparation of Nutrient broth and agar

2. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs

3. Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining

4. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC

5. Microbiological Quality of Water (MPN)

6. Microbiological quality of milk

7. Enumeration of Lactic acid bacteria from fermented foods

8. Yeast & Mould count from fruits

9. Enumeration of spores from pepper

10. Inhibitory effect of spices on microbial load in fish & flesh foods

11. Enumeration & Isolation of E. colifrom processed meat/chicken

12. Thermal destruction of microbes: TDT & TDP

13. Enumeration & Isolation of Staphylococci from ready to eat street foods

14. Effect of cleaning and disinfection on microbial load

FT P32   FOOD CHEMISTRY LABORATORY   0   0   3   2

COURSE OBJECTIVES

➢ To enable students to study the methods to understand the physical and chemical properties of foods
➢ This course will enable the students to be familiar with nutrient composition of foods
➢ To gain knowledge in quantitative methods in assessing nutritional status of individuals and groups

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

➢ Better understanding the physical and chemical properties of food. Familiarize in precipitation of casein and gelatin of starch.
➢ Understanding the food groups, constituents of food, energy from food
➢ Exposing to nutritional assessment, food constituents and their daily dietary allowances

LIST OF EXPERIMENTS:

1. Determination of boiling point and freezing point of water
2. Estimation of sugars
3. Stages of sugar cookery
4. Estimation of gluten content
5. Estimation of polyphenols
6. Determination of acidity
7. Determination of gelatinization
8. Determination of natural pigments in foods
9. Fat acidity in foods-flour
10. Determination of refractive index of fats

FT P33 FLUID MECHANICS AND MACHINERY LABORATORY 　　0　0　3　2

COURSE OBJECTIVES

➢ To identify safe operating practices and requirements for laboratory experiments. To design and conduct an experiment as well as to analyze and interpret data.

➢ To cover the elements of fluid mechanics in fluid flow systems.

➢ To cover a range of experimental techniques aiming to provide students with a general knowledge and understanding of the subject fluid mechanics and machinery, including recommendations for further studies.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

➢ Provide the students with a solid foundation in fluid flow principles
➢ Able to understand measurement of coefficient of discharge of fluid by various flow measuring devices.
➢ Provide the students knowledge in calculating performance analysis in turbines and pumps and can be used in power plants
➢ Able to understand to analyze practical problems in all power plants and chemical industries
➢ Given the required flow rate and pressure rise, select the proper pump　　to optimize the pumping efficiency
➢ Confidence in the hydraulic design of turbines and should be able to identify suitable pumps and turbines for different working conditions.

LIST OF EXPERIMENTS:

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Visualizing the flow structures through various models.
5. Proving Bernoulli's theorem.
6. Conducting experiments and drawing the characteristics curves of centrifugal pump.
7. Conducting experiments and drawing the characteristics curves of submersible pump.

8. Conducting experiments and drawing the characteristics curves of jet pump.

9. Conducting experiments and drawing the characteristics curves of pump in series and parallel.

10. Conducting experiments and drawing the characteristics curves of reciprocating pump.

11. Conducting experiments and drawing the characteristics curves of Gear pump.

12. Conducting experiments and drawing the characteristics curves of Pelton wheel.

13. Conducting experiments and drawing the characteristics curves of Francis turbine.

14. Conducting experiments and drawing the characteristics curves of Kaplan turbine.

15. Conducting experiments and drawing the characteristics curves of hydraulic ram.

SEMESTER IV

FT T41 PROBABILITY AND STATISTICS   3   1   0   4

COURSE OBJECTIVES

- ➢ This course aims at providing the required skill to apply the statistical tools in engineering problems.
- ➢ To introduce the basic concepts of probability and random variables.
- ➢ To introduce the basic concepts of two dimensional random variables.
- ➢ To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- ➢ To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- ➢ Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- ➢ Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- ➢ Apply the concept of testing of hypothesis for small and large samples in real life problems.
- ➢ Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- ➢ Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

UNIT I: PROBABILITY AND RANDOM VARIABLES

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.   (12)

UNIT II: TWO - DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).   (12)

UNIT III: TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.   (12)

UNIT IV: DESIGN OF EXPERIMENTS

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.   (12)

UNIT V: STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling. (12)

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.

2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.

3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.

4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

COURSE OBJECTIVES

- ➢ To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.
- ➢ To acquire knowledgeable of food components and characteristics and techniques available for their analysis.
- ➢ To design an experiments in food analysis
- ➢ To acquaint the skills in the analysis of foods by spectroscopic techniques.
- ➢ To provide knowledge in the applications and practices of chromatographic techniques in the analysis of foods for purposes of trade, compliance, quality assurance.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- ➢ Understand the principles behind analytical techniques in food analysis.
- ➢ Know the methods of selecting appropriate techniques in the analysis of food products.
- ➢ Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.
- ➢ Familiarize with the current state of knowledge in food analysis.

UNIT I: INTRODUCTION

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude fiber and dietary fiber.   (12)

UNIT II: LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.   (12)

UNIT III: SPECTROSCOPIC TECHNIQUES

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; IR Spectroscopy in online determination of components of food- FT-IR tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer and ICP-AES in analysis of mineral elements and fluorimeter in vitamin analysis.   (12)

UNIT IV: CHROMATOGRAPHIC TECHNIQUES

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; Column chromatography for purification analysis- Ion exchange and affinity chromatography; HPLC and GC in food analysis; Significance of MS detectors in HPLC and GC; FAME analysis in oils and fats.   (12)

UNIT V: ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY

Basic principles; application of the electrophoresis in food analysis; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars; Estimation of simple sugars and disaccharides by polarimeter.   (12)

TEXT BOOKS:

1. Pomeranz, Yeshajahu. ‒Food Analysis: Theory and Practice‖. 3rd Edition. Aspen Publishers / Springer, 2000.
2. Kirk, R.S. and R. Sawyer ‒Pearson's Composition and Analysis of Food‖. 9th Edition. Longman, New York, 1991
3. Nielsen, S. Suzanne. ‒Food Analysis‖. 3rd Edition. Springer, 2003.

REFERENCES:

1. Otles, Semih. ‒Methods of Analysis of Food Components and Additives‖. CRC Press, 2005.
2. Nollet, Leo M.L. —Hand Book of Food Analysis‖ II Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004.
3. Nollet, Leo M.L. — Food Analysis by HPLC‖. II Rev. Edition, Marcel & Dekker, 2000
4. Otles, Semih. —Handbook of Food Analysis Instruments‖. CRC Press, 2009.

FT T43 FUNDAMENTALS OF HEAT AND MASS TRANSFER   3 1 0 4

COURSE OBJECTIVES
- ➢ To understand the principles and applications of heat and mass transfer operations.
- ➢ To introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems
- ➢ To provide useful information concerning the performance and design of particular systems and processes.
- ➢ To acquire knowledge on formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated indifferent chapters will be assigned and studied in detail.
- ➢ To gain experience in designing experiments for thermal systems, the design, fabrication, and experimentation of a thin film heat flux gage will be attempted as part of laboratory requirements.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Understand the basic laws of heat and mass transfer phenomena
- ➢ Design heat and mass transfer equipments.
- ➢ Account for the consequence of heat transfer in thermal analyses of engineering systems.
- ➢ Evaluate heat transfer coefficients for natural convection, forced convection inside ducts and exterior surfaces.
- ➢ Analyze heat exchanger performance by using the method of log mean temperature difference and heat exchanger effectiveness.
- ➢ Calculate radiation heat transfer between black and gray body surfaces

UNIT I: HEAT TRANSFER – CONDUCTION
Basic transfer processes – heat, mass and momentum – heat transfer process - conductors and insulators - conduction – Fourier's fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – extended surfaces (fins) - solving problems in heat transfer by conduction.   (12)

UNIT II: HEAT TRANSFER - CONVECTION
Newton Rikhman's law – film coefficient of heat transfer - convection – free and forced convection - dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in heat transfer by convection.   (12)

UNIT III: HEAT TRANSFER – HEAT EXCHANGER
Heat exchangers – parallel, counter and cross flow – evaporator and condensers - Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers - solving problems in heat exchangers.   (12)

UNIT IV: HEAT TRANSFER: RADIATION
Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff's law – Planck's law - Stefan-Boltzman's law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.   (12)

UNIT V: MASS TRANSFER

Mass transfer – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases – molecular diffusion in liquids, biological solutions and gels-Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.   (12)

TEXT BOOKS:

1. Bellaney, P.L. ‒Thermal Engineering‖. Khanna Publishers, New Delhi, 2001
2. Geankoplis C.J. ‒Transport Process and Unit Operations‖. Prentice-Hall of India Private Limited, New Delhi, 1999

REFERENCES:

1. Jacob and Hawkins. ‒Elements of Heat Transfer‖.John Willey and Sons Inc. New York, 1983
2. EcKert, E.R.G. ―Heat and Mass Transfer‖. McGraw Hill Book Co., New York, 1981
3. Holman, E.P. ―Heat Transfer‖. McGraw-Hill Publishing Co. New Delhi, 2001
4. Coulson, J.M. and etal. ―Coulson & Richardson's Chemical Engineering‖, 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
5. McCabe, W.L., J.C. Smith and P.Harriot ―Unit Operations of Chemical Engineering‖, 6th Edition, McGraw Hill, 2003.

FT T44 NUTRITIONAL BIOCHEMISTRY   4   0   0   4

COURSE OBJECTIVES
➢ This course provides introduction to biochemistry of macro- and micronutrients with a limited focus on medical aspects of nutrient deficiencies and metabolism.

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Chemical structures and chemical properties of macro- and micronutrients.
➢ Processes involved in digestion and absorption of macro- and micronutrients.
➢ Major pathways for metabolism of nutrients and key mechanisms regulating these pathways.
➢ Essential functions of nutrients in human cells and tissues.
➢ Pathologies associated with nutrient deficiencies, nutrient toxicities, and with common metabolic disorders

UNIT I : METABOLIC PATHWAYS
Carbohydrates – Aerobic and anaerobic degradation, glycogenesis, glycogenolysis, gluconeogenesis, HMP shunt pathway.Hormonal regulations of blood glucose.Bioenergetics – Principles of bioenergetics, free energy – endergonic and exergonic process, role of high energy compounds in energy storage, formation of ATP- Biological oxidation and electron transport chain - Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain. (12)

UNIT II : PROTEIN AND AMINO ACIDS
Protein degradation, fate of nitrotgen (urea cycle), metabolism of aromatic, sulfur containing, BCAA and other amino acid pool. Glutamine and alanine cycle, protein biosynthesis. Nucleic acids- metabolism of nucleic acid components, biosynthesis of nucleotides. (12)

UNIT III: METABOLISM
Lipids- Metabolism of triaclyglycerol, β oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies.Oxidative stress and antioxidants – Free radicals – definition, formation in biological systems, defense against free radicals. Role of free radicals and antioxidants in health and disease Determination of free radicals, lipid peroxides and antioxidants. (12)

UNIT IV : VITAMINS AND MINERALS IN METABOLISM
Regulation of metabolism – Interrelationship of carbohydrate, protein and lipid metabolism, Role of Vitamins and Minerals in Metabolism, metabolic adaptation during starvation, exercise, stress and diabetes mellitus. (12)

UNIT V : REGULATORY FUNCTIONS
Significances of enzymes in food metabolism Classification, Chemical nature – Enzyme inhibition, enzyme pattern in disease pattern. Hormones: Classification – synthesis – regulatory functions and mechanism of hormone action - Prostaglandin – structure, biosynthesis, metabolism and biological action and their role in pathology. (12)

TEXT BOOKS AND REFERENCES:
1. Murray, R.K., Graner, D.K., Mayes, P.A. and Rodwell, V.W. (2000): 25th Ed. Harpers Biochemistry Macmillan Worth Publishers.
2. Nelson, D.L., and Cox, M.M. (2000): 3rd Ed. Lehninger's Principles of Biochemistry, Macmillan Worth Publishers. Department of Food Science and Technology 44
3. Conn, E.E., Stumpf, P.K., Bruening, G. and Doi, R.H. (2001): 5th Ed. Outlines of Biochemistry, Heinemann Medical Books Ltd.
4. Raghuramulu, N., Madhavan Nair and K. Kalyanasundaram, S. (2003). A Manual of Laboratory Techniques, NIN, ICMR.

FT T45   THERMODYNAMICS   4   0   0   4

COURSE OBJECTIVES
- To introduce fundamental thermodynamic principles and their application
- To explain the concepts of chemical potential and fugacity
- Apply phase rule for different binary and multi component systems
- To determine equilibrium criteria for homogeneous chemical reactions
- Ability to apply various thermodynamics laws for microbial growth and product formation

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Apply various laws of thermodynamics to various processes and real systems.
- Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties for various ideal gas processes.
- Understand thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.
- Estimate Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants.

UNIT I:THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS
First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.   (12)

UNIT II:SOLUTION THERMODYNAMICS
Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.   (12)

UNIT III:PHASE EQUILIBRIA
Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.   (12)

UNIT IV:CHEMICAL REACTION EQUILIBRIA
Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.   (12)

UNIT V:THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION
Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product.   (12)

TEXT BOOKS:

1. Smith J.M., Van Ness H.C., and Abbot M.M. –Introduction to Chemical Engineering Thermodynamics‖, VI Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. ─A Text Book of Chemical Engineering Thermodynamics‖, PHI, 2003.
3. Christiana D. Smolke, ―The Metabolic Pathway Engineering Handbook Fundamentals‖, CRC Press Taylor & Francis Group, 2010.

REFERENCE:

1. Sandler S.I. ―Chemical and Engineering Thermodynamics‖, John Wiley,1989.

FT T46   UNIT OPERATIONS IN FOOD PROCESSING   4   0   0   4

COURSE OBJECTIVES

> - To understand the principles involved in separation methods.
> - To study the principles and laws governing the physical, chemical, or biochemical stages of different processes, and the apparatus or equipment by which such stages are industrially carried out.
> - To focus the transformation processes of raw materials into final products, or on conservation of materials and products

COURSE OUTCOMES
On successful completion of the module students will be able to:
> - Understand Principles of separation methodsused in the process industry.
> - Gain the knowledge on different equipments developed for separation.
> - Acquire the concept of crystallization and distillation

UNIT I: EVAPORATION AND CONCENTRATION
Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator.   (12)

UNIT II: MECHANICAL SEPARATION
Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press-sedimentation – gravitational sedimentation of particles in a fluid – Stoke's law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment- Membrane technology-types and applications.   (12)

UNIT III: SIZE REDUCTION
Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger's, Bond's and Kick's laws for crushing-size reduction equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.
(12)

UNIT IV: CONTACT EQUILIBRIUM SEPARATION
Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator –

continuous leaching – decantation systems – extraction towers-washing – equipments.   (12)

UNIT V: CRYSTALLIZATION AND DISTILLATION

Crystallization – equilibrium -solubility and equilibrium diagram – rate of crystal growth – equilibrium crystallization-crystallization equipment – classification – construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation – binary mixtures – flash and differential distillationsteam distillation – theory – consumption – continuous distillation with rectification – vacuum distillation - batch distillation – operation and process – advantages and limitations-distillation equipments – construction and operation – factors influencing the operation.
(12)

TEXT BOOKS:

1. Geankoplis, C.J. –Transport Processes and Separation Process Principles‖, 4th Edition, Prentice Hall, 2003.

2. McCabe W.L., Smith J.C. ―Unit Operations in Chemical Engineering‖, 7th Edition, McGraw – Hill Int., 2001,
3. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
4. Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi.

REFERENCES:
1. Richardson, J.E. etal., ―Coulson & Richardson‘s Chemical Engineering‖ Vol.2 (Praticle Technology & Separation Processes‖) 5th Edition, Butterworth – Heinemann / Elsevier, 2003.
a. Coulson, J.M and J.F. Richardson,―Chemical Engineering‖. Volume I to V. The Pergamon Press. New York, 1999
b. McCabe, W.L., J.C.Smith and P.Harriot, ―Unit Operations of Chemical Engineering‖, McGrawHill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
c. Sahay, K. M. and K.K.Singh, ―Unit operation of Agricultural Processing‖, Vikas Publishing House Pvt. Ltd., New Delhi, 2004

FT P41 FOOD ANALYSIS LABORATORY   0   0   3   2

COURSE OBJECTIVES
  ➤ Analysis of foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

COURSE OUTCOMES
  On successful completion of the laboratory students will be able to:
  ➤ Better understanding in analysis of foods and food products for chemical components.
  ➤ Knowing standards for food products.
  ➤ Obtain knowledge of adulterants in foods.

List of Experiments:
Part A

1. Calibration of basic instrumentation used for food analysis
2. Proximate analysis of marketed food products
3. Spectrophotometry Analysis
4. Chromatographic Analysis
5. Electrophoresis Analysis
6. Viscosity Analysis

Part-B (Any 5)

1. Determination of moisture in spices powder by distillation method and Hot air oven method.
2. Determination of total fat, protein in milk and milk products.
3. Rancidity test for fried foods to assess primary and secondary oxidative products.
4. Determination of Vitamin C in fruit juices.
5. Estimation of synthetic Food colour in sweets, confectioneries and beverages.
6. Determination of Iron content in foods.
7. Determination of Iodine content in iodized salt.
8. Detection of Annatto, lead, MSG, sulphur-di-oxide, Emulsifiers and stabilizers in food products.
9. Detection of anti oxidant in foods.
10. Determination of soluble and insoluble fibre in foods.
11. Detection of adulterants in edible oil and ghee.
12. Column chromatographic separation of colours
13. The identification of sugars in fruit juice using TLC.

COURSE OBJECTIVES
- ➢ To develop knowledge in handling basic operation of various equipments
- ➢ To determine the efficiency of the various instruments.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
- ➢ Have knowledge on the basic principles of chemical engineering and its applications.
- ➢ Be able to apply the skill of material balance and energy balance in unit operations unit process

LIST OF EXPERIMENTS:

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter

2. Determination of economy and thermal efficiency of rotary flash evaporator

3. Solving problems on single and multiple effect evaporator

4. Determination of separation efficiency of centrifugal separator.

5. Determination of collection efficiency in cyclone separator.

6. Determination of efficiency of liquid solid separation by filtration.

7. Determination of absorption efficiency in a packing tower

8. Determination of particle size of granular foods by sieve analysis.

10. Determination of performance characteristics in size reduction using the burr mill.

11. Determination of energy requirement in size reduction using the ball mill andhammer mill.

12. Performance evaluation of pin mill and hammer mill.

13. Performance evaluation of a steam distillation process.

14. Visit to a solvent extraction, sugar industry.

FT P43 NUTRITIONAL BIOCHEMISTRY LABORATORY   0   0   3   2

COURSE OBJECTIVES
  ➢ This course provides introduction to biochemistry of macro- and micronutrients with a limited focus on medical aspects of nutrient deficiencies and metabolism.

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
  ➢ Chemical structures and chemical properties of macro- and micronutrients.

  ➢ Processes involved in digestion and absorption of macro- and micronutrients.

  ➢ Major pathways for metabolism of nutrients and key mechanisms regulating these pathways.

  ➢ Essential functions of nutrients in human cells and tissues.

  ➢ Pathologies associated with nutrient deficiencies, nutrient toxicities, and with common metabolic disorders

LIST OF EXPERIMENTS:

1. Estimation of blood and urine glucose

2. Estimation of hemoglobin and iron

3. Estimation of total protein , serum albumin and globulin

4. Estimation of phosphorus in urine

5. Estimation of ascorbic acid in urine

6. Estimation of cholesterol

7. Estimation of urea in urine

8. Estimation of creatinine in urine

9. Estimation of nitrogen in urine

SP P44 PHYSICAL EDUCATION   0   0   0   0

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 45 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

FT T51 FOOD ADDITIVES   4   0   0   4

COURSE OBJECTIVES

➢ To expose the students to the use of different chemical additives in foods   during food processing and preservation
➢ To understand the various acidity regulators and preservatives used in food.
➢ To known the various antioxidants and anti-caking agents and various coloring agent and sweeteners used in food.

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ To understand the principles of chemical preservation of foods
➢ To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
➢ To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

UNIT I: INTRODUCTION

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.   (12)

UNIT II: ACIDITY REGULATORS AND PRESERVATIVES

Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations. (12)

UNIT III: EMULSIFIERS, STABILIZERS AND THICKENERS

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.   (12)

UNIT IV: ANTIOXIDANTS AND ANTI-CAKING AGENTS

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anti-foaming

and propellants, Anti-caking agents – definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.   (12)

UNIT V:COLOR AND ARTIFICIAL SWEETENERS

Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.   (12)

TEXT BOOKS:
1. Mahindru, S. N. ‒Food Additives- Characteristics Detection and Estimation‖, TATA McGraw Hill, 2000
2. Wilson, R. ‒Ingredient Handbook Sweeteners‖, Blackwell, 2007

REFERENCES:
1. Emerton, V. ‒Food Colors‖, Blackwell, 2008
2. Peter A Williams and Glyn O Philips, ― Gums and stabilizers for the Food Industry‖, RSC, 2006.
3. Branen, A. L. ―Food Additives‖ 2nd Edition, CRC press, 2002

FT T52 ENZYME AND FERMENTATION TECHNOLOGY   4 0 0 4

COURSE OBJECTIVES

- To insure that learners have acquired the facts, concepts and principles necessary to understand various techniques of enzyme production and purification and fermentation process.
- To discuss the current advancement of enzyme and fermentation technology applications in industry.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the display the instructive and comprehensive current knowledge of enzyme technology and fermentation.
- Explain the enzyme mechanisms and kinetics, production and recover.
- Categorize enzymes, including the ones produced through the recombinant method and various reactors in food technology.

UNIT I: INTRODUCTION
Enzyme Technology, Immobilized enzymes and their uses, Enzyme Kinetics, Cellulases for Biomass Conversion, Enzyme Engineering, Industrial enzymes, Production and extraction of enzymes: Carbohydrate active enzymes, Proteases, Lipases, Nucleic acid enzymes.   (12)

UNIT II: ENZYME STRUCTURE
Covalent modification of enzyme structure – irreversible and reversible modification - Ligand induced conformational changes – basic concepts of allosterism and allosteric enzymes, models proposed to explain the mechanism of functioning (MWC and KNF); structural aspects of aspartate carbamoyltransferase, role of allosteric enzymes in metabolic regulation – feedback inhibition - Multienzyme systems – basic concepts, types with examples, structural and functional aspects of pyruvate dehydrogenase, fatty acid synthetase, ‗Arom' complex and tryptophan synthetase - Membrane bound enzymes in metabolic regulation - Isoenzymes – basic concepts, method of detection, examples and their metabolic significance.   (12)

UNIT III: Applications of enzymes
Medical applications of enzymes: In diagnosis – general principles and use of alanine amino transferase, aspartate amino transferase, lactate dehydrogenase, creatine kinase, acid and alkaline phosphatase - In therapy – specific applications of few selected enzymes, prodrug activation with examples, enzyme replacement therapy -**Industrial applications of enzymes** – catalysts in the manufacturing and other conversion processes - Enzymes as analytical tools - Immobilisation of enzymes: basic concepts, methods used, properties of IME and their applications in industry, medicine, enzyme electrodes - Newer approaches to the application of enzymes – reactions in organic solvents.   (12)

UNIT IV: INTRODUCTION TO FERMENTATION TECHNOLOGY
Interaction between Chemical Engineering. Introduction to fermentation processes, the chronological development of the fermentation industry, the component parts of a fermentation process, Microbial culture selection for fermentation processes.   (12)

UNIT V: REACTOR

Gaden's Fermentation classification, Design and operation of fermenters, Basic concepts for selection of a reactor, Rheology of fermenter, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor, Scale up of Bioreactor. (12)

TEXT BOOKS AND REFERENCES:

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by T. Palmer Affiliated East-West Press Pvt. Ltd. New Delhi
2. Fundamentals of Enzymology – N. C. Price and L. Stevens, Oxford University Press
3. Nature of Enzymology – R. L. Foster, Croom Helm Applied Biology Series, London
4. Enzyme Technology – Pandey, Webb, Soccol and Larroche. Asiatech Publishers, INC New Delhi
5. Enzyme Nomenclature by IUBMB Academic Press Inc.
6. Enzyme structure and function – A. Fuerst, Freeman, USA
7. Immobilised Enzymes – M. D. Trevan
8. Enzymes – Boyer, Academic Press
9. Advances in Enzymology – Series edited by N. O. Kaplan, Academic Press
10. Enzyme Biotechnology by G. Tripathi, Technoscience Publications
11. Enzyme Reaction Engineering by T. P. Jayadev Reddy, Biotech Books, Delhi
12. Enzymes and Immobilised Cells in Biotechnology by A. Laskin Butterworths Biotechnology Series.
13. Bailey, J.E. and Ollis D.F., Biochemical Engineering Fundamentals, Mcgraw Hill Higher Education; 2nd edition, 2001
14. Stanbury, P.E., Whitaker, A., Hall, S., Principles of Fermentation Technology 2nd edition, Butterworth-Heinemann, 2016

FT T53 REFRIGERATION AND COLD CHAIN MANAGEMENT   4   0   0   4

COURSE OBJECTIVES
- To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components.
- To provide knowledge on design aspects of cold storage systems.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Demonstrate the operations in different Refrigeration & cold storage systems
- Design Refrigeration & cold storage systems
- Design the cold chain management system

UNIT I: REFRIGERATION PRINCIPLES
Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - simple vapour compression cycle – T-S diagram – p-h chart - application of refrigeration.   (12)

UNIT II: VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS
Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working.   (12)

UNIT III: REFRIGERANTS AND VAPOUR ABSORPTION CYCLE
Refrigerants – properties – classification – comparison and advantages – chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants - vapour absorption cycle – theoretical - deviation in practice - Electrolux refrigerator – construction and principles.   (12)

UNIT IV: SHELF – LIFE OF FOOD PRODUCTS
Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deteriroration- Kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf – life testing– the 11 steps procedure. Storage of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size , insulation, entry –exit position, palletization, proper disk-space for air-circulation, automatic door – closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc. Humidification, de, humidification and heat pump dryer.   (12)

UNIT V: COLD CHAIN
Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf-life; just – in-time deliveries; Temperature limits;-in various countries-Europe, US, Australia etc; Chilling and freezing;- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc; Thaw indicators.   (12)

TEXT BOOKS:

1. Anand, M.L. ─ Refrigeration& Air-Conditioning‖. Asian Books Pvt., Ltd., 2002.
2. Sun, Da-Wen. ─ Advances in Food Refrigeration‖. Leatherhead Publishing, 2001.
3. Kennedy, Christopher J. ─Managing Frozen Foods‖. CRC / Woodhead Publishing, 2000.
4. James, S.J. and C. James. ─ Meat Refrigeration‖. CRC / Woodhead Publishing, 2002.
5. Stringer, Mike and C. Dennis. ─Chilled Foods: A Comprehensive Guide‖. 2nd Edition, CRC / Woodhead Publishing, 2002.

REFERENCES:

1. Evans, Judith. ─Frozen Food Science and Technology‖. Wiley-Blackwell , 2008.
2. Hui, Y.H. etal., ─ Handbook of Frozen Foods‖. Marcel Dekker, 2004.

FT T54 FOOD PROCESSING AND PRESERVATION   4 0 0 4

COURSE OBJECTIVES
- To impart thorough knowledge on the technical skills in various aspects of food processing and preservation.
- To inculcate the students to work in a hygienic way.
- To familiarize the recent methods of minimal processing of foods and understand the materials and types of packaging for foods.

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Understand the principles of food processing and preservation.
- Understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- Familiarize with the recent methods of minimal processing of foods and understand the materials and types of packaging for foods.

UNIT I: PRINCIPLES OF MASS AND ENERGY BALANCE

Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation of process time temperature-schedules. (12)

UNIT II: CANNING OF FOOD PRODUCTS

Newer methods of thermal processing; batch and continuous;canning- application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods. (12)

UNIT III: DRYING PROCESS FOR TYPICAL FOODS

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages. (12)

UNIT IV: NON-THERMAL METHODS

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology. (12)

UNIT V: RETORT PROCESSING TECHNOLOGY

Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials. (12)

TEXT BOOKS:

1. Sivasankar, B. –Food Processing and Preservationǁ. Prentice Hall of India, 2002.

2. Khetarpaul, Neelam. –Food Processing and Preservation.ǁ Daya Publications, 2005

3. Singh, M.K. –Food Preservationǁ Discovery Publishing, 2007.

4. Fellows, P.J. –Food Processing Technology: Principles and Practiceǁ. 2nd Edition, CRC Wood Head Publishing, 2000.

5. GopalaRao, Chandra. –Essentials of Food Process Engineeringǁ. B.S. Publications, 2006.

REFERENCES:

1. Rahman, M. Shafiur. —Handbook of Food Preservationǁ. Marcel & Dekker, 2006.

2. Zeuthen, Peter and Bogh-Sarensen, Leif. –Food Preservation Techniquesǁ. CRC / Wood Head Publishing, 2003.

3. Ranganna, S. —Handbook of Canning and Aseptic Packagingǁ. Tata McGraw-Hill, 2000.

FT P51 FOOD PROCESSING AND PRESERVATION LABORATORY　　0　0　3　2

COURSE OBJECTIVES
- To understand the concept of preservation of foods
- To analyze the various techniques and additives for food processing and preservation

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
- Ability to select the specific preservation technology suitable for a specific food
- Ability to Process the different categories of food

LIST OF EXPERIMENTS:

1. Testing of physical and chemical characteristics of oil observation.

2. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)

3. Refrigeration and Freezing of vegetables and fruits

4. Drying of vegetables and fruits with and without additives - Drying rate studies including, constant rate and falling rate periods and the effects of various factors on them.

5. Osmotic drying of foods with salt and sugar.

6. Canning & bottling of vegetable and fruit products

7. Filtration and concentration of fruit juices

8. Production of extruded products.

9. Spray drying of juices/milk

10. Pasteurization of milk

11. Retort processing of foods

12. Testing of canning products

FT P52 ENZYME AND FERMENTATION TECHNOLOGY   0   0   3   4
LABORATORY

COURSE OBJECTIVES

➢ To acquire the knowledge on enzymes and their function during chemical reaction and temperature effects

➢ To gain the concept of batch sedimentation, flocculation and centrifugation

➢ To understand the basics of selection of microbe(s), inexpensive nutrients for fermentation process, fermenters and techno-economic studies of bio-products

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

➢ Familiar in the enzymes formation and their usage in food technology

➢ Gain more knowledge in fermentation process in food technology

List of Experiments:

1. Assay of enzymes for activity

2. Effect of pH on enzymes

3. Effect of temperature on enzymes

4. Immobilization of enzyme by entrapment and comparison with free enzyme

5. Enzyme deactivation by heat and / or relation with blanching

6. Enzymes in meat tenderization

7. Batch Sedimentation

8. Flocculation

9. Centrifugation

10. Enzyme Lysis

11. Case study involving selection of suitable microbe(s), inexpensive nutrients for fermentation process, fermenters and techno-economic studies of bio-products.

12. Extraction of antibiotics using annular centrifugal extractor

13. Brewery Industry Visit

COURSE OBJECTIVES
- ➢ To enhance the Employability and Career Skills of students
- ➢ To orient the students towards grooming as a professional
- ➢ To make them Employable Graduates.
- ➢ To develop their confidence and help them attend interviews successfully.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ At the end of the course Learners will be able to:
- ➢ Make effective presentations
- ➢ Participate confidently in Group Discussions.
- ➢ Attend job interviews and be successful in them.
- ➢ Develop adequate Soft Skills required for the workplace

UNIT I: ART OF COMMUNICATION
Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback.

UNIT II: INTRODUCTION TO SOFT SKILLS
Attitude – Self-Confidence – Leadership Qualities – Emotional Quotient – Effective Time Management Skills – Surviving Stress – Overcoming Failure – Professional Ethics – Interpersonal Skills.

UNIT III: WRITING
Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis.

UNIT IV: SPEAKING PRACTICE
Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions – Presentations

UNIT V: APTITUDE
Verbal and Numerical aptitude.

REFERENCE BOOKS:
1.   Nicholls, Anne. Mastering Public Speaking. Jaico Publishing House,2003.
2.   Aggarwal, R.S. Quantitative Aptitude. S.Chand&Co.,2004.
3.   Leigh, Andrew and Michael Maynard. The Perfect Leader. Random House   Business Books,1999.
4.   Whetton .A.David and Kim S. Cameron. Developing Management Skills. Pearson Education, 2007.
5.   K.R. Lakshminarayan. Developing Soft Skills. Scitech, 2009.
6.   Sherfield M Robert. Developing Soft Skills Pearson Education, 2005.
7.   Hair O_ Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions. Pearson Education,2008.
8.   Chaney Lilian and Jeanette Martin. Intercultural Business Communication, Fourth Edition. Pearson Education, 2008.

FT T61 FOOD PROCESS ENGINEERING   4   0   0   4

COURSE OBJECTIVES
- ➢ To expose the students to the fundamental knowledge of food, its properties and different methods of food processing
- ➢ To understand the importance of material properties to the texture of food.
- ➢ To understand the importance of thermal processing equipment, Milk pasteurization, Canning operations, Quality considerations and process optimization, Shelf life studies, Validation of heat processes.
- ➢ To gain knowledge on the types of freezers used in low temperature for food processing,
- ➢ extrusions, cookers, evaporators and heating used in food processing.

COURSE OUTCOME

On successful completion of the module students will be able to:
- ➢ Understand the importance of material properties to the texture of food.
- ➢ Importance of thermal processing equipment, Milk pasteurization, Canning operations, Quality considerations and process optimization, Shelf life studies, Validation of heat processes.
- ➢ Understand the importance of Water binding and drying in food processing and preserving food materials.
- ➢ Able to know the types of freezers used in low temperature for food processing
- ➢ Analyze the types extrusions, cookers, evaporators and heating used in food processing.

UNIT I:RHEOLOGY AND TEXTURE OF FOOD MATERIALS
Concept of rheology, elastic, plastic and viscous behaviour, viscoelasticity, rheological models and constitutive equations. Methods of texture evaluation, subjective and objective measurements. Aerodynamic and hydrodynamic characteristics. Application to separation, pneumatic handling and conveying. Material handling: Material handling machines and conveyors. Pre-treatment unit operations: Cleaning, Dehullingand Dehusking, Sorting & Grading, Peeling, Mixing and Forming.Size reduction and separation. Agitation and Mixing. Mechanical Separations: Centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machines. Filtration: Principles involved in filtration. Pressure and vacuum filtration. Expression: batch and continuous type.. Extraction and Leaching, Crystallization and Distillation: Basic principles involved. Baking, Roasting and Frying equipment.   (12)

UNIT II:THERMAL PROCESSING
Concept of thermo bacteriology: Arrhenius analogy, its application in design. Determination of heat resistance of micro organisms.Thermal processing: Blanching, Pasteurizations and Sterilization - principles, different methods and equipments. Processing in containers, process time, T- evaluation, Design of batch and continuous sterilization. Design and analysis of fermenter. Shelf life: Calculation of shelf life. Shelf life requirements, Deteriorative reactions. Accelerated testing.Transport properties of barriers. Simulations of product - package environment interaction. Shelf life simulation for moisture, oxygen, and light sensitive products.   (12)

UNIT III: WATER BINDING AND DRYING

Raults Law. Water sorption Isotherms - Hysteresis. Water activity measurement method. Water binding and its effect on enzymatic and non-enzymatic reactions and food texture. Control of water activity and moisture. Permeability: Theoretical considerations. Permeability of gases and vapours. Permeability of multilayer materials. Permeability in relation to packaging requirement of foods.Drying: Principles of drying, drying rate kinetics, Classification, mass and energy balance. Different types of dryers and components - roller, spray, tray, compartment, fluidized bed etc. (12)

UNIT IV: FOOD PROCESSING LOW TEMPERATURE

Freezing of Foods, Types of freezers including, ice cream freezers, Freeze concentration and freeze drying. Freezing curves, phase diagrams, methods of freeze concentration, design problems. Membrane processes: Ultra filtration, Reverse osmosis, Electro dialysis, per-evaporation and micro filtration. (12)

UNIT V: FOOD PROCESSING HIGH TEMPERATURE

Extrusion: Extrusion cookers, cold extrusion, single and twin screw extrusion. Low pressure and high pressure extrusion, properties of Food materials, its significance in equipment design, processing and handling Evaporation: Principles of evaporation, types and selection evaporators, mass and energy balance. Design of single and multiple effect evaporators, recompression heat and mass recovery and vacuum creating devices. Fouling of evaporators and heat exchanges.Non – Thermal Methods: Microwave and Dielectric & Infrared heating: Physical parameters. Heat transfer phenomenon. Equipment and application. Irradiation - Principle and its equipments, Blending and pulverization equipments. (12)

TEXT BOOKS:
1. Toledo, Romeo T. ‒Fundamentals of Food Process Engineering‖ II Edition. CBS Publishers, 2000.
2. Fellows P. J ‒Food Processing Technology‖ Woodhead Publishing, 1998.
3. Smith P. G ‒Introduction to Food Process Engineering‖. Springer, 2005
4. Earle, R.L, —Unit Operations in Food Processing‖. Pergamon Press. Oxford. U.K, 2003

REFERENCES:
1. Sahay, K. M. and K.K.Singh..‒Unit operation of Agricultural Processing‖, Vikas Publishing House Pvt. Ltd., New Delhi, 2004
2. Berk, Zeki. ‒Food Process Engineering and Technology‖. Elsevier, 2009.

FT T62 BAKING AND CONFECTIONERY TECHNOLOGY   4 0 0 4

COURSE OBJECTIVES
- ➢ To familiarize with the commercial methods of baking bread and recent advances in bakery industry
- ➢ To learn microbiological aspects of bakery products, sanitation and hygiene of baking industries.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Understand the basics of the types of baking and the ingredients needed for baking.
- ➢ Gain the details on the equipments needed in the baking industry.
- ➢ Acquire the knowledge on the various process involve in making breads
- ➢ Analyse the materials required for making cakes, cookies and gain knowledge on manufacturing of confectionary products.

UNIT I:INTRODUCTION TO BAKING
Classification of bakery products. Bakery ingredients and their functions-Essential ingredients: Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.
(12)

UNIT II:EQUIPMENTS
Introduction to utensils and equipments used in bakery industry with their purpose.Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating-Fermentation enclosures and brew equipment - Ovens and Slicers; Extrusion. Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph.   (12)

UNIT III:BREAD MAKING PROCESS
The Chemistry of dough Development.   Bread   making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process-Dough retarding and freezing-emergency No time process. Advantages and disadvantages of various methods of bread-making. Characteristics of good bread: Internal characters; external characters.Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.   (12)

UNIT IV:BAKERY PRODUCTS
Production of cakes and cookies/biscuits. Types of biscuit dough_s –Developed dough, short dough_s, semi-sweet, enzyme modified dough_s and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.   (12)

UNIT V:CONFECTIONERY PRODUCTS
Definition, importance of sugar confectionery. General technical aspects of industrial sugar confectionery manufacture - compositional effects. Manufacture methods of high boiled sweets: - Ingredients -.prevention of recrystalization and stickiness Types of confectionery products-

Caramel, Toffee and Fudge and other confections-:- ingredients - Formulation - Processing method- Quality control- Aerated confectionery- Methods of aeration- Manufacturing process- Chemistry of Hydrocolloids, Hydrocolloid pre treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products. (12)

TEXT BOOKS:

1. Matz, Samuel A., "Bakery Technology and Engineering", III Edition, Chapman & Hall, London.

2. Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", II Edition Aspen publication. Maryland, 1999

REFERENCES:

1. Edwards W.P. "Science of bakery products", RSC, UK,2007

2. Samuel A. Matz., "Equipment for Bakers", Pan Tech International Publication. 1988.

3. Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition, Blackie Academic and professional, Glasgow,1995.

FT T63 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY   4 0 0 4

COURSE OBJECTIVES
- The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of fruits and vegetables.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Better understanding of the concepts of physiological characteristics of fruits and vegetables Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.
- Participants will understand the process involved in freezing and dehydration of fruits and vegetables, process involved in canning and preserving of juices.

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UNIT I: BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS
Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Morphology, structure and composition of fruit and vegetable. Production and processing scenario of fruits and vegetable: India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus.
(12)

UNIT II: FRESH FRUITS AND VEGETABLES
Physical, Textural characteristics, structure and composition. Maturity standards; Importance, methods of Maturity determinations maturityindices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Storage practices: Control atmospheric, Bead atmosphere, hypotactic storage, cool store, Zero emerge cool chamber, stores striation. Commodity pre-treatment's - chemicals, wax coating, pre-packaging, phytonutrients in fruits and vegetables grading, cleaning, Physiological post harvest diseases chilling injury and disease. Handling and packaging of fruits and vegetables.   (12)

UNIT III: FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES
General pre processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance.   (12)

UNIT IV:CANNING, PUREES AND JUICES
Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/ pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance.   (12)

UNIT V:FRUIT AND VEGETABLE PRODUCTS

Ready to eat fruit and vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic, Dried Onion, Powder. Garlic: Dried Garlic, Powder, Oil. Potato: Wafer; starch, Papad, Carrot: Preserve, candy, Pickle, Jam. Cauliflower and cabbage: Dried cauliflower and cabbage, Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves).Bitter gourd: Pickle, Dried bitter gourd. Indian Food Regulation and Quality assurance.

(12)

TEXT BOOKS AND REFERENCES:

1. Fellows, P J. ‒Food Processing Technology: Principles and Practice‖. 2nd Edition, CRC/ Woodhead, 1997.
2. Salunke,D. K and S. S Kadam ‒Hand Book of Fruit Science and Technology: Production, Composition, Storage and Processing‖. Marcel Dekker, 1995.
3. Sivasankar, B. ‒Food Processing & Preservation‖, Prentice Hall of India, 2002.

FT P61 FRUITS AND VEGETABLE PROCESSING LABORATORY   0   0   3   2

COURSE OBJECTIVES

➢   To develop skills related to preservation and analytical techniques in fruit and vegetable products

➢   To know about the use of various techniques and additives for fruit and vegetable processing and quality analysis

COURSE OUTCOME

On successful completion of the laboratory students will be able to:

➢   know about the ways by which squash, pies, ketchup jams, pickles can be prepared and preserved.

LIST OF EXPERIMENTS:

1. Preparation of orange squash and cordial.

2. Preparation of canned peas / pine apple.

3. Preservation and processing of certain vegetables by drying and dehydration

4. Preparation of Jam/Jelly and its preservation by sugar

5. Preparation of pickles

6. Osmotic concentration/dehydration of certain fruits and vegetables using

7. concentrated sugar and salts solutions

8. Preparation of malt based drink.

9. Preparation of fruit juice/pulp and its preservation by chemical Preservatives/ thermal processing.

10. Preparation of tomato puree/ketchup and its preservation by chemical preservatives

11. Experiment on preparation of fruit bar.

12. Experiment on preparation of Ready to serve beverages.

13. Experiment on quality evaluation of fruit beverages.

14. Experiment on fermented fruit and vegetable preparation.

15. Experiment on quality evaluation of fermented fruit and vegetable products.

FT P62 BAKING AND CONFECTIONERY TECHNOLOGY   0   0   3   2
LABORATORY

COURSE OBJECTIVES

> This course will enable the student to acquaint with the preparation of various bakery products and perform quality analysis for the same

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:

> Know the detail on toffees, biscuits, breads and sugar boiled confectionaries can be prepared.

LIST OF EXPERIMENTS:

1. Study of ingredients (major and minor): characteristics of flour, yeast, shortening, sugar, egg and salts.

2. Experiment on leavening action of baking powder, sodium- bicarbonate and ammonium-bi-carbonate.

3. Determination sedimentation value of flour

4. Estimation of water absorption power (atta, and maida)

5. Determination dough rising capacity of yeast

6. Studies of dough characteristics farinographic and extensographic

7. Preparation of biscuits-different types.

8. Preparation of bread-different types.

9. Preparation of toffees.

10. Preparation of sugar boiled confectionary.

11. Preparation of candy.

12. Visit to a bakery/confectionary industry.

HS P63 GENERAL PROFICIENCY – II   **0   0   3   1**

COURSE OBJECTIVES
- To enable the learner to communicate effectively and appropriately in real life situation
- To use English effectively for study purpose across the curriculum;
- To develop interest in and appreciation of Literature;
- To develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing;
- To revise and reinforce structure already learnt.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

UNIT I: COMPOSITION ANALYSIS
Technical and Non-Technical Passages (GRE Based) Differences in American and British English – Analyzing Contemporary issues – Expanding Terminology.

UNIT II: WRITING
Job Application Letter Writing – Resume Writing

UNIT III: ORAL SKILLS
Group Discussion – Introduction and Practice – Team Work – Negotiation Skills – Organizing and Attending Meetings – Facing Interviews

UNIT IV: ADAPTING TO CORPORATE LIFE
Corporate Etiquette – Grooming and Dressing

UNIT V: APTITUDE
Verbal and numerical aptitude

REFERENCE BOOKS:
1. Pushplata and Sanjay Kumar, Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews, PHI Learning, Delhi, 2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw- Hill, 2012.
3. Thorpe, Edgar, Test of Reasoning, Tata McGraw-Hill, 2013.
4. Prasad, H.M, How to prepare for Group Discussion and Interview, Tata McGraw- Hill, 2012.
5. Career Press Editors,101 Great Resumes, Jaico Publishing House,2003.
6. Aggarwal, R.S, A Modern Approach to Verbal and Non-Verbal Reasoning, S.Chand& Co., 2012.

FT T71 DAIRY PROCESS TECHNOLOGY   4   0   0   4

COURSE OBJECTIVES

- ➢ To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry
- ➢ To produce trained work force for dairy sector.
- ➢ To maximize the production of international quality milk & milk products for export as well as for local consumption.
- ➢ To minimize the milk losses through improvement in industry wide practices.
- ➢ To reduce pollution through proper waste management.
- ➢ To enhance the quality of milk by controlling adulteration at reception points.

COURSE OUTCOMES

On successful completion of the module students will be able to:
- ➢ Receiving and handling the milk.
- ➢ Quality control tests/lab tests/adulteration tests.
- ➢ CIP of tanks and utensils. Milk / milk products processing.
- ➢ Packaging &preservation.

UNIT I:PROPERTIES OF MILK

Milk-Types-Composition-Physical-Chemical and Thermal Properties-Heat Capacity, Density-Freezing-Boiling point-Expansion-Agitation-Viscosity-Classification of milk Market and Special Milk Handling-effects of Merits on Milk-toxicity of metals.   (12)

UNIT II:PROCESSING AND QUALITY PARAMETERS OF MILK

Processing of Milk- Pasteurization-HTST, UHT, sterilization, Homogenization, Filtering and Clarification of Milk-cream separation-Methods and Equipment's-Emulsification – Fortification, packaging of milk and milk products, judging and grading of milk, national and international standards of milk and milk products.   (12)

UNIT III:MILK PRODUCTS

Traditional dairy products, Manufacturing of Yogurt, Cheese, Butter, Ghee, Ice-cream, malted products, evaporated milk products - properties, Classification-processing Methods, Equipment used, standards and quality parameters.

UNIT IV:MILK POWDER PROCESSING AND MILK SUBSTITUTES

Processing of Milk Powder- Composition - Properties- methods of drying, substitutes for milk and milk products – casein, lactose and other by-products, weaning foods, therapeutic foods, fortification and enrichment.   (12)

UNIT V:STORAGE SANITATION AND EFFLUENT TREATMENT

Storage of Milk in Tanks-Storage of ice cream and other milk products - in cold storage - Cleaning and Sanitation-Importance-Detergents-Properties-Cleaning procedures-Cleaning in place-Dairy effluent treatment and disposal.   (12)

TEXT BOOKS:

1. Ananthakrishnan, C.P., and Sinha, N.N., ‒Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1984.
2. Warner, J.N., ‒Principles of Dairy Processing‖, Wiley Eastern Pub. Co., New York, 1975.
3. Walstra, P., ‒Diary Technology: Principles of Milk Properties and Processes‖. Marcel Dekker, 1999
4. Spreer, Edgar ‒Milk and Diary Product Technology‖. Marcel Dekker, 2005.

REFERENCES:

1. Tufail Ahmed., ―Dairy Plant Engineering and Management‖, KitabMahal Publishers, Allahabad, 1997.
2. Lampert, Lincoln M. ‒Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products‖. Chemical Publishing Company,
   1998.
3. Selia, Jane dos Reis Coimbra and Jose A. Teixeir ‒Engineering Aspects of Milk and Dairy Products‖. Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009

COURSE OBJECTIVES
  - ➢ To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
  - ➢ To help become skilled in systems for food safety surveillance
  - ➢ To be aware of the regulatory and statutory bodies in India and the world
  - ➢ To ensure processed food meets global standards

COURSE OUTCOMES

On successful completion of the module students will be able to:
  - ➢ Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
  - ➢ Awareness on regulatory and statutory bodies in India and the world
  - ➢ Appreciate the relationship between food, nutrition and health.
  - ➢ Acquire knowledge on certification.

UNIT I: FOOD SAFETY
Importance of food safety in the food processing industry Risk classification, National and international food regulatory agencies, General food laws and food safety regulations, Nutritional labeling regulation (mandatory and optional nutrients, nutritional descriptors and approved health claims); Microbial contamination (including cross-contamination/indirect contamination) Chemical contamination, Physical contamination, Allergen contamination.   (12)

UNIT II : Food Safety Programs
 Definitions and importance, Good Manufacturing Practices (GMPs), Pest Control Program, Facility Maintenance, Personal Hygiene, Supplier Control, Sanitary Design of Equipment and Infrastructure, Procedures for Raw Material Reception, Storage and Finished Product Loading, Sanitation Program. (Sanitation Standard Operating Procedures (SSOPs)., Product Identification, Tracking and Recalling Program, Preventive Equipment Maintenance Program, Education and Training Program.   (12)

UNIT IV:Hazard Analysis and Risk Assessment
Physical hazards (metals, glass, etc), Chemical hazards (food additive toxicology, natural toxins, pesticides, antibiotics, hormones, heavy metals and packaging components), Biological hazards (epidemiology of biological pathogens: virus, bacteria and fungi), Evaluation of the severity of a hazard Controlling Food Hazards . Hazard Analysis Critical Control Point (HACCP) system.   (12)

UNIT IV:Food Hygiene Programs
Personal hygiene, Training programs, Infrastructure, Personal habits, Hygiene verification, Water in the food industry, Water sources, Water uses, Water quality, Treatments, Cleaning and sanitation, Cleaning agents, Sanitizing agents, Equipment and systems, Evaluation of sanitation efficacy- Pest Control, Pest Classification (insects, rodents and birds), Prevention and control.   (12)

UNIT V:Food Safety regulations and Certifications:
National and international food quality regulations, Quality systems- Introduction to the legal system, principles in the general food law, principles of self control, risk analysis on food, international food trade,Codex Alimentarius, traceability, EU-regulations on the hygiene of foodstuffs, and EUregulations on the official food control. Food quality standard: IPM, GAP, Organic farming, GMP, Standard of food quality and food quality analysis, Environmental risk assessment in food safety aspect, Food hygiene and surveillance system, Standard of food quality and control system, Food

industries and quality assurance in food production, ISO certifications. Indian Food regulations – History of Indian Food Regulations: BIS, ISI, FPO, PFA and FDA. Food Safety and Standards Act 2006. (12)

TEXT BOOKS AND REFERENCES
1. Early, R. (2005): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (2006). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (2006): Food Analyasis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (2000): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organisation, Geneva.
5. FSSAI, FSIS, EU and FAO website for updates.

COURSE OBJECTIVES
- ➢ The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used.
- ➢ This course will enable students to appreciate the application of scientific principles in the packaging of foods.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ The different types of materials and media used for packaging foods.
- ➢ Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, labelling of foods
- ➢ Methods of packaging, shelf life and food factors affecting packaging

UNIT I :INTRODUCTION TO FOOD PACKAGING
Packaging terminology- definition . Functions of food packaging, Packaging environment. Characteristics of food stuff that influences packaging selection.   (12)

UNIT II:PACKAGING MATERIAL AND THEIR PROPERTIES
Glass, Paper and paper board, Corrugated fibre board (CFB), Metal containers: Tin Plate and Aluminum, Composite containers, Collapsible tubes,Plastic Films, Laminations, Metalized films, Co extruded films, Testing of packaging material.   (12)

UNIT III:PACKAGING SYSTEMS AND LABELING
Vacuum Packaging, Controlled atmospheric packaging,Modified atmospheric packaging, Aseptic Packaging, Retort processing, Microwave packaging,Active Packaging, intelligent packaging, Edible packaging, Shrink and stretch packaging. labeling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act –2004.
                    (12)

UNIT IV: PACKAGING OF FRESH AND PROCESSED FOODS
Packaging of Fruits and vegetables, Fats and Oils,Spices, meat, Poultry and sea foods, Dairy Products, Bakery, beverages, Dehydrated and frozen foods. Liquid and powder filling machines – like aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines.   (12)

UNIT V : PACKAGING DESIGN & ENVIRONMENTAL ISSUES IN PACKAGING
Food marketing and role of packaging-Packaging aesthetic and graphic design; Coding and marking including bar coding; Consumer attitudes to food packaging materials; Packaging Laws and regulations, safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials; Packaging material residues in food products; Environmental & Economic issues, recycling and waste disposal.   (12)

TEXT BOOKS AND REFERENCES:
1. Robertson, G.L. 2006 Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis
2. NIIR. (2003). Food Packaging Technology Handbook, National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
3. Ahvenainen, R. (Ed.) 2003 Novel Food Packaging Techniques, CRC Press
4. Han, J.H. (Ed.) 2005 Innovations in Food Packaging, Elsevier Academic Press
5. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) 2003 Food Packaging Technology,CRC Press

FT P71   TESTING OF PACKAGING MATERIALS LABORATORY   0   0   3   2

COURSE OBJECTIVES

- ➢ Testing methods for packaging materials to assure quality
- ➢ Use of various techniques to check the barrier properties of packaging materials to avoid contamination

COURSE OUTCOMES

On successful completion of the laboratory students will be able to:
- ➢ On the completion of the course, the students will able to get experience on testing food packaging materials to assure quality of foods.

LIST OF EXPERIMENTS:

1. Testing of physical/mechanical properties of food packaging material

2. Testing of thermal shock resistance of glass

3. Gas/Vacuum packaging of foods and shelf life studies.

4. Determination of Water Vapor Transmission rate of Packaging Material.

5. Determination of grease resistance of papers used in food industry – butter paper & toffee wraps.

6. Determination of adhesive test of tapes

7. Determination of drop test using food packets

8. Estimation of water absorption test in paper based materials

9. Experiment on sealing of plastic cups

10. Edible packaging of Food Samples.

11. Study of Sorption Isotherm for Food Package Design.

12. Packaged food cut-out analysis.

FT P72   DAIRY PROCESS TECHNOLOGY LABORATORY   0   0   3   2

COURSE OBJECTIVES
  ➢ Preservation and analytical techniques in milk and milk products
  ➢ Use of various techniques and additives for milk product processing and quality analysis

COURSE OUTCOMES
  On successful completion of the laboratory students will be able to:
  ➢ On the completion of the course, the students will able to get experience on dairy process technology.

LIST OF EXPERIMENTS:
  1. Analysis of milk
  2. Platform test - Methylene Blue Reduction Test, clot on boiling test
  3. Determination of protein in milk by formol titration (pynes method)
  4. Determination of lactose content of milk by polarimeter
  5. Estimation of milk fat by Gerber method or Milko tester
  6. Phosphatase test
  7. Determination of adulterant and preservatives of milk
  8. Efficiency of sterilization in preparation of sterilized milk by turbidity test.
  9. Determination of redox potential, acidity and pH of milk

10. Determination of viscosity, density and specific gravity of milk Milk products and Quality Analysis

  11. Preparation and analysis of Yoghurt
  12. Preparation and analysis of Cottage cheese
  13. Preparation and analysis of Ice-cream/ Cream
  14. Preparation and analysis of Butter/ Ghee
  15. Preparation and analysis of sterilized flavored milk

FT P73 INDUSTRIAL VISIT/TRAINING   0   0   2   1

The students are required to undergo in plant training for a period of two weeks /four industrial visits during the summer vacation after the fourth semester. Each student has to submit a detailed report on the training programme undergone. Each student will be evaluated by an internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 50 marks

FT PW7   PROJECT WORK-I   0   0   6   4

COURSE OBJECTIVES

➢ To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.

➢ To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

➢ On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester. In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed internally for a total of 50 marks. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment.

FT T81 PROFESSIONAL ETHICS   **2   0   0   1**

COURSE OBJECTIVES

➢ To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

CORSE OUTCOMES
➢ Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

The course should covered the following topics by way of Seminars, Expert Lectures and

ASSIGNMENTS
Engineering Ethics– Moral issues, Ethical theories and their uses Engineering as Experimentation–Code of Ethics Engineer's responsibility for safety Responsibilities and rights Global issues of engineering ethics

REFERENCEBOOKS
1. MikeMartin and Roland Schinzinger, –Ethics in Engineering‖, Tata McGraw-Hill, 2003

FT T82 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT   4   0   0   4

COURSE OBJECTIVES
- ➢ To introduce process economics and industrial management principles to food technology
- ➢ To acquire knowledge on interest, investment costs
- ➢ To gain knowledge on profitability, investment alternative and replacement
- ➢ To understand the concept of economic balance and quality and quality control

COURSE OUTCOMES
On successful completion of the module students will be able to:

- ➢ Teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I :PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION
Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.   (12)

UNIT II: ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION
Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.   (12)

UNIT III : PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT
Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.   (12)

UNIT IV : ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE
Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.   (12)

UNIT V : ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL
Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control.   (12)

TEXT BOOKS:
1. Peters, M. S. and Timmerhaus, C. D., ‒Plant Design and Economics for Chemical Engineers‖, V Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., "Introduction to process Economics", IIEdn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., ‒Production and Costing‖, Khanna Publishers, New Delhi, 1988.

REFERENCES:
1. Allen, L.A., ‒ Management and Organization‖, McGraw Hill.
2. Perry, R. H. and Green, D., ‒ Chemical Engineer's Handbook ‒, VII Edn., McGraw Hill.

FT T83   MEAT, FISH AND POULTRY PROCESSING TECHNOLOGY   4   0   0   4

COURSE OBJECTIVES
- ➢ The course aims to develop the knowledge of students in the area of animal product processing and technology.
- ➢ This course will enable students to appreciate the application of scientific principles in the processing of these materials.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.
- ➢ Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I: INTRODUCTION
Recent trends in meat processing. Types of Meat and its sources, composition, structure, of meat and meat products. Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products.   (12)

UNIT II: MEAT PROCESSING
Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meat-aging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.   (12)

UNIT III: FISH PROCESSING
Types of fish, composition, structure and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Chilling of fish, Freezing and Individual quick freezing. Canning and smoking operations, Salting and drying of fish, pickling. Radiation processing of fish and fish products. Seafood quality Assurance, Advances in fishery by products technology.   (12)

UNIT IV: POULTRY
Introduction, Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products. Unit operation involved in poultry processing. (12)

UNIT V: EGG PROCESSING
Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing.   (12)

TEXT BOOKS:
1. Govindan. T.K, "Fish Processing Technology", Oxford and IBH Publishers, New Delhi, 1985.

2. Lawrie, R.A. "Meat Science", Second Edition. Pergamon Press, Oxford, UK. 1975.

3. Stadelmen, W.J. and Cotterill, O.J., "Egg Science and Technology", Second Edition, AVI, Westport, 1977.

REFERENCES:

1. Joseph Kerry, John Kerry and David Ledwood. "Meat Processing" , Woodhead Publishing Limited, England (CRC Press), 2002.

2. Mead, G. "Poultry Meat Processing and Quality", Woodhead Publishing, England, 2004.

3. Wheaton, F.W. and Lawson, T.B., "Processing of Aquatic Food Products", John Wiley & Sons Publishers, New York. 1985.

FT PW8 PROJECT WORK - II   0   0   9   8

COURSE OBJECTIVES

  ➢ To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

  ➢ On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Extension and completion of project work started in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department. In the Phase II, the project work and the report will be evaluated by the internal assessment committee by conducting two reviews and one demo for a total of 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.

SEMESTER V – ELECTIVE I, II

FT E01   BIOLOGY AND CHEMISTRY OF FOOD FLAVOURS   4   0   0   4

COURSE OBJECTIVES
  ➢ To understand the flavour compounds involved in development of flavor
  ➢ To understand the analytical techniques involved in flavor analysis

COURSE OUTCOMES
On successful completion of the module students will be able to:
  ➢ Better understanding and knowledge of contribution of different compounds for the development of flavor and Analytical techniques involved in flavor analysis.

UNIT I: INTRODUCTION
Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.   (12)

UNIT II: FLAVOUR COMPOUNDS
Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours. (12)

UNIT III: THE CHEMICAL SENSES
Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.   (12)

UNIT IV:FLAVOUR ANALYSIS
Subjective versus Objective methods of analysis; psychophysics and sensory evaluationand its types, ENOSE, ETONGUE; Instrumental analysis; sample handling and artifacts; data handling.
                                                                                     (12)

UNIT V: TEACHING FLAVOUR CONCEPTS
Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench. (12)

TEXT BOOKS:
  1. Fisher, Carolyn and Thomas R. Scott. ‒Food Flavours: Biology and Chemistry‖. The Royal Society of Chemistry, 1997.
  2. Heath, H.B. and G. Reineccius. ― Flavor Chemistry and Technology‖. CBS Publishers, 1996.
  3. Reineccius, Gary. ‒Flavor Chemistry and Technology‖. II Edition, Taylor & Francis, 2006.
  4. Shahidi, Fereidoon and Chi-Tang Ho. ‒Flavor Chemistry of Ethnic Foods‖. Kluwer Academic / Plenum, 1999.
  5. Ashurst, Philip R. ‒Food Flavorings‖. III Edition, Aspen Publications, 1999.

REFERENCES:
  1. Hofmann, Thomas. ―Challenges in Taste Chemistry and Biology‖. American Chemical

Society Publications, 2004.
2. Charalambous, G. –Food Flavors: Generation, Analysis and Process Influence‖. Elsevier, 1995.

FT E02   PULSE AND OIL SEED TECHNOLOGY   4   0   0   4

COURSE OBJECTIVES
- ➢ The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology.
- ➢ This is necessary for effective understanding specific aspects of food processing related to these foods.
- ➢ This course will enable students to appreciate the application of scientific principles in the processing of these materials.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- ➢ Understand the application of scientific principles in the processing technologies specific to the materials.
- ➢ Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I: INTRODUCTION
Present status and future prospectus of Pulse and Oil seeds, Morphology of legume. Classification and types of legumes and pulses. Chemical composition and nutritional value. Anti-nutritional factors, their chemistry, methods of removal of anti-nutritional factors.   (12)

UNIT II: LEGUMES
Processing of legumes: Home scale, Cottage Scale and commercial methods of dehulling. Modern techniques in Dal mills. Processing of Red gram, Bengal gram, Green gram, Black gram. Dal milling – Principle, methods, equipments and effect on quality. Principle products, Dry and Wet milling of pulses, Fermented Products of legumes. Soaking – Principles, Methods of socking - Sprouting, Puffing, Roasting & Parboiling of Legumes, Physical and Bio-chemical changes during these processes. Cooking quality of dhal – methods, factors affecting quality of dhal and cooking of dhal. Quick cooking dhal, Instant dhal.   (12)

UNIT III: SOYA PROCESSING
Soya as a source of protein and oil; Processing of Soya - soya milk, soy protein Isolate, soya paneer, soya sauce; extrusion technology and production of textured vegetable proteins.   (12)

UNIT IV: OIL SEEDS
Chemical composition and characters of oil seed and Oils, Anti-nutritional factors, elimination Methods. Post Harvest Technology of Oil seeds, Handling Drying, Storage, Grading, Pre treatments, cleaning, Dehulling, Size reduction and flaking. Oil extraction: Traditional Methods, Ghani, Power Ghanis, Expellers - Principle of Expeller, structure design of expeller. Solvent extraction process: Principle, Pre treatment - Breaking, Cracking, flaking.   (12)

UNIT V: OIL SEED PROCESSING

Extraction principles, factors affecting the extraction process. Desolventization. Refining of Oils - Degumming, neutralization, bleaching, filtration, deodorization, their Principles and process controls. New Technologies in oil seed processing, utilization of oil seed meals of different food uses. High protein Product, like protein concentrate and isolates. (12)

TEXT BOOKS:

1. Lawson, Harry ─Food Oils and Fats: Technology, Utilization, and Nutrition‖. CBS Publishers, 1997.
2. Hamm, Wolf and Richard J Hamilton ─Edible Oil Processing‖ Blackwell Publishing, 2004
3. Gunstone, Frank D. ─The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses‖ Blackwell Publishing, 2004.

REFERENCES:

1. Rajah, Kanes K. —Fats in Food Technology‖, Blackwell / Ane Books, 2004.
2. Sivasankar, B. ─Food Processing & Preservation‖, Prentice Hall of India, 2002.

FT E03   TRADITIONAL FOODS   4 0 0 4

COURSE OBJECTIVES
> To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

COURSE OUTCOMES
On successful completion of the module students will be able to:
> To understand the historical and traditional perspective of foods and food habits
> To understand the wide diversity and common features of traditional Indian foods and meal patterns.

UNIT I:HISTORICAL AND CULTURAL PERSPECTIVES
Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.   (12)

UNIT II:TRADITIONAL METHODS OF FOOD PROCESSING
Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sun-drying, osmotic drying, brining, pickling and smoking.   (12)

UNIT III:TRADITIONAL FOOD PATTERNS
Typical breakfast, meal and snack foods of different regions of India.Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods. (12)

UNIT IV:COMMERCIAL PRODUCTION OF TRADITIONAL FOODS
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.   (12)

UNIT V:HEALTH ASPECTS OF TRADIONAL FOODS
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.   (12)

TEXT BOOKS:

1. Sen, Colleen Taylor ‒Food Culture in Indiaǁ Greenwood Press, 2005.
2. Davidar, Ruth N. ‒Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

FT E04   FUNCTIONAL FOODS AND NUTRACEUTICALS   4   0   0   4

COURSE OBJECTIVES
- ➢ To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- ➢ To understand the role of Nutraceuticals and functional food in health and disease

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Knowledge of the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction
- ➢ Understand the role of Nutraceuticals and functional food in health and disease

UNIT I: INTRODUCTION AND SIGNIFICANCE
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes.   (12)

UNIT II: ANALYSIS OF PHYTOCHEMICALS
Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.   (12)

UNIT III: ASSESSMENT OF ANTIOXIDANT ACTIVITY
In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology;Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.   (12)

UNIT IV: ROLE IN HEALTH AND DISEASE
Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.   (12)

UNIT V: SAFETY ISSUES
Health Claims, regulations and safety issues- International and national.   (12)

TEXT BOOKS:
1. Bisset, Normal Grainger and Max Wich H ―Herbal Drugs and Phytopharmaceuticals‖, II Edition, CRC, 2001.
2. Wildman, Robert ―Handbook of Nutraceuticals and Functional Foods‖. CRC, 2006.
3. Webb, P P. ‒Dietary Supplements and Functional Foods‖. Blackwell, 2006.
4. Ikan, Raphael ―Natural Products: A Laboratory Guide‖, 2nd Edition, Academic Press / Elsevier, 2005.

5. Tipnis, H.P. ‒Bioavailability and Bioequivalence: An Update‖ New Age International,

REFERENCES:

1. Shi, John, FereidoonShahidi and Chi-Tang Ho ‒Asian Functional Foods‖. CRC/Taylor &Francis, 2007.
2. Watson, Robald Ross ‒Functional Foods and Nutraceuticals in Cancer Prevention‖. Blackwell Publishing, 2007.
3. Gibson, G.R. and C.M.Willams. ‒Functional Foods: Concept to Product‖. Woodhead, 2000.
4. Hanson, James R. ―Natural Products: The Secondary Metabolites‖, Royal Society of Chemistry, 2003.

FT E05   SPICES AND PLANTATION TECHNOLOGY   **4   0   0   4**

COURSE OBJECTIVES

➢ To familiarize the students about the processing techniques of various major and minor spices, coffee and tea, cocoa and cocoa products
➢ To gain the knowledge on packaging, grading and quality analysis of spices

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Understand the processing steps involved for different plantation products and spices.
➢ Acquire the knowledge on processing of coffee and tea
➢ Understand the processing steps involved for cocoa and cocoa products and processing of coconut, oil palm, arecanut and cashew

UNIT I: IMPORTANCE AND PROCESSING OF SPICES
A. Major Spices
Post Harvest Technology, composition, processed products of - Pepper, Cardamom, onion, ginger and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Enzymatic synthesis of flavour identical - Quality control, Flavour of major spices - Spice oil and oleoresins.

B. Minor Spices

Post Harvest Technology, composition, processed products of - Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – flavours, Quality control,Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures.   (12)

UNIT II: PROCESSING OF COFFEE AND TEA
A. Coffee
- Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the manufacture of coffee powder – Instant coffee, methods, process and equipment involved– Chicory chemistry - Quality grading of coffee.

B. Tea
- Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong andctc – Chemistry and technology of CTC tea – Manufacturing process and equipment involved – Green tea manufacture – Instant tea manufacture – Grading of tea, Processing and quality control.

(12)

UNIT III: CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS
Occurrence - Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates. (12)

UNIT IV: PROCESSING OF COCONUT, OILPALM, ARECANUT AND CASHEW
Processing of plantation crops – production and importance – processing of coconut, oilpalm,

arecanut, cashew– harvesting and stages of harvest – drying, cleaning and grading – production of value added products – packaging and storage of produces.   (12)

UNIT V: PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES
Cleaning and grading of spices - packaging and storage of spices – grading specifications – Agmark, ASTA, ESA specifications - processes involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives.   (12)

TEXT BOOKS:
1. Pandey,P.H.2002. Post   Harvest   Engineering of   Horticultural Crops   through Objectives.SarojPrakasam, Allahabad.
2. Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest Technology.Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi.PP. 514.

REFERENCES:
1. ASTA, Official analytical methods of the American Spice Trade Association, IV Edition, 1997
2. Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins. 1981.
3. Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1981
4. Pruthi, J.S. Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA. 1980.

FT E06   FOOD PROCESS EQUIPMENT DESIGN   4   0   0   4

COURSE OBJECTIVES
➢ To understand the construction requirements, process design, fabrication and installation of equipments and to enhance the knowledge in the design of food processing equipments.

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Ability to design, fabricate and operate processing equipments

UNIT I: INTRODUCTION
Material of construction: Introduction to material selection; Material properties; Environmental effects on material selection; Mechanical properties & strength of materials.
(12)

UNIT II: CONSTRUCTIONREQUIREMENTS
Design basis: Design code; Design pressure, stress & factor of safety; Corrosion allowance; Weld joint efficiency factor; Design loadings; Criteria of failure.   (12)

UNIT III: DESIGNOFPIPESANDPRESSUREVESSELS
Design of pipe and pipe fittings. Process vessels under internal and external pressure; Design of attachments and closures;   (12)

UNIT IV: DESIGNOF SUPPORTS
Design of flange connections & threaded fasteners; Design of supports; Bracket or Lug supports, Leg Supports, Skirt Supports.   (12)

UNIT V: DESIGNOFPROCESSEQUIPMENTS
Process Design of double pipe heat exchanger; Shell & Tube Heat Exchanger. Design of Evaporator; Agitation Vessels and centrifugal separator. Design of Rotary Dryer. (12)

TEXT BOOKS:
1. B.C.Bhattacharya.―Introduction to Chemical Equipment Design — Mechanical Aspects, CBS Publishers,Delhi.1991.
2. Anantha krishnan.C.P.and M.N.Sinha.―Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi,1997.

REFERENCES
1. Groff, GaneK. and Muthu, JohnF.,―Operations Management Selected Readings,D.B.TaraporevalaSonsandCo,Bombay,1975.
2. Thuesen,H.G., Febrycky,W.J. and Thuesen,G.J.,―Engineering Economy, Prentice–Hall Inc,NewJersey,1978.
3. Stoner,A.F.James.―Management ,Prentice-HallofIndia,NewDelhi,1994.

FT E07   INTELLECTUAL PROPERTY RIGHTS   4   0   0   4

COURSE OBJECTIVES
 ➢ To give an idea about IPR, registration and its enforcement.

COURSE OUTCOMES
On successful completion of the module students will be able to:
 ➢ Ability to manage Intellectual Property portfolio to enhance the value of the firm

UNIT I:INTRODUCTION
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.   (12)

UNIT II:REGISTRATION OF IPRs
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad. 12)

UNIT III:AGREEMENTS AND LEGISLATIONS
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.
                                                                                                (12)

UNIT IV:DIGITAL PRODUCTS AND LAW
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.   (12)

UNIT V:ENFORCEMENT OF IPRs
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.   (12)

TEXT BOOKS:
   1. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
   2. S. V. Satakar, ‒Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES:
   1. Deborah E. Bouchoux, ‒Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets‖, Cengage Learning, Third Edition, 2012.
   2. Prabuddha Ganguli,‖Intellectual Property Rights: Unleashing the Knowledge Economy‖, McGraw Hill Education, 2011.
   3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

COURSE OBJECTVES
- ➢ The course aims to develop the knowledge of students in the area of Cereal processing and technology.
- ➢ This is necessary for effective understanding specific aspects of food processing related to these foods.
- ➢ This course will enable students to appreciate the application of scientific principles in the processing of these materials.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Be able to understand and identify the specific processing technologies used for cereals
- ➢ Understand the application of scientific principles in the processing technologies specific to the materials.

UNIT I:PRODUCTION, STRUCTURE AND COMPOSITION
Status, major growing areas and production of cereals and millets in India and the world, structure, Physical properties; Density, Bulk density, Angle of repose, Hardness, asperity, porosity, stack of milling and moisture on physical properties. Chemical composition, Distribution of nutrients and Aroma of cereals and millets; anti-nutritional factors.   (12)

UNIT II:WHEAT AND RICE
Wheat: Morphology, Physicochemical properties, Wheat Quality, Wheat Milling, quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Milling of rice: Conventional Milling, Modern milling, Advantages and disadvantages of milling machineries, By products of rice milling, Parboiling of rice: Aging of rice: Enrichment: - Need of Enrichment, Methods of enrichment, Enrichment levels, fortification of amino acids. -Processed Foods from rice: Breakfast cereals, flakes, puffing, canning and instant rice.   (12)

UNIT III:OTHER CEREALS
Corn - Morphology, Physico-chemical properties, Corn milling - Wet and dry milling, Milling fractions and modify starches Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; HFCS; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Rye bread; Traditional and Fermented cereal products.   (12)

UNIT IV:MILLETS
Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - storage, insect control; processing - Pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.   (12)

UNIT V:BAKED AND EXTRUDED PRODUCTS
Baked foods - chemical dough development, mechanical dough development, sheeting extrusion other rapid methods; Bread staling – theory, manifestation, retardation measures; Indian Confectionery. Extrusion processing – methods and products.   (12)

TEXT BOOKS AND REFERENCES:

1. Matz, Samuel A. ― The Chemistry and Technology of Cereals as Food and Feed‖ II Edition, CBS, 1996.

2. Delcour, Jan A. and R. Carl Hoseney. ‒Principles of Cereal Science and Technology‖. III Edition. American Association of Cereal Chemists, 2010.

3. Kulp, Karel ―Handbook of Cereal Science and Technology‖. IIEdition,CRC Press, 2000.

4. Morris, Peter C. and James H Bryce ―Cereal Biotechnology‖. CRC / Woodhead, 2000

F

FT E09   INSTRUMENTATION AND PROCESS CONTROL   4   0   0   4

COURSE OBJECTIVES
- To familiarize the students with concepts of process dynamics and control leading to control system design.
- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.
- Gain the knowledge on advanced control systems

UNIT I:INSTRUMENTATION
Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.   (12)

UNIT II:OPEN LOOP SYSTEMS
Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.   (12)

UNIT III:CLOSED LOOP SYSTEMS
Closed loop control systems, development of block diagram for feed-back control systems servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.   (12)

UNIT IV:FREQUENCY RESPONSE
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings.   (12)

UNIT V:ADVANCED CONTROL SYSTEMS
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.   (12)

TEXT BOOKS:
1. Stephanopoulos, G., ─Chemical Process Control─, Prentice Hall of India, 2003.
2. Coughnowr, D., ─ Process Systems Analysis and Control ─,. 3rd ed., McGraw Hill, 2008.

REFERENCES:
1. Marlin, T. E., ─ Process Control ─, IInd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., ─Principles and Practice of Automatic Process Control‖,IIEdn., John Wiley, New York, 1997.

FT E10   BIOLOGICAL SPECTROSCOPY   4   0   0   4

COURSE OBJECTIVES
- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Basics of optical rotary dispersion methods and nuclear magnetic resonance
- Principles and applications of mass spectrometry and X-ray diffraction
- Microscopic techniques and its applications
- Spectroscopic techniques for various biological applications

UNIT I: OPTICAL ROTATORY DISPERSION
Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins.   (12)

UNIT II: TYPES OF NUCLEAR MAGNETIC RESONANCE
Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – ESR multidimensional nmr spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging   (12)

UNIT III: TYPES OF MASS SPECTROMETRY
Ion sources sample introduction – mass analyzers and ion detectors – bimolecular mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.   (12)

UNIT IV: X-RAY DIFFRACTION
Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction.   (12)

UNIT V: SPECIAL TOPICS AND APPLICATIONS
Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods. (12)

TEXT BOOKS:
1. Banwell, Colin N. and E.M. McCash. ‒Fundamentals of Molecular Spectroscopy‖ IVth Edition, Tata McGraw-Hill, 2017.
2. Aruldas, G. ‒Molecular Structure and Spectroscopy‖. IInd Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. ─ Introduction to Spectroscopy:‖ IIIrd Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. ‖Spectroscopic Methods in Organic Chemistry‖. VIth Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Siuzdak, Gary. ‒Mass Spectrometry for Biotechnology ‖. Academic Press / Elsevier,1996.
2. Hammes, Gordon G. ‒Spectroscopy for the Biological Sciences‖. John Wiley, 2005.
3. Campbell I.D and Dwek R.A., ― Biological Spectroscopy ‒, Benjamin Cummins and Company, 1986.
4. Atkins P.W., ‒Physical Chemistry ‒,10th Edition, Oxford University Press India, 2014.

COURSE OBJECTIVES

➤ To learn about basis of nanomaterial science, preparation method
➤ To attain the knowledge on characterization techniques and application

COURSE OUTCOMES

On successful completion of the module students will be able to:

➤ Familiarize about the science of nonmaterial's
➤ Demonstrate the preparation of nonmaterial's
➤ Develop knowledge in characteristic nonmaterial's

UNIT I   INTRODUCTION

Nanoscale Science and Technology- Implications for Physics,   Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and   effect on   properties: Mechanical, Electronic, Optical, Magnetic and   Thermal   properties. Introduction to properties and motivation for study (qualitative only).   (12)

UNIT II   GENERAL METHODS OF PREPARATION

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.   (12)

UNIT III   NANOMATERIALS

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.   (12)

UNIT IV   CHARACTERIZATION TECHNIQUES

X- ray diffraction technique,   Scanning   Electron   Microscopy - environmental   techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.   (12)

UNIT V   APPLICATIONS

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS),   Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.   (12)

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., ―Nanomaterials: Synthesis, Propertiesand

Applications‖, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, ‒Nanoscale Charecterisation of surfaces & Interfaces‖, 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, ‒Nanotechnology‖, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,‒The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations‖. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

FT E12   FOOD PLANT LAYOUT   4   0   0   4

COURSE OBJECTIVES:
- To enable the students understand the various concepts of process development, design consideration and cost estimation in food industry.
- To gain knowledge on quantitative analysis for plant layout and practical layouts

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Apply the knowledge to design projects for setting up a Food Processing Industry.
- Development of the pilot layout and Implement quantitative analysis for plant layout and practical layouts

UNIT I: OVERALL DESIGN OF AN ENTERPRISE

Plant design, sales planning for plant design. Plant Location, levels of Plant location. Location of layout: location factors, plant site selection. Location theory and models, industrial buildings and grounds. Classification of Dairy and Food Plants, farm level collection and Chilling center. Space requirement.   (12)

UNIT II: 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.   (12)

UNIT III: DEVELOPMENT AND PRESENTATION OF LAYOUT

Development of the pilot layout, constructing the detailed layout: Functional design: Sitting of different sections in a plant, Layout installations.layout of watering, lighting and drainage.   (12)

UNIT IV: QUANTITATIVE ANALYSIS FOR PLANT LAYOUT

Engineering economy.Linear programming. Queing theory.Common Problems in Plant Layout and Process scheduling.Siting of Process sections, Equipment selection and capacity determination, Arrangement of process, and service equipment .Estimation of Services and Utilities. Office layout, line balancing, Flexibility.   (12)

UNIT V: PRACTICAL LAYOUTS

PRACTICAL LAYOUTS: Common materials of construction of Food plant, building. Maintenance of Food Plant Building, Illumination and ventilation, Cleaning & sanitization, painting and colour coding, Fly and insect control.   (12)

TEXT BOOKS:
1. M Moore, Mac Millan, ‒Plant Layout & Design‖. Lames, New York, 1971.
2. H.S. Hall & Y.S. Rosen, ‒Milk Plant Layou‖. FAO Publication, Rome, 1963.
3. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas,‒Food Plant Design (Food Science and Technology)‖, CRC Press, 2005.

REFERENCE:
1. ‒Food plant engineering system‖ by Theunis C. Robberts, II Edition, CRC Press, Washington, 2013
2. ‒Food plant economic‖ by Zacharias B. Maroulis and George D. Saravacos published by Taylor and Francis Group, LLC, 2008
3. John Holah, HuubLelieveld, ―Hygienic Design of Food Factories‖, Woodhead Publishing, 2011.
4. Slade, S. ‒Food Processing Plant‖ Vol. 1, Leonard Hill Books, 1990

FT E13   SPECIALITY FOODS   4   0   0   4

COURSE OBJECTIVES
  - ➢ To introduce students to various therapeutic and speciality foods.
  - ➢ To know the food based on genetics, therapeutic foods , specific consumer oriented foods,

COURSE OUTCOMES
On successful completion of the module students will be able to:
  - ➢ Understand the benefits of various Nutritional and healthy foods.
  - ➢ Able to understand the various specialty foods.

UNIT I :NEED AND SCOPE OF SPECIALTY FOODS
Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods.   (12)

UNIT II: PROCESS OF FOOD
A. Specialty foods based on sources; Cereals and millets, Legumes and pulses, Fruits andvegetables, Animal food sources, By product based, Non conventional foods.

B. Specialty foods based on process; Innovative process technology, Food additives basis,Bioactive components, Novel neutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods.
C. Specialty foods based on growing condition - organic, inorganic farming.   (12)

UNIT III: SPECIALTY FOOD BASED ON GENETICS
Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods.Supplementary foods.   (12)

UNIT IV : THERAPEUTIC FOODS
Modification of diets in disorders, feeding purposes Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney , metabolic disorders, allergy, endocrine disorders.   (12)

UNIT V: SPECIFIC CONSUMER ORIENTED FOODS
Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance.   (12)

TEXT BOOK:
  1. Yanyun Zhao ‒Specialty Foods: Processing Technology, Quality, and Safety‖, CRC Press, 2012

REFERENCES:
  1. Steve Taylor, ‒Advances in Food and Nutrition Research‖, Volume 49, Elsevier Inc. ,2005
  2. Parvinder S. Bali, ‒Food Production Operation‖, Oxford University, 2014

COURSE OBJECTIVES
- ➤ The course aims to gain knowledge on machinery and process involved in beverage technology and fermentation process involved in making beverage process

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➤ Be able to understand various concepts, principles and procedures involved in processing of beverages.
- ➤ Demonstrate various unit operations involved in the food beverage manufacturing and also
- ➤ List the quality control steps in beverage preparation.
- ➤ Able to understand and how to prepare carbonated beverages and packing methods.
- ➤ Able to understand and how to prepare Non carbonated beverages and packing methods.
- ➤ Able to understand and how to prepare carbonated beverages in quality control

UNIT I: BASIC INGREDIENTS IN BEVERAGES
Beverage-definition-why we drink beverages-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.   (12)

UNIT II: FERMENTED BEVERAGES ALCOHOLIC
Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc.,Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc,), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc.b) Industrial chemicals: Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation; process descriptions and key controls for optimal production.   (12)

UNIT III: CARBONATED BEVERAGES
Procedures- carbonation equipments-ingredients-preparation of syrups-Filling system-packaging-containers and closures. Packaging of specific foods with its properties like bread, biscuits coffee, milk powder, carbonated beverages snack foods etc.,   (12)

UNIT IV: NON CARBONATED BEVERAGE
Coffee bean preparation-processing-brewing-decaffeination- instant coffee-Teatypes- black, green and oolong- fruit juices, nectars, quash, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages.   (12)

UNIT V: QUALITY CONTROL
Effective application of quality controls, brix, acidity to brix ratio, single strength of juice- sanitation and hygiene in beverage industry-Quality of water used in beverages - threshold limits of various ingredients according to PFA, EFSA and FDA – Absolute requirements of Soluble solids and titrable acidity in beverages.   (12)

TEXT BOOKS:

1. Ashurst, P.R, ―Chemistry and technology of Soft drink and fruit juices‖, 2nd edition, Blackwell

   Publishing Ltd. 2005.
2. Steen, D.P and Ashurst, P.R, ―Carbonated soft drinks – Formulation and manufacture‖, Blackwell Publishing Ltd. 2000.
3. Shankunthala Manay, N. and Shadakdharaswamy, M, ‒Foods – Facts and Principles‖, New Age International Pvt. Ltd, 3rd revised edition 2000.
4. Charles, W.Bamforth, ‒Food, fermentation and microorganisms‖, Blackwell Science Publishing Ltd. 2005.

REFERENCES:

1. Amalendu Chakraverty et al, ‒Handbook of Post Harvest Technology‖, Ed:.,Marcel Dekker Inc. (Special Indian edition) 2000.
2. Robert.W.Hutkins, ‒Microbiology and Technology of Fermented foods‖, IFT Press, Blackwell Publishing Ltd. 2006.
3. ‒Brewing yeast and fermentation Chris Boulton and David Quain‖, Blackwell Science Ltd
4. ‒Prevention of Food Adulteration Acts and Rules Manual‖

FT E15   MILLING TECHNOLOGY   4 0 0 4

COURSE OBJECTIVES

➢ To emphasize the various processing methods involved in converting raw material into quality food products
➢ To expose to the various equipments used for milling process of food materials

COURSE OUTCOMES

On successful completion of the module students will be able to:
➢ U nderstand the important properties of grains and its nutritional value
➢ Know about the byproducts obtained from milling of Rice and its wastes.
➢ Gain the knowledge on byproducts obtained from milling of wheat and its wastes.
➢ Understand the byproducts obtained from milling of pulses and its wastes.
➢ Understand the byproducts obtained from milling of oil seeds and its wastes, recognize the significance of quality parameters in selection, product development and value addition

UNIT I:GRAIN PROPERTIES

Importance of grains and cereals-definitions,Grain   structure, Physico-   chemical properties of grains and its nutritional value. Storage of cereal grains in relation to maintaining grain quality–types of storage structures.   (12)

UNIT II:MILLING OF RICE

Rice milling flow sheet. Explanation of steps in milling operations - Cleaning, Parboiling -Physio – chemical changes during Parboiling and effects of qualities of rice. Methods of Parboiling, Milling, Shellers, Paddy Separator, Whitener, Polisher, Grader, and modern rice mill. By products from rice milling and waste utilization.   (12)

UNIT III:MILLING PROCESS OF WHEAT

Wheat milling flowsheet. Explanation of stepsin milling, Cleaning Principles of Parboiling of wheat - Methods of Parboiling, Sifters, De-stoners, Rollermilling-Breakrolls, and reductionrolls, Sifting and purifying, plansifters. Bran separation. Efficiency of milling process. By products from wheat milling and waste utilization.

Milling of Corn: Corn–types. Dry and wet milling of corn–flow sheet and explanation, By products from corn milling, cornstarch, cornsyrup, cornflakes. Waste utilization.   (12)

UNIT IV:MILLING OF PULSES

Importance of legumes. Milling and processing of Legumes-Methods of milling of pulses. Processing methods-dehulling losses and effect of dehulling on nutritive value. Grading methods, Cooking quality.   (12)

UNIT V:MILLING OF OIL SEEDS

Oil seed processing - natural sources of oil. Physio-chemical properties, mechanical extraction - Oil processing machinery, solvent extraction, factor sinfluencing extraction, types of solvents. Refining of oil, hydrogenation, winterization, changes during storage. Oil seed flour concentrates and isolate.   (12)

TEXT BOOKS:

1. Chakraverty,A.―Post Harvest Technology of Cereals, Pulses and Oil Seeds, Third Edition,
2. Oxford & IBH publishing & Co., NewDelhi, 2000.Sahay,K.M. and Singh.K.K. ― Unit operations of Agricultural Processing, Vikas Publishing House, NewDelhi,1996.

REFERENCES:

1. KulpK and PontJG,―Handbook of Cereal Science and Technology, Second Edition, ChipsLtd. USA, 2000.
2. Khader, VijayaandVimala,V., ―Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007.
3. Harry Lawson.― Food Oils and Fats, Technology, Utilization and Nutrition, CBS Publishers and Distributors, NewDelhi,1997.

FT E16   CREATIVITY, INNOVATION AND NEW FOOD   4   0   0   4
PRODUCT DEVELOPMENT

COURSE OBJECTIVES
  ➢ To study the various issues related to Creativity, Innovation and New Product development.

COURSE OUTCOMES
On successful completion of the module students will be able to:
  ➢ Impart the knowledge of various aspects of Creativity, Innovation and New Product development
  ➢ Acquire knowledge of various ideas for create an idea for project selection.
  ➢ Gain the knowledge of various ideas for new product planning.
  ➢ Able to understand the new product development impart and model preparation to develop the patent for the product.

UNIT I:INTRODUCTION
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.   (12)

UNIT II:PROJECT SELECTION AND EVALUATION
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)   (12)

UNIT III:NEW PRODUCT PLANNING
Design of proto type - testing - quality standards - marketing research - introducing new products.
         (12)

UNIT IV:NEW PRODUCT DEVELOPMENT
Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).   (12)

UNIT V:MODEL PREPARATION & EVALUATION
Creative design - Model Preparation - Testing - Cost evaluation - Patent application.   (12)

TEXT BOOKS:
  1. Twiss, Brian. ‒Managing Technological Innovation‖, Pitman Publishing Ltd., 1992.
  2. Watton, Harry B. ―New Product Planning‖, Prentice Hall Inc., 1992.

REFERENCES:
  1. Nystrom, Harry ‒Creativity and Innovation‖, John Wiley & Sons, 1979.
  2. Khandwalla, N. – ‒Fourth Eye (Excellence through Creativity) - Wheeler Publishing‖, 1992.
  3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

FT E17 DOWNSTREAM PROCESSING 4 0 0 4

COURSE OBJECTIVES

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques
- create the final product formulation and its operations

UNIT I: INTRODUCTION

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products. (12)

UNIT II: PHYSICAL METHODS OF SEPARATION

Unit operations for solid-liquid separation - filtration and centrifugation. (12)

UNIT III: ISOLATION OF PRODUCTS

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods. (12)

UNIT IV: PRODUCT PURIFICATION

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques. (12)

UNIT V: FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, drying and lyophilization in final product formulation. (12)

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu ‒Bioseparations – Downstream Processing for Biotechnology‖, John Wiley, 1988.
2. Sivasankar, B. ‒Bioseparations: Principles and Techniques‖. PHI, 2005.
3. Asenjo, Juan A. ‒Separation Processes in Biotechnology‖. CRC / Taylor & Francis, 1990.

REFERENCES:

1. Ghosh, Raja ‒Principles of Bioseparations Engineering‖. World Scientific, 2006
2. ‒Product Recovery in Bioprocess Technology‖. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

| FT E18 | FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT | 4 | 0 | 0 | 4 |

COURSE OBJECTIVES

- ➢ To understand the global trends and development methodologies of various types of products and services
- ➢ To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- ➢ To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- ➢ To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- ➢ To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Define, formulate and analyze a problem
- ➢ Solve specific problems independently or as part of a team
- ➢ Gain knowledge of the Innovation & Product Development process in the Business Context
- ➢ Work independently as well as in teams
- ➢ Manage a project from start to finish

UNIT I: FUNDAMENTALS OF PRODUCT DEVELOPMENT
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management. (12)

UNIT II: REQUIREMENTS AND SYSTEM DESIGN
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design. (12)

UNIT III: DESIGN AND TESTING
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation. (12)

UNIT IV: SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal. (12)

UNIT V: BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management. (12)

TEXT BOOKS:
1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:
1. Hiriyappa B, ‒Corporate Strategy – Managing the Business‖, Author House, 2013.
2. Peter F Drucker, ‒People and Performance‖, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, ‒Enterprise Resource Planning – Concepts‖, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

FT E19	MANAGEMENT OF FOOD WASTE	4	0	0	4

COURSE OBJECTIVES
- ➢ To impart the knowledge regarding various types of waste generated from various food processing industries and their effective treatment and disposal management.
- ➢ Treatment methods and recycling of waste product from food industry.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Able to apply the technical knowledge of waste management in food industry.
- ➢ Awareness of Importance in treating waste product from food industry.
- ➢ Knowledge of Treatment methods and recycling of waste product from food industry

UNIT I: CLASSIFICATION & CHARACTERIZATION OF FOOD INDUSTRY WASTE
Classification and characterization of waste from various food industries; Need for treating waste from various food industries. (12)

UNIT II: WASTE FROM MEAT, DAIRY AND VEGETABLE PROCESSING INDUSTRY
Classification, analysis and disposal of waste from meat; Bioremediation and utilization of dairy waste. Treatment of water from fruit and vegetable processing industry. (12)

UNIT III: TREATMENT METHODS OF WASTE FROM FOOD INDUSTRY
Treatment methods for liquid waste from food industry; Design of activated sludge process, bioremediation, trickling filter process and Anaerobic Digestion Treatment methods for solid waste from food industry-drying, incineration and Design of solid waste management. (12)

UNIT IV: RECYCLING AND UTILIZATION OF WASTE PRODUCT FROM FOOD INDUSTRY
Treatment of water from food industry -BOD, COD, RO. Recovery of protein from potato starch plant, utilization of molasses, utilization of waste from meat and fish for live stock and poultry. (12)

UNIT V: REGULATORY ISSUES WITH FOOD INDUSTRY WASTE
International and national scenario on disposal of waste from food industries; Regulatory issues with food industry waste. (12)

TEXT BOOKS:
1. Herzka, A. and Booth, R.G. ―Food Industry and Trade: Recycling Waste‖. Applied Science Publishers, 1981.
2. Tegge, G., Green, J. H., and A. Kramer. ―Food Processing Waste Management;: AVI Publishing, 1979 .

REFERENCES:
1. VassoOreopoulou and Winfried Russ. ―Utilization of by-products and Treatment of Waste in the Food Industry‖. Springer, 2007.
2. Ioannis S. Arvanitoyannis. ―Waste Management for the Food Industries‖. Academic Press, 2008.

FT E20   **GENETIC ENGINEERING AND GENETICALLY**   4   0   0   4
                              MODIFIED FOODS

COURSE OBJECTIVES
- To study genetically modified plants which are commercially available
- To study transgenic animals and their engineering method
- To understand genetically modified microorganisms and their applications in foods
- To know about Pharmaceutical applications of genetically engineered plants
- To understand Risk and safety assessment of the GM foods and their labeling

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the genetically modified plants which are commercially available
- Know about the transgenic animals and their engineering method
- Understand the genetically modified microorganisms and their applications in foods
- Know about the Pharmaceutical applications of genetically engineered plants
- Understand the risk and safety assessment of the GM foods and their labeling

UNIT I: BASICS OF RECOMBINANT DNA TECHNOLOGY
Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.   (12)

UNIT II: DNA LIBRARIES
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera.   (12)

UNIT III: SEQUENCING AND AMPLIFICATION OF DNA
Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.   (12)

UNIT IV: TRANSGENIC TECHNOLOGY
DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid.   (12)

UNIT V: APPLICATIONS OF RDNA TECHNOLOGY IN FOODS
Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr TM tomato, Monsanto Round-Up TM Ready, Ciba GeigyBasta TM resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon.   (12)

TEXT BOOKS:

1. Rees, Andy ‒Genetically Modifies Food: A Short Guide for the Confused‖. Pluto Press, 2006.
2. Ahmed, Farid E. ‒Testing of Genetically Modified Organisms in Food‖. Food Products Press, 2004.

REFERENCE:

1. Halford, Nigel G. ‒Genetically Modified Crops‖. Imperial College Press, 2003.

COURSE OBJECTIVES
- ➢ The course aims to develop the knowledge of students in the area of food storage
- ➢ This is necessary for effective understanding specific aspects of food storage

COURSE OUTCOMES

On successful completion of the module students will be able to:
- ➢ Ability to understand the Processing and different storage techniques
- ➢ Ability to identify suitable equipment for fruit and vegetable processing
- ➢ Ability to implement their idea about detailed manufacturing technologies of carbonated and non carbonated nonalcoholic beverages consumed in daily life in food industries.

UNIT I: COLD STORAGE

Cold storage- Moist air and applied psychrometry, Estimation of cooling load, Air conditioning systems, Evaporators, Compressors, Condensers, Expansion devices, Cooling towers, Different types of refrigerants, Transmission and distribution system of cool air, Thermal and vapor insulation materials, Design of small capacity cold storage, Instrumentation and climate management in cold storage.   (12)

UNIT II: FROZEN STORAGE

Quality loses in frozen foods- Physical changes, Chemical changes in food components, Nutritional aspects of freezing, Microbiology of frozen products, Glass transitions temperature and stability of frozen foods, Temperature requirements during frozen storage, Shelf-life of frozen foods- shelf-life testing, Modelling loss of quality in frozen foods, Time-Temperature integrators, Packaging of frozen foods, Different types of freezers.   (12)

UNIT III: CONTROLLED ATMOSPHERIC STORAGE

Biochemical considerations of CAS, Gas exchange mechanisms, Mass balance principles, Gas generators, Equipment's for producing and regulating controlled atmosphere, Design of controlled atmosphere storage chambers.   (12)

UNIT IV: MODIFIED ATMOSPHERIC STORAGE

Overview of Modified atmospheric storage, Gases and Vapor applied to modified atmosphere processing operations, MAP modelling- Kinetics of food deteriorative reactions, Shelf-life testing, Enzyme kinetics applied to MAP, MAP design with oxygen modeling.   (12)
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UNIT V: HYPOBARIC STORAGE

History of Hypobaric storage, Experimental errors in hypobaric storage research, Gas and vapor mass transfer at low pressure, Requirements for installation- measurement devices (Relative humidity, Pressure, Air-change rate, Oxygen, Carbon dioxide, Ethyl alcohol, Acetaldehyde, hypobaric acid vapor), Flow control, Humidity control, Effects on food, Effects on microbes.   (12)

TEXT BOOKS AND REFERENCES:
1. ―Hypobaric storage in food industry- Advances in technology and theory‖- Stanley.P.Berg
2. ‒Frozen food science and Technology‖- Judith.A.Evans
3. ‒Engineering for storage of fruits and vegetables‖- Chandra Gopala Rao

COURSE OBJECTIVES

➢ The course aims to develop the knowledge of students in the area of Fat and Oil processing and technology.
➢ This is necessary for effective understanding specific aspects of food processing related to these foods.
➢ This course will enable students to appreciate the application of scientific principles in the processing of these materials.

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Be able to understand and identify the specific processing technologies used for Fats and oils
➢ Understand the application of scientific principles in the processing technologies specific to the materials.

UNIT I: RAW MATERIALS AND PROPERTIES
Overview of fats and oil, sources of fats and oils- vegetables, animal fat; properties of fats and oils – nomenclature ad structure; chemical properties and reactions – hydrolysis and free fatty acids, esterification, inter-esterification, saponification and iodine value, oxidative stability, peroxide value, conjugated dienes, anisidine value; physical properties – colour, crystal structure f fat, thermal properties, density, SFI, optical and spectroscopical properties.   (12)

UNIT II: FAT AND OIL PROCESSING
Recovery of fats and oils from plant and animal sources, refining, bleaching hydrogenation, fractionation, process and product of inter-esterification deodorization.   (12)

UNIT III: QUALITY OF FATS AND OILS
Flavour quality of fats and oils – formation of flavours and off-flavours, hydrolytic rancidity, oxidative rancidity, flavour impact of oxidation compound, factors affecting flavour quality – intrinsic and extrinsic , methods to measure flavour quality - chemical, sensory analysis, oil quality improvement through processing.   (12)

UNIT IV: OILS AND FATS APPLICATIONS
Utilization of fats and oils: shortening technology, margarine types and preparation technology, liquid oil technology, speciality fats and oils, by product utilization.   (12)

UNIT V: NOVEL DEVELOPMENT IN FATS AND OIL TECHNOLOGY
Strategies for replacement of fats in food products – lipid based fat replacement – sucrose polyesters, propoxylated derivatives of glycerides, wax esters, esters of polycarboxylic acids, glyceryl fatty esters, partially digestible fat substitutes, protein based fat replacement, role of carbohydrate in replacement of fat, genically engineered and identity preserved oils.   (12)

TEXT BOOK:
1. Introduction to oils and fats – ― Richard D.O'Brien‖ and ―Watter. E. .farr‖,:Peter. J.Wan‖. Seconf edition.

EMERGING TECHNOLOGIES IN FOOD 4 0 0 4
PROCESSING

COURSE OBJECTIVES

➢ The course aims to develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.
➢ This course will enable students to understand the advantages and disadvantages over existing technologies.

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Be able to understand and identify the different recent processing technologies and their application.
➢ Understand the application of scientific principles in the processing food technologies specific to the materials.

UNIT I: HIGH PRESSURE PROCESSING OF FOODS

Introduction, principles, use of high pressure to improve food safety and stability. Effectsof high pressure on food quality, Applications of high pressure. HPP of Salads/Ready Meals – effects on microorganisms, enzyme activity, texture and nutrients. (12)

UNIT II: PULSED ELECTRIC FIELD PROCESSING

Mechanism of action, PEF treatment systems; PEF processing of liquid foods and beverages. High intensity electric field pulses on solid foods. Non thermal methods- its applications - Application of light pulses in sterilization of foodsand packaging materials. (12)

UNIT III: NOVEL METHOD

Non thermal processing by radio frequency electric fields; Ultrasound as a food preservation tool; Freeze drying - Food irradiation - advantages and applications. – Super critical fluidextraction – Aseptic processing in foods - extrusion cooking – equipment. (12)

UNIT IV; HURDLE TECHNOLOGY

Basics of hurdle technology – Mechanism, Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived antimicrobials – Antimicrobial enzymes– bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle). (12)

UNIT V: INNOVATION IN FOOD REFRIGERATION

Vacuum cooling of foods; High pressure freezing; Freeze drying (lyophilisation) – Theory – Equipment - Effect on foods – Freeze concentration – Theory – Equipment. (12)

TEXT BOOKS:

1. Da-Wen Sun,‒Emerging Technologies for Food Processing‖, Academic press/ Elsiever, London, UK,2005.

REFERENCES:

1. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food stability safety and quality, Kluwer Academics / Plenum Publishers, New York (2002).
2. Da –Wen Sun, ‒Thermal Food Processing: New Technologies and Quality Issues, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, Florida,USA, 2012.
3. Gustavo V.Barbosa-Canovas, Maria S.Tapia and M.Pilar Cano, ― Novel Food Processing Technologies‖. CRC Press, 2004.

FT E24 TOTAL QUALITY MANAGEMENT   4   0   0   4

COURSE OBJECTIVES
 ➢ To facilitate the understanding of Quality Management principles and process.

COURSE OUTCOMES

On successful completion of the module students will be able to:
 ➢ The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.
 ➢ Ability to remember the basics of quality
 ➢ Ability to apply TQM tools and techniques to resolve quality problems
 ➢ Ability to demonstrate quality management system

UNIT I : INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.   (12)

UNIT II :TQM PRINCIPLES

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.   (12)

UNIT III: TQM TOOLS AND TECHNIQUES - I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.   (12)

UNIT IV :TQM TOOLS AND TECHNIQUES - II

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.   (12)

UNIT V :QUALITY MANAGEMENT SYSTEM

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT **SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS**.**   (12)

TEXT BOOK:
 1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ‒Total Quality Management‖, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:
 1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2011.
 2. B.Janakiraman and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2009.
 3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Learning 7th print,Pvt. Ltd., 2011.
 4. ISO 9001-2015 Quality Management Systems.

FT E25 COMPUTER APPLICATION IN FOOD INDUSTRY   4   0   0   4

COURSE OBJECTIVES
  ➢ The main objective of introducing this course in food technology is to expose the student with fundamental knowledge on hardware and software of computers. It will also impart knowledge related to the applications of computation in food industries

COURSE OUTCOME
On successful completion of the module students will be able to:
  ➢ Know various software for their application in food technology
  ➢ Application of MS Excel to solve the problems of Food Technology
  ➢ Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product
  ➢ Application of computers in instrumentation and control of food machinery, inventory control, process control etc.

UNIT I: INTRODUCTION
Importance of computerization in food industry, operating environments and information systems for various types of food industries, principles of communication.   (12)

UNIT II: SUPERVISORY CONTROL AND DATA ACQUISION (SCADA)
Introduction to SCADA, SCADA systems hardware and firmware, SCADA systems software and protocols, landlines, local area network systems, modems, central site computer facilities.
            (12)

UNIT III : SPREADSHEET APPLICATIONS
Data entry, interpretation and solving problems; Cells, cell reference, functions, preparation of charts, use of macros to solve engineering problems; use of add-ins, use of solver etc.,
            (12)

UNIT IV: WEB HOSTING AND WEBPAGE DESIGN
Domain registration, web hosting, webpage design using web publishing software; Introduction to File Transfer Protocol (FTP); Online food process control from centralized server system in processing plant.   (12)

UNIT V: USE OF MATLABS IN FOOD INDUSTRY
Introduction, MATLAB interactive sessions, computing with MATLAB, Script files and editor/debugger; MATLAB help system, problem solving methodologies; Numeric, cell and structure array; Arrays, multidimensional arrays, element by element operations ; Matrix operations, polynomial operations using arrays, cell arrays, structure arrays; Functions and Files in MATLAB: Elementary mathematical functions, user defined functions; Advanced function programming, working with data files; Programming using MATLAB, Program design and development, Relational operators and logical variables, Logical operators and functions, Conditional statements, loops, the switch structure, debugging MATLAB programs, applications to simulation Plotting and Model Building in MATLAB; XY plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function.
            (12)

TEXT BOOKS:

1. David Bailey and Edwin Wright. Practical SCADA for Industry. Elsevier
2. William J. Palm. Introduction to MATLAB 7 for engineers. McGraw Hill Professional
3. Da Wen Sun. Computation Fluid Dynamics in Food Processing. CRC press

REFERENCES:

1. Jenny Chapman. Web Design: A Complete Introduction. John Wiley & Sons
2. Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall.