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***

FOREWORD

Food is an essential part of everyone's lives as it gives us the energy and nutrients to grow and develop, be healthy and active, to move, think and learn. The food you consume on a daily basis is the result of extensive food research, a systematic investigation into a variety of foods, their properties and compositions. After the initial stages of research and development comes the mass production of food products using principles of food technology. If you se the world Hunger Map, Hunger exists all over the world. However, the majority of undernourished people live in developing countries like India and the reason is not the lack of food production but the lack of technology for storage and processing of food.

India ranks first in milk production, second in fruits and vegetables production in the worlds. However, it's a global share in international market is just 1%. Only 2% of these commodities are processes into value-added products. Hence, there is a need for maximum commercial utilization of fruits and vegetables and other food commodities to adapt modern production and marketing activities to the requirements of the world market and cater to domestic demand. Over the past few years, the demand has been exponentially increasing due to various socio- economic factors such as increased population and income.

Within the next 50 years, the world's population is expected to rise to over 9 billion which is alarming and so is the problem of availability of safe food. Food Technology makes it possible for the majority of the world's current population of seven billion to have better access to an abundant, diverse food supply that is largely safe, flavorful, nutritious, convenient and economical than ever before.

Food Technology course was started at Vignan's University in the year 2014 to address the above-mentioned problems in food sector.

The very aim of this Food Technology course is to import knowledge and skills related to food processing, preservation, storage and development of innovative food products with the help of advanced technologies leading to sustainable growth of food sector.

R-19 curriculum comprises of:

- Two modular courses with industry support.
- Enhanced skills-based courses for improving employment opportunities
- Advanced courses like food plant equipment design, food processing operations, unit operations.
- Laboratory sessions embedded into as many courses as possible.

In R19 curriculum, every care has been taken to accommodate the knowledge and skills requirements of industry through proper activities for practice. While making the graduates industry ready, it also enables them to be successful in competitive examinations like GATE and engineering services.

Students are offered training in various fields of foo technology such as bakery and confectionery Technology, dairy technology, fruits and vegetable processing technology, beverage technology etc. Curriculum of the B. Tech Food Technology consists of core Food Technology courses, elective courses, some basic courses of science that form the bridge to technology, industry internships and project works. In the new curriculum of R-19, skill-oriented activities are included to enable the students to acquire hands -on experience of technology to make them technocrats, who are better suited for industry requirements. The board of studies consisting eminent personalities along with experienced faculty members of the university have designed the curriculum to offer knowledge and skill of Food Technology on the above-mentioned areas.

External BoS Members:

1. **Dr. Srinivas Maloo,** Associate Professor & Head, Dept of Food Technology, Osmania University.
2. **Dr. Rama Chandra Pradhan**, Professor & Head, Department of Food Process Engineering, NIT, Rourkela.
3. **Dr. Ch. V. V. Satyanarayana**, Professor & University Head, Food Process Engineering, Bapatla.
4. **Mr. Aniket Banarjee**, Senior Manager, FMCG, Marino Food Products Pvt. Ltd., Hyderabad.
5. **Dr. Sridevi Panyalaraju**, Scientist, ANGRAU, Guntur.
6. **Mr. Prashant Bagade**, Head, National Collateral Management Services Ltd., Hyderabad.

I thank all the Bos Members, Academic council and University authorities for encouraging and supporting us in designing this innovative curriculum for our students.

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

VISION

To evolve into a Centre of Excellence in Science & Technology through creative and innovative practices in teaching – learning, towards promoting academic achievement and research excellence to produce internationally accepted, competitive and world class professionals who are psychologically strong & emotionally balanced, imbued with social consciousness & ethical values.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry - institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among students and contribute to the economic and technological development of the region, state and nation.

Department of
FOOD TECHNOLOGY

VISION

To create trained, and skilled human resources well versed in engineering aspects of food processing to cater the needs of the rapidly growing food processing sector.

MISSION

- To establish itself as the leader in human resource development for supporting the food processing sector.
- To provide knowledge and skills for better preservation, processing and value addition to agro-products, with the aim of supporting the producers.
- To promote research and development for product and process and assurance of high level of hygiene and safety of processed food.
- To promote food safety laws and regulations for supporting a competitive, modern and safe food market for the consumers.

B.Tech. - FOOD TECHNOLOGY

Programme Educational Objectives (PEOs)

PEO1: Graduates of the programme will have successful career in technical or professional fields.

PEO2: Graduates of the programme will have technical competency in solving challenging societal tasks in ethical and economical manner.

PEO3: Graduates of the programme will reveal lifelong learning and teamwork in their profession.

Programme Specific Outcomes (PSOs)

PSO1: Design and analyze components/systems that can effectively utilize food waste and their valoriza tion.

PSO2: Design and analyze the recent developed tools in food processing sector for Non-Thermal process ing and Hurdle Technology.

Programme Outcomes (POs)

The graduates of Engineering will be able to:

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamen tals, 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 teamwork:** 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 principle 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.

B.Tech.
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I YEAR

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

I Year I Semester

Course Code	Course Title	L	T	P	C
19HS102	Engineering Mathematics - I (B)	3	1	2	5
19HS115	Engineering Physics	3	0	2	4
19EE101	Basics of Electrical & Electronics Engineering	3	0	2	4
19ME101	Engineering Graphics & Design	2	0	2	3
19HS121	Organic Chemistry	3	0	2	4
19PC001	Physical Fitness, Sports & Games-I	0	0	3	1
	Total	**14**	**1**	**11**	**21**

I Year II Semester

Course Code	Course Title	L	T	P	C
19HS108	Engineering Mathematics - II (B)	3	1	2	5
19FT101	Food Biochemistry and Nutrition	3	0	2	4
19CS101	Programming for Problem Solving	2	0	4	4
19HS122	English Proficiency and Communication Skills	0	0	2	1
19ME103	Workshop	1	0	2	2
19HS123	Technical English Communication	2	0	2	3
19HS124	Constitution of India	1	0	0	1
19EE102	Basic Engineering Products	2	0	2	3
19PC002	Physical Fitness, Sports & Games-II	0	0	3	1
	Total	**14**	**1**	**19**	**24**

L : Lecture Hours/week ; T : Tutorial Hours/week
P : Practical Hours/week ; C : Credits of the Course

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II YEAR

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

II Year I Semester

Course Code	Course Title	L	T	P	C
19HS203	Probability and Statistics	3	1	0	4
19FT201	Food Chemistry and Toxicology	3	0	2	4
19FT202	Food Microbiology	3	0	2	4
19FT203	Fundamentals of Fluid Mechanics	3	0	2	4
19FT204	Thermodynamics and Heat Engines	3	0	0	3
19MS303	Principles of Management & Organizational Behaviour	3	0	0	3
19PC003	Life Skills-I	0	0	2	0
19PC004	Technical Seminar-I	0	0	2	1
19PC005	Intra-Disciplinary Projects-I	0	0	3	1
19PC006	Physical Fitness, Sports & Games-III	0	0	2	1
	Total	**18**	**1**	**15**	**25**

II Year II Semester

Course Code	Course Title	L	T	P	C
19FT211	Fundamentals of Heat and Mass Transfer	3	0	2	4
19FT212	Food Processing Operations	3	0	2	4
19FT213	Principles of Food Processing and Preservation	3	0	2	4
19FT214	Meat Fish and Polutry Process Technology	3	0	0	1
19HS204	Environmental Studies	1	0	0	3
19PC007	Life Skills-II	0	0	2	1
19PC009	Technical Seminar-II	0	0	2	1
19PC008	Intra Disciplinary Projects-II	-	-	2	1
***	Open Elective-I	3	0	0	3
	Total	**16**	**0**	**12**	**22**

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III YEAR

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

III Year I Semester

Course Code	Course Title	L	T	P	C
19FT301	Dairy Technology	3	0	2	4
19FT302	Fruits and Vegetable Processing	3	0	2	4
19FT303	Cereals Pulses and Oilseeds Process Technology	3	0	2	4
19HS205	Soft Skills Lab	0	0	2	1
19PC010	Employability Skills-I	0	0	2	0
19HS301	Professional Ethics, Human Values & Gender Equity	2	0	0	2
19PC011	Inter Departmental Projects-I	-	-	4	2
19PC012	Modular Course	-	-	-	1
***	Department Elective-I	3	0	0	3
***	Open Elective-II	3	0	0	3
	Total	**18**	**0**	**12**	**24**

III Year II Semester

Course Code	Course Title	L	T	P	C
19FT311	Spices and Plantation Crops Process Technology	3	0	2	4
19FT311	Bakery and Confectionery Technology	3	0	2	4
19FT313	Food Additives	3	1	0	4
19HS206	Professional Communications Lab	0	0	2	1
19PC013	Employability Skills-II	0	0	2	1
19PC014	Inter Departmental Projects-II	-	-	4	2
***	Department Elective-II	3	0	0	3
***	Open Elective-III	3	0	0	3
	Total	**15**	**1**	**12**	**22**

B.Tech.
FT
IV YEAR

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

IV Year I Semester

Course Code	Course Title	L	T	P	C
19FT401	Food Quality Safety and Standards	3	0	0	3
19FT402	Food Plant Layout and Equipment Design	3	0	2	4
19FT403	Food Packaging	3	0	2	4
19PC015	Societal Centric and Indstry Related Projects	-	-	6	3
***	Department Elective - III	3	0	0	3
***	Department Elective-IV	3	0	0	3
	Total	**15**	**0**	**10**	**20**

IV Year II Semester

Course Code	Course Title	L	T	P	C
19PC016/19PC017	Project Work / Internship	-	-	24	12
	Total	**-**	**-**	**24**	**12**

In addition to L, T, P, C the following information in hours/semester is also provided for each course.

WA/RA : Writing Assignment / Reading Assignment
SSH/HSH : Self Study Hours / Home Study Hours
CS : Case Study and Example
SA : Skills Activity
S : Seminar
BS : Beyond Syllabus

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ELECTIVES

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

DEPARTMENT ELECTIVE COURSES

ELECTIVE - I

Course Code	Course Title	L	T	P	C
19FT331	Refrigeration Engineering and Cold Chain	3	-	-	3
19FT332	Engineering Properties of Food Materials	3	-	-	3
19FT333	Instrumental Methods of Food Analysis	3	-	-	3
19FT334	Introduction to Biochemical Engineering and Enzyme Technology	3	-	-	3
19FT335	Instrumentation and Process Control	3	-	-	3
19FT336	Emerging Trends in Food Processing	3	-	-	3

ELECTIVE - II

Course Code	Course Title	L	T	P	C
19FT337	Nutraceutical and Functional Foods	3	-	-	3
19FT338	Grain Storage Technology	3	-	-	3
19FT339	Maintenance of Food Equipment	3	-	-	3
19FT340	Food Toxicology Agrochemical Residues in Food	3	-	-	3
19FT341	Strategy and Marketing of Food Products	3	-	-	3
19FT342	Extrusion Technology	3	-	-	3

ELECTIVE - III

Course Code	Course Title	L	T	P	C
19FT430	Food Biotechnology	3	-	-	3
19FT431	Bioprocess Engineering	3	-	-	3
19FT432	Food Plant Layout Management and Utilities	3	-	-	3
19FT433	Post Harvest Management of Fruits and Vegetables	3	-	-	3

ELECTIVE - IV

Course Code	Course Title	L	T	P	C
19FT434	Project Planing Preparation and Management	3	-	-	3
19FT435	Waste Management and by Product Utilization	3	-	-	3
19FT436	Dairy and Food Processes	3	-	-	3
19FT437	Nano Technology	3	-	-	3

B.Tech.
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ELECTIVES

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

OPEN ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
19AE521	Basic Automobile Engineering	3	-	-	3
19AE531	On Road and Off-road Vehicles	3	-	-	3
19AE532	Safety Systems in Automobiles	3	-	-	3
19AE541	Vehicle Maintenance and pollution Norms	3	-	-	3
19BI521	Community Informatics	3	-	-	3
19BI531	Health Informatics	3	-	-	3
19BI532	Software Tools for Sustainable Biodiversity	3	-	-	3
19BM521	Basic Clinical Sciences	3	-	-	3
19BM522	Assist Devices and Implant Technology	3	-	-	3
19BM531	Clinical Instrumenatation	3	-	-	3
19BM532	Biomaterial and Artificial Organs	3	-	-	3
19BM533	Biomedical Equipments	3	-	-	3
19BM541	Medical Imaging Techniques	3	-	-	3
19BM542	Medical Physics	3	-	-	3
19BT521	Elements of Biotechnology	3	-	-	3

B.Tech.
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ELECTIVES

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

OPEN ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
19BT531	Community Medicine and Public Health	3	-	-	3
19BT532	Biodiversity Economics, Trade and Commerce	3	-	-	3
19BT533	Bioplastics and Biocomposites Engineering	3	-	-	3
19CE521	Environmental Pollution & Control	3	-	-	3
19CE522	Building Technology	3	-	-	3
19CE531	Disaster Management	3	-	-	3
19CE532	Solid Waste Management	3	-	-	3
19CE533	Remote Sensing & Geographical Information System	3	-	-	3
19CE541	Environmental Impact Assessment	3	-	-	3
19CS531	Python Programming	3	-	-	3
19CS532	R Programming	3	-	-	3
19CS533	Data Structures	3	-	-	3
19CS534	Database Management Systems	3	-	-	3
19CS535	Operating Systems	3	-	-	3

B.Tech.
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ELECTIVES

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

OPEN ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
19CS541	Data Mining Techniques	3	-	-	3
19CS542	Internet of Things	3	-	-	3
19EC521	Embedded Linux	3	-	-	3
19EC531	Embedded Systems and RTOS	3	-	-	3
19EC532	Microcontrollers for Embedded Systems	3	-	-	3
19EC541	Design of IOT Systems (IOT)	3	-	-	3
19EE521	Solar PV Technologies-I	3	-	-	3
19EE531	Solar PV Technologies-II	3	-	-	3
19EE532	Design & Economics of PV plants	3	-	-	3
19EE541	Solar Thermal Conversion Systems	3	-	-	3
19FT521	Introduction of Food Laws and Regulation	3	-	-	3
19FT531	Food Quality and Evaluation	3	-	-	3
19FT532	Subjective and Objective Evaluation in Food Products	3	-	-	3
19FT541	Food Safety and Public Health	3	-	-	3
19HS521	Modern Indian History and Indian Culture	3	-	-	3

B.Tech.
FT
ELECTIVES

R-19 CURRICULUM

(Applicable for students admitted into First Year from academic year 2019-20 onwards)

OPEN ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
19HS531	Polity and Governance in India	2	-	-	2
19HS532	Economic and Social Development in India	2	-	-	2
19HS541	Geography of India	2	-	-	2
19IT521	OOPs through JAVA	3	-	-	3
19IT541	Data Science using Python	3	-	-	3
19MS521	Business Environment and Ethics	3	-	-	3
19MS522	Managerial Economics	3	-	-	3
19MS531	Marketing and HR Management	3	-	-	3
19MS532	Finance for Engineers	3	-	-	3
19MS541	Production and Operations Management	3	-	-	3
19ME521	Biomechanics & Kinesiology	3	-	-	3
19ME522	Basics in Robotics	3	-	-	3
19ME531	Advances in Robotics	3	-	-	3
19ME532	Reliability Engineering	3	-	-	3
19ME533	Field and Service Robots	3	-	-	3
19ME534	Energy Audit & Management	3	-	-	3
19ME535	Supply Chain Management	3	-	-	3
19TT531	Fashion Product Development	3	-	-	3
19TT532	Costing of Fashion and Apparel Production	3	-	-	3
19TT541	Fashion Marketing and Visual Merchandising	3	-	-	3

Note : Students should not choose open electives offered by their branch.

I

YEAR

FOOD TECHNOLOGY

B.Tech.

I SEMESTER

19HS102	-	Engineering Mathematics - 1 (B)
19HS115	-	Engineering Physics (C)
19EE101	-	Basics of Electrical & Electronics Engineering
19ME101	-	Engineering Graphics & Design
19HS121	-	Organic Chemistry
19PC001	-	Physical Fitness, Sports & Games -I

II SEMESTER

19HS108	-	Engineering Mathematics - II (B)
19FT101	-	Food Bio Chemistry and Nutrition
19CS101	-	Programming for Problem Solving
19HS122	-	English Proficiency and Communication Skills
19ME103	-	Workshop
19HS123	-	Technical English Communication
19HS124	-	Constitution of India
19EE102	-	Basics of Engineering Products
19PC002	-	Physical Fitness, Sports & Games - II

COURSE CONTENTS

I SEM AND II SEM

19HS102 ENGINEERING MATHEMATICS I (B)
BASIC MATHEMATICS

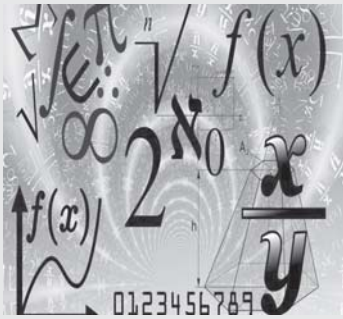
Hours Per Week :

L	T	P	C
3	1	2	5

Total Hours :

L	T	P
45	15	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	45	-	10	-	5



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COURSE DESCRIPTION AND OBJECTIVES:

To acquaint students with fundamental principles of mathematics through partial fractions, induction, calculus, numerical methods that serves as an essential tool in several engineering applications.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Demonstrate the technique of numerical methods to solve integrals.	1, 2
2	Apply the methods of differentiation and integration for functions.	1, 2
3	Resolve algebraic expressions into partial fractions and to prove the identities by mathematical induction.	1, 2
4	Analyse the continuity and differentiability of functions.	1, 2
5	Use software tools to obtain and verify the solutions.	5

SKILLS:

- ✓ *Prove empirical mathematical relations using mathematical induction.*
- ✓ *Resolve given fractional polynomials into partial fractions.*
- ✓ *Test the functions of one variable for their continuity and differentiability.*
- ✓ *Apply numerical methods for integrating functions and finding roots of algebraic equations.*

ACTIVITIES:

- *Find continuity, differentiability and the limit of a given function.*
- *Find appropriate value of integrals using trapezoidal, Simpson's rules.*
- *Find an appropriate root for a given function using Newton - Raphson method.*

UNIT - I **L-9**

MATHEMATICAL PRELIMINARIES:

Partial fractions-introduction, proper and improper fractions, resolution into partial fractions, type 1, type 2, type 3, type 4.

Mathematical induction-introduction, principles of mathematical induction.

UNIT - II **L-9**

TRIGONOMETRY : Introduction; Trigonometric functions-properties; Compound angles.

UNIT - III **L-9**

DIFFERENTIAL CALCULUS : Introduction; Limits; Continuity; Differentiation; Methods to compute derivatives; Partial differentiation.

UNIT - IV **L-9**

INTEGRAL CALCULUS : Introduction; Integration; Methods to compute integrals; Definite integration.

UNIT - V **L-9**

NUMERICAL METHODS – I

NUMERICAL INTEGRATION : Trapezoidal rule; Simpson's 1/3 rule; Simpsons 3/8 rule.

Solutions of Algebraic and Transcendental Equations : Introduction; Bisection method; Iteration method; Newton-Raphson method.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

Students are expected to do atleast ten of the following experiments.

1. Mathematical preliminaries.
2. Partial fractions for fractional polynomial.
3. Limits of functions.
4. Continuity of functions.
5. Differentiation of functions of one or two variables.
6. Integration of functions.
7. Definite integrals of functions.
8. Trapezoidal rule for numerical integration of functions.
9. Simpson's 1/3 rule for numerical integration of functions.
10. Simpson's 3/8 rule for numerical integration of functions.
11. Newton-Raphson method.

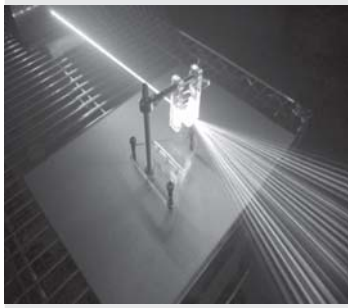
TEXT BOOK:

1. C. W. Evans, "Engineering Mathematics - A Programmed Approach", Special Indian Edition, Stanley Thornes (Publishers) Ltd., Cheltenham, UK, 2011.

REFERENCE BOOKS:

1. P. S. Rao, "A Textbook of Remedial Mathematics", 2nd edition, Pharma Med Press, 2015.
2. A. Jeffrey, "Mathematics for Engineers and Scientists", 6th edition, (Special Indian Edition), CRC Press, 2013.

19HS115 ENGINEERING PHYSICS (C)



Source: *http://physicsopenlab.org/2017/08/29/laser-diffraction-grating/*

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	0	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	15	0	10	2	3

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of this course is to present the principles and concepts of Physical Optics. It provides an in-depth understanding of Lasers, optical fibres and ultrasonics followed by crystal Physics and Nano-materials and their applications as relevant to an Engineer.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the concepts of Physical Optics in view of engineering applications.	1
2	Analyze the wavelengths of Laser for suitable applications in the field of industry, medicine and communication and to foster the knowledge on optical fibers to realize fiber optic communication and fiber optic sensors.	1
3	Recognize the importance of Crystal Physics relevant to biophysical systems.	2
4	Evaluate Ultrasonic wave velocity in liquids and solids and to apply Ultrasonic waves in medical diagnostics.	5
5	Compute the dimensions of nano particles to consolidate the physical aspects of nanomaterials.	6

SKILLS:

- ✓ *Apply the dynamics of light to realize various potential applications in Engineering.*
- ✓ *Evaluate the concepts of Lasers and optical fibers to realize vivid applications in Science and Engineering.*
- ✓ *Determine and analyse the crystal structures.*
- ✓ *Enunciate the importance of Ultrasonics in medicine.*
- ✓ *Production and characterization of nanomaterials aiming at their applications.*

ACTIVITIES:

- *Determination of thickness of a given thin object.*
- *Measurement of resolving power of grating.*
- *Measurement of specific rotation of a given medium.*
- *Designing laser instrument for measuring height of a room.*
- *Study on the numerical aperture of optical fibers prepared from different materials.*
- *Identification of materials from the determination of acceptance angle of a given fiber.*

UNIT - I **L-8**

PHYSICAL OPTICS :

Interference: Introduction; Superposition principle; Division of wave front; Division of amplitude; Newton's rings; Michelson interferometer; Applications.

Diffraction: Introduction-Fraunhofer and Fresnel diffraction; Fraunhofer diffraction at a slit; Plane transmission diffraction grating; Dispersive and resolving powers of grating.

Polarization: Polarized and unpolarized light; Double refraction; Nicol prism; Quarter and half wave plates; Laurent's half shade polarimeter.

UNIT - II **L-12**

LASERS & OPTICAL FIBRES:

LASERS: Characteristics of laser light; Spontaneous and stimulated emission of radiation; He-Ne laser; CO_2 laser; Semiconductor laser and applications; Holography and applications.

FIBRE OPTICS: Principle of optical fibre; Acceptance angle; Numerical aperture; Types of fibres; Dispersion and attenuation in optical fibres; Optical fibre communication system; Fibre optic sensors; Applications.

UNIT - III **L-8**

CRYSTAL PHYSICS:

Crystal Physics: Introduction-Fundamental terms of crystal physics; Lattice parameters; Crystal systems; Packing factor for SC, BCC and FCC; Miller indices; Distance of separation between successive (h k l) planes; X-ray diffraction; Bragg's law; Applications.

UNIT-IV **L-9**

ULTRASONICS:

Introduction; Properties of ultrasonic waves; Types of ultrasonic waves; Production of ultrasonic waves; Determination of velocity of ultrasonic waves in solids and liquids; Ultrasound in medicine.

UNIT- V **L-8**

ELEMENTS OF NANOMATERALS:

Introduction; Concept of quantum size effect; Synthesis of nanomaterials -top-down and bottom-up approaches-ball milling & sol-gel methods; Applications of nanomaterials; Characterization of nanomaterials by Electron Microscopy and Atomic Force Microscopy (AFM).

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS:30**

1. Newton's rings–Determination of wavelength of a given light source.
2. Plane diffraction grating – Determination of dispersive power.
3. Polari meter –Determination of optical rotation by a given liquid.
4. Laser - Determination of wavelength by using diffraction grating.
5. Optical fibre – Determination of numerical aperture–acceptance angle.
6. Melde's Experiment - Determination of the frequency of tuning fork.
7. Photoelectric effect - Determination of Planck's constant.
8. Determination of velocity of ultrasonic wave's velocity in liquid medium using interferometer method.
9. Dye penetrant test method.
10. Determination of wavelength of given light source using diffraction grating method
11. Stewart & Gees experiment- Study of magnetic field along the axis of a current carrying coil.
12. Solar cell – Determination of fill factor & efficiency.
13. LED – Study of V-I characteristics.

TEXT BOOKS:

1. M. N. Avadhanulu, P. G. Kshirsagar and T. V. S. A. Murthy, "A Text Book of Engineering Physics", 11th edition, S Chand & Company Ltd., 2019.
2. S. Sharma and J. Sharma, "Engineering Physics", Pearson India Education Services Pvt. Ltd., 2018.

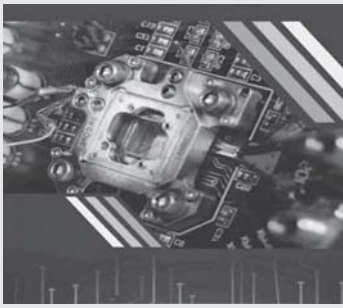
REFERENCE BOOKS:

1. W. T. Silfvast, "Laser Fundamentals", 2nd edition, Cambridge University Press, 2004.
2. D. Halliday, R. Resnick and J. Walker "Fundamentals of Physics", 6th edition, John Wiley and Sons, 2001.
3. N. Subrahmanyam and BrijLal, "Optics", S. Chand & Company Ltd., 2018.
4. M. R. Srinivasan, "Engineering Physics" New Age International Pulishers, 2006.
5. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology" Tata McGraw Hill, 2003.

LABORATORY MANUALS:

1. Dr. R. Das, C.S.Robinson, Rajesh Kumar and Prasanth Kumar Sahu, "A Text Book of Engineering Physics Practical", University Science press, 1st edition, 2010.
2. Jayaraman, "Engineering Physics Laboratory manual", 1st edition, Pearson education, 2014.

19EE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING



Source: https:// engineering interview questions.com

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	40	-	8	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an in-sight into the functioning of basic electrical components like resistor, inductor and capacitor. It deals with the constructional and operational details of both DC & AC machines. It also deals with the basic electronic components like P-N junction diode, Zener diode, Transistor and their characteristics.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the resistive circuits with independent sources and find its solution.	1, 2, 3
2	Solve the AC (single and three phase) and DC circuits using different methods.	1, 2, 3
3	Familiarize the concepts of electromagnetism and its applications.	1, 2
4	Explain the types of electrical equipment, machines and its applications.	1, 2
5	Acquire the knowledge about the characteristics and working principles of semiconductor diodes, transistor.	1, 2

SKILLS:

- ✓ *Distinguish between linear and nonlinear elements by looking at VI characteristics.*
- ✓ *Develop a simple loop generator.*
- ✓ *Design a voltage regulator using Zener diode.*
- ✓ *Design a half and full wave rectifiers using PN junction diode.*

ACTIVITIES:

- *Decoding the value of resistors.*
- *Design and fabricate a simple loop permanent magnet generator.*
- *Design and fabricate a simple air cored transformer.*
- *Fabricate full and half wave rectifiers using PN junction diodes.*
- *Fabricate a voltage regulator using Zener diode.*

UNIT – I **L - 9**

FUNDAMENTALS OF ELECTRIC CIRCUITS: Concept of network; Active and passive elements; Voltage and current sources; Concept of linearity and linear network; Unilateral and bilateral elements; R, L and C as linear elements; Ohm's Law; Kirchhoff's Laws-application to simple series, parallel circuits; Mesh and nodal analysis of resistive circuits with DC source (Simple numerical problem).

UNIT – II **L - 9**

FUNDAMENTALS OF AC CIRCUITS: Generation of AC voltage-frequency, average value, R.M.S. value, form factor, peak factor for sinusoidal only; Analysis of single-phase ac circuits consisting of R, L, C, RL, RC (series and parallel) (simple numerical problems).

BALANCED THREE PHASE SYSTEMS: Relation between phase and line quantities of voltages and currents in star and delta connected systems (Elementary treatment only).

UNIT – III **L - 9**

FUNDAMENTALS OF ELECTROMAGNETISM: Concepts of magneto motive force; Reluctance; Flux and flux density; Concept of self inductance and mutual inductance; Coefficient of coupling (only elementary treatment and Simple numerical problems).

TRANSFORMERS: Principle of operation of single phase transformer; Constructional features; EMF equation (simple numerical problems).

UNIT – IV **L - 9**

DC MACHINES: Constructional details of a DC Machine; DC Generator-principle of operation; EMF equation (simple numerical problems); DC Motor-principle of operation; Torque equation (simple numerical problems).

AC MACHINES: Principle of operation of three phase induction motor; Slip ring and squirrel cage motors; Torque equation; Constructional details of synchronous machine.

UNIT – V **L - 9**

SEMICONDUCTOR DEVICES: Classification of semiconductors; P-N junction diode-operation and its characteristics; Half wave rectifier-operation, efficiency; Full wave rectifiers-types, operation, efficiency; Zener diode and its characteristics; Zener diode as Voltage regulator; Bi polar junction transistor-operation, types (NPN & PNP).

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS-30**

1. Verification of Ohm's law.
2. Verification of Kirchhoff's current law.
3. Verification of Kirchhoff's voltage law.
4. Measurement of Energy in single phase resistive load circuit.
5. Measurement of Power in single phase resistive load circuit.
6. Transformation ratio of a single phase transformer at different loads.
7. Determination of R.M.S. Values of sinusoidal waveform.
8. Determination of impedance in complex AC circuits.
9. Verification of PN junction diode characteristics under both forward and reverse bias.
10. Verification of Zener diode characteristics under reverse bias.

TEXT BOOKS:

1. V. K. Mehta, "Principles of Electrical Engineering and Electronics", 3rd edition, S. Chand & Co., Publications, New Delhi, 2010.
2. D. P. Kothari, "Basic Electrical and Electronics Engineering", 1st edition., TMH, New Delhi, 2014.

REFERENCE BOOKS:

1. Millman and Halkias, "Integrated Electronics", Mc Graw Hill, 1979.
2. A. K. Thereja and B.L. Thereja, "Electrical Technology", Vol.–II, S. Chand & Co.,Publications, 2007.
3. U. Bakshi and A. Bakshi, "Basic Electrical Engineering", 1st edition, Technical Publications, Pune, 2005.

19ME101 ENGINEERING GRAPHICS AND DESIGN

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P
30	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	15	-	-	-	3

SOURCE:
https://
www.gettyimage.in

COURSE DESCRIPTION AND OBJECTIVES:

Engineering graphics is the Language of Engineers and is the most effective way of communicating and sharing technical ideas in the form of pictures/drawings. The objective of this course is to familiarize the students with the conventional concepts of engineering drawing and computer aided drawing.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Communicate the technical ideas in the form of drawings.	1
2	Apply the drawing skills in representing various geometrical features.	1
3	Develop orthographic projections and isometric views of various objects.	2
4	Estimate the lateral surface area of regular geometrical solids.	2
5	Sketch simple objects and their pictorial views using AutoCAD.	5

SKILLS:

- ✓ *Convert isometric views of objects into orthographic views and vice versa.*
- ✓ *Visualize the shape of the 3D components.*
- ✓ *Create pictorial views by using AutoCAD.*
- ✓ *Understand projections by visualization.*

UNIT - I **L-6 P-6**

INTRODUCTION & ENGINEERING CURVES: Types of lines; Lettering; Dimensioning; Geometric construction of lines; Polygons (Angle, ARC, General and Inscribe in circle method); Conical curves (General method); Ellipse by Oblong method.

UNIT - II **L-6 P-6**

ORTHOGRAPHIC PROJECTIONS OF POINTS & LINES: Principle of projection; Planes of projections; Projections of points; Projection of straight lines-inclined to one plane, inclined to both planes.

UNIT - III **L-6 P-6**

PROJECTION OF PLANES: Projection of planes inclined to one reference plane - triangle, square, regular pentagon and hexagon.

PROJECTIONS OF SOLIDS: Projection of solids axis inclined to one reference plane - prism, pyramid, cylinder and cone.

UNIT - IV **L-6 P-6**

DEVELOPMENT OF SURFACES: Development of lateral surfaces of simple solids (Prisms, Pyramids, Cylinder and Cone).

ORTHOGRAPHIC VIEWS: Conversion of pictorial views into orthographic views.

UNIT - V **L-6 P-6**

DRAFTING USING COMPUTER PACKAGE: Introduction to 2D modelling software - AutoCAD; Conversion of isometric view into orthographic views of simple castings; Conversion of orthographic views into isometric view of simple solids (Prisms, Pyramids, Cylinders and Cones).

TEXT BOOKS:

1. N. D. Bhatt, “Engineering Drawing”, 53rd edition, Charotar Publication, 2014.
2. B. Agrawal and C.M. Agrawal “Engineering Drawing”, 2nd edition, Tata McGraw-Hill, 2014.

REFERENCE BOOKS:

1. J. Hole, “Engineering Drawing”, 2nd edition, Tata McGraw-Hill, 2008.
2. K. L. Narayana, “Engineering drawing”, 2nd edition, Scitech Publications, 2008.

19HS121 ORGANIC CHEMISTRY

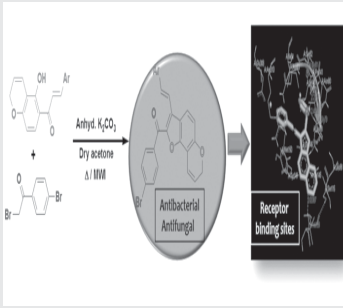
Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	10	-	10	-	05



Source:
Koya Prabhakara Rao. et al., *Journal of Heterocyclic Chemistry,* ***2019****, 56 (1), 73-80*

COURSE DESCRIPTION AND OBJECTIVES:

The course is aimed at offering fundamental concept towards the synthetic methods of common organic compounds including polymers and pharmaceuticals. This course enlightens the students about the fundamentals of bonding, reaction intermediates and stereo-chemical aspects. It provides student to understand advanced level mechanistic aspects of synthesis and characterization techniques for future prospectus.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply various types of reaction intermediates for a variety of organic reactions.	1,2
2	Evaluate the relationship between stereochemistry and biological activity of the optically active compounds.	1,2,3
3	Analyze various synthetic methods with feasible mechanisms for preparing drug molecules.	1,2,3
4	Apply the concept of “Green chemistry” using organic and bio-catalysis for the synthesis of organic compounds.	1,2,3
5	Apply various instrumental techniques for determining the structures of organic compounds.	3,4,5

SKILLS:

- ✓ *Analyze the reactivity of substrates.*
- ✓ *Write a plausible reaction mechanism for different reactions.*
- ✓ *Differentiate optically active and optically inactive compounds.*
- ✓ *Recognize the importance of green chemistry.*
- ✓ *Characterize organic compounds by various structural elucidation techniques.*

ACTIVITIES:

- *Synthesis, purification and characterization of drugs.*
- *Freidal-Crafts Acylation and Alkylation reactions.*
- *Synthesis of organic compounds by catalytic method eg. proline.*

UNIT - I **L-9**

CHEMICAL BONDING AND REACTION INTERMEDIATES:

Chemical Bonding - Introduction to VBT and VSEPR theory; MO theory of diatomic molecules (O_2 and CO); Molecular orbital energy diagram of Ethylene, 1, 3-Butadiene and Benzene.

Reaction Intermediates - Bond fissions; Formation and reactivity of carbanions; Formation and reactivity of carbenium ions; Formation and reactivity of free radicals; Formation and reactivity carbenes.

UNIT - II **L-9**

STEREOCHEMISTRY:

Representations of 3-Dimensional structures; Structural isomers and stereo isomers; Symmetry and chirality; Optical isomerism-enantiomers, diastereomers (Lactic acid and Tartaric acid); Absolute configurations and conformational analysis–ethane and cyclohexane, relevance of stereochemistry in Biology eg. thalidomide, resolution and asymmetric synthesis.

UNIT - III **L-9**

ORGANIC REACTIONS AND SYNTHESIS OF DRUG MOLECULES:

Introduction to reactions involving substitution, addition, elimination, C-C bond formation; **Oxidation -**jones reagent**, Reduction -** $NaBH_4$ and LAH, synthesis of aspirin.

Organometalic Chemistry - Introduction; Grignard & cross coupling reactions.

UNIT - IV **L-9**

GREEN CHEMISTRY:

12 Principles of Green Chemistry; Catalysis including transition metal catalysis (Catalytic Hydrogenation and Wilkinson's Catalyst); Organocatalysis and Bio-catalysis.

UNIT - V **L-9**

STRUCTURAL ELUCIDATION OF ORGANIC COMPOUNDS:

IR Spectroscopy-principle, identification of functional groups; NMR spectroscopy - principle, chemical shift; ^{1}H-NMR- Ethyl Alcohol; Cis-Trans isomers; Mass spectroscopy-principle, fragmentation (Nitrogen Rule); Introduction to XRD.

TEXT BOOKS:

1. A. Bahl and B. S. Bahl, "Text Book to Organic Chemistry", 8th edition, S.Chand, 2009.
2. R. T. Morrison and R. M. Boyd, "Organic Chemistry", 6th edition, Pearson Publications, 2008.
3. G. Patrick, "A Very Short Introduction to Organic Chemistry", Oxford Publishers, 2017.

REFERENCE BOOKS:

1. O. P. Agarwal, "Reactions and Reagents", 46th edition, Goel Publications, 2005.
2. I. L. Finar, "Organic Chemistry", Vol – I, 6th edition, Longman Scientific Publications, 2006.
3. J. March,"Advanced Organic Chemistry", 4th edition, Wiley India Pvt. Ltd, 2007.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS:30**

1. Determination of melting point & boiling point of organic compounds.
2. Analysis of functional groups of organic compounds (any 5 functional groups).
   a. Carboxylic Acids.
   b. Phenols.
   c. Aldehydes.
   d. Ketones.
   e. Amines.
3. Preparation and characterization of aspirin.
4. Separation of organic compounds by thin layer chromatography.
5. Preparation of paracetamol.
6. Synthesis of organic compounds by solvent free methods.
7. Henry (Nitro Aldol) reaction of benzaldehyde and nitromethane.
8. Reduction of aldehydes using sodium borohydride ($NaBH_4$).
9. Oxidation using potssium permanaganate ($KMnO_4$).

TEXT BOOKS:

1. J. Mendham, R. C. Denney, J. D. Bares, M. Thomas and B. S. Sankar, “Vogel’s Text book of qualitative Chemical Analysis”, Pearson Publications - Volume I, 2009.
2. S. F. Brian, Antony J. Hannaford, P. W. G. Smith, A. R. Tatchell “Vogel’s text book of Practical Organic chemistry”, 5th edition, Longman Scientific & Technical, 1989.

19HS108 ENGINEERING MATHEMATICS II (B)

MATRICES & ORDINARY DIFFERENTIAL EQUATIONS

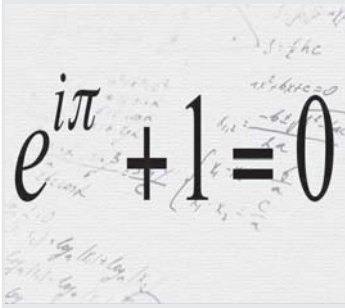
Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	5	-	5



Source:

https://www.google.co.in/search?q=mathematics+pictures&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiQ-837lvXiAhVPVH0KHe56CVEQ_AUIECgB#imgrc=Esg2yM5aAVbqDM:

COURSE DESCRIPTION AND OBJECTIVES :

To provide students with solid foundation in mathematical fundamentals such as matrices, ordinary differential equations and their applications required for engineering applications.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Demonstrate the concept of analytical and numerical methods to solve differential equations.	1, 2
2	Finding inverse of a matrix and powers of a matrix.	1, 2
3	Appreciate applications of first order differential equations.	1, 2
4	Determine rank, eigen values and eigen vectors of a matrix and solution of a system of linear equations.	1, 2
5	Use software tools to obtain and verify the solutions.	5

SKILLS:

- ✓ *Test the consistency of system of linear equations and solve them using Matrix algebra methods.*
- ✓ *Solve first and higher order linear differential equations analytically and numerically through appropriate methods.*
- ✓ *Study some real life problems through differential equations.*

ACTIVITIES:

- *Testing given system of simultaneous linear equations for consistency.*
- *Computing powers of a matrix using Cayley-Hamilton theorem and diagonalisation.*
- *Solve D.E of first and higher order through appropriate analytical and numerical methods.*

UNIT – I **L-9**

MATRICES : Definition; Types; Matrix Algebra; Elementary row and column operations; Inverse of a matrix; Rank of a matrix; Triangular form; Echelon form; Normal form.

Consistency of system of linear equations-cramer's rule, matrix inversion method, gauss elimination method.

UNIT – II **L-9**

EIGEN VALUES AND EIGEN VECTORS : Eigen values-eigen vectors, properties (without proofs); Cayley-Hamilton theorem (without proof), applications; Power of a matrix; Inverse of a matrix.

UNIT – III **L-9**

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS : Basic Definitions; Variables separable; Homogeneous differential equations; Linear differential equations; Exact and non-exact differential equations.

UNIT – IV **L-9**

SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS : Linear differential equations with constant coefficients; Homogeneous differential equations of second order; Methods to find particular integral when RHS is of the form-e^{ax}, sin ax, cos ax.

UNIT – V **L-9**

APPLICATIONS OF FIRST ORDER DIFFERENTIAL EQUATIONS : Newton's law of cooling; Law of natural growth and decay; Orthogonal trajectories.

NUMERICAL METHODS TO SOLVE DIFFERENTIAL EQUATIONS : Euler's and Runge-Kutta methods.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS:30**

1. Basic rules of matrix algebra.
2. To find rank of a matrix.
3. Solving system of equations using cramer's rule.
4. Solving system of equations using matrix inversion method.
5. Solving system of equations using Gauss-Jordan method.
6. Eigenvalues and Eigenvectors for given Matrix.
7. Cayley Hamilton theorem and its applications to square matrices.
8. Solving differential equations of first order.
9. Euler's method to solve first order ODE.
10. Runge-Kutta method to solve first order ODE.

TEXT BOOKS:

1. H. K. Dass and Er. Rajanish Verma, "Higher Engineering Mathematics", S. Chand & Co., 3rd edition, 2015.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th edition, 2018.

REFERENCE BOOK:

1. J. Bird, "Higher Engineering Mathematics", Routledge (Taylor & Francis Group), 2018.

19FT101 FOOD BIO-CHEMISTRY AND NUTRITION

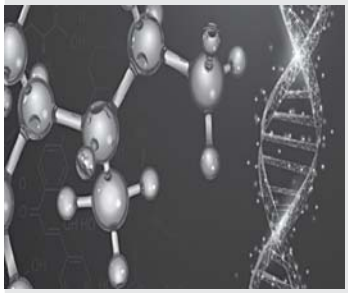
Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5



Source:

https://www.bioc.cam.ac.uk/news/images/2015/0-carousel-for-news-articles-2015.png/@@images/5e11d637-eb30-4a1d-a202-d9ee01aa2e34.png

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the students' knowledge on biological basis of nutrition, metabolic pathways, enzyme activity and mechanisms by which diet can influence health. The objective of this course is to empower the students with methods and techniques for molecular weight estimation of proteins, qualitative analysis of edible fats and oils and make nutrient profiles for balanced diet and health.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Identify and analyse various pathways for carbohydrate metabolism.	2, 4
2	Investigate the cause and mechanism of lipid metabolism in cellular system.	4
3	Analyse the complex structure of protein and various nutritional parameters of protein.	2, 1
4	Analyse the enzyme reactions and investigate enzyme kinetics parameters.	4
5	Identify and design nutritional diet to ensure nutritional security for healthy, diseased, sports personnel, pregnant women and elderly persons.	2, 3

SKILLS:

- ✓ *Separation and molecular weight estimation of proteins.*
- ✓ *Quality analysis of edible fats and oils.*
- ✓ *Identify and recommend micro and macro nutrient profile for balanced diet and health.*
- ✓ *Enzyme activity measurement and determining the mechanism of the reaction.*

UNIT - I **L-9**

CARBOHYDRATE METABOLISM : Classification; Structure and function of monosaccharides, disaccharides and polysaccharides; Metabolic pathways-glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, ATP balance, gluconeogenesis.

UNIT - II **L-9**

LIPID METABOLISM : Classification-structure and functions, essential fatty acids, digestion and absorption of lipids; Lipids - utilization of fats, biosynthesis of fatty acids and fats, clinical disorders associated with fats.

UNIT - III **L-9**

PROTEIN METABOLISM : Primary, secondary and tertiary structures of proteins; Metabolism of proteins (digestion and absorption); Nitrogen balance and nitrogen pool; Evaluation of quality of protein - biological value, net protein utilization, protein efficiency ratio, PDCAAS.

UNIT - IV **L-9**

ENZYMES : Definition; Function; Classification; Nomenclature; Co-enzymes and its function; Mechanism of enzyme action (lock and key method and Induced fit); Enzyme kinetics (Michaelis Menten equation) & environmental effects-enzyme inhibitions (Line weaver burk plot, competitive, uncompetitive and noncompetitive and mixed); Applications of enzymes in food industries.

UNIT - V **L-9**

VITAMINS AND MINERALS : Basic properties-occurrence, physiological functions of vitamins and minerals; Introduction to human nutrition - nutritive values of foods, basal metabolic rate, techniques for assessment of human nutrition; Diets and disorders - balanced diet, recommended dietary allowances for various age groups (according to physiological status, athletic and geriatric persons, pregnant and lactating women, etc.), deficiency diseases of different nutrients.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Preparation of standard acid and alkali solutions.
2. Preparation of standard graph for quantification of biomolecules.
3. Verification of Beer-Lambert's law using colorimetry.
4. Acid hydrolysis and action of salivary amylase on starch.
5. Enzymatic hydrolysis of sucrose and measurement of optical rotation.
6. Testing creatinine activity.
7. Separation of proteins by SDS-PAGE.
8. Gelling properties of starch.
9. Specific gravity and oxidative rancidity of fat and oils.
10. Identification of proteins (Qualitative Tests)
11. To study general properties of the enzyme Urease & Achromatic time of salivary amylase.
12. Blood glucose estimation.
13. Determination of carbohydrate by anthrone method.
14. Determination of carbohydrate by DNS method.
15. Determination of Iodine Value for fats.

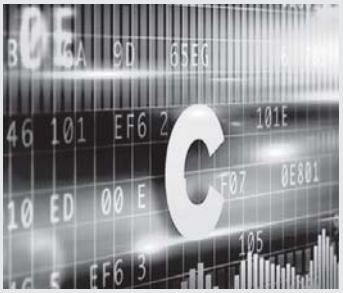
TEXT BOOKS:

1. M. M. Cox, "Lehninger Principles of Biochemistry". 4th edition. New York: Worth Publishers, 2000.
2. R. F. Boyer, "Modern Experimental Biochemistry", 3rd edition, Pearson Education, 2009.

REFERENCE BOOK:

1. D. Voet, J. G. Voet and C. W. Pratt, "Fundamentals of Biochemistry", 4th edition. John Willey & Sons, 2013.

19CS101 PROGRAMMING FOR PROBLEM SOLVING



Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	30	5	20	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on basic concepts of C programming language and problem solving through programming. It covers basic structure of C program, data types, operators, decision making statements, loops, functions, static and dynamic data structures. At the end of this course, students will be able to design, implement, test and debug modular C programs.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understanding of how to write simple, but complete, C programs.	1
2	Identification of suitable data type operands and design of expressions having right precedence.	2
3	Application of decision making and iterative features of C Programming language effectively.	1
4	Design and development of non-recursive and recursive functions and their usage to build large modular programs.	3
5	Selection of problem specific static/dynamic data structures and suitable accessing methods.	2
6	Development of C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	3

SKILLS:

- ✓ *Analysis of a given problem to be solved.*
- ✓ *Design of algorithm/solution for a given problem.*
- ✓ *Identification of suitable data types for operands.*
- ✓ *Application of suitable control statements for decision making.*
- ✓ *Design of non-recursive and recursive functions to perform different tasks.*
- ✓ *Selection of static or dynamic data structures for a given problem and manipulation of data items.*
- ✓ *Development of C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

ACTIVITIES:

- *Analysis of a given problem.*
- *Design of algorithm/ solution.*
- *System testing*
- *Implementation (coding and unit testing) of algorithm.*

UNIT - I **L - 9**

INTRODUCTION TO C: Structure of a C program; Pre-processor statement; Inline comments; Variable declaration statement; Executable statement; C Tokens; C-character set-identifiers and keywords; Type qualifiers and type modifiers; Variables and constants; Punctuations and operators.

Data Types: Basic data types; Storage classes; Scope of a variable; Formatted I/O; Reading and writing characters.

UNIT - II **L - 9**

OPERATORS AND CONTROL STATEMENTS: Operators-assignment, arithmetic, relational, logical, bitwise, ternary, address, indirection, size of, dot, arrow, parentheses operators; Expressions-operator precedence, associative rules; Control statements-category of statements, selection, iteration, jump, label, expression and block.

UNIT - III **L - 9**

ARRAYS AND FUNCTIONS: Array-declaration, initialization, reading, writing, accessing and passing as a parameter to functions, 2D-arrays, multidimensional arrays; Function-declaration, prototype, definition, calling by value and call by address, standard library functions and recursive functions.

UNIT - IV **L - 9**

STRINGS AND POINTERS: Strings-declaration, string library functions, array of strings, command line arguments; Pointers-declaration, initializing pointers, multiple indirection, relationship between arrays and pointers; Dynamic memory allocation functions.

UNIT - V **L - 9**

STRUCTURES AND UNIONS: Structures-defining a structure, declaration of a structure objects, operations on structures; Pointers to a structure; Array of structures; Nested structures; Unions; Bit –fields.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

Experiment 1:

(a) Write a C program to display a simple message on the standard output device using puts ().

(b) Every character holds an ASCII value (an integer number in the range of 0 to 255) rather than that character itself, which is referred to as ASCII value. Likewise, for a given input whether it is character or digit or special character or lower case or upper case letter, find corresponding ASCII value.

Example: ASCII value of 'A' is 65.

Experiment 2:

(a) For the given Basic salary, compute DA, HRA and PF using the following criteria and find out the Net Salary of an Employee by deducting PF and IT.

DA = (Basic salary *25)/1000

HRA= (Basic salary * 15)/100

Gross salary = Basic salary + DA + HRA

PF = Gross salary * 10/100

IT= Gross salary * 10/100

Net Salary = Basic Salary + DA + HRA – (PF + IT)

(b) Write a C program to swap the two integers with and without using additional variable.

Example: Before swapping values of a =4, and b = 5 and after swapping a = 5, and b = 4.

Experiment 3:

(a) Write a C program to check whether a given character is a vowel or consonant.

Hint: Read input from the user, and check whether it is an alphabet or not. If it is an alphabet, then check whether it is a vowel or a consonant. Otherwise display it is not an alphabet.

(b) The marks obtained by a student in '*n*' different subjects are given as an input by the user. Write a program that calculates the average marks of given 'n subjects and display the grade. The student gets a grade as per the following rules:

Average	Grade
90-100	O
80-89	E
70-79	A
60-69	B
50-59	C
<50	F

Experiment 4:

(a) Write a C Program to print Floyd triangle for the user given number of rows.

Example : If the user entered 4 rows, then the output is as follows:

```
1
2 3
4 5 6
7 8 9 10
```

(b) Write a C Program to print the * for the given number of times in a rows to form a diamond shape.

Example : If the user input is 5, then the output is as follows:

```
  *
 ***
*****
 ***
  *
```

Experiment 5 :

(a) Write a C Program to check whether the given number is a palindrome or not.

Hint : To check whether a number is a palindrome or not, reverse the given number and compare the reversed number with the given number, if both are same then the number is palindrome otherwise not.

Example : Given Number = 121, Reversed number = 121.

(b) Write a C Program to calculate sum of the individual digits of the given number.

Hint : To find the sum of the digits of given number, use modulus operator (%) to extract individual digits of a number and keep on adding them.

Example : Given number is 9875. Sum of the digits of given number "9875" is 9+8+7+5 = 29

Experiment 6:

(a) Write a program to search for a given number in the given set of numbers.

Example: Read set of numbers *L*={2,4,6,1}. Search whether 4 is present in the set or not.

(b) Write a program to perform the following operations on a given list of elements.

i. Insert the given element at the beginning of the list and at the end of the list.

Example: The given list is *L*={1,2,3,8}. Insert '0' at the beginning of the list and at the end of the list. Hence the resultant list is *L*={0,1,2,3,8,0}

ii. Delete an element at the beginning of the list and at the end of the list.

Example: The given list is *L*={1,2,3,8}. Delete an element at the beginning of the list and at the end of the list. Hence the resultant list is *L*={2,3}

Experiment 7:

Write a C program to perform the following operations on a list.

(a) Find the maximum or the largest element in a given list.

(b) Find the minimum or the smallest element in a given list.

Hint: Choose one dimensional array to store the given list of data items.

Experiment 8:

Write a C program to perform addition, subtraction, multiplication operations on the two given matrices using functions.

Experiment 9:

(a) Write a C program to compute the factorial of a given number using recursion.

Hint: Factorial is represented using '!' and it is calculated as n! = n*(n-1)*(n-2)*…*3*2*1.*As a function factorial(n)=n*factorial(n-1). Note: 0!=1.*

(b) Write a C program to swap two numbers using call by value and call by reference.

Experiment 10:

(a) Write a C program to read string using gets() function and use puts() function to print the contents of the string.

(b) Write a C program to copy a given string into another string without using standard string handling library function **strcpy()**.

Hint: Read one string as an input and then with the help of loop copy the content of given string into the new string. If the storage space allocated to the new string is less than the given string, entire string will not be copied into the new string.

Example: consider storage space allocated to new string is 20 and given string length is 30. In this case, your program can only copy 20 characters from given string into the new string.

Experiment 11:

(a) Write a C program to reverse a string without using standard string handling library function. Do not use another array to store the reversed string.

Hint: If a user enters a string "hello", then on reversing it will be displayed as "olleh".

(b) Write a C program to find whether the given two strings are same or not.

Hint: User need to enter two strings *s1 and s2* and check whether the two strings are same or not. For example: s1=hello, s2=hello output: YES

Experiment 12:

Given a string S, consisting of uppercase and lowercase letters, change the case of each alphabet in the string. That is, all the uppercase letters should be converted to lowercase and all the lowercase letters should be converted to uppercase.

Input: Vignan University
Input: Vignan University

Experiment 13:

(a) Write a C program to access the integer elements of the array using pointers.

Hint: Declare a pointer variable and assign the base address of the array to it and print the values of an array using pointer variable.

(b) Declare a character array to hold the input string and declare a character pointer variable. Assign the character array base address to the pointer and then display the every element of the character array.

Hint: Increment the pointer in loop.

Experiment 14:

Write a C program to count the number of vowels and consonants in a string using pointers.

Hint: Use pointers to read the content of the string.

Experiment 15:

Create a jagged array [array of variable length lists] with no of rows and no of columns in each row as specified by the user

Hint: Use Dynamic memory allocation (malloc() or calloc())

Input:

Enter no of rows: 3

Enter no of columns in Row 1: 3

Enter no of columns in Row 2: 5

Enter no of columns in Row 3: 2

Enter the elements row wise:

8 6 5

8 4 6 9 7

9 2

Output :

8 6 5

8 4 6 9 7

9 2

Experiment 16:

Write a C program for the following:

Customer billing system is a structure, having customers_name, street_address, city, state, account_number, payment_status(paid/ not_paid), payment_date(current date/ due_date), and amount as members. In this example, payment_date is also structure includes month, day and year as members. So, every customer record can be considered as nested structure. Display the payment_status of each customer.

Hint: Use nested structure concept.

Experiment 17:

Write a C program for the following: Define a structure named 'Complex' consisting of two floating point members called "real and imaginary". Let c1 and c2 are two Complex variables; compute the sum of two variables.

TEXT BOOKS:

1. B. A. Forouzan, R. F. Gilberg, "Programming for Problem Solving", 1st edition, Cengage, 2019.
2. A. Mittal, "Programming in C - A practical Approach", 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. R. Thareja, "Introduction to C Programming", 2nd edition, Oxford University Press India, 2015.
2. H. Schildt, "C: The Complete Reference", 4th edition, Tata McGraw-Hill, 2017.
3. B. S. Gottfried, "Programming with C", 4th edition, Tata McGraw-Hill, 2018.

19HS122 ENGLISH PROFICIENCY AND COMMUNICATION SKILLS

Hours Per Week :

L	T	P	C
-	-	2	1

Total Hours :

L	T	P
-	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
15	15	-	10	-	-

Source: *www.google.com*

COURSE DESCRIPTION AND OBJECTIVES:

The course will provide students an exposure on a wide range of language used in everyday situations. They will read, analyze, and interpret material from a variety of general topics and practice reading, writing, listening and speaking skills in English, to use it confidently in their professional and social contexts.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to read and grasp the content and significance of news, articles and reports on a wide range of general topics connected with their interests.	1
2	Apply suitable strategies to achieve comprehension, like listening for main points; checking comprehension by using contextual clues etc.	1
3	Ability to follow lectures or talks on topics within their own field, and well structured presentations outside their field.	2
4	Apply their knowledge of functional English to communicate effectively in real life situations and demonstrate good presentation skills in classroom situations.	3

SKILLS:

- ✓ *Reading strategies for global meaning and for specific details.*
- ✓ *Writing with a purpose.*
- ✓ *Listening for drawing inferences.*
- ✓ *Speaking fluently with appropriate stress and intonation.*

UNIT - I **P-6**

Introducing self / others (SWOT Analysis), Expressing needs/feelings/opinions:

Skill Focus:

- Reading – Understanding factual information.
- Writing – Understanding word order and sentence formation.
- Listening – Decoding for meaning following elements of stress, intonation and accent.
- Speaking – Articulating individual sounds/syllables clearly, speaking fluently with intelligibility.
- Vocabulary – Discerning use of right word suiting the context, Preliminary English Test (PET) word list.
- Grammar – Spellings, Use of Nouns, Adjectives, Verbs, Prepositions.

Practice: Units 1 – 6 in the Text Book, *Objective PET.*

UNIT - II **P-6**

Describing people and things:

Skill Focus:

- Reading – Drawing inferences from sentences and short messages(True/False statements).
- Writing – Rewording, Sentence transformation, Convincing.
- Listening –Understanding short messages and conversations.
- Speaking – Role-plays, Short conversations.
- Vocabulary / Grammar – Use of Adjectives/Adverbs, Comparatives and Superlatives.

Practice: Units 7 – 12 in the Text Book, *Objective PET.*

UNIT - III **P-6**

Describing places and processes, Spatial and temporal aspects, Giving directions/instructions:

Skill Focus:

- Reading – Reading between the lines, Drawing inferences, True/False.
- Writing –Developing hints, Writing short messages/paragraphs.
- Listening – Searching for factual information, Gap filling.
- Speaking – Snap Talks, JAM, Elocution.
- Vocabulary / Grammar – Prepositions, Phrasal Verbs, PET word list.

Practice: Units 13 – 18 in the Text Book, *Objective PET.*

UNIT - IV **P-6**

Narrating, Predicting, Negotiating, Planning:

Skill Focus:

- Reading – Reading for comprehension, evaluation and appreciation.
- Writing – Letters, E-mails, 7 C's.
- Listening – Following long conversations / Interviews.
- Speaking – Participating in Group Discussions, Debates, Mini-presentations.
- Vocabulary / Grammar – Modals, Conditionals, Verb forms (Time and Tense).

Practice: Units 19 – 24 in the Text Book, *Objective PET.*

UNIT - V **P-6**

Requesting, Denying, Suggesting, Persuading:

Skill Focus:

- Reading – Understanding factual information.
- Writing – Short stories, Explanatory paragraphs.
- Listening – Inferring information from long speeches/conversations.
- Speaking – Making announcements, Presentations.
- Vocabulary / Grammar - Punctuation, Cloze tests.

Practice: Units 25 – 30 in the Text Book, *Objective PET.*

TEXT BOOK:

1. L. Hashemi and B. Thomas, "Objective PET", Student's Book with answers, 2nd edition, Cambridge University Press, 2015.

REFERENCE BOOK:

1. A. Capel and R. Nixon, "Introduction to PET", Oxford University Press, 2009.

19ME103 WORKSHOP

Source: http://woodtech.weebly.com

Hours Per Week :

L	T	P	C
1	-	2	2

Total Hours :

L	T	P
15	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
10	20	-	-	-	-

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with different workshop trades and tools and also introduction of CNC machines. The objective of this course is to provide hands on experience in carpentry, fitting, tinsmith, black smithy, house wiring and welding.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Identify various tools connected to the carpentry, fitting, tinsmith, black smithy, house wiring and welding.	1
2	Fabricate different models using workshop trades.	2
3	Develop methodology as per specifications of the product.	2
4	Understand various advance machine tools and its components.	1,3

SKILLS:

- ✓ *Understand the concepts of making various wooden joints for house hold purpose.*
- ✓ *Design and develop various sheet metal products.*
- ✓ *Fabricate various agriculture tools by using forging technique.*
- ✓ *Create products by using different trades for Industrial applications.*

ACTIVITIES:

- *To make wooden joints like Mortise and Tenon joint, T-lap Joint which are used to prepare a wooden furniture.*
- *To prepare metal joints and metal sheet products like V-Joint and trays by using mild steel flats and Galvonised iron sheets.*
- *Trials on electrical circuit connections.*

UNIT- I **L-3 P-6**

ENGINEERING MATERIALS: Introduction; Classification; Ferrous & non ferrous metals and alloys; Physical, Electrical, Optical & Mechanical Properties.

UNIT- II **L-3 P-6**

CARPENTRY: Introduction; Classification of wood; Marking tools; Measuring tools; Holding tools; Cutting tools & supporting tools; Classification of joints; Safety precautions.

UNIT- III **L-3 P-6**

FITTING: Introduction; Vices; Try square; Files; Hacksaw.

TIN SMITHY: Introduction; Metals used in sheet metal work; Classification of tools.

UNIT- IV **L-3 P-6**

FORGING: Introduction; Tools and equipment used in forging; Smith's forge or hearth.

HOUSE WIRING: Concepts of basic electricity; Single phase and three phase circuits; Knowledge of different electrical wirings-residential-offices, hospitals, godowns.

UNIT- V **L-3 P-6**

WELDING: Concepts of welding; Arc welding; Gas welding; Soldering and brazing.

CNC: Introduction; Components of CNC; Types of CNC systems.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Fabrication of mortise and tenon joint using carpentry tools.
2. Fabrication of T-lap joint using carpentry tools.
3. Fabrication of V-fit using fitting tools.
4. Fabrication of U-fit using fitting tools.
5. Fabrication of truncated cylinder using tin smith tools.
6. Fabrication of square tray using tin smith tools.
7. Forging of S shape using black smith technique.
8. Forging of square to round cross section using black smith technique.
9. Peformance of 1 lamp controlled by one way switch using house wiring.
10. Performance of 2 lamp controlled by one way switch using house wiring.
11. Demonstration of CNC and welding operations.

TEXT BOOKS:

1. S. K. H. Choudhury, "Elements of Work Shop Technology", 11th edition, Media Promoters, 1997.
2. V. S. Venkatachalapathy, "First year Engineering Workshop Practice", Ramalinga Publications, 2014.

REFERENCE BOOKS:

1. T. V. Gopal, T. Kumar and G. Murali, "A first Course on Workshop Practice: Theory, Practice and Work Book", Suma Publication, 2005.
2. K. V. N. Pakirappa, "Workshop Technology", Radiant Publishing House, 5th edition, 2011.

19HS123 TECHNICAL ENGLISH COMMUNICATION

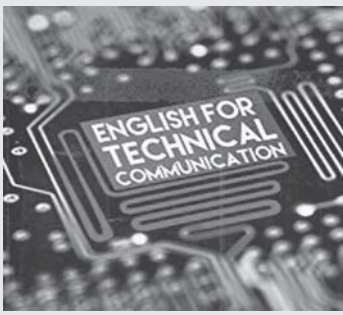
Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P
30	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
13	15	-	13	-	6



SOURCE:
www.google.com

COURSE DESCRIPTION AND OBJECTIVES:

The course will introduce students to the specific use of English for Technical Communication. In this course students will read, analyze, and interpret material from general and technical fields, and will practice reading, writing, listening and speaking skills on a variety of contemporary topics

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand and interpret a wide range of materials on technology.	1
2	Apply a variety of strategies to achieve comprehension, including listening for main points; checking comprehension using contextual clues etc.	1
3	Apply functional/academic language and grammar to express clearly while speaking and make short presentations on general/technical topics.	2
4	Apply functional/academic language and grammar to write clearly on topics related to technology and writing in the workplace.	3

SKILLS:

- ✓ *Oral communication skills to make presentations.*
- ✓ *Paraphrasing and summarizing skills.*
- ✓ *Etiquette in interpersonal communication.*
- ✓ *Language competence to work in international environments.*

UNIT - I **L-6**

ENVIRONMENTAL CONSCIOUSNESS:

Reading: Reading for comprehension (general/technical articles); Reading subskills-predicting, skimming, scanning, reading for inference; Reading and note making (**Reading Texts:** 1) Is a Global Agreement the Only Way to Tackle Climate Change? 2) How to Regain Green Cover 3) Solution to Plastic Pollution).

Writing: Precis writing; Paraphrasing; Functional grammar [articles, prepositions of time, place, direction and movement, verb; tense, subject; verb agreement]; Glossary of 25 words from the texts studied.

Listening: Anupam Mishra; TED Talk on Water Harvesting (LC); Answering comprehension based Qs; Listening to improve pronunciation

Speaking: Functional English(LC); Introducing oneself; Speaking of likes & dislikes/hobbies; Speaking of daily/weekly routine; Speaking of past and present habits/ activities/events; Speaking of future plans.

UNIT - II **L-6**

SPACE TREK:

Reading: Reading for global understanding; Reading for specific information; Guessing meanings from context; Inter-textual (extrapolative) reading;

Reading Texts: 1) The Hubble Telescope 2) Genesis of ISRO 3) A Home in the Sky

Writing: Writing formal and informal letters; Functional grammar; Modals[Receptive practice of modals like can, could, will, would, shall, should, may, might, must, ought to, used to; Receptive practice of modals for habit, advice, ability, permission, obligation and possibility]; Framing questions: Open ended & Close ended

Listening: Listening to a debate on "Colonising the Moon" (LC); Listening subskills; Listening for global understanding; Listening for specific information; Note Making

Speaking: (LC) Making mini presentations on general topics; Sharing information about ISRO / NASA/ Elon Musk

UNIT - III **L-6**

TRAVEL AND TOURISM:

Reading: Reading for specific information; Reading with a focus to learn new words; Reading critically for the narrative tone; 50 most commonly used collocations; **(Reading Texts:** 1) Ten Reasons Why Travel is a Waste of Time 2) Southern Splendour 3) Tourism in India: Role in Conflict and Peace.)

Writing: Paragraph writing [writing a topic sentence, supporting sentences, effective introductions & conclusions, cohesive devices]; Stages of writing: planning /organising /writing /editing /rewriting; Functional grammar [relative pronouns, comparative adjectives, adverbs of time, frequency, place & manner, speaking of the future/ simple future using *will* and *am/is/are + going to*]

Listening: (LC) Listening to a Song; Listening for global meaning; Listening for getting at the nuances and the mood of the singer.

Speaking: (LC) Telephonic Skills; Participating in an interactive video or telephone talk.

UNIT - IV **L-6**

ENERGY:

Reading: Reading for factual information; Reading for extrapolation; Reading for understanding author's stance; **(Reading Texts:** 1) In Search of Our Energy Solution 2) Wind Energy 3) How pertinent is the nuclear option).

Writing: Current modes of communication; Writing an E-mail; Fax texting; SMS texting for Mobile

Speaking: Group Discussion (LC) – Language functions; initiating a discussion; expressing one's opinion; leading a discussion; agreeing/ disagreeing to someone's view; cutting into a speech; **(G.D Topics:** Dumping of nuclear wastes, Exploring eco-friendly energy options, Lifting subsidies on petrol, diesel, LPG, etc).

Listening: Listening to an Interview (LC) related to the text ; Listening critically for understanding the attitude/tone of the speaker.

UNIT – V **L-6**

MEDIA MATTERS:

Reading: Reading for factual understanding; Reading for specific information; Reading for inferring words/phrases from context; Reading for summarizing the main ideas/points in a diagrammatical form; Reading for extrapolation; **Reading Texts**: 1) The Evolution of Media 2) The Top Ten Developments in Journalism in the 2000s 3) Criminal Cases and the Media.

Writing: Drafting a report/proposal (LC); Using graphic tools [tables, pie & bar charts; Writing an abstract; Leveraging ICT for communication; Preparing a Ppt (LC).

Speaking: Making short presentations [individual/team] with the aid of Ppt (LC); Physical appearance, body language & voice modulation; Making impromptu presentations

Listening: Listening to a radio program (LC); Watching a movie scene (LC); Subskills: Listening to understand one's viewpoint; Listening to understand speaker's intention; Listening for local understanding.

LIST OF LAB ACTIVITIES **TOTAL HOURS: 30**

1. Note making while reading a technical/general article.
2. Paraphrasing.
3. Paragraph writing.
4. Note taking while listening to a technical/general talk.
5. Precis writing/summarising.
6. Preparing an outline for developing a report.
7. Writing a short report.
8. Making a ppt and mini presentations with the aid of a ppt.
9. Using language functions suiting the context.
10. Team presentations/group discussion.
11. Using collocations.
12. Speaking face to faceon the telephone with appropriate stress and intonation.

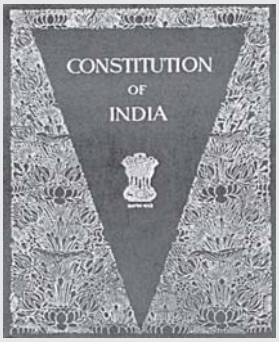
TEXT BOOK:

1. K. Elango, et.al., "Mindscapes: English for Technologists and Engineers", Orient Blackswan, 2014.

REFERENCE BOOKS:

1. M. Balasubrmanyam, "Business Communication" Vani Educational Books, 1985.
2. T. Balasubramanian, "A Text book of Phonetics for Indian Students", Orient Longman, 1989.
3. N. Krishnaswamy and Sriraman, T., "Current English for Colleges", Macmillan India Ltd. 1995.
4. M. Krishna and M. Banerjee, "Developing Communication Skills", Macmillan India Ltd.,1990.
5. V. R. Narayanaswamy, "Strengthen your Writing", Orient Longman, 1979.
7. B. Jean Naterop and Rod Revell., "Telephoning in English", Cambridge University Press, 1997.

19HS124 CONSTITUTION OF INDIA



Source:
www.livemint.com

Hours Per Week :

L	T	P	C
1	-	-	1

Total Hours :

L	T	P
12	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
2	12	1	2	-	-

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with a basic understanding of Indian Polity and Constitution and make them understand the functioning of government at the centre and state besides local self government, in order to equip the them with knowledge on fundamental rights and duties of a citizen in democracy.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyze the major articles and provisions of Indian Constitution.	6,8
2	Understand the constitution and its role in safeguarding individual rights.	6,8
3	Understand the functioning of organs of the State in a democracy.	6,8
4	Understand the relationship between rights and duties of citizens.	6,8

SKILLS

- ✓ *Understanding of the basics of Indian Constitution.*
- ✓ *Awareness on fundamental rights, duties and DPSP*
- ✓ *Knowledge of the functioning of various institutions in democracy*

UNIT - I **L - 7**

PHILOSOPHY OF INDIAN CONSTITUTION: Meaning of the constitution law and constitutionalism; Historical perspective of the Constitution of India; Salient features and characteristics of the Constitution of India.

Scheme of the fundamental rights; Scheme of the fundamental right to equality; Scheme of the fundamental right to certain freedom under article 19; Scope of the right to life and personal liberty under article 21; The scheme of the fundamental duties and its legal status; The directive principles of state policy; Its importance and implementation.

UNIT - II **L - 8**

WORKING OF INDIAN CONSTITUTION: Federal structure and distribution of legislative and financial powers between the union and the states; Parliamentary form of Government in India; The constitution powers and status of the President of India; emergency provisions: National emergency, President rule, Financial emergency.

Amendment of the constitutional powers and procedure; The historical perspectives of the constitutional amendments in India; Local self-government; Constitutional scheme in India.

TEXT BOOK:

1. P. M. Bhakshi, “Constitution of India”, 15th edition, Universal Law Publishing, 2018.

REFERENCE BOOK:

1. S. Kashyap, “Our Constitution”, 2nd edition, National Book Trust, India, 2011.

19EE102 BASIC ENGINEERING PRODUCTS

Source:
http://sazehpardazi.ir/wp-content/uploads/2017/01/Mokran-tank.jpg

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P
30	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	40	-	8	5	-

COURSE DESCRIPTION AND OBJECTIVES:

This course enable the students to understand the basics of civil, mechanical, electrical and electronics systems and components used in day-to-day life. It deals with construction materials, power generation principles and working of a few commonly used household appliances. Besides, the student will be able to identify/appreciate various concepts, service and maintenance of engineering products.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Describe the working principle of IC engine, refrigeration and air conditioning systems.	1,2,6
2	Gain awareness on choosing appropriate construction materials.	1,2,6
3	Install, operate, maintain and troubleshoot basic electrical engineering appliances.	1,2 3,4,6
4	Analyze the different lighting sources and it's features.	1, 2, 6
5	Know the basic electronics engineering appliances.	1, 2, 6

SKILLS:

- ✓ *Trouble shoot issues relating to air conditioning and refrigeration systems.*
- ✓ *Testing the quality of different construction materials.*
- ✓ *Identify UPS requirements for a given load.*
- ✓ *Design a composition of heating element for a particular application.*
- ✓ *Provide an earthing for domestic outlet.*
- ✓ *Select, configure and maintain a few engineering appliances. Such as TV, Radio, Telephone, Mobile phone, Wifi Router, Micro oven, PA system etc.*

ACTIVITIES:

- *Trouble shooting of immersion heater and induction heaters.*
- *Disassembe and assembe the domestic appliances such as mixer grinder, fan etc.*
- *Provide earthing for domestic outlet.*
- *Design the electric wiring system for a prototype house.*
- *Design the UPS for a defined load.*
- *Practice assembly of a FM radio.*
- *Configure a wifi router for required number of users.*

UNIT - I **L - 6**

WORKING PRINCIPLE OF AC, REFRIGERATOR, PUMPS, IC ENGINES AND SCREW JACK: Working principle of air conditioner and refrigerator; Components; Assembly and disassembly; Working principle of Centrifugal and Reciprocating pumps-types, parts and applications; Working principle of screw jack and its components; Working principle of IC engines-2 stroke and 4 stroke.

UNIT - II **L - 6**

BRICKS: General; Qualities and classification of bricks; Tests for bricks; Size and weight of bricks; Timber-definition, qualities of good timber, decay of timber and advantages of timber in construction.

CEMENTS: Types and composition of cement; Setting of cement; Tests for physical properties of cement; Different grades of cement.

AGGREGATES: Classification of aggregates; Source; Size and shape of aggregates; Tests for aggregates.

STEEL: Types of steel; Physical properties and mechanical properties of steel; Simple layout design; Paints; Tiles fitting; Ventilation; Furniture and green house aspects.

UNIT - III **L - 6**

POWER GENERATION: Overview of Power System Structure; Conventional and non-conventional power generation sources.

PROTECTION SCHEMES: Earthing procedure; Switch fuse unit (SFU); MCB; Methods of electrical wiring systems.

ENERGY STORAGE SYSTEMS: Types of batteries; Important characteristics for batteries; Elementary calculations for energy consumption.

UNINTERRUPTIBLE POWER SUPPLY (UPS) : Components in UPS; Functionality; Calculation of ratings for UPS components to a specific load.

UNIT - IV **L - 6**

LIGHT: Working of Incandescent; Fluorescent, MV, SV and LED Lamps; Comparison and applications.

HEAT: Resistance and Induction Heating; Comparison and applications.

MOTOR: Motors used in domestic applications-mixer grinder, ceiling fan, hair dryer, washing machine, air coolers, vacuum cleaner and electric vehicle.

UNIT - V **L - 6**

HOUSE HOLD ELECTRONIC APPLIANCES: Working principles of television; Radio; Remote control; Telephone; Microwave oven; Cell phone; PA system; WiFi router and DTH.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

Demonstration of Modelling / functioning / disassembly / assembly / fault rectification / understanding of the following.

1. Air-conditioners and Refrigerators.
2. 2 Stroke and 4 Stroke Engines.
3. Reciprocating Pumps.
4. Power Screw Jack.
5. Size and Water absorption capacity of Bricks.
6. Initial and final setting time of Cement.
7. Toughness value of coarse aggregates.
8. Bulking of Sand.
9. Earthing Schemes.
10. Electric Wiring.
11. UPS system.
12. Immersion Heater and Iron Box.
13. Induction Heater.
14. Ceiling Fan and Mixer.
15 Washing Machine.
16. Incandescent and Fluorescent lamps.
17. Television and Remote Control.
18. Microwave oven.
19. Telephone and Mobile Phone.
20. PA System.

TEXT BOOKS:

1. M. S. Shetty, “Concrete Technology”, 1st edition, S. Chand & Co., 2005.
2. S. C. Rangwala, “Engineering Materials”, 36th edition, Charotar Publishing House, Anad, 2009.
3. Govindasamy and A. Ramesh, “Electrical Engineering - Electrical Machines and Appliances Theory, 1st edition, Tamilnadu Text Book Corporation, 2010.

REFERENCE BOOKS:

1. Janakaraj and A. Sumathi, “Electrical Engineering - Electrical Machines and Appliances Theory”, 1st edition, Tamilnadu Text Book Corporation, 2011.
2. M. Brain, “How Stuff Works”, 1st edition, John Wiley & Sons, 2001.
3. P. Kumar, “Basic Mechanical Engineering”, 1st edition, Pearson Publishers, 2013.

II

YEAR

FOOD TECHNOLOGY

B.Tech.

I SEMESTER

19HS203	-	Probability and Statistics
19FT201	-	Food Chemistry and Toxicology
19FT202	-	Food Microbiology
19FT203	-	Fundamentals of Fluid Mechanics
19FT204	-	Thermodynamics and Heat Engines
19MS303	-	Principles of Management and Organizational Behavior
19PC003	-	Life Skills - I
19PC004	-	Technical Seminar - I
19PC005	-	Intra-disciplinary Project - I
19PC006	-	Physical fitness, Sports & Games - III

II SEMESTER

19FT211	-	Fundamentals of Heat and Mass Transfer
19FT212	-	Food Processing Operation
19FT213	-	Principles of Food Processing and Preservation
19FT214	-	Meat Fish and Poultry Process Technology
19HS204	-	Environmental Studies
19PC007	-	Life Skills - II
19PC008	-	Technical Seminar - II
19PC009	-	Intra-disciplinary Project - II
	-	Open Elective - I

COURSE CONTENTS

I SEM AND II SEM

19HS203 PROBABILITY AND STATISTICS

Source:

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQ2H_fEK4A4rWHm83kqb5gst_7sST2AYcfIF0-ebiDcJ48P74opnCA

Hours Per Week :

L	T	P	C
4	-	-	4

Total Hours :

L	T	P
60	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
20	45	-	10	-	5

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with foundation in elementary topics of statistics and probability such as descriptive statistics, correlation, regression, probability, random variables, distributions, test of hypothesis required for various engineering applications.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to active the following outcomes:

COs	Course Outcomes	POs
1	Determine values of various descriptive measures.	2
2	Learning the concept of curve fitting process and apply it in correlation and regression.	2
3	Appreciate the use of concept of probability in real life situations.	2
4	Apply various probability distributions and their properties to a given situation.	2
5	Analyse a given hypothesis for acceptance or rejection.	3

SKILLS:

- ✓ *Analyse the data using measures of central tendency.*
- ✓ *Fit an appropriate curve for a given set of data.*
- ✓ *Test the statistical data for rejection or acceptance.*

UNIT – I **L-12**

DESCRIPTIVE STATISTICS

Basic definitions-frequencies, graphical representation, histogram, ogive curves; Measures of central tendency-arithmetic mean, median, mode, mean deviation, standard deviation; Symmetry and skewness-karl pearson's coefficient of skewness.

UNIT – II **L-12**

CURVE FITTING, CORRELATION, REGRESSION

Least squares method; Curve fitting-straight line, parabola, exponential curve only;

Covariance; Correlation-types, pearson's coefficient of correlation, rank correlation, spearman's rank correlation; Regression-regression lines.

UNIT – III **L-12**

PROBABILITY

Introduction and definition-classical and axiomatic approach; Addition theorem; Conditional probability; Multiplication theorem; Total probability; Bayes theorem.

UNIT – IV **L-12**

RANDOM VARIABLES, DISTRIBUTIONS

Random variables-discrete and continuous variables; Introduction to distributions;

Binomial distribution-definition, mean and standard deviation, recurrence relation, applications, fitting of binomial distribution.

Poisson distribution-definition, mean and standard deviation, recurrence relation, poisson distribution is an approximation of binomial distribution, applications, fitting of poisson distribution.

Normal distribution-definition, normal curve, mean and standard deviation, median, mode, normal distribution applications.

UNIT – V **L-12**

TEST OF HYPOTHESIS

Population and sampling; Parameters and statistics; Types of sampling;

Test of hypothesis-null hypothesis, errors, level of significance, confidence limits, testing large samples, one mean, two means, one proportion, two proportions.

Test of significance- t-distribution for small sample, difference between means of small sample,

chi square test for goodness of fit, chi square test for testing of independence of attributes.

TEXT BOOKS:

1. H. K. Dass and R. Verma, "Higher Engineering Mathematics", S. Chand & Co., 3rd edition, 2015.
2. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2012.

REFERENCE BOOKS:

1. P. R. Vittal, "Mathematical Statistics", Margham Publications, Chennai, 2018.
2. K. S. Trivedi, "Probability and Statistics with Realiability, Queueing and Computer Science Applications", 2nd edition, Wiley Student edition, 2008.
3. A. Singaravelu, "Probability and Statistics", 22nd edition, Meenakshi Agency, 2015.

19FT201 FOOD CHEMISTRY AND TOXICOLOGY

Source:
http://bsp.iitd.ac.in/Wordpress/wp-content/uploads/2018/10/chemical.jpg

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the chemical composition and properties of food nutrients and their physical, chemical, nutritional and functional changes during handling, processing, storage and utilization. The objective of this course is to impart knowledge on innate properties of food molecules and their interactions with other food constituents and to empower the students with analytical techniques for identification and quantification of various biomolecules present in food.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the role of biomolecules and water for various deteriorative reactions.	2
2	Analyse the chemistry and processing aspects of protein and fats in food.	2
3	Identify various colour based compounds responsible for food colour and development of food colorant from biological sources.	2, 3
4	Development of nutrient rich food while ensuring lower anti-nutritional factors.	3
5	Identify and analyse various toxins in food and formulate strategies to overcome food intoxication.	2, 4

SKILLS:

- ✓ *Perform analytical techniques associated with food using basic analytical instrumentation.*
- ✓ *Critically analyze the chemical information, synthesize the information and validate it.*
- ✓ *Select appropriate analytical technique when presented with a practical problem.*

ACTIVITIES:

- *Checking different physico-chemical properties of water*
- *Estimation of total carbohydrate and their importance in food industry*
- *Checking efficacy of various solvents for edible oil extraction.*
- *Potein and evaluation of their functional properties in industry*
- *Absorption kinetics of vitamins and minerals*

UNIT - I **L-9**

SCOPE AND DEVELOPMENT OF FOOD CHEMISTRY : Water in foods - role and types of water in foods, functional properties of water, water activity and sorption isotherm; Carbohydrates-changes of carbohydrates on cooking, dietary fibre, browning reactions, enzymatic and non-enzymatic browning.

UNIT - II **L-9**

PROTEINS IN FOODS : Protein-structure and function, physical and chemical properties, nutritional changes in protein; Determination methods-physical, chemical; Lipids in foods-role and use of lipids/fat, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; oil processing-refining, hydrogenation, inter esterification.

UNIT - III **L-9**

PIGMENTS IN ANIMAL AND PLANT KINGDOMS : Heme pigments - chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behavior; Technology for retention of natural colors of food stuffs.

UNIT - IV **L-9**

VITAMINS AND MINERALS : Requirements; Allowances; Enrichment; Restorations; Fortifications; Loss of vitamins and minerals; Optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors.

UNIT - V **L-9**

PRINCIPLES OF FOOD TOXICOLOGY : Classification of food toxicants; Exposure; The dose-response curve; Absorption; Distribution and elimination of toxicants; Natural toxins in foods of plant origin; Marine toxins; Mycotoxins; Toxicants resulting from food processing; Biotransformation reactions (Phase I & Phase II); Risk assessment; Food, law and safety.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Qualitative test for all carbohydrates - Solubility, Molisch, Anthrone, Iodine test.
2. Qualitative test for pentoses, reducing sugars, (Bial's, Fehling's, Benedict's, Barfoed's test)
3. Qualitative test for Glucose, Fructose, Sucrose (Osazone, Acid hydrolysis, Selewanoffs.)
4. Quantitative test for all amino acids, aromatic amino acids, sulphur containing amino acids. (Ninhydrin, Xanthoproteic, Nitro Prusside test).
5. Quantitative tests for peptide bonds and proteins (Biuret test & Folin - Lowry test).
6. Separation of amino acids by paper chromatography.
7. Separation of lipids by thin layer chromatography.
8. Estimation of viscosity and refractive index of foods.
9. Determination of free fatty acid content in fats and oils.
10. Estimation of chlorophyll and carotenoids in foods.
11. Enzymatic browning: Kinetics of polyphenol oxidase.
12. Functional properties of proteins.
13. Meat pigments extraction and characterization.
14. Study of chemical leavening agents.
15. Properties of sugars/nonenzymatic browning.

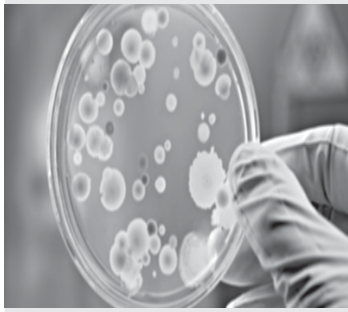
TEXTBOOKS:

1. H. D. Belitz, W. Grosch and P. Schieberle, "Food Chemistry", 4th edition, Springer, 2009.
2. O. R. Fennema, S. Damodaran and K. L. Parkin "Fennema's Food Chemistry", 4th edition, CRC press, 2007.

REFERENCE BOOKS:

1. M. Swaminathan, "Essentials of Food and Nutrition", 1st edition, Ganesh & Co, 1974.
2. L. H. Meyer, "Food Chemistry", 3rd edition, Reinhold Pub. Corp, 1960.
3. S. Ranganna, "Handbook of Analysis and Quality Control for Fruit and Vegetable Product", 2nd edition, Tata McGraw-Hill Education, 1986.

19FT202 FOOD MICROBIOLOGY



Source:
http://old.matis.is/english/emphasis/food-safety-and-environment/microbiology

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	55	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with basics of food microbiology, preservation and spoilage of various food products. The objective of this course is to enable students to apply, identification and enumeration techniques of microbes found in food products.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge of morphology and staining techniques to identify various micro-organisms.	1, 2
2	Analyse the cause of food spoilage and to formulate list of precaution to avoid spoilage.	4, 5
3	Design preservation conditions based on various intrinsic and extrinsic properties of food.	2, 3
4	Investigate the impact of environmental hurdles to control microbial growth.	4
5	Use the principle of canning to avoid spoilage by pathogenic bacteria.	1,3
6	Development of fermented food and apply the potential of beneficial microbes for health promotion.	4

SKILLS:

- ✓ *Prepare and sterilize media.*
- ✓ *Identify types of microorganisms present in food products.*
- ✓ *Prepare pure cultures of microbes.*
- ✓ *Isolate microorganisms from the food sample.*

UNIT - I **L-9**

INTRODUCTION TO FOOD MICROBIOLOGY : History of food microbiology; Moulds-general characteristic of moulds, classification and identification of moulds; Yeasts and yeast like fungi-general characteristics of yeasts, classification and identification of yeasts, yeasts of industrial importance; Bacteria-Morphological characteristics important in food bacteriology; Morphology of bacteria-yeast, mold and actinomycetes, spores and vegetative cells, gram-staining.

UNIT - II **L-9**

FOOD SPOILAGE : Cause and spoilage-microbial spoilage of foods, cause of spoilage, classification of foods by ease of spoilage, factors affecting different types and number of microorganisms in food; Factors affecting growth and survival of microorganisms in foods-growth curve, serial dilution technique, contamination of food , sources of contamination; Food spoilage-spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products.

UNIT - III **L-9**

FOOD PRESERVATION : Intrinsic factors-nutrient content, pH, buffering capacity, redox potential, inhibitory substances and biological structures (Antimicrobial barriers and constituents) water activity; Extrinsic factors-relative humidity, temperature and gaseous atmosphere; Methods of food preservation-high temperature, low temperature, drying, irradiation, chemical preservatives, bio-preservatives, hurdle technology, active packaging, novel food processing technologies.

UNIT - IV **L-9**

FOOD BORNE INTOXICATION AND DISEASES : Intoxication and diseases from microbes-pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera; Microbiology of canned foods-causes of spoilage, appearance of the unopened container, types of biological spoilage of canned foods, flat sour spoilage, TA spoilage, sulphide spoilage.

UNIT - V **L-9**

ROLE OF BENEFICIAL MICROBES IN FOOD INDUSTRIES: Fermented dairy products-bacteria used in yoghurt making, bacteria and fungi used in cheese making; Fermented vegetables-sauerkraut, pickles, fermented alcoholic beverages, acetic acid fermentation; Oriental fermented foods-soy sauce, miso, tempeh, ang-khak, natto, tofu, idli; Micro-organism as a food-single cell protein, probiotics, production of amino-acids, production of enzymes, production of other substances added to foods- dextran, lactic acid, citric acid.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Introduction to different types of equipment used in food Microbiology Lab.
2. Preparation and sterilization of media.
3. Gram staining and microscopic examination of bacteria.
4. Techniques of pure culture (Pour plate and streak plate).
5. Isolation and Identification of molds from foods.
6. Microbial examination of milk.
7. To perform MBRT for milk.
8. Microbial examination of fruits and vegetable products – Isolation, Identification.
9. Microbial examination of Fermented food – Isolation, Identification.
10. Determination of effect of various preservatives on the suppression of microbial growth.
11. preparation of fermented food products.
12. Microbial examination of cereal and cereal products.
13. Canning of fresh fruits and vegetables and understanding the principles.
14. Enumeration and isolation of anaerobic bacteria in food products.
15. Industrial visit and report preparation.

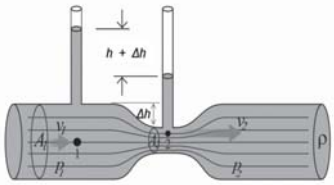
TEXT BOOKS:

1. W. C. Frazier and D. C. Westhoff, “Food Microbiology”, 4th edition, Tata McGraw Hills Publishing Company Limited, 2004.
2. J. M. Jay, “Modern Food Microbiology”, 4th edition, Springer, 2000.

REFERENCE BOOKS:

1. J. Garbutt, “Essentials of Food Microbiology”, 2nd edition, Taylor and Francis, 1997.
2. M. J. Pelczar, E. C. S. Chan and N. R. Krieg, “Microbiology”, 5th edition, Tata McGraw-Hill Education Pvt. Ltd, 1998.
3. S.J. Forsythe, “Microbiology of Safe Food”, 2nd edition, Blackwell Publishing Limited, 2010

19FT203 FUNDAMENTALS OF FLUID MECHANICS



Source:
http\\www.wikipremed.com mcat_course.php code=010108

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	50	-	5	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with fundamentals of fluid statics, dynamics, compressible and incompressible fluids, fluidization, transportation and metering of fluids. The objective of this course is to train students on the basic concepts of fluid flow and its application to food process industries.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand basic principles of fluid mechanics.	1
2	Analyze fluid flow problems with the application of the momentum and energy equations.	2
3	Design the fluid machinery like pumps, compressors.	3
4	Investigate dimensionless groups by dimensional analysis.	4
5	Design of fluidized bed reactor.	3

SKILLS:

- ✓ *Analyze fluid flow situations for type of flow.*
- ✓ *Prescribe conditions for maintaining a given type of flow.*
- ✓ *Determine the velocity and pressure drop of fluid flowing through pipes.*
- ✓ *Select a meter for measuring flow rate and velocity of a flowing fluid.*
- ✓ *To select the pump for a given engineering application.*

UNIT - I **L-9**

INTRODUCTION TO FLUIDS : Definitions; Properties; Units and dimensions; Measurement of fluid pressure - absolute and gauge pressure, pressure head of the liquid; Compressible and non compressible fluids; Surface tension; Capillarity; Pressure measuring devices - piezometer, simple manometers, inclined manometers, differential manometers, problems.

UNIT - II **L-9**

KINEMATICS OF FLUID FLOW : Introduction and classification of flows-steady, uniform, non uniform, laminar and turbulent, continuity of fluid flow, boundary layer, fully developed flow; Bernoulli's theorem - problems on bernoulli's theorem; Venturimeter; Pitot tube; Orifice meter; Rotameter; Problems on venturimeter and orifice meter.

UNIT - III **L-9**

FLOW THROUGH SIMPLE PIPES : Loss of head in pipes-darcy's formula, chezy's formula for loss of head in pipes, minor losses of energy, Hagen Poiseuille equation, drag, drag coefficients, terminal velocity; Fluidization - introduction, types of fluidization, applications of fluidization, problems on fluidization.

UNIT - IV **L-9**

FLOW THROUGH ORIFICES : Types of orifices; Jet of water; Hydraulic coefficients - experimental method for hydraulic coefficients; Different discharges - discharge through a rectangular orifice, discharge over a triangular notch, stepped notch; Dimensional analysis - similitude, buckingham's pi theorem, hydraulic similitude.

UNIT - V **L-9**

DESIGN OF PIPES AND PUMPS : Pipes; Fittings; Valves; Pumps; Developed head & power requirement in pumps; Suction lift; Cavitation; Classification of pumps-reciprocating pump, centrifugal pumps, power requirement in pumps, introduction to compressors, fans and blowers.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Identification of laminar and turbulent flows.
2. Verification of Bernoulli's Equation.
3. Measurement of flowing fluid using Venturimeter.
4. Measurement of flowing fluid using Orifice meter.
5. Determination of friction loss in fluid flow through pipes.
6. Determination of friction loss in fluid flow through fittings.
7. Determination of pressure drop in packed bed.
8 Determination of pressure drop in fluidized bed.
9. Determination of characteristics of centrifugal pump.
10. Determination of characteristics of reciprocating pump.
11. Determination of Head loss due to Sudden Expansion.
12. Determination of Head loss due to Sudden Contraction.
13. Calculating Coefficient of discharge of V – notch.
14. Measurement of flowing fluid using Rotameter.
15. Determination of Hydraulic coefficients for an orifice.

TEXTBOOKS:

1. P. N. Modi and S. M. Seth, "Hydraulics and Fluid Mechanics", 14th edition, Standard Publishers, 2002.
2. R. K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machinery",1st edition, Laxmi Publications Pvt. Ltd, 2002.

REFERENCEBOOKS:

1. R. J. Grade, "Fluid Mechanics Through Problems", 1st edition, Wiley Eastern Ltd, 1992.
2. A. M. Micheal and S. D. Khepar, "Water Well and Pump Engineering", 2nd edition, Tata McGraw Hill, 2005.
3. J. Lal, "Hydraulic Machines", 6th edition, Metropolitan Book house, 2001.
4. A. M. Michael, "Irrigation Theory and Practice", 2nd edition, Vikas Publishing House, 2008.

19FT204 THERMODYNAMICS AND HEAT ENGINES

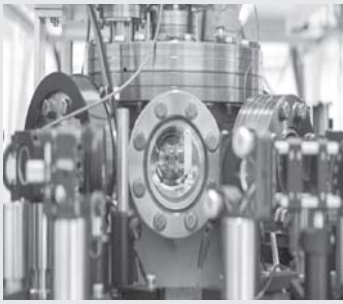
Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5



Source:

httpswww.sciencemag.org news201510scientists-build-heat-engine-single-atom

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with laws of thermodynamics, refrigeration, liquefaction and steam generation processes. The objective of this course is to make students understand the theory and applications of classical thermodynamics, and thermodynamic properties, equations of state and the methods used to describe and predict phase equilibrium.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand fundamentals of thermodynamic properties.	4
2	Derive and discuss the laws of thermodynamics.	1
3	Develop profound knowledge on refrigeration cycles.	2
4	Apply knowledge on different types of steam generators.	3

SKILLS:

- ✓ *To select suitable refrigerant for specific process.*
- ✓ *To estimate the thermal and volumetric properties of real fluids.*
- ✓ *To suggest industry specific boiler and usage.*

UNIT - I **L-9**

BASIC CONCEPTS : The scope of thermodynamics; Dimensions and units; Different measurements - amount or size, force, temperature, pressure, work, energy, heat, zeroth law.

UNIT - II **L-9**

FIRST LAW OF THERMODYNAMICS : Joule's experiment; Internal energy; Statement of first law; Energy balance for closed system; Thermodynamic state and state functions; Equilibrium; Phase rule; Reversible processes; Constant-v and constant-p processes; Enthalpy; Heat capacity.

UNIT - III **L-9**

THE SECOND LAW OF THERMODYNAMICS: Statements of the second law; Heat engines; Thermodynamic temperature scales; Entropy; Mathematical statement of the second law; Third law of thermodynamics.

UNIT - IV **L-9**

REFRIGERATION AND LIQUEFACTION : The carnot refrigerator; The vapor compression cycle; The choice of refrigerant; Absorption refrigeration; Liquefaction processes.

UNIT - V **L-9**

STEAM GENERATORS: Classification of boilers; Comparison of fire tube and water tube boilers; Function of mountings and accessories; Constructional and operational details of cochran, babcock and wilcox boiler.

TEXT BOOKS

1. J. M. Smith, H. C. Vanness and M. M. Abbot, "Introduction to Chemical EngineeringThermodynamics", 6th edition, Tata McGraw Hill, 2005.
2. R. K. Rajput, "Thermal Engineering", 8th edition, Laxmi Publications, 2010.
3. Y. V. C. Rao, "Chemical Engineering Thermodynamics",1st edition, Universities Press, 2004.

REFERENCE BOOK

1. P. K. Nag, "Engineering Thermodynamics", 5th edition, McGraw-Hill Education India Private Limited, 2013.

19MS303 PRINCIPLES OF MANAGEMENT & ORGANIZATIONAL BEHAVIOR

Source :
www.goric astanisic.fi

Hours Per Week :

L	T	P	C
4	-	-	4

Total Hours :

L	T	P
50	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
10	45	-	-	-	-

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with human behavior in organizations. Conceptual frameworks, case discussions, and skill-oriented activities applied to course topics which include: motivation, group dynamics, leadership, communication, diversity, organizational design, and culture. Class sessions and assignments are intended to help participants acquire skills and concepts to improve organizational relationships and effectiveness.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1.	Differentiate personality traits, job attitudes of people.	1,4
2.	Understand person-organization fit.	1,4
3.	Apply group decision making techniques.	1,8
4.	Analyze various communication channels effectiveness.	2,5,8
5.	Analyze various communication channels effectiveness.	3
6.	Develop strategies of organizational diversity.	6

SKILLS:

- ✓ *To conduct a survey on the practical application of laws of economics.*
- ✓ *To collect data on sales of consumer durable goods and predict the sales for a later year.*
- ✓ *To find different case studies relating to different market conditions and to do an analysis.*
- ✓ *To find out low demand differentiates between normal and inferior goods.*
- ✓ *To analyze the role of a business economist in the everyday functioning of an organization taking live examples.*

UNIT - I **L-9**

INTRODUCTION TO OB : Management-functions, roles, skills; Organizational behavior; disciplines that contribute to the ob field, challenges and opportunities for ob; Diversity-diversity in organizations, biographical characteristics, ability, implementing diversity management strategies; Attitudes-components, major job attitudes.

UNIT - II **L-9**

EMOTIONS, MOODS & VALUES : Emotions and moods-functions & sources of emotions and moods, affective events theory, emotional intelligence; Personality-the mbti, the big five personality models, other personality traits relevant to ob; Values-importance, terminal, instrumental, and generational values, person-job fit, person-organization fit, international values.

UNIT - III **L-9**

PERCEPTION & MOTIVATION : Perception-meaning, factors that influence perception, person perception, attribution theory, common shortcuts in judging others, applications, perception and decision making; The rational model-bounded rationality, ethics in decision making, common biases and errors in decision making; Motivation-early theories of motivation, contemporary theories of motivation.

UNIT - IV **L-9**

THE GROUP : Basics-defining and classifying groups, stages of group development; Group properties-roles, norms, status, size, and cohesiveness, diversity; Group decision making-group think and group shift, group decision-making techniques; Work teams-differences between groups and teams, types of teams, creating effective teams, context, composition, processes.

UNIT - V **L-9**

COMMUNICATION & LEADERSHIP : Communication-functions, process, direction, interpersonal communication, organizational communication, choice of communication channel, persuasive communication, barriers to effective communication; Leadership-overview of trait, behavioral and contingency theories, charismatic and transformational leadership; Organization structure-designs , organizational culture, functions.

TEXT BOOK:

1. Robbins, Judge, and Vohra, “Essentials of Organizational Behavior”, 15th edition, Pearson Education India, 2014.

REFERENCE BOOKS :

1. F. Luthans, Organisational Behavior, 12th edition, McGraw-Hill, 2010.
2. D. L. Nelson, J. C. Quick : ORGB, 4th edition, Cengage Learning, 2014.
3. J. R. Schermerhorn, Organizational Behavior, 12th edition, John Wiley & Sons, 2011.

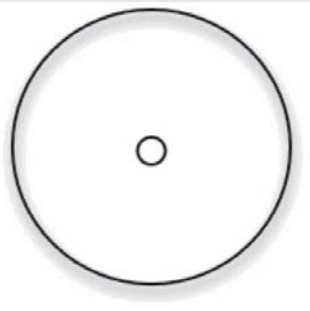
19PC005 INTRA-DISCIPLINARY PROJECTS-I

Hours Per Week :

L	T	P	C
-	-	2	1

Total Hours :

L	T	P
-	-	30



Source:

https://www.google.com/search?q=3.+Intra-disciplinary+project+I&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi7h8GZ9qTjAhUjSo8KHVTwCigQ_AUIESgC&biw=1366&bih=625#imgrc=ZTT9dcMpa_wxIM:

DESCRIPTION AND OBJECTIVES:

These projects arise from a combination of courses. The major objective of these projects is to enable students understand the relationship between the courses.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to map different courses to gain the knowledge of intra-disciplinary engineering.	1
2	Function effectively as an individual and as a member or leader in diverse teams.	9
3	Comprehend and write effective reports and make effective presentations.	10

LIST OF INTRA - DISCIPLINARY PROJECTS

- Study on hypoglycaemic activity of foods.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Physico-chemical and microbiological assessment of fresh banana.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Chemical and microbiological analysis of ketchup.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Chemical properties and sensory evaluation of yogurt produced from soya milk.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Study of rheological properties of rice milk.
  (Combination of courses: Fluid Mechanics, Food bio Chemistry and Nutrition)
- Physico-chemical and microbiological assessment of sun dried banana.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Extraction and microbiological analysis of essential oils from citrus peels.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Bio-fortification of fermented soya products.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Physic-chemical and microbiological assessment of freeze dried banana.
  (Combination of courses: Thermodynamics and Heat Engine, Food Microbiology)
- Extraction of bioactive components from food waste and assessing its anti-pathogenic properties.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)

- Physico-chemical and microbiological assessment of microwave dried banana.
  (Combination of courses: Food Chemistry and Food Microbiology)
- Chemical and microbiological studies of sauce.
  (Combination of courses: Food Microbiology, Food biochemistry and Nutrition)
- Fortification of different kefir and its physic-chemical studies.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Physico-chemical and microbiological assessment of fresh kiwi.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Metabolism of phenolic acids in whole meat and dry malt.
  (Combination of courses: Food microbiology, Food Biochemistry and Nutrition)
- Physico-chemical and microbiological assessment of microwave dried mushroom.
  (Combination of courses: Food Chemistry and Food Microbiology)
- Physico-chemical and microbiological assessment of tray dried banana.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Production of lactic acid from fermentation of agro based cellulosic waste.
  (Combination of courses: Food Biochemistry and Nutrition and Food Microbiology)
- Assessment of non-lactic acid bacteria in fresh cucumber and physic-chemical studies.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Physico-chemical and microbiological assessment of solar dried banana.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Fermentation of oat milk and study of its physic-chemical and microbiological aspects.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Effect of homogenization on physico-chemical and microbiological quality of milk.
  (Combination of courses: Food Microbiology and Fundemaentals of Fluid Mechanics)
- Identification and isolation of antimicrobial substances against pathogenic E. coli.
  (Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)
- Physico-chemical and microbiological assessment of solar dried banana.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Microbial and chemical analysis of irradiated cashew nuts.
  (Combination of courses: Food Chemistry and Food Microbiology)
- Physico-chemical and microbiological assessment of microwave dried banana.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Physico-chemical and microbiological assessment of freeze dried banana.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Study of physico-chemical and microbiological properties with refrigeration.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Physico-chemical and microbiological assessment of sun dried kiwi.
  (Combination of courses: Food Microbiology and Food biochemistry and Nutrition)
- Physico-chemical and microbiological assessment of fresh mushroom.
  (Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)
- Clarification of wine with different clarifiers.
  (Combination of courses: Food Processing Operations and Fundamentals of Fluid Mechanics)
- Determination of physico-chemical and microbiological quality of pineapple fruit leather.
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Profiling curcumin content in turmeric powder and its microbiological assessment
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Physico-chemical and microbiological assessment of solar dried kiwi.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)

- Physico-chemical and microbiological studied of fruit juice preserved by pasteurisation. *(Combination of courses: Fundamentals of Fluid Mechanics and Food Microbiology)*
- Essential oil extraction and antimicrobial study from cardamom. (*Combination of courses:* Food Chemistry and Nutrition, Food Microbiology)
- Quality analysis of extruded food product *(Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)*
- Physico-chemical and microbiological assessment of freeze dried kiwi. *(Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)*
- Determination of physico-chemical and microbiological quality of orange fruit leather. *(Combination of courses: Food Processing Operation and Food Biochemistry and Nutrition and Food Microbiology)*
- Essential oil extraction and antimicrobial study from pepper. *(Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)*
- Microbial and chemical analysis of UVC treated milk. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Chemical and microbiological studies of jam. *(Combination of courses: Food Microbiology and Fundamentals of Fluid Mechanics)*
- Physico-chemical and microbiological assessment of fresh kiwi. *(Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)*
- Chemical and microbiological studies of jelly. *(Combination of courses: Food Microbiology and Fundamentals of Fluid Mechanics)*
- Study of natural ant nutritional factors in food and methods to hinder their effects. (*Combination of courses:* Food Microbiology and Food Biochemistry and Nutrition)
- Role of pectin methyl esterase in physic-chemical properties of jam. *(Combination of courses: Fundamentals of Fluid Mechanics and Food Biochemistry and Nutrition)*
- Fermentation of coconut milk and study of its physic-chemical and microbiological aspects. *(Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)*
- Physico-chemical and microbiological assessment of sun dried mushroom. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Study of rheological properties of peanut milk. *(Combination of courses: Fundamentals of Fluid Mechanics, Food Biochemistry and Nutrition)*
- Chemical properties and sensory evaluation of yogurt produced from rice milk. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Physico-chemical and microbiological assessment of solar dried mushroom. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Chemical properties and sensory evaluation of yogurt produced from peanut milk. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Fermentation of flaxseed milk and study of its physic-chemical and microbiological aspects. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Determination of physico-chemical and microbiological quality of apple fruit leather. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Essential oil extraction and antimicrobial study from turmeric. *(Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)*
- Study of rheological properties of coconut milk. *(Combination of courses: Fundamentals of Fluid Mechanics, Food Biochemistry and Nutrition)*
- Physico-chemical and microbiological assessment of microwave dried mushroom. *(Combination of courses: Food Microbiology and Food Processing Operations)*
- Determination of physico-chemical and microbiological quality of guava fruit leather. *(Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)*

- Clarification of fruit juice with different clarifiers.
  (Combination of courses: Food Processing Operations, Food Biochemistry and Nutrition)
- Physico-chemical and microbiological assessment of freeze dried mushroom.
  (Combination of courses: Thermodynamics of Heat Engine and Food Microbiology)
- Determination of physico-chemical and microbiological quality of berries fruit leather.
  (Combination of courses: Food Chemistry and Food Microbiology)
- Essential oil extraction and antimicrobial study from clove.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Fermentation of peanut milk and study of its physico-chemical and microbiological aspects.
  (*Combination of courses:* Food Microbiology and Food Biochemistry and Nutrition)
- Study of anti-oxidant and pre-biotic properties in onion and garlic.
  (*Combination of courses:* Food Biochemistry and Nutrition and Food Chemistry)
- Physico-chemical and microbiological assessment of fresh mushroom.
  (*Combination of courses:* Food Microbiology and Food Biochemistry and Nutrition)
- Fermentation of soya milk and study of its physic-chemical and microbiological aspects.
  (Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)
- Determination of physico-chemical and microbiological quality of grapes fruit leather.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Study of chemical properties of food additives and its safety parameters
  (Combination of courses: Food Biochemistry and Nutrition, Food Microbiology)
- Physico-chemical and microbiological study of different processed juice.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Microbial and physico-chemical analysis of UVC treated apple juice.
  (Combination of courses: Food Microbiology and Fundamentals of Fluid Mechanics)
- Determination of physico-chemical and microbiological quality of mango fruit leather.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Physico-chemical and microbiological studied of fruit juice preserved by sterilization.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Chemical properties and sensory evaluation of yogurt produced from oat milk.
  (Combination of courses: Food Biochemistry and nutrition, Food Microbiology)
- Physico-chemical and microbiological study of different processed cheese.
  (Combination of courses: Food Biochemistry and nutrition, Food Microbiology)
- Changes in chemical and microbial properties of chips with change in oil quality.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- A study on Biofilm in Food industry and development of a method to control it.
  (Combination of courses: Food Chemistry and Food Microbiology)
- Physico-chemical and microbiological studied of fruit juice preserved by membrane filtration.
  (Combination of courses: Food Microbiology and Fundamentals of Fluid Mechanics)
- Development of probiotic plant based cheese and study of the chemical properties.
  (Combination of courses: Food Microbiology and Fundamentals of Fluid Mechanics)
- Physico-chemical and microbiological studies of tomato puree.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Fermentation of rice milk and study of its physico-chemical and microbiological aspects.
- Physico-chemical properties and sensory evaluation of yogurt produced from coconut milk.
  (Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)
- Essential oil extraction and antimicrobial study from ginger.
  (Combination of courses: Food Microbiology and Food Chemistry)
- Physico-chemical and microbiological study of different processed milk.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)

- Physico-chemical and microbiological study of different processed bakery products.
  (Combination of courses: Food Chemistry, Food Biochemistry and Nutrition)
- Effect of physico-chemical properties with hydrogenation of vegetable oil.
  (Combination of courses: Thermodynamics and Heat engines, Food Biochemistry and Nutrition)
- Study of rheological properties of soya milk.
  (Combination of courses: Fundamentals of Fluid Mechanics, Food Biochemistry and Nutrition)
- Essential oil extraction and antimicrobial study from garlic.
  (*Combination of courses:* Food Microbiology, Food Biochemistry and Nutrition)
- Study of anti-oxidant and anti-microbial properties of turmeric.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Surface decontamination and microbial analysis of fruits by irradiated.
  (Combination of courses: Food Chemistry, Food Biochemistry and Nutrition)
- New fermented product development by changing concentration and type of yeast.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Comparative study of chemical composition and microbial stability of different plant based milk.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Shelf life study of coagulated product of Soymilk and comparative study with paneer.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Isolation of probiotic bacteria from chilli crowns and study of its chemical properties.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Comparative study for physico-chemical, properties of a CAS and MAS food product.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Study of physiological and probiotic characteristics of different Lactic acid bacteria.
  (Combination of courses: Food Microbiology, Food Biochemistry and Nutrition)
- Effect of enzymatic treatment on physico-chemical properties of juice.
  (Combination of courses: Food Biochemistry and Nutrition, Fundamentals of fluid mechanics)
- Development of a chemical treatment for inactivating enzymes in fruits.
  (Combination of courses: Food Microbiology and Food Chemistry)
- Study of moisture dependant properties of stored grains.
  (Combination of courses: Food Microbiology and Food Chemistry)
- Reducing the water content in food as a preservation principle – Dehydration, Drying.
  (Combination of courses: Fundamentals of Fluid Mechanics and Thermodynamics and Heat Engines)
- Case study on different pathogenic, spoilage and beneficial bacteria.
  (Combination of courses: Food Microbiology and Food Biochemistry and Nutrition)

NOTE: The afore - mentioned list is not exhaustive and the objective is to provide an idea of some of the projects that can be executed by students arising from a combination of courses. Students are given full flexibility to choose any projects of their choice under the supervision of faculty Mentors.

19FT211 FUNDAMENTALS OF HEAT AND MASS TRANSFER

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:

https://www.ukexchangers.com/heat-exchange-products/tube-in-tube-heat-exchangers

COURSE DESCRIPTION AND OBJECTIVES:

This course deals on imparting fundamental understanding on the phenomena of heat and mass transfer. The objective of this course is to train students on principles of heat and mass transfer, methodologies for determining the rate of heat and mass transfer and perform heat exchanger design calculations.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the basic laws of heat and mass transfer.	1
2	Design suitable insulation for heat exchange equipment.	3
3	Formulate equations to calculate the heat transfer coefficient .	2
4	Identify the suitable heat exchanger for a given process.	3
5	Analyse heat exchanger performance.	2
6	Understand various mass transfer operations.	1

SKILLS:

- ✓ *Estimate the rate of heat flow through a wall, cylinder or sphere.*
- ✓ *Insulation thickness estimation.*
- ✓ *Determine heat transfer coefficients.*
- ✓ *Estimate double pipe heat exchanger length required for specified conditions.*
- ✓ *Perform basic calculations required for heat exchanger design.*
- ✓ *Select the correct type of heat exchanger required for a specific process.*
- ✓ *Determine the emissivity of a body.*

UNIT - I **L-9**

HEAT TRANSFER AND ITS APPLICATIONS: Nature of heat flow-conduction, convection, radiation; Heat transfer by conduction-fourier's law, one dimensional heat flow through slab/cylinder/sphere derivation, concept of electrical analogy, thermal resistance of slab/cylinder/sphere, heat flow through composite wall/cylinder and sphere, thermal contact resistance, industrial applications of composite walls.

UNIT - II **L-9**

CONVECTION: Heat flow by convection-natural convection and forced convection, newton's law of cooling, heat transfer coefficient, concept of overall heat transfer coefficient, critical thickness of insulation; Dimensional analysis-buckingham pi theorem, dimensionless numbers for heat transfer by natural convection and forced convection using buckingham pi theorem, significance of dimensionless numbers; Concept of thermal boundary layers; Important correlations in forced and natural convection.

RADIATION: Heat flow by radiation-absorptivity, transmissivity, reflectivity, black body, white body, grey body, Stefan-Boltzmann law, emissivity, Kirchhoff's law, equation for rate of heat transfer between two bodies (black bodies & non black bodies), shape factors.

UNIT - III **L-9**

HEAT EXCHANGER: Heat exchange equipment-counter currents and parallel currents flows, energy balances, rate of heat transfer, LMTD, individual heat transfer coefficient, overall heat transfer coefficient, fouling factors, shell and tube and plate heat exchangers; Heat exchanger design; Application of different types of exchangers in food industry.

UNIT - IV **L-9**

BOILING AND CONDENSATION: Boiling heat transfer-types of boiling, pool boiling of liquid, critical heat flux concept, pool boiling of saturated liquids, film boiling; Condensation heat transfer-drop wise and film type condensation; Evaporators-falling film evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator, methods of feeding in multiple effect evaporator; Application of different evaporators in food industry.

UNIT - V **L-9**

MASS TRANSFER: Introduction-fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolar counter diffusion, mass transfer coefficient; Qualitative discussion on various mass transfer operations-distillation, liquid liquid extraction, leaching, absorption and adsorption.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Determination of heat transfer coefficient by natural convection.
2. Determination of overall resistance in composite wall.
3. Emissivity measurement.
4. Determination of thermal conductivity of metal rod.
5. Determination of heat transfer coefficients of double pipe heat exchanger.
6. Determination of critical heat flux points of Nichrome Wire.
7. Shell and Tube heat exchanger.
8. Liquid-liquid diffusivity experiment.
9. Surface evaporation experiment.
10. Gas-diffusivity measurement experiment.

TEXT BOOK:

1. R. K. Rajput, "Heat and Mass Transfer", 5th edition, S. Chand and Co. Ltd, 2008.

REFERENCE BOOKS:

1. Y. A. Cenger and A. Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", 5th edition, McGraw Hill India, 2014.
2. A. S. Lavine, F. P. Incropera, D. P. DeWitt and T. L. Bergman, "Fundamentals of Heat and Mass Transfer", 7th edition, Wiley India, 2011.
3. R. E. Treybal, "Mass Transfer Operations", 3rd edition, McGraw-Hill Book Company, 1980.

19FT212 FOOD PROCESSING OPERATIONS

Source:
http: agroindustriindonesia. blogspot.com/2011/ 01/manufacturing- operations-and.html

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the principles and practices of multiple unit operations involved in processing industries. The objective of this course is to impart knowledge to students on engineering concepts of unit operations. Identify, formulate, review, and analyze complex engineering problems in food processing. Apply the range of equipment used to perform each major food processing operations.

COURSE OUTCOMES

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge of physical properties of food to design various processing methods for particulate solids and material handling equipment.	1, 3
2	To investigate the validity of various laws of size reduction and analyse particle size using screen analysis.	4
3	Design and development of filtration system for separation of suspended solids.	3
4	Identify various agitation and mixing equipment and apply the principle of crystallization for various food application.	1, 2
5	Use of psychrometric tool for solving drying problems and analyse the concept of leaching in food processing.	4

SKILLS

- ✓ *Perform cumulative and differential particle size analysis.*
- ✓ *Identify the suitable mixer required for mixing cohesive and non-cohesive solids.*
- ✓ *Recognize the required specifications of the size reduction equipment for a given feed.*
- ✓ *Identify the filtration equipment required for a specific application.*
- ✓ *Compare the efficiency of separation, size reduction, mixing and drying equipments*

UNIT - I **L-9**

PROPERTIES AND CHARACTERIZATION OF SOLIDS : Properties, handling and characterization of particulate solids; Properties of particulate masses; Storage and mixing of solids; Mixers for cohesive and non-cohesive solids; Transportation of solid particulate mass - belt, screw, apron conveyers, bucket elevators, pneumatic conveying.

UNIT - II **L-9**

PRINCIPLE OF COMMINUTION : Laws of size reduction - rittingers law, kicks law, bonds crushing law, work index, problems; Classification of size reduction equipment - crushers, grinders, ultra-fine grinders, cutting machines, problems; **I**ndustrial screening - different types of screening equipment in industries, screen efficiency.

UNIT - III **L-9**

FILTRATION : Classification of filters based on nature of filtration and external force; Principles of cake filtration - specific cake resistance, filter-medium resistance; Types of membranes; Permeate flux; Concentration polarization; Micro filtration; Separation techniques - separations based on motion of particles through fluids, gravity settling, centrifugal settling, sink and float method, flotation, flotation agents.

UNIT - IV **L-9**

AGITATION AND MIXING OF LIQUIDS : Agitation equipment - impellers, propellers, paddles, turbines; Power consumption in agitated vessels; Crystallization - crystal geometry, principles of crystallization, nucleation, types of nucleation.

UNIT - V **L-9**

DRYING : Psychrometry - humidification and dehumidification operations; Drying theory - thin layer drying, deep bed drying, and types of dryers; Leaching-leaching principles, leaching process with examples.

LABORATORY EXPERIMENT

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Determination of particle size using screen analysis.
2. Calculation of effectiveness of screen.
3. Verification of size reduction laws using jaw crusher.
4. Verification of size reduction laws using ball mill.
5. Verification of size reduction laws using roll crusher.
6. Determination of compressibility coefficient using sedimentation process.
7. Determination of filter medium resistance and cake resistance using plate and frame filter press.
8. Determine the efficiency of cyclone separator.
9. Drying characters of food material.
10. Determination of percentage recovery of coal from coal sand mixture using Froth Floatation cell.
11. Determination of energy consumption in size reduction (crushability test (roll or jaw crusher), Ball mill grindability indices.
12. Sampling of materials (Riffle sampling and cone quartering sampling).
13. Size separation: tabling, froth flotation.
14. Total energy calculation in mixing of two granular solids.
15. Determination of mixing index.

TEXTBOOKS:

1. R. L. Earle, “Unit Operations in Food Processing”, 2nd edition, Pergamon Press, 2003.
2. W. L. Mc Cabe, J. C. Smith and P. Harriot, “Unit Operations of Chemical Engineering”, 7th edition, McGraw-Hill. Inc., 2005.

REFERENCE BOOKS:

1. J. M. Coulson and J. F. Richardson, “Chemical Engineering” 1st to 5th volume, The Pergamon Press,1999.
2. K. M. Sahay and K. K. Singh, “Unit Operation of Agricultural Processing”, 2nd edition, Vikas Publishing House Pvt. Ltd, 2004.
3. C. J. Geankoplis, “Transport Process and Unit Operations”, 4th edition, Prentice-Hall of India, 2004.

19FT213 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
https://www.newportnaturalhealth.com/2017/04/best-food-preservation-techniques/

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basic principles involved in food preservation methods. The objective of this course is to provide students with the knowledge of basic food preservation principles and processing methods to control food spoilage and deterioration.

COURSE/ OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply various physical, chemical and biological methods of food preservation to extend shelf life of food.	1
2	Use the principle of low temperature preservation to avoid food spoilage.	2, 3
3	Investigate the impact of various types of thermal processing on food preservation and analyse thermal sterilization kinetics.	4
4	Formulate thermal process condition to attain sterility and ensure safe food.	4
5	Apply the knowledge of various non-thermal processing techniques for food preservation.	5
6	Identify chemical preservatives and their safe usage limit.	2

SKILLS:

- ✓ *Identify appropriate processing and preservation method for a given food.*
- ✓ *Identify and suggest suitable food additive for a given food product.*
- ✓ *Troubleshoot problems related to food safety during food processing.*

UNIT - I **L-9**

INTRODUCTION : Scope of food processing, importance and need of food preservation; Historical developments; Principles of food preservation - preservation by physical methods, chemical methods and biological methods; Water activity vs Food stability.

UNIT - II **L-9**

FOOD PRESERVATION BY LOW TEMPERATURE : Processing; Mechanism; Preservation by low temperature-refrigeration, chilling, freezing, freezing curve, changes occurring during freezing, types of freezing, thawing and its effects.

UNIT - III **L-9**

FOOD PRESERVATION BY HIGH TEMPERATURE : Different thermal operations-sterilization, pasteurization, blanching, and UHT processing; Canning-different unit operations involved, canning equipment, types of canning containers; Thermal destruction of Microorganisms – D value, F- value, Z-value.

UNIT - IV **L-9**

FOOD PRESERVATION BY NON-THERMAL METHODS: Non-thermal treatments - irradiation, microwave, dielectric heating, high pressure processing, pulsed electric field, hurdle technology, ohmic heating, novel processing.

UNIT - V **L-9**

CHEMICAL FOOD PRESERVATION : Types of chemical preservatives used to preserve the food and its functions; Permissible limits and safety aspects of using chemical preservative.

TEXTBOOKS:

1. Physical Principles of Food Preservation: Revised and Expanded, 2nd edition, Marcus Karel, Daryl B. Lund, 2008.
2. J. P. Fellows, “Food Processing Technology, Principles and Practices”, 2nd edition, Wood Head Publishing, 1999.
3. N. N. Potter and J. H. Hotchkiss, “Food Science,” 5th edition, Springer, 1998.

REFERENCE BOOKS:

1. H. Ramaswamy, M. Marcotte, “ Food Processing: Principles and Applications” Hardcover, Import, 2005.
2. B. Lal, G. B. Siddappa and G. N. Tandon, “Preservation of Fruits and Vegetables,” 2nd edition, ICAR Publication, 1967.

19FT214 MEAT FISH & POULTRY PROCESS TECHNOLOGY

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5

Source:
httpswww.indiaretailing.com20170131foodfood-groceryprocessed-chicken-just-5-per-cent-total-poultry-market

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the various sources of animal foods such as meat, fish and poultry, technology involved in their value addition, preservation and storage. The objective of this course is to make students aware of various processing technology. Equipments, handling and quality standards of meat, fish and poultry products.

COURSE OUTCOMES :

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to apply basic food preservation principles and processing on meat, fish and poultry products.	1
2	Analyse the effect of different composition, nutritive value on spoilage and factors affecting the spoilage of meat, fish and poultry.	2
3	Investigate the impact of various methods of preservation of muscle food.	4
4	Design and Development of processing to minimize waste and by-product utilization.	3

Skills:

- ✓ *Analyze the chemical composition and other sensory properties of meat.*
- ✓ *Suggest suitable processing methods for meat, fish and poultry products.*
- ✓ *Propose storage conditions for meat products and identify spoilage.*
- ✓ *Specify packaging solutions for efficient transportation of meat, fish and poultry.*

UNIT - I **L-9**

INTRODUCTION TO MEAT, POULTRY AND FISH : Scope of meat, poultry and fish industry in india; Current levels of production, consumption and export of category products; Structure and composition of muscle and associated tissue - muscle tissue, skeletal muscle, skeletal muscle fiber, myofibrils, myofilaments, smooth muscle, cardiac muscle, epithelial tissue, nervous tissue, connective tissues, adipose tissue, muscle bundles and associated connective tissues; Muscle and fibre types; Chemical composition of skeletal muscle safety/health and hygienic considerations.

UNIT - II **L-9**

POST MORTEM CHANGES IN MEAT: Slaughtering and stunning of meat by different scientific methods - mechanical, electrical, chemical methods, ritual/religious methods of slaughter, jewish, halal, jhatka and spanish methods; Dressing and cutting of carcass in sheep, pig and buffalo; Conversion of muscle to meat - homeostasis, exsanguination, circulatory failure to muscle, post-mortem pH decline, rigor mortis, enzymatic degradation; Properties of fresh meat - water holding capacity, color, pigments.

UNIT - III **L-9**

MEAT PROCESSING AND PRESERVATION : Ante-mortem examination of meat animals; Processing - scientific techniques of slaughtering, dressing, post-mortem inspection, storage, tenderization, meat cuts and grades, packaging; Beef, mutton, pork as human foods - cured meat products, sausages, by-products, frozen and canned meat products; Principles of various meat preservation techniques - chilling, freezing, curing, smoking, thermal processing, canning, dehydration, irradiation and hurdle concept; Restructured meat products - tumbling, massaging, chunking, forming, tearing and forming; Value added meat products - luncheon meats, meat patties, meat loaves, meat balls and meat nuggets.

UNIT - IV **L-9**

EGG : Basic properties of egg - structure, composition, nutritional and functional characteristics of eggs; Grading; Spoilage; Storage; Transportation of whole eggs; Processing of eggs for liquid products (white, yolk and whole egg) and solid products (albumen powder and whole egg powder) for preservation through freezing & drying; Poultry - pre-slaughter care and consideration; Operations in preparation of dressed poultry - its storage and marketing, quality and safety considerations, utilization of by-products, Poultry cuts.

UNIT - V **L-9**

FISH : Types, catch, examination; Care in handling & transportation; Processing of shell-fish, crabs, oysters, lobsters, frog legs for domestic and export markets; Processing of fish-filleting and freezing, canning, salting & drying of fish; Fish product and by products - production of fish paste, fish oils, sauce, fish protein concentrates, by products of fish processing industry.

TEXT BOOKS:

1. G. C. Mead, "Poultry Meat Processing and Quality", Woodhead Publishing, 2004.
2. C. G. Scanes, G. Brant, and M. E. Esminger, "Poultry Science", Prentice Hall, 2004.
3. R. Martin, R. Collete, and J. Slavin, "Fish Inspection, Quality Control and HACCP", Technomic Publishing Co., 1997.

REFERENCE BOOK:

1. L. M. L. Nollet, and F. Tolbra, "Advanced Technologies of Meat Processing", CRC Press, 2006.

19HS204 ENVIRONMENTAL STUDIES

Hours Per Week :

L	T	P	C
1	-	-	1

Total Hours :

L	T	P
15	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
10	15	5	-	-	5

Source:

https://stock.adobe.com/uk/images/sustainable-development-logo

COURSE DESCRIPTION AND OBJECTIVES:

This is a multidisciplinary course which deals with different aspects using a holistic approach. The major objective of the course is to plan appropriate strategies for addressing environmental issues. The course also brings awareness of nature and judicious use of natural resources for long term sustenance of life on this planet. The course also enables the students to understand their responsibility required to react effectively to natural, man-made and technological disasters.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the importance of environment and natural resources.	6,7
2	Gain the concept on protection of biodiversity and maintain healthy environment.	7,8
3	Analyze the sources of pollutants and their effects on atmosphere.	4,8
4	Identify the evidence of global warming, ozone depletion and acid rain.	7
5	Develop a basic understanding of prevention, mitigation, preparedness, response and recovery.	7,8

SKILLS:

- ✓ *Acquire fieldwork techniques to study, observe and prepare documents, charts, PPTs, Models etc.*
- ✓ *Understand how natural resources should be used judiciously to protect biodiversity and maintain ecosystem.*

ACTIVITIES:

- *Painting contests on environmental issues and themes.*
- *Models of energy resources, Pollution and Solid Waste Management-3R strategy.*

UNIT - I **L-3**

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Environmental Studies: Multidisciplinary nature of environmental studies-definition, scope and its importance; Concept of sustainability and sustainable development; Natural resources; Deforestation-causes and impacts; Water resources-use and over exploitation of surface and ground water, conflicts over water; Heating of earth and circulation of air; Air mass formation and precipitation; Energy resources-renewable and non-renewable energy sources; Land resources-soil erosion and desertification.

UNIT - II **L-3**

ECOSYSTEMS AND BIODIVERSITY

Ecosystem: Structure and functions of an ecosystem; Energy flow:food chains, food webs and ecological succession; Types forest-grassland, desert and aquatic ecosystems (ponds, rivers, lakes, streams, ocean, estuary).

Biodiversity: Genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity; India as a mega diversity; Endangered and endemic species of India; Hotspots of biodiversity; Threats to biodiversity; Conservation of biodiversity.

UNIT - III **L-3**

ENVIRONMENTAL POLLUTION

Pollution: Air, Water, Soil, Chemical and Noise pollution; Nuclear hazards and human health risks; Solid waste management-control measures of urban and industrial wastes; Pollution case studies.

UNIT - IV **L-3**

ENVIRONMENTAL POLICIES AND PRACTICES: Climate change; Global warming; Acid rain; Ozone layer depletion and impacts on human communities and agriculture; Environmental laws-wildlife Protection Act, Water (pollution prevention and control) Act, Forest Conservation Act, Air (pollution prevention and control) Act; Environmental Protection Act; Tribal populations and rights; EIA-Introduction, definition of EIA; EIS-scope and objectives.

UNIT - V **L-3**

HUMAN COMMUNITIES AND THE ENVIRONMENT:

Human population growth: Impacts on environment; Human health and welfare; Resettlement and rehabilitation of project affected persons; Case Studies; Disaster management-floods, earthquake, landslides and cyclones; Environmental communication and public awareness; Case studies (C.N.G Vehicles in Delhi).

Field work / Environmental Visit: Visit to a local area to document environmental assets – river/ forest / grassland / hill /mountain; Visit to a local polluted site; Study of local environment - common plants, insects, birds; Study of simple ecosystems – pond, river, hill slopes; Visit to industries/water treatment plants/effluent treatment plants.

TEXTBOOKS:

1. A. Kaushik and C. P. Kaushik, “Perspectives in Environmental Studies”, 5th edition, New Age International Publishers, 2016.
2. Y. Anjaneyulu, “Introduction to Environmental Science”, B. S. Publications, 2015.

REFERENCE BOOKS:

1. M. Basu & S.Xavier, “Fundamentals of Environmental Studies”, Cambridge University Press, 2016.
2. K. Mukkanti, “A Textbook of Environmental Studies”, S. Chand Company Ltd., 2009.

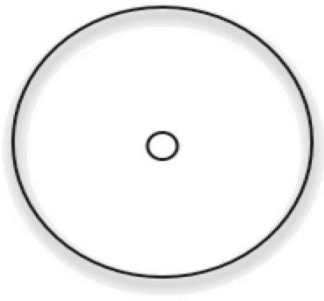
19PC009 INTRA-DISCIPLINARY PROJECTS-II

Hours Per Week :

L	T	P	C
-	-	2	1

Total Hours :

L	T	P
-	-	30



Source:

https://www.google.com/search?q=3.+Intra-disciplinary+project+I&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi7h8GZ9qTjAhUjSo8KHVTwCigQ_AUIESgC&biw=1366&bih=625#imgrc=ZTT9dcMpa_wxlM:

COURSE DESCRIPTION AND OBJECTIVES:

These projects arise from a combination of courses. The major objective of these projects is to enable students understand the relationship between the courses.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to map different courses to gain the knowledge of intra-disciplinary Engineering.	1
2	Function effectively as an individual and as a member or leader in diverse teams.	9
3	Comprehend and write effective reports and make effective presentations.	10

LIST OF INTRA - DISCIPLINARY PROJECTS

- Development of Fruit flour.
  (Combination of courses: Food chemistry, Principles of Food Processing and Preservation (PFP))
- Shelf life study of fruit flour.
  (Combination of courses: Food Microbiology, Food Chemistry)
- Development of Instant fruit tea (beverage) powder.
  (Combination of courses: PFP, Food Processing Operations (FPO))
- Shelf life study of instant tea powder.
  (Combination of courses: Food Microbiology, PFP)
- Development of Refractance window for drying of fruits
  (Combination of courses: FPO, Food Microbiology)
- Effect of Refractance window (RW) drying on quality of guava lather.
  (Combination of courses: Food Chemistry, FPO)
- Sun Drying study of guava and its modeling
  (Combination of courses: PFO, PFP)
- Sun drying study of Mango and its modeling.
  (Combination of courses: FPO, PFP)

- Study of microwave drying characteristics of banana.
  (Combination of courses: FPO, Thermo Dynamics and Heat Engines)
- Development of banana chips from the dried banana powder.
  (Combination of courses: FPO, Food Chemistry)
- Microwave drying of papaya.
  (Combination of courses: FPO, PFP)
- Microwave drying of guava.
  (Combination of courses: FPO, PFP)
- Freeze drying of orange and its modeling.
  (Combination of courses: PFP, Thermo Dynamics and Heat Engine)
- Freeze drying of dates and resins.
  (Combination of courses: FPO, PFP)
- Comparative study of microwave drying and Freeze drying for Grapes.
  (Combination of courses: FPO, PFP)
- Comparative study of Sun drying and microwave drying for Guava.
  (Combination of courses: FPO, PFP)
- Sun drying of papaya and its kinetics study.
  (Combination of courses: FPO, PFP)
- Sun drying of grapes and its kinetics study.
  (Combination of courses: FPO, Fundementals of Heat and Mass Transfer)
- Freeze drying of strawberries and its modeling study.
  (Combination of courses: FPO, PFP)
- Effect of different drying technologies on surface characteristics of locally available mushrooms.
  (Combination of courses: FPO, Food Chemistry)
- Study of sun drying characteristics of local banana.
  (Combination of courses: FPO, Food Chemistry)
- Effects of blanching on enzymatic study of apples.
  (Combination of courses: FPO, PFP)
- Effect of blanching on enzymic study of potatoes.
  (Combination of courses: FPO, PFP)
- Effect of enzymatic clarification on grape juice .
  (Combination of courses: FPO, PFP)
- Size reduction study of buckwheat by hammer mill and its shelf life study.
  (Combination of courses: FPO, PFP)
- Size reduction study of buckwheat by ball mill and its shelf life study
  (Combination of courses: FPO, PFP)
- Dehydration study of strawberries.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Osmotic dehydration of grapes and resins.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Osmotic dehydration of strawberry.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Shelf life study of onion powder.
  (Combination of courses: PFP, Food Microbiology)
- Sun drying of onions and its kinetics study.
  (Combination of courses: PFP, FPO)

- Diffusion study of resin and its mass modeling.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Mass modeling for sundried banana.
  (Combination of courses: PFP, Heat and Mass Transfer)
- Mass modeling for freeze dried strawberry.
  (Combination of courses: PFP, Heat and Mass Transfer)
- Mass modeling for osmotic dehydrated grapes and resins.
  (Combination of courses: PFP, Heat and mass transfer)
- Micro- Filtration of cashew apple juices and its preservation.
  (Combination of courses: PFP and FPO)
- Ultra filtration of cashew apple juices and its preservation.
  (Combination of courses: PFP and FPO)
- Nano filtration of cashew apple juices and its preservation.
  (Combination of courses: PFP and FPO)
- Comparative study and mass modeling for different filtered juice.
  (Combination of courses: PFP and FPO)
- Micro- Filtration of grape juices and its preservation.
  (Combination of courses: PFP and FPO)
- Ultra filtration of grape juices and its preservation.
  (Combination of courses: PFP and FPO)
- Nano filtration of grape juices and its preservation.
  (Combination of courses: PFP and FPO)
- Fouling characteristics of cashew apple juice filtered by different filtration techniques
  (Combination of courses: PFP, Heat and Mass Transfer)
- Fouling characteristics of grape juice filtered by different filtration techniques.
  (Combination of courses: PFP, Heat and Mass Transfer)
- Spray Drying of flavored milk for development of flavored milk powder and its shelf life study
  (Combination of courses: PFP and Food Microbiology)
- Spray drying characteristics of fruit juices
  (Combination of courses: PFP and Food Chemistry)
- Pasteurization of milk by shell and tube heat exchanger and its physico - chemical study
  (Combination of courses: PFP and Thermodynamics and Heat Engine)
- Pasteurization of milk by Plate heat exchanger and its shelf life study.
  (Combination of courses: PFP and Food Microbiology)
- Pasteurization of fruit juices and its shelf life study.
  (Combination of courses: PFP and Food Microbiology)
- Evaporative cooling and mass modeling of fruits.
  (Combination of courses: PFP and Heat and mass transfer)
- Evaporative cooling and mass modeling of vegetables
  (Combination of courses: PFP and Heat and mass transfer)
- Heat radiation and emissivity study of solar dried potato.
  (Combination of courses: PFP and Heat and mass transfer)
- Comparative study of hurdle technology and filtration of pineapple juice.
  (Combination of courses: PFP and FPO)
- Comparative study of hurdle technology and filtration of watermelon juice.
- Comparative study of hurdle technology and filtration of apple juice.
  (Combination of courses: PFP and FPO)

- Mathematical modeling for enzymatic clarification of pineapple juice.
  (Combination of courses: PFP, FPO)
- Canning of tomato and its mass modeling.
  (Combination of courses: PFP, FPO)
- Spray drying of tomato juice and its shelf life study.
  (Combination of courses: PFP, Food Microbiology)
- Development of tomato juice powder and its sieving characteristics.
  (Combination of courses: PFP, FPO)
- Screening efficiency of different dried fruit powders.
  (Combination of courses: PFP, FPO)
- Screening efficiency of different dried vegetable powders.
  (Combination of courses: PFP, FPO)
- Screening efficiency of different dried varieties of wheat powders.
  (Combination of courses: PFP, FPO)
- Comparative study of High pressure processing and clarification of carrot juice.
  (Combination of courses: PFP, FPO)
- Comparative study of High pressure processing and clarification of mango juice.
  (Combination of courses: PFP, FPO)
- Study of Freezing characteristics of grapes/grape juice.
  (Combination of courses: PFP, FPO)
- Freezing characteristics study of orange juice.
  (Combination of courses: PFP, Heat and Mass Transfer)
- Influence of type and state of crystallization and preservation characteristics of honey
  (Combination of courses: PFP, FPO)
- Factors affecting the stability of frozen foods
  (Combination of courses: PFP, Heat and Mass Transfer)
- Characterization of fruit powder flowability
  (Combination of courses: PFP, Food Chemistry)
- Characterization of vegetable powder flowability
  (Combination of courses: PFP, Food Chemistry)
- Ultrasound assisted nucleation of some liquid and some model foods during freezing
  (Combination of courses: PFP, FPO)
- The effects of WPI and Gum Arabic inhibition on the solid-phase crystallization kinetics of lactose at different concentrations.
  (Combination of courses: PFP, Thermodynamics and Heat Engine)
- Effect of relative humidity and temperature on fruit powder flowability.
  (Combination of courses: PFP, Food Chemistry)
- Effect of relative humidity and temperature of vegetable powder flowability.
  (Combination of courses: PFP, Food Chemistry)
- Study of relationship between crystallization mechanisms and microstructure of milk fat.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Crystallization kinetics of precooked potato starch under different drying conditions (methods).
  (Combination of courses: FPO, PFP)
- Physical characteristics of spray-dried dairy powders containing different vegetable oils.
  (Combination of courses: PFP, FPO)
- Solidification and phase transformation behavior for food fat preservation.
  (Combination of courses: FPO, Food Chemistry)

- Microwave-integrated extraction of total fats and oils.
  (Combination of courses: PFP, FPO)
- Pulse electric field assisted extraction of juice from food plants.
  (Combination of courses: PFP, FPO)
- Extraction using moderate electric fields.
  (Combination of courses: PFP, FPO)
- Novel high pressure extraction technology.
  (Combination of courses: PFP, FPO)
- Solid liquid extraction of oil of grape fruit and its preservation(rancidity) studies.
  (Combination of courses: FPO, Thermodynamics and Heat Engine)
- Microwave-assisted extraction of tea polyphenols from green tea leaves.
  (Combination of courses: PFP, FPO)
- Microwave-assisted extraction of tea caffeine from green tea leaves.
  (Combination of courses: PFP, FPO)
- Freeze drying and its freezing characteristics of grape fruit
  (Combination of courses: PFP, FPO)
- Development of premix of gulabjamun and its preservation studies.
  (Combination of courses: PFP, FPO)
- Development of Peda premix and its preservation studies.
  (Combination of courses: PFP, FPO)
- Study of moisture transfer properties of dried fruit powders.
  (Combination of courses: PFP, FPO)
- Study of moisture transfer properties of dried vegetable powders.
  (Combination of courses: Food Chemistry, Heat and Mass Transfer)
- Rehydration characteristics of dried onion flakes.
  (Combination of courses: PFP, FPO)
- Rehydration characteristics of dried mango powder.
  (Combination of courses: PFP, FPO)
- Freeze drying characteristics of peas and its rehydration ratio.
  (Combination of courses: PFP, FPO)
- Preservation of maize pollen.
  (Combination of courses: PFP, FPO)
- Quick freezing preservation of fruits.
  (Combination of courses: PFP, FPO)
- Quick freezing preservation of vegetables.
  (Combination of courses: PFP, FPO)
- Study of traditional food preservation methods for selected areas.
  (Combination of courses: PFP, FPO)
- Effect of sesame seed flour on millet biscuit characteristics and its shelf life study.
  (Combination of courses: PFP, FPO)
- Mathematical modeling of heat and mass transfer for canning process.
  (Combination of courses: FPO, Heat and Mass Transfer)
- Comparative study of Mass modeling of filtered juice and centrifuged juice.
  (Combination of courses: FPO, Heat and Mass Transfer)

NOTE: The afore - mentioned list is not exhaustive and the objective is to provide an idea of some of the projects that can be executed by students arising from a combination of courses. Students are given full flexibility to choose any projects of their choice under the supervision of faculty Mentors.

III

YEAR

FOOD TECHNOLOGY

B.Tech.

I SEMESTER

19FT301	-	Dairy Technology
19FT302	-	Fruits and Vegetable Processsing
19FT303	-	Cereals Pulses and Oilseeds Process Technology
19HS205	-	Soft Skills Laboratory
19PC010	-	Employability Skills - I
19HS301	-	Professional Ethics,Human Values & Gender Equity
19PC011	-	Inter Departmental Project -I
19PC012	-	Modular Course
	-	Department Elective - I
	-	Open Elective - II

II SEMESTER

19FT311	-	Spices and Plantation Crops Process Technology
19FT312	-	Bakery and Confectionery Technology
19FT313	-	Food Additives
19HS206	-	Professional Communications Laboratory
19PC013	-	Employability Skills - II
19PC014	-	Inter Departmental Project - II
	-	Department Elective - II
	-	Open Elective - III

COURSE CONTENTS

I SEM AND II SEM

19FT301 DAIRY TECHNOLOGY

Source:
https:// navbharattimes. indiatimes.com/ career/science/dairy-technology/ articleshow/ 52268574.cms fruit and vegetable processing -

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5

PRE-REQUISITE COURSES: Food Microbiology; Food Chemistry, Fundamentals of Fluids Mechanics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with handling, processing and preservation of milk and milk products. The objective of this course is to impart knowledge about milk, milk processing methodologies, processing equipments, byproduct utilization and to bestow skills.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the composition of milk and identify various processing methods of milk.	2
2	Apply the knowledge of separation techniques for production of cream and butter.	1
3	Analyse the nutritional properties of value added dairy based products.	2
4	Development of fermented and unfermented dairy based beverages and speciality products.	3
5	Formulation development for various cream based and indigenous dairy products.	4

SKILLS:

- ✓ *Determine physico-chemical properties of milk.*
- ✓ *Perform Standardization of milk for different products.*
- ✓ *Proficiency on processing and manufacturing methods of milk and dairy products.*
- ✓ *Identify the milk processing equipment required for a specific application.*

UNIT – I **L-9**

GENERAL INTRODUCTION : Basics properties of milk - milk, definition, composition, physico-chemical properties of milk; Pre-processing of milk - buying and collection of milk, cooling and transportation of milk, receiving, preheating, filtration/ clarification, cooling, storage of raw milk, standardization; Pasteurization - definition, objectives, methods of pasteurization, homogenization, bottling, and storage; CIP.

UNIT – II **L-9**

CREAM : Introduction - definition, classification, composition, cream production, factors affecting fat percentage of cream, types of cream, defects in cream, their causes and prevention; Butter - definition, classification, composition, method of manufacture, packaging and storage, butter over run, theories of churning, continuous butter making, defects in butter, their causes and prevention.

UNIT – III **L-9**

BUTTER OIL : Basic properties of butter oil - definition, composition, nutritive value, methods of manufacture, cooling, packaging, storage and distribution, defects in butter oil, their causes and prevention; Cheese - method of manufacture, different varieties of cheese, defects in cheese, their causes and prevention, cheddar cheese, curing of cheese.

UNIT – IV **L-9**

DIFFERENT MILK PRODUCTS : Sterilized milk; Sweetened condensed milk; Whole milk powder, Skim milk powder; Soft curd milk; Special milk - flavored milks, chocolate drinks, vitaminized/irradiated milk, and concentrated milk.

Fermented milk - types of starter culture and their propagation, natural butter milk, cultured butter milk, acidophilus milk, bulgarian butter milk, kumis, kefir; Yoghurt-preparation, starter culture and defects.

UNIT – V **L-9**

ICE CREAM : Basics of ice-cream - definition, classification, composition, nutritive value, role of constituents in ice cream; Method of manufacture; Packaging; Hardening and storage; Over run in ice cream; Defects in ice cream, their causes and prevention; Indigenous milk products - ghee, khoa, chhana, paneer, dahi and shrikhand; By-products of dairy industry - classification, principle and method of utilization; Casein (industrial) - method of manufacture, defects, uses, casein (edible).

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **Total Hours: 30**

1. To determine the physico-chemical properties of milk.
2. To conduct the platform tests of milk sampling of dairy products.
3. To check the efficiency of pasteurization of milk.
4. To conduct MBRT Test of milk.
5. Detection of common adulterants in milk and milk products.
6. Preparation and analysis of flavored milk.
7. Problems on standardization of milk.
8. Preparation and analysis of milk powder by using spray dryer.
9. Preparation and analysis of Yoghurt with mixed culture.
10. Preparation and analysis of sweetened condensed milk.
11. Preparation and analysis of peda by scraped surface heat exchanger.
12. Rapid detection methods for dairy microbes.
13. Introduction to milko-scan for rapid detection of properties of milk.
14. Industrial visit and its report preparation.
15. Preparation of frozen desserts.

TEXTBOOKS:

1. S. De, “Outlines of Dairy Technology”, 1st edition, Oxford University Press, 1980.
2 J. N. Warner, “Principles of Dairy Processing”, 3rd edition, Wiley Eastern Ltd., Delhi, India, 1976.

REFERENCE BOOKS:

1. K. S. Bangarappa and K. L. Acharya, “Indian Dairy Products”, 2nd edition, Asia Publishing House, Bombay,1974.
2. P. Walstra, “Dairy Science and Technology”, 2nd edition, Taylor & Francis, 2006.

19FT302 FRUITS AND VEGETABLE PROCESSING

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
https://www.postharvest.biz/en/company/irta-stp-servicio-tecnico-poscosecha_id:26251,seccion:news,noticia:77965/

PRE-REQUISITE COURSES: Food Chemistry; Fundamentals of Heat and Mass Transfer.

COURSE DESCRIPTION AND OBJECTIVES:

Deals with technologies related to handling, processing and storage of fruits and veetables. Impart skill and knowledge required to apply the principles and concepts behind fruit and vegetable processing including post-harvest handling.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge on processing of fruit and vegetable.	3
2	Develop the preservation techniques to improve the shelf life of seasonal fruits.	2
3	Apply the knowledge of canning for preservation of fruit and vegetable products.	1
4	Identify the factors affecting the shelf life of minimally processed foods.	2
5	Develop fermented fruits and vegetable food products.	4

Skills:

- ✓ *Specify physiological, physical, chemical and nutritional properties of fruits and vegetables.*
- ✓ *Identify and overcome undesirable changes which can occur during fruits and vegetables processing.*
- ✓ *Identify and predict the post-harvest handling factors affecting the shelf life of fruits and vegetables.*
- ✓ *Suggest suitable processing and storage conditions for fruit and vegetable products.*

UNIT - I **L-9**

FRUITS AND VEGETABLES : Current status of production and processing of fruits and vegetables; Chemical composition; Pre and postharvest changes; Role of plant growth regulators in relation to storage; Maturity standards for storage, and desirable characteristics of fruits and vegetables for processing; Conditions for transportation and storage.

UNIT - II **L-9**

PROCESSING OF FRUITS AND VEGETABLES : Processing of fruit based beverages-squashes, cordials, and nectars; Products and packaging - syrups, pulp, concentrations of juices, packaging, storage; Tomato product and its quality control; Canning and bottling (oven dry pack , oven wet pack , slow water bath, fast water bath and pressure bottling).

UNIT - III **L-9**

VALUE ADDED PRODUCT OF FRUITS AND VEGETBLES : Processing technology of jam, jelly and marmalades, tests for determining of end point, and problems in preparation; Properties of pectin; Difference between jam and jelly; Defects in jam, jelly and marmalades.

UNIT - IV **L-9**

FERMENTED FRUITS AND VEGETABLE PRODUCTS : Vinegar - production, its uses and quality control checks; Pickles and chutney processing - role of lactic acid bacteria in pickling with vinegar and fermentation, sauerkraut, kimchi; Preparation and processing of wine; Preparation of fruit leather and bar.

UNIT - V **L-9**

MINIMALLY PROCESSED FRUITS AND VEGETABLES : Factors affecting shelf life and the quality of minimally processed fruits and vegetables; Physiology and biochemistry of fresh cut; Preservation by freezing - general methods for freezing of fruits and vegetables, problem relating to storage of frozen products, standards for frozen fruits and vegetables; Dehydration of fruits and vegetables - methods of drying; Packaging (cap and map storage).

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **Total Hours: 30**

1. Determination of quality parameters of different fruits and vegetables processed products.
2. Experiment on drying kinetics with different dryers.
3. Textural properties analysis using penetrometer.
4. Determination of sugar acid ratio in fruits and vegetables.
5. Determination of pectin content in fruits and vegetables.
6. Preparation of jam and determination of TSS and viscosity.
7. Preparation of apple cider (vinegar).
8. Preparation of jelly and marmalade and determination of TSS and viscosity.
9. Testing the adequacy of blanching.
10. Preparation of pickles, chutneys and their quality and cost evaluation.
11. Preparation of tomato products and their quality and cost evaluation.
12. Concentration of fruit juice and spray drying.
13. Preparation of fruit leather and its quality and cost evaluation.
14. Clarification of juices with enzymes.
15. Wine and alcoholic beverage preparation.

TEXT BOOKS:

1. R. P. Srivastava and S. Kumar, “Fruit and Vegetable Preservation - Principles and Practices”, 6th edition, International Book Distributors, 2003.
2. G. Lal, G. S. Siddappa and G. L. Tandon, “Preservation of Fruits and Vegetables”, 3rd edition. ICAR, New Delhi, 1998.

REFERENCE BOOKS:

1. N. L. Kent and D. Evers, “Technology of Cereals”, 4th edition, Wood head Publishing Co. Ltd., Cambridge, England. Scott. Flour milling process, 1983.
2. N. Shakuntalamanay and M. Sadaksharaswamy, “Foods - Facts and Principles”, 3rd edition, New AgeInternational (P) Ltd Publishers, New Delhi, 2008.
3. S. Gupta, “Fruits and Vegetables Processing Hand Book”, 2nd edition, EIRI, Delhi, 2005.

19FT303 CEREALS PULSES AND OILSEEDS PROCESS TECHNOLOGY

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5

Source:

https://www.istockphoto.com/au/photo/cereals-and-legumes-assortment-on-wooden-table-gm1022260272-274464115

PRE-REQUISITE COURSES: General Physics and Mathematics; Food Chemistry.

COURSE DESCRIPTION AND OBJECTIVE

This course offers knowledge on various processing technologies of cereals, legumes and oil seeds. The objective of this course is to make students understand specific aspects related to processing, storage, product formulation and by-product utilization from cereals, legumes and oil seeds.

COURSE OUTCOMES

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge of physical properties of food and psychrometric tool to design and develop grain dryers.	1,3
2	Investigate the impact of parboiling/hydrothermal treatment on milling characteristics of rice.	4
3	Analyse the method of wheat milling and baking qualities of flour.	2
4	Apply the knowledge of dry and wet milling of corn and development of value added products.	1,3
5	Design and development of processing facilities for sorghum, minor millets and oil seeds.	3

Skills

- ✓ *Determine physico-chemical properties of cereals, pulses and oil seeds.*
- ✓ *Process major cereals and quality analysis of the cereal products.*
- ✓ *Handle cereal processing equipment.*
- ✓ *Extract oil from different oil seeds and quality analysis of oils.*
- ✓ *Identify and suggest appropriate storage conditions for grains.*

UNIT - I **L-9**

GRAIN PROPERTIES, GRAIN DRYING AND TYPES OF DRYERS : Physico-chemical properties of grains; Psychrometry - theory of grain drying, methods of grain drying; Grain dryers - selection, design, and specifications of grain dryers; Moisture calculation and drying numerical.

UNIT - II **L-9**

RICE MILLING AND RICE PRODUCTS: Basic properties - rice structure, varieties of rice, classification; Parboiling - principles of parboiling of paddy, hydrothermal treatments, conditioning of paddy, physico-chemical characteristics, cooking quality of rice; By-products of rice milling and their utilization (rice barn, husk); Storage - aging of rice, quality changes, processed products based on rice; Rice milling equipment - de-stoner, centrifugal de-husker, rubber-roll sheller, paddy separator, polisher, whitener, rice grader.

UNIT - III **L-9**

WHEAT MILLING : Basic properties of wheat - Introduction, varieties, composition and structure; Wheat Milling - flour milling, cleaning, conditioning/hydrothermal treatment, grinding (milling), storage of finished products; Baking quality and milling quality of wheat; Components of a wheat mill : break roll, break sifting system, reduction roll, reduction sifting system, scratch system.

UNIT – IV **L-9**

CORN MILLING : Composition and structure; Corn dry milling and wet milling - tempering, degerming, beall degermer, corn flour, corn flakes, liquid glucose, dextrose powder; Different breakfast cereals.

PULSES MILLING : classification, composition and structure; Dehulling of pulses - traditional dry milling methods, modern methods of pulses milling, cftri method, pitting, pulse milling efficiency; Soybean processing - protein isolates, and protein concentrates.

UNIT - V **L-9**

SORGHUM / MINOR MILLETS : Basic properties and products - sorghum constituent, structure, milling, different products; Millets constituent, structure, milling, different products (foxtail millet, finger millets, pearl millets); Importance of millets.

PROCESSING OF OILSEEDS : Processing of oilseeds - pre-processing, production and refining oil vegetable oil; Oilseeds as a non-oil source - oilseed meal as a protein source, application of oilseed meal, amino acids availability in different oilseed meals; Shortening - characteristics, uses, manufacturing process, types of shortening, margarine, mayonnaise, salad oil, peanut butter, vegetable ghee.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **Total Hours: 30**

1. Determination of Physical properties of cereals, pulses and oil seeds.
2. Determination of Physical properties of cereals, pulses and oil seeds with change in moisture
3. Experiment on Dehusking of paddy.
4. Experiment on Polishing of brown rice.
5. Cooking quality of rice.
6. Parboiling of paddy.
7. Milling of pulses.
8. Determination of protein from legumes.
9. Experiment on extraction of oil from oil seeds.
10. Experiment on adulteration of cereal & oil seeds.
11. Gluten content of flour.
12. Wheat milling and efficiency of milling.
13. Alcoholic acidity determination of flour.
14. Determination of peroxide value, iodine value and saponification value for different variety of oils.
15. Development of new extruded product.

TEXT BOOK

1. A. Chakraverty, “Post-Harvest Technology of Cereals, Pulses and Oil seeds”, 3rd edition, Oxford and IBH Publishing Company Pvt. Limited, 2006.
2. A. Chakraverty, A. S. Mujumdar, G. S. V. Raghavan and H. S. Ramaswamy,”Handbook of postharvest technology: cereals, fruits, vegetables, tea, and spices”, 2nd edition, Marcel Dekker, New York, 2003.
3. A. Chakraverty, and R. P. Singh. Postharvest technology and food process engineering. CRC Press, 2016.

REFERENCE BOOK

1. E. V. Araullo, D. B. D. Padua and M. Graham, “Rice- Post Harvest Technology”, 1st edition, International Development Research Centre, Canada, 1976.
2. K. Rosentraterand and A. Evers, “Kent’s Technology of Cereals”, 5st edition, Wood head Publishing Co. Ltd., Cambridge, England, 2017.
3. N. Shakuntalamanay and M. Shadaksharaswamy, “Foods - Facts and Principles”, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi, 2008.

19HS205 SOFT SKILLS LABORATORY

Source:
https//5.imimg.com

Hours Per Week :

L	T	P	C
-	-	2	1

Total Hours :

L	T	P
-	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	-	-	20	-	2

COURSE DESCRIPTION AND OBJECTIVES:

To impart students employability skills like resume preparation and facing interviews. To enable trainees to develop interpersonal and leadership skills. To train them on work place skills like making presentations, participating in group discussions etc.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to introspect on individual strengths and weaknesses, and emerge as a balanced personality with improved self-awareness and self-worth for their future.	12
2	Ability to prepare a resume and gain the confidence to communicate effectively.	10
3	Possess the interpersonal skills to conduct himself/herself effectively in everyday professional and social contexts.	8
4	Ability to adopt professionalism into daily activities.	8
5	Observe gender sensitive language and workplace etiquette in his professional life.	8

SKILLS:

- ✓ *Balance social and emotional intelligence quotients though SWOC, JOHARI etc. activities.*
- ✓ *Prepare tailor made resume and face various job interviews with enriched personality traits.*
- ✓ *Plan personal and professional goals.*
- ✓ *Solve personal and professional life hiccups with confidence and maturity.*

ACTIVITIES:

- *Formal and informal communication*
- *SWOT analysis*
- *Stephen covey time management matrix*
- *Stress management technique*
- *Vocabulary flashcards*
- *Group discussions*
- *Resume preparation*
- *Mock-Interviews*
- *Reading comprehension activities*
- *Listening comprehension activity by watching american accent video*

UNIT - I **P - 6**

SOFT SKILLS: Need for soft skills, professionalism, employability skills - **Communication**: Need for effective communication - the process of communication, levels of communication, flow of communication, choice of diction and style with reference to setting (formal, semi-formal or informal) -communication networks, barriers to communication, miscommunication, noise and ways to overcome the barriers- **Career Planning**: Job vs. career, goal setting, SWOT analysis, planning and prioritization, time management : four quadrant system, self-management, stress-management.

ACTIVITIES: Johari Window for SWOT analysis; Setting a SMART goal using the provided grid; Writing a Statement of Purpose (SOP) - Stephen Covey's Time Management matrix

UNIT - II **P - 6**

VOCABULARY BUILDING: Word etymology, roots, prefixes & suffixes, synonyms & antonyms, collocations, one-word substitutes, analogies, idioms and phrases, contextual guessing of unfamiliar words, task-oriented learning (50 words)- **Functional English:** Situational dialogues, Role plays (including small talk), Self introduction, Opening and closing a telephonic conversation, Making an appointment, Making a query, Offering/Passing on information, Communicating with superiors, Expressing agreement/objection, Opening bank account (combination of prepared and impromptu situations given to each student) - **Group Discussion:**Articulation and flow of oral presentation, dynamics of group discussion, intervention, summarizing and conclusion, voice modulation, content generation, Key Word Approach (KWA), Social, Political, Economic, Legal and Technical Approach (SPELT), View Point of Affected Part (VAP), language relevance, fluency and coherence.

ACTIVITIES: Making a flash card (one per day by each student) – vocabulary exercises with hand-outs – Vocabulary quiz - Viewing a recorded video of GD & Mock sessions on different types of GD topics- controversial, knowledge, case study (including topics on current affairs)

UNIT - III **P - 6**

RESUME PREPARATION: Structure and presentation, defining career objective, projecting one's strengths and skill-sets, summarizing, formats and styles and covering letter- **Facing Interviews:**

Interview process, understanding employer expectations, pre-interview planning, opening strategies, impressive self-introduction, answering strategies, other critical aspects such as body language, grooming, other types of interviews such as stress-based interviews, tele- interviews, video interviews, frequently asked questions (FAQs) including behavioural and HR questions and the aspect looked at by corporate during interviews

ACTIVITIES: Appraising some samples of good and bad resumes, preparing the resume, writing an effective covering letter- writing responses and practicing through role plays and mock interviews on the FAQs including feedback

UNIT - IV **P - 6**

READING COMPREHENSION: Reading as a skill, techniques for speed reading, understanding the tone, skimming and scanning, appreciating stylistics, impediments for speed reading, eye fixation, sub-vocalization, critical reading, reading based on purpose, reading for information, reading for inference- **Listening Comprehension:** Listening as a skill, different types of listening, active and passive listening, top-down approach, bottom-up approach, understanding the non verbal cues of communication; intonation and stress

ACTIVITIES: Reading comprehension exercises with texts drawn from diverse subject areas. (Hand-outs) -Narration of a story, Speech excerpts with different accents (Indian, British, American), listening comprehension exercises with audio and video excerpts

UNIT - V **P - 6**

PAPER PRESENTATION: Selection of a topic, preparing an abstract, gathering information, organizing the information, drafting the paper, citing reference sources – writing striking introductions, discussing the methodology used, developing the argument, presentation style, language, presenting the paper and spontaneously answering audience questions -**Mind your language -** How Language Reflects Personality**: G**ender sensitive language in MNCs - **Seven essential skills** for a team player; attentive listening, intelligent questioning, gently persuading, respecting other's views, assisting others, sharing, participating actively.

ACTIVITIES: Watching & discussing videos on corporate etiquette- Presenting a paper - Quiz on corporate etiquette.

TEXT BOOKS:

1. E. Holffman, "Ace the Corporate Personality", McGraw Hill, 2001.
2. A. Furnham, "Personality and Intelligence at work", Psychology Press, 2008.

REFERENCE BOOKS:

1. K. Mohan & NP Singh, "Speaking English Effectively" 1st edition, Macmillan, 2008.
2. S.P. Dhanvel, "English and Soft Skills", Orient Blackswan, 2011.

19HS301 PROFESSIONAL ETHICS, HUMAN VALUES & GENDER EQUITY

Hours Per Week :

L	T	P	C
2	-	-	2

Total Hours :

L	T	P
30	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
6	6	7	-	-	10

Source:
https://www.google.com/search?q=professional+ethics&client

COURSE DESCRIPTION AND OBJECTIVES:

The course will provide students with an understanding on Engineering Ethics and the nature of moral issues and dilemmas faced by engineers in their professional lives. It will give them an awareness on professional rights and responsibilities of an engineer and acquaint them on the Code of Conduct and Ethics prescribed by professional bodies like IEEE, ASME etc for its members

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to engage in an informed critical reflection on the nature of professionalism and ethical challenges inherent in engineering profession.	6, 7 8,9,12
2	Apply awareness of professional rights and responsibilities of an engineer to conduct themselves ethically within an organization.	6,7,8 9,12
3	Apply understanding of safety norms to highlight ethical issues in risky situation.	6,7,8 9,12
4	Understand the role of professional bodies, and the code of ethics and industrial standards prescribed for engineers.	6,7,8 9,12

SKILLS:

- ✓ *Safety & Environment consciousness.*
- ✓ *Ethical behaviour and decision-making at workplace.*
- ✓ *Ability to work in large teams.*
- ✓ *Emotional intelligence for workplace.*

UNIT – I **L-6**

INTRODUCTION TO PROFESSIONAL ETHICS: Morals, values and ethics; Civic virtue; Respect for others, Living peacefully; Caring; Sharing; Honesty; Valuing time; Co-operation; Commitment, empathy; Self-confidence; Courage, Character; Spirituality; Service learning; Introduction to Engineering Ethics; Profession; Professionalism.

UNIT – II **L-6**

NATURE OF MORAL ISSUES: Moral dilemmas (Problem of Vagueness, Conflicting Reasons & Disagreement); Types of inquiry (Normative, Conceptual & Factual); Moral autonomy; Kohlberg's & Carol Gilligan's theory; Impediments to responsible action; Theories of right action (Bentham's Theory of Utilitarianism, Theory of Consequentialism etc.).

UNIT – III **L-6**

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineers' responsibility for safety ; Assessment of safety and risk; Testing for safety; Risk benefit analysis; Reducing risk; Government regulator's approach to risk; A balanced outlook on law; Discussion of case studies: Challenger disaster / Chernobyl disaster; Code of ethics; Professional societies; Sample code of ethics like ASME, ASCE, IEEE etc.

UNIT – IV **L-6**

RIGHTS AND RESPONSIBILITIES AT WORKPLACE: Organizational complaint procedures; Whistle blowing; Environment and the workplace; Gender equity; Understanding gender; Organizational policies regarding gender; Gender roles; Looking beyond stereotypical generalizations; Service rules; Conflict of interest; Prevention of sexual harassment; Women rights under labour laws.

UNIT – V **L-6**

ETHICS IN A GLOBAL CONTEXT: Intellectual Property Rights ;Business ethics; Transparency & fair practices; Discussion of case study; Enron-Dhabol project; Environmental ethics; Challenge of sustainable development; UN Conventions & protocols on environment; Discussion of case studies; Bhopal gas tragedy, pacific gas & electric company Vs. environmental activist, Erin Brockovich; Computer ethics; Automation & artificial intelligence; Cyber security & cyber laws; Case study; Wiki leaks; Role in technological development; Weapons development.

TEXT BOOKS:

1. M. Mike and S. Roland, "Introduction to Engineering Ethics", 2nd Edtion, McGraw-Hill Higher Education, 2010 .
2. M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, "Engineering Ethics", Prentice Hall of India, Reprint 2013.

REFERENCE BOOK:

1. B. C. Fleddermann, "Engineering Ethics", 4th edition, Pearson Education/Prentice Hall, 2014.

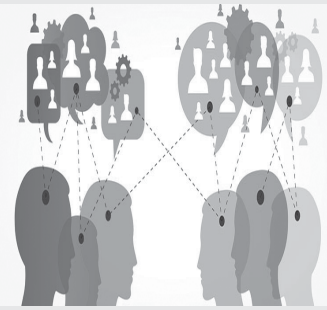
19PC011 INTER-DEPARTMENTAL PROJECTS-I

Hours Per Week :

L	T	P	C
-	-	4	2

Total Hours :

L	T	P
-	-	60



Source:

https://www.google.com/search?q=3.+Inter-disciplinary+project+I&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi7h8GZ9qTjAhUjSo8KHVTwCigQAUIESgC&biw=1366&bih=625#imgrc=-dFL_VXrz5spXM:

COURSE DESCRIPTION AND OBJECTIVES:

These projects are aimed at enabling students understand the relationship between the courses of various programs. Students will get an idea of how interesting technologies or processes, prototype or working model can be developed by culmination of technologies from courses of different programs.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to apply inter-disciplinary Engineering knowledge.	1
2	Function effectively as an individual and as a member or leader in diverse teams.	9
3	Comprehend and write effective reports and make effective presentations.	10

LIST OF INTER - DEPARTMENTAL PROJECTS-I

- Development of Biosensor for early detection of Rancidity in Cooking Oil.
  (Combination of Courses from the Branches of ECE, Material Science and Food Technology).
- Detection of infestation in wheat kernels by Hyperspectral Image Processing.
  (Combination of Courses from the Branches of ECE and Food Technology).
- Curcumin content profiling during storage of local turmeric powder.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Selection of ethylene scrubber for active packaging of local banana.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Prototype instrument development for non-destructive detection of pesticide residue in sweet corn using Raman technology.
  (Combination of Courses from the Branches of Electrical Department and Food Technology).

- Assessment of cold chain for perishable commodities.
  (Combination of Courses from the Branches of Food Technology and Chemical Engineering).
- Bioactive Analysis of Wheatgrass.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Usability of smartphone to evaluate the efficiency of polyaniline based Sensor for indication of freshness of fish fillet during Chemical spoilage.
  (Combination of Courses from the Branches of ECE and food technology).
- Design of cold plasma machine “dielectric-barrier discharges prototype”
  (Combination of Courses from the Branches of Physics and Food Technology).
- Development of Biosensor for smart packaging of climacteric fruits.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Bio gas generation from food waste from industry.
  (Combination of Courses from the Branches of Agricultural and Technology).
- Use of corn waste for development of PLA.
  (Combination of Courses from the Branches of Food Technology and Electrical Engineering).
- Design of Solid-state anaerobic digestion for methane production from food waste.
  (Combination of Courses from the Branches of Chemical and Food Technology).
- Development of E-vision for quality evaluation of turmeric.
  (Combination of Courses from the Branches of ECE and Food Technology).
- Development of E-nose for quality evaluation of wine.
  (Combination of Courses from the Branches of ECE and Food Technology).
- Prototype instrument development for deshelling of pine nuts.
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Development of automatic instrument for deshelling of coconut.
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Prototype instrument development to extract bud from sugarcane.
  (Combination of Courses from the Branches of mechanical engineering and food technology).
- Ultrasound assisted freezing of marine products.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Design of a plate freezer for effective freezing of fish fillet.
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Freeze concentration of milk for low cost transportation.
  (Combination of Courses from the Branches of Applied Engineering and Food Technology).
- Profiling of cheddar cheese quality with time.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Study on different health effects caused by milk tea.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Development of high quality paneer from cow and buffalo milk.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Development of biodegradable plates from rinds of different fruits.
  (Combination of Courses from the Branches of Applied Engineering and Food Technology).

- Probiotic milk with high health benefits.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Design of centrifugal sheller for paddy
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Biodegradable packaging for different cereals
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Use of image processing in automatic pineapple harvester
  (Combination of Courses from the Branches of Agricultural Engineering and Food Technology).
- Development of biosensor for detection of alcohol in beer
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Development of biosensor for detection of aromatic compounds in aged rice
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Development of biosensor for detection of esters in hydrogenated oil
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Prototype instrument development for non-destructive detection of quality of milk using spectral information
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Design of spray dryer of milk and baby food products
  (*Combination of Courses from the Branches of* Mechanical Engineering and Food Engineering).
- Development of Pulse Electric Field for liquid foods
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Design of an Ohmic *Pasteurisers*
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Design of a basic dairy with cost estimation and profit calculation
  (Combination of Courses from the Branches of Applied Engineering and Food Technology).
- Design of a fruit and vegetable processing plant with cost estimation and profit calculation
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Design of a rice processing plant with cost estimation and profit calculation
  (Combination of Courses from the Branches of Agricultural Engineering and Food Technology).
- Design of a corn milling industry with cost estimation and profit calculation
  (Combination of Courses from the Branches of Agricultural Engineering and Food Technology).
- Validating and evaluating the performance of various microwave-based applicators designed specifically for pasteurizing shell eggs
  (Combination of Courses from the Branches of Agricultural Engineering and Food Technology).
- Determining the commercial feasibility of producing safe, high quality shelf-stable and chilled extended shelf life low-acid food products via high pressure-temperature processing
  (Combination of Courses: Agricultural Engineering and Food Technology).
- Evaluate if high pressure processing has an effect on the migration rate of additives or contaminates in food contact packaging materials
  (Combination of Courses: Food Technology and Chemical Engineering).
- Measure migration rates of organic and inorganic chemicals (nano-particulate clays and

quantum dots) within composite packaging materials to determine the food contact risk factors of these materials
(Combination of Courses: Material Science and Food Technology).

- A multi-disciplinary project to generate the supporting data needed to establish a set of minimum process conditions that achieve a minimum 5 log reduction of Salmonella for low-moisture extruded foods
(Combination of Courses: Mechanical Engineering and Food Technology).
- Determining and analyzing the efficacy of cooling methods used in school food service operations to cool leftover foods to produce recommendations on proper cooling methods in compliance with FDA Food Code regulations
(Combination of Courses: Agricultural Engineering and Food Technology).
- Determination of Inorganic Chemicals Released from Polymer-clay Nanocomposite Food Packaging.
(Combination of Courses: Polymer Science/chemical Engineering and Food Technology)
- Determination of organic and inorganic chemicals released from polymer-clay nanocomposite food packaging.
(Combination of Courses: Chemical Engineering and Food Technology)
- Effect of High Pressure Processing on Migration Characteristics in Flexible Packaging Materials: Part II.
(Combination of Courses: Chemical Engineering and Food Technology)
- Detection of Botulinum Neurotoxin Using Fret-Based Quantum Dot Sensors II.
(*Combination of Courses:* Physics and Food Technology)
- Enhancing Legacy Technologies for Pasetuerization.
(Combination of Courses: CSE and Food Technology)
- Evaluation of Coxiella burnetii and Listeria monocytogenes Inactivation in Bovine and Non-Bovine Milk Pasteurization.
(Combination of Courses: Biotehnology and Food Technology)
- Factors Affecting Arsenic levels in Juices Processed by Filter Aids.
(Combination of Courses: Chemical Engineering and Food Technology)
- High Pressure Processing of Frozen Pet Foods for Pathogen Inactivation.
(*Combination of Courses:* Food Technology and Biotechnology)
- Inactivation of Clostridium botulinum Spores Using High Pressure Processing-Part III.
(*Combination of Courses:* Food Technology and Biotechnology)
- Migration Database of Additives and Contaminants in Food Packaging Systems for Use in Predictive Migration Models: Part II.
(Combination of Courses: CSE and food technology)
- A New TDT Apparatus for Measuring Bacterial Inactivation as a Function of Temperature and Humidity in Spices and Other Particulate Foods.
(Combination of Courses from the Branches of Mechanical Engineering and Food Technology)
- Testing of the Low-Tech, Low Cost Sensor for Measuring Cooler Heat Transfer Rates.
(Combination of Courses from the Branches of Biotechnology and Food Technology).
- Ultraviolet Light Decontamination of Coconut Water.
(Combination of Courses from the Branches of Biotechnology and Food Technology).

- Understanding Migration Nanoparticles Polymer Films Semiconductor Nanocrystals. *(Combination of Courses from the Branches of Quantum Dots)(Physics/ Material Science and Food Ttechnology).*
- Understanding the Phylogeny, Subtyping and Virulence Plasmids of Selected *Clostridium* botulinum Strains Using PFGE, Microarrays and Whole Genome Sequencing. *(Combination of Courses from the Branches of Biotechnology and Food Technology).*
- Validation of High Pressure Processing to Inactivate Isolated Salmonella spp. In Buffered Peptone Water and Frozen Chicken Blend Pet Food. (*Combination of Courses from the Branches of Biotechnology and Food Technology).*
- Validation of HPP to achieve reduction of Salmonella spp. and Listeria monocytogenes inoculated in various food models. *(Combination of Courses from the Branches of Biotechnology and Food Technology).*
- Validation of HPP to inactivate Salmonella spp., Listeria monocytogenes and E. coli O157:H7 in juices. *(Combination of Courses from the Branches of Biotechnology and Food Technology).*
- Design of a low cost extruder with temperature and pressure controlling device. *(Combination of Courses from the Branches of Agricultural Engineering and Food Technology).*
- Design of instant coffee tablet making machine. (*Combination of Courses from the Branches of* Mechanical Engineering and Food Technology)
- Development of an equipment which measures angle of repose and angle of friction of grains at same time. *(Combination of Courses from the Branches of Agricultural Engineering and Food Technology).*
- Development of moisture sorption isotherm for any extruded product developed in lab. *(Combination of Courses from the Branches of Agricultural Engineering and Food Technology).*
- Study of moisture sorption isotherm of local dairy sweets. *(Combination of Courses from the Branches of Agricultural Engineering and Food Technology).*
- Design a low cost freeze dryer for different functional foods. *(Combination of Courses from the Branches of Agricultural Engineering and Food Technology).*
- E-vision of quality detection of grape juice. *(Combination of Courses from the Branches of Electrical Engineering and Food Engineering).*
- Design of low cost homogenizer for milk. *(Combination of Courses from the Branches of Mechanical Engineering and Food Technology).*
- Development of pneumatic polisher for rice. *(Combination of Courses from the Branches of Mechanical Engineering and Food Technology).*
- Extraction of color for flowers for textile industry. *(Combination of Courses from the Branches of Textile Technology and Food Technology).*
- Extraction of beta carotenoids for pharmaceutical industries. *(Combination of Courses from the Branches of Pharmacy and Food Technology).*
- Extraction of anthocyanin from grape and its incorporation in lozenges for colour. *(Combination of Courses from the Branches of Pharmacy and Food Technology).*
- Extraction of lycopene compound from tomatoes and incorporating in a chewing gum. *(Combination of Courses from the Branches of Chemical Engineering and Food Technology) .*
- Development of color sorter for fruits. *(Combination of Courses from the Branches of Mechanical Engineering and Food Technology).*
- Development of a fruit and vegetable grader using biosensor. *(Combination of Courses from the Branches of Biotechnology and Food Technology).*

- Development of E-tongue for sensory of wine.
  (Combination of Courses from the Branches of ECE and Food Technology).
- Development of semi/automatic traditional food processing equipment's.
  (Combination of Courses from the Branches of Mechanical Engineering and Food Technology).
- Extraction of flavonoids from tea for development of pharmaceutical product.
  (Combination of Courses from the Branches of Pharmacy and Food Technology).
- Design and development of a multi transducer ultrasonicater for extraction.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Image analysis of food products for surface characterization.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Development of a customised programme for TPA
  (Combination of Courses from the Branches of CSE and Food Technology).
- Hyperspectral imaging for microbial detection in food
  (Combination of Courses from the Branches of CSE and Food Technology).
- Early detection of mastitis in dairy animals using electronic devices.
  (Combination of Courses from the Branches of ECE and Food Technology).
- Study of electrical properties of food products for quality evaluation.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Study of surface characterises of dried fruits and vegetables using SEM.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Study of internal structure of fruits and vegetables for drying using TEM
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Development of automatic porosity measurement equipment.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Design of an automatic food blancher.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Design and development of a solar dryer for fruits and vegetables.
  (Combination of Courses from the Branches of Agricultural Engineering and Food Technology).
- Development of photo sensor for infrared absorbance collection from food.
  (Combination of Courses from the Branches of Biotechnology and Food Technology).
- Hyperspectral imaging as an online quality inspection in food industry.
  (Combination of Courses from the Branches of CSE and Food Technology).
- Development of photo sensor for Vis-NIR absorbance collection from fruits.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Detection and development of a kitchen friendly Urea detector in milk.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).
- Automatic formulation of material balance and price balancing software.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Development of a kitchen based milk adulteration detecting system.
  (Combination of Courses from the Branches of Electrical Engineering and Food Technology).
- Physico-chemical properties detector for milk and liquid system using major constituents.
  (Combination of Courses from the Branches of Chemical Engineering and Food Technology).

NOTE: The afore - mentioned list is not exhaustive and the objective is to provide an idea of some of the projects that can be executed by students arising from a combination of courses from various branches. Students are given full flexibility to choose any projects of their choice under the supervision of faculty mentors from a combination of different departments.

19FT311 SPICES AND PLANTATION CROPS PROCESS TECHNOLOGY

Source:
https://www.hindustantimes.com/fitness/weight-loss-diet-include-these-8-herbs-and-spices-for-faster-result/story-e4O4dmY0iknzJ4dwk5ZxDN.html

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVE

This course details with processing, packaging and storage of different kinds of spices and condiments. The objective of this course is to make students aware of various techniques involved in processing of spices and condiments, their value addition.

COURSE OUTCOMES

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the scope, processing methods and production scenario of spices and plantation crops.	2
2	Apply the fundamentals of mechanical processing for value addition in spices, condiments and plantation crops.	1
3	Identify the adulteration and select ideal packaging solutions for spice, plantation crops and condiments.	2,5
4	Design, develop and apply appropriate techniques for post-harvest processing of spices and speciality products.	3,5

Skills

- ✓ *Identification of different bioactive compounds present in plantation crops.*
- ✓ *Evaluating process changes in spice and plantation.*
- ✓ *Developing new methods for measurement of different bioactive compounds.*
- ✓ *Evaluating different flavoring and aroma compounds present in spices.*
- ✓ *Analyze chemical composition of spices and plantation crops.*
- ✓ *Suggest a technology for extraction of essential oil from different spices.*
- ✓ *Identify adulteration in spice and plantation products.*

UNIT - I **L-9**

INTRODUCTION TO SPICES : Types of spices; Production; Pre-harvest and post-harvest problems in processing; Drying; Storage and packaging; Health benefits; Products and processing-spice powder and paste, their processing, quality, storage, flavoring components; Spice based food additives-volatiles, essential oils and oleoresins; Extraction and utilization of essential oils; Standards and specifications of spices; Market value of spices in India; Definition of major and minor spice.

UNIT - II **L-9**

POSTHARVEST HANDLING OF MAJOR SPICES : Post harvest processing of major spices-turmeric, pepper, onion, chili including, introduction, harvesting, production status, health benefits, post-harvest technology and treatments; Processing into marketed products; Adulteration; Specifications for marketed products; Packaging and different grades; Processing of oleoresin from the major spices.

UNIT - III **L-9**

POSTHARVEST HANDLING OF MINOR SPICE: Post harvest processing of minor spice-cardamom ginger, criander, cumin, garlic, saffron, vanilla, clove, nutmeg including, Introduction, harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades; Processing of oleoresin from the minor spices; Health benefits of minor spices.

UNIT - IV **L-9**

POSTHARVEST HANDLING OF PLANTATION CROPS :

PROCESSING OF TEA : Types of tea; Chemistry of tea manufacturing; Tea quality-tea aroma precursors, tea flavor, grades of tea, storage of tea, instant tea, and processed tea products

PROCESSING OF COFFEE : Processing of coffee cherries by wet and dry methods to obtain coffee beans-prinding, storage and preparation of brew, soluble/instant coffee, use of chicory in coffee, decaffeinated coffee.

UNIT - V **L-9**

PROCESSING OF PLANTATION CROPS :

Processing of Cocoa - chemical composition of cocoa beans, cocoa processes, leaning, roasting, alkalization, cracking and fanning, nib grinding for cocoa liquor, cocoa butter and cocoa powder. manufacturing process for chocolate, ingredients, mixing, refining, conching, tempering, moulding, enrobing, packaging to obtain chocolate slabs, chocolate bars, enrobed and other confectionary products.

Coconut & Cashew - introduction, harvesting, production status, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades; Health benefits of plantation crops; Pre and post-harvest problems in processing of crops; Different by-products obtained from coconut and cashew, processing of by-products.

LABORATORY EXPERIMENTS

LIST OF EXPERIENTS **Total Hours: 30**

1. Identification of spices, condiments and plantation crops and their flavoring or bioactive compounds.
2. To Identify the Adulteration in spices.
3. To Extract the oleoresin from pepper and cloves by using Soxhlet apparatus.
4. Determination of moisture content of Spices by Steam Distillation method.
5. Extraction of Oleoresin from Cardamom and chili powder.
6. Extraction of Oleoresin from Turmeric powder and Ginger.
7. Quantification and extraction of Curcumin from Turmeric.
8. Chemical analysis of Spices: Moisture, valuable oils, specific gravity.
9. Study of standard specifications of spices.
10. Preparation of different spice powders.
11. To determine the polyphenol content in spices.
12. To check the antimicrobial property in spices.
13. Drying and roasting of coffee beans.
14. New-product development from coconut.
15. Postharvest processing of cashew-nut from cashew-apple.

TEXT BOOKS:

1. K. G. Shanmugavelu, “Spices and Plantation Crops”, 1st edition, Oxford and IBH Publishing Co., 1979.
2. S. Gupta, “Hand Book of Spices and Packaging with Formulae”, 2nd edition, Engineers India Research Institute, 2002.

REFERENCE BOOKS:

1. D. K. Salunkhe and S. S. Kadam, “Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing”, 1st edition, CRC Press, 1995.
2. N. K. Jain, “Global Advances in Tea Science”, 1st edition, Aravali Books International, 1999.
3. M. N. Clifford and K. C. Willson, “Coffee: Botany, Biochemistry and Production of Beans and Beverage”, 1st edition, AVI publishing Co.,1985.

19FT312 BAKERY AND CONFECTIONERY TECHNOLOGY

Source:
http://www.puremalt.com/ingredieants/bakery_confectionery_and_desserts

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5

PRE-REQUISITE COURSES: Food Chemistry.

COURSE DESCRIPTION AND OBJECTIVE

This course deals with bakery and confectionery sector of food processing. The objective of this course is to acquaint the students with preparation methods for various bakery and confectionary products, quality control aspects, processing parameters and handling of equipment's.

OUTCOMES

Upon completion of the course, student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Identify various ingredients used in bakery and confectionary products.	2
2	Analyse the function and interaction of carbohydrate and protein during dough development.	2
3	Develop suitable method for value added bakery product development.	3
4	Investigate the impact of processing methods on quality of baked and confectionary products.	4
5	Formulate recipes for new bakery product development.	2

Skills

- ✓ *Prepare commonly consumed bakery products like bread and fermented foods, cookies, biscuits, cakes and Icing.*
- ✓ *Judge the quality of raw-materials.*
- ✓ *Predict the physiochemical changes during processing.*
- ✓ *Handling of various bakery equipment's.*

Unit - I **L-9**

I**NTRODUCTION :** Global and Indian status of bakery and confectionary industry; Review of raw materials used; Ingredients and their role in bakery industry - Wheat, wheat flour, sugar, fat and oils, egg, yeast, salt, leavening agents, moistening agent, improvers and emulsifiers; Rheological testing of dough.

Unit - II **L-9**

BREADS : Ingredients and process flow of preparation; Types of breads; Bread making process - straight dough, rapid processing, mechanical dough development; Various faults in breads - staling of bread, losses during manufacturing; Effect of process parameters on quality; Process flow sheet of breads; Equipment's used - make up equipment, functions of mixing and mixer type (horizontal, vertical, planetary and continuous mixers) and blenders used in bakery industry, divider, rounder, moulder, proofer, different oven, slicer and packaging materials used.

Unit - III **L-9**

CAKES : Ingredients, flour specification, process flow, and quality evaluation, faults and corrective measures; Preparation of other bakery products - pastries, doughnuts, rusks, crackers, pizzas and wafers, and assessing their quality parameters; Biscuits and cookies - process flow and manufacturing; Biscuits-ingredients and flour specifications, process flow manufacturing, types of biscuits and crackers, faults in biscuits, process flow for different types of biscuits and crackers, effect of process parameters on quality; Types of dough developed - developed dough, short dough, semi-sweet, enzyme modified dough; Importance of the consistency of the dough; Packaging material for cakes and biscuits; Gluten free products and pasta - raw material, processing and quality parameters.

Unit - IV **L-9**

CONFECTIONERY : Raw materials used in confectionery; Chocolate processing technology and candy bars-production of chocolate mass, presentation and application of vegetable fats; Sugar confectionery-hard boiled sweets, cotton candy, fruit drops, center filled toffees, caramel, lollipops, chewing gums and bubble gums and assessment of their quality parameters.

Unit - V **L-9**

MISCELLANEOUS : Co-extruded products-breakfast cereals, spaghetti, vermicelli; Fudges; Lozenges toffees; Marshmallow and fondants; Bakery plant layout; Safe practices in work-place sanitation; Code for hygienic conditions.

LABORATORYEXPERIMENTS

LISTOFEXPERIMENTS **TOTAL HOURS: 30**

1. Gluten determination of cereal flour.
2. Determination of dough raising capacity.
3. Amylase activity by falling number test.
4. Determination of fat content in cookies.
5. Preparation of bread by different methods.
6. Preparation of cookies and biscuits.
7. Preparation of milk and dark chocolate.
8. Preparation of cake.
9. Preparation of extruded products.
10. Preparation of different type of candies.
11. Determination of rheological properties of bakery products.
12. Determine textural properties of bakery products.
13. Water absorption index and solubility test of extruded products.
14. Preparation of marshmallow and cotton candy.
15. Preparation of fondant and fudges.

TEXTBOOKS:

1. W. J. Sultan,"Baker's Handbook on Practical Baking",5th edition,US wheat Associates, Wiley, 1989.
2. J. Kingslee, "A Professional Textto Bakery and Confectionery",3rd edition,New Age International,New Delhi, 2006.

REFERENCEBOOK:

1. E. B. Jackson, "Sugar Confectionery Manufacture", 2nd edition,Springer, 1995.

19FT313 FOOD ADDITIVES

Source:
https://www.cbhs.com.au/health-well-being-blog/blog-article/2015/03/12/food-additives-harmful-or-harmless

Hours Per Week :

L	T	P	C
3	-	-	4

Total Hours :

L	T	P
45	15	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION & OBJECTIVES:

This course will impart knowledge about various food additives used in food industry. By the end of the course students will be able to understand different types of food additive and their importance in food processing.

COURSE OUTCOMES:

Upon completion of the the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse and identify various food additives and their safe usage limit.	2
2	Apply the knowledge of naturally available food additives for food preservation.	1
3	Investigate the impact of antioxidant and chelating agents on shelf life of food products.	4
4	Formulate optimal level of stabilizer and thickener in various food products.	2
5	Develop suitable formulations for multi-additive mix for preservation of speciality products.	3

SKILLS:

- ✓ *Apply different coloring matter in developing new food products.*
- ✓ *Preserve food in a synergistic manner using chelating and antioxidants.*
- ✓ *Make use of different thickening agents in modifying the food texture.*
- ✓ *Develop different variety of food products using different flavor on same basic ingredient.*
- ✓ *Determine toxicity level of each food additive.*

Unit - I **L-9**

INTRODUCTION : What are food additives, role of food additives in food processing functions, classification; Intentional & unintentional food additives; Toxicity and safety evaluation of food additives; Beneficial effects of food additives/toxic effects; Food additives generally recognized as safe (GRAS).

Unit - II **L-9**

NATURALLY OCCURRING FOOD ADDITIVES : Classification, role in food processing, health implications, food colors, natural food colors, types, chemical nature, impact on health, preservatives, natural preservation, chemical preservatives, chemical action on human and food system.

Unit - III **L-9**

ANTI-OXIDANTS AND CHELATING AGENTS : Introduction, role in foods, types of antioxidants, natural and synthetic, examples; Chelating agents - their mode of action in foods examples; Surface active agents - mode of action in foods, examples.

Unit - IV **L-9**

STABILIZERS AND THICKENERS : Role in food processing, examples, bleaching & maturing agents, eamples of bleaching and maturing agents; Starch modifiers - chemical nature, role in food processing; Buffers-acids & alkalis, examples, types, role in food processing.

Unit - V **L-9**

FLAVORING AGENTS : Artificial sweeteners, non-nutritive sweeteners, special dietary supplements, their health implications, role in food processing; Flavoring agents - natural flavors, synthetic flavors, chemical nature, role of flavoring agents in food processing, examples; Anti-caking agents - role in food processing; Humectants - definition, role in food processing; Clarifying agents - definition, examples and role in food processing.

TEXT BOOKS:

1. A. L. Brenan, P. M. Davidson and S. Salminen, “Food Additives”, 2nd edition, Marcel Dekker, 2001.
2. A. B. George, “Encyclopedia of food and color additives: 2nd edition, CRC press, 1996.

REFERENCE BOOK:

1. D. L. Madhavi, S. S. Deshpande and D. K. Salunke, “Food Antioxidants: Technological, Toxicological and Health perspective” 2nd edition, Mercel Dekker,1996.

19HS206 PROFESSIONAL COMMUNICATION LABORATORY

Source:
https://encrypted

Hours Per Week :

L	T	P	C
-	-	2	1

Total Hours :

L	T	P
-	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
15	10	-	10	-	-

COURSE DESCRIPTION AND OBJECTIVES:

To improve the overall communication skills (LSRW) of students and prepare them for their profession as engineers and managers. To provide them exposure to conventions of corporate communication and training them on how to function in the business world.

COURSE OUTCOMES:

Upon completion of the the course, student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to communicate effectively both in their academic as well as professional environment.	10
2	Clear grasp on the register of business language.	8
3	Possess the ability to write business reports and proposals clearly and precisely to succeed in their future.	12
4	Potentiality to make effective presentations and participate in formal meetings.	10

SKILLS:

- ✓ *Articulate effective spoken and listening abilities needed for professional and social success in interpersonal situations, group interactions, and personal and professional presentations.*
- ✓ *Explore specific functions and vocabulary in a business context.*
- ✓ *Produce short business reports, proposals and correspondence.*
- ✓ *Write various business documents through reading techniques.*

ACTIVITIES:

- *Paraphrasing an article or a video in own words and finding topic sentence in newspaper articles*
- *Finding out new words from a professional view point and understanding the meaning and its usage*
- *Reviewing samples of well prepared proposals and reports*
- *Drafting different proposals / reports on assigned topics*
- *Classroom activities of team and individual presentations*
- *Finding missing appropriate sentence in the text*
- *Using vocabulary in context*

UNIT - I **P - 6**

BUSINESS ENGLISH VOCABULARY: Glossary of most commonly used words (formal and informal usage)

ELEMENTS OF TECHNICAL WRITING: Sentence structure, reducing verbosity, arranging ideas logically, building coherence, cohesive devices and transitional words.

MECHANICS OF WRITING: Stylistic elements, the purpose, the reader's viewpoint (audience), elementary rules of grammar, choice of diction, elementary principles of composition, matters of form, punctuation, conventions of business communication, language and professional tone, code of conduct (not sending illegal, offensive, disparaging personal remarks or comments) in written business communication.

Activity: Basic grammar practice, framing paragraphs on topics allocated, paraphrasing an article or a video, finding topic sentences in newspaper articles, finding out new words from a professional viewpoint and understanding the meaning and its usage

UNIT - II **P - 6**

BUSINESS CORRESPONDENCE: E-mail-nature and scope, e-mail etiquette, clear call for action, common errors in composing e-mails, office communication such as meeting agenda and minutes of the meeting, notice, circular and memo

LETTER-WRITING: Formal and informal letters, structure of formal letters, expressions of salutations, different types of letters [such as sales letter, complaint letter, response to the complaint letter (dispute resolution), letter of permission, letter of enquiry, claim letter – letter of apology], introductory and concluding paragraphs and clear call for action.

PROFESSIONAL PROPOSAL/REPORT: Differentiating proposals and reports, Drafting formal business proposals, types of reports such as factual reports, feasibility reports and survey reports, parts of a report (such as title page, declaration, acknowledgements, table of contents, abstract, introduction, findings, conclusion and recommendations)

ACTIVITY: Perusing samples of well-prepared business emails, memo, letter writing and short proposals and reports, students will draft business correspondence writing tasks and different proposals/reports on topics assigned.

UNIT - III **P - 6**

SPEAKING: Speaking in business context, assertiveness, politeness, making requests, queries and questions, negotiations, asking for information, offering suggestions, conflict resolution, contacting clients, initiating, addressing delegates (in public), features of a good power-point presentation (making PPT), delivering the presentation effectively, telephone etiquettes, delivering seminar/proposal/report effectively, team meeting etiquettes (face to face and conference call), making effective one minute presentations

ACTIVITY: Watching videos/listening to audios of business presentations, classroom activities of team and individual presentations, using PPTs, mock exercises for BEC speaking, presenting (speaking) the written components completed in Unit 1

UNIT - IV **P - 6**

READING: Reading and comprehending business documents, learning business register, regularizing the habit of reading business news, suitable vocabulary, skimming and scanning text for effective and speedy reading and dealing with ideas from different sectors of corporate world in different business contexts

ACTIVITY: Hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choice, using right vocabulary as per the given context and editing a paragraph

UNIT - V **P - 6**

LISTENING: Specific information in business context, listening to telephonic conversations/messages and understanding the intended meaning, understanding the questions asked in interviews or in professional settings, summarizing speaker's opinion or suggestion

ACTIVITY: Working out BEC/TOEFL/IELTS listening exercises with hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choices, using right vocabulary in context-editing a paragraph, listening to a long conversation such as an interview and answer MCQs based on listening.

TEXT BOOKS:

1. G. B. Hart, "Cambridge English Business Bench Mark: Upper Intermediate", 2nd edition, CUP, 2014.
2. CUP, Cambridge: BEC VANTAGE Practice Papers, CUP, 2002.

REFERENCE BOOKS:

1. Schnurr, "Exploring Professional Communication: Language in Action". London: Routledge, S 2013.
2. S. John, " The Oxford Guide to Effective Writing and Speaking", 2005.

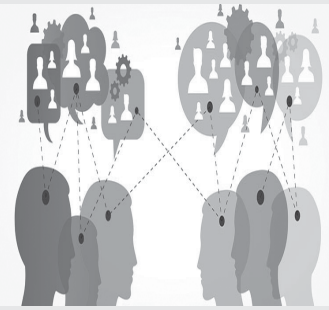
19PC014 INTER-DEPARTMENTAL PROJECTS-II

Hours Per Week :

L	T	P	C
-	-	4	2

Total Hours :

L	T	P
-	-	60



Source:

https://www.google.com/search?q=3.+Inter-disciplinary+project+I&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi7h8GZ9qTjAhUjSo8KHVTwCigQAUIESgC&biw=1366&bih=625#imgrc=-dFL_VXrz5spXM:

COURSE DESCRIPTION AND OBJECTIVES:

These projects are aimed at enabling students understand the relationship between the courses of various programs. Students will get an idea of how interesting technologies or processes, prototype or working model can be developed by culmination of technologies from courses of different programs.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Ability to map different courses to gain the knowledge of inter-disciplinary Engineering.	1
2	Function effectively as an individual and as a member or leader in diverse teams.	9
3	Comprehend and write effective reports and make effective presentations.	10

LIST OF INTER - DEPARTMENTAL PROJECTS-II

- Electro – fermentation
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Removal of allergens from foods by application of modern biotechnology
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- RFID in food packaging
  (Combination of Courses from the Branches of Food Technology and ECE)
- Development of fusion sweets or desserts and analysis of nutritional values
  (Combination of Courses from the Branches of Food Technology and Biomedical Engineering)
- Production of bio diesel from foods (food wastes)
  (Combination of Courses from the Branches of Food Technology and Petroleum Engineering)
- Development of nutrispreads
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Development of confectionery products using artificial sweetner and their analysis
  (Combination of Courses from the Branches of Food Technology and Biotechnology)

- Production of nanofibres
  (Combination of Courses from the Branches of Food Technology and Material Science)
- HPLC fingerprinting in various specially prepared foods
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Detection of toxins in foods using advanced technology
  (Combination of Courses from the Branches of Food Technology and Biomedical)
- Novel techniques for detection of freshness of fruit juices.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Lactitol production.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Development of bakery products with high dietary fiber content.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Image analysis of grains.
  (Combination of Courses from the Branches of Food Technology and Bioinformatics)
- Image analysis of bakery products to evaluate shelf life.
  (Combination of Courses from the Branches of Food Technology and Bioinformatics)
- Analysis of multi vitamin drugs using different bioanalytical techniques.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Plasticizing effect of yerba mate powder/Basil leaf extract incorporate in Nano starch edible film from cassava.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Preservation of fruits coated with and nano starch particle edible film at ambient temperature.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Biodegradable film from sugarcane bagasse (Nano cellulose) and it application on preservation of fruits.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Edible film from Banana and its application on preservation of kiwifruit.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering).
- Development of model for mechanical properties Nano cellulose based biodegradable film.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Microstructure and physico-chemical evaluation of nano-emulsion-based antimicrobial peptides embedded in bioactive packaging films.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Biodegradable starch/clay nano composite films for food packaging applications.
  (Combination of Courses from the Branches of Food Technology and Material Science).
- Microstructure and physico-chemical evaluation of nano-emulsion-based antimicrobial peptides embedded in bioactive packaging films.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Chitosan nanocomposite film based on Ag-NP biosynthesis by Bacillus subtilis as packaging materials.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Chitosan nanocomposite film based on Au-NP biosynthesis by Bacillus subtilis as packaging materials.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).

- Development of novel microbial sensors.
  (Combination of Courses from the Branches of Food Technology and ECE)
- A starch based biodegradable film modified by nano silicon dioxide.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Hydrophobic-modified nano-cellulose fiber/PLA biodegradable composites for lowering water vapor transmission rate (WVTR) of paper.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Perspectives on Utilization of Edible Coatings and Nano-laminate Coatings for Extension of Postharvest Storage of Fruits and Vegetables.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Antimicrobial activity of chitosan, organic acids and nano-sized solubilisates for potential use in smart anti microbially-active packaging for potential food applications.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Microstructure and physico-chemical evaluation of nano-emulsion-based antimicrobial peptides embedded in bioactive packaging films.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Development of model for mechanical properties Nano cellulose based edible film.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Understanding of starch biosynthesis in cassava for quality improvement.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering).
- Bioactive compounds and advanced processing technologies.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Biotechnological potential of yeasts in functional food industry.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Promising effects of â-glucans on glyceamic control in diabetes.

  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Propolis applications in antimicrobial and antioxidative protection of food quality.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Microelectronic packaging
  (Combination of Courses from the Branches of Food Technology and EEE).
- Particle-based stabilization of water-in-water emulsions containing mixed biopolymers.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Cereal biopolymers for nano- and microtechnology.
  (Combination of Courses from the Branches of Food Technology and Biotechnology).
- Advances on food authenticity technologies and chemometric approaches.
  (Combination of Courses from the Branches of Food Technology and Chemical Engineering).
- Occurrence, synthesis, toxicity and detection methods for acrylamide determination in processed foods with special reference to biosensors.
  (Combination of Courses from the Branches of Food Technology and ECE)
- Lowering the barrier properties between oepn source optimizers and industrial MATLAB users
  (Combination of Courses from the Branches of Food Technology and Mechanical Engineering)
- Monitoring strategies for quality control of agricultural products using visible and near-infrared spectroscopy.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)

- Recognition of weeds with image processing.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Effect of extrusion processing on physicochemical, functional and nutritional characteristics of rice and rice-based products.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Valorisation of pineapple wastes for food and therapeutic applications.
  (Combination of Courses from the Branches of Food Technology and Phramacy)
- Dying of clothes using natural dyes extracted from foods.
  (Combination of Courses from the Branches of Food Technology and Textile Technology)
- Adsorption of starch, amylose, amylopectin and glucose monomer and their effect on the flotation of hematite and quartz.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Low cost equipment design for storage of food to increase the shelf life.
  (Combination of Courses from the Branches of Food Technology and Mechanical Engineering)
- Determination of Ca addition to the wheat flour by using laser induced breakdown spectroscopy.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Validation and application of GC method for determining fatty acids and tyrans fat in some bakery products.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Edible films and coatings from wheat and corn proteins and shelf life study.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Edible films from pectin: Physical-mechanical and antimicrobial properties.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Development of Edible Films and Coatings with Antimicrobial Activity.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Oxygen and aroma barrier properties of nano edible films.
  (Combination of Courses from the Branches of Food Technology and Biotecnology)
- Antimicrobial Edible Films and Coatings.
  (Combination of Courses from the Branches of Food Technology and Biotecnology)
- Physicochemical properties and application of pullulan edible films and coatings in fruit preservation.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Antimicrobial and enzymatic anti browning Nano film used as coating for bamboo shoot quality improvement.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- MAP for prevention of mold spoilage of bakery products with different pH & water activity levels.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Inactication of food spoilage bacteria by UV irradiation.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Genetically modified enzymes used in food production and processing.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- GMO's for production of high quality bakery products.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Development of plasmids for industrial yeast transformation.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)

- Improvement in shelf life and safety of perishable foods by plant essential oils and smoke antimicrobials.
  (Combination of Courses from the Branches of Food Technology and Biotechnology.
- Improvement in yield and productivity in crop plants.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Improvement of in yield and productivity in animal products.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Developmengt of Prosweets.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Multigrain muffins and analysis of nutritional properties.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Decrease in baking times of special flours to prevent gluten lumps.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Texture and nutritional profiles of different proteins and fibers.
  (Combination of Courses from the Branches of Food Technology and Textile Technology)
- X – ray machines for metallized film packaging.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Enzyme based amperometric biosensors for food analysis.
  (Combination of Courses from the Branches of Food Technology and ECE)
- HPLC and Electrophoresis in the analysis of soybean proteins and peptides in food stuffs
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Toaster with bakery product shield.
  (Combination of Courses from the Branches of Food Technology and EEE)
- Bakery product characteristics as influenced by convection heat flux
- Novel computational tools in bakery process data analysis.
  (Combination of Courses from the Branches of Food Technology and CSE)
- Determination of soft wheat in semolina and durum wheat bread by analysis of DNA microsatellites.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Anti oxidant properties of organic and non organic tea.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Physico chemical and functional properties of deoiled rice bran and its utilization in the development of extruded product.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Fungal lipase production by solid state fermentation.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Production and evaluation of baked and extruded snacks from blends of millet, pigeon pea and cassava cortex flour.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Bioelectricity generation of single chamber membrane less microbial fuel cell using waste water from chocolate industryReliable and primary tool for detection of food borne pathogens
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Extraction of natural colours from fungi isolated from various food source.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)

- Optimization and extraction of proteins from watermelon seeds.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)
- Develop an electronic nose for prediction of early fungal spoilage of bakery products.
  (Combination of Courses from the Branches of Food Technology and ECE)
- Development of low cost irradiation machine for food disinfestation .
  (Combination of Courses from the Branches of Food Technology and Mechanical Engineering)
- Develop a software for analysizing nutreints in exotic foods.
  (Combination of Courses from the Branches of Food Technology and CSE)
- Electrostatic spraying of potassium sorbate for the reduction of yeats and mold on cakes.
  (Combination of Courses from the Branches of Food Technolgy and Biotechnology)
- Physico chemical and electronic nose measurements on the study of biscuit baking kinetics.
  (Combination of Courses from the Branches of Food Technology and ECE)
- Modeling the effects of adding hydrocolloids on bread staling using neural networks.
  (Combination of Courses from the Branches of Food Technology and CSE)
- Modeling of heat and entropy sorption of maize by neural network method.
  (Combination of Courses from the Branches of Food Technology and CSE)
- Extraction of alpha – tocopherol from brown rice in preparation for analysis by usin UV – Vis
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Usage of single cell proteins in different foods preparation.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Isolate and purify the bioactive peptides from food source.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Predictive modelling approach applied to spoilage fungi on solid media.
  (Combination of Courses from the Branches of Food Technology and Biotechnology)
- Development of low cost microcentrifuge using e – waste.
  (Combination of Courses from the Branches of Food Technology and Mechanical Engineering)
- Plant design for constructing a food industry using less space.
  (Combination of Courses from the Branches of Food Technology and Civil Engineering)
- Nutritional analysis of herbal drinks.
  (Combination of Courses from the Branches of Food Technology and Agriculture Engineering)

NOTE: The afore - mentioned list is not exhaustive and the objective is to provide an idea of some of the projects that can be executed by students arising from a combination of courses from various branches. Students are given full flexibility to choose any projectsof their choice under the supervision of faculty mentors from a combination of differ ent departments.

IV

YEAR

FOOD TECHNOLOGY

B.Tech.

I SEMESTER

19FT401	-	Food Quality Safety and Standards
19FT402	-	Food Plant Layout and Equipment Design
19FT403	-	Food Packaging
19PC015	-	Societal Centric and Industry related Projects
	-	Department Elective - III
	-	Department Elective - IV

II SEMESTER

19PC016 / 19PC017	-	Internship / Project work

COURSE CONTENTS

I SEM AND II SEM

19FT401 FOOD QUALITY SAFETY AND STANDARDS

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P
45	15	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	45	-	-	5	5

Source:
https://www.google.com/search?q=7.+Food+Quality+safety+and+standards&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi-64DH96TjAhXo_XMBHSUDAr0Q_AUIESgC&biw=1366&bih=625#imgrc=Q7vSVyoYuyIB1M:

COURSE DESCRIPTION AND OBJECTIVE:

The course deals with global food safety laws, standards and regulations. The objective of the course is to impart knowledge to students on national and international food standards along with application of ISO and HACCP in food processing industries.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse and identify various food additives and their safe usage limit.	2
2	Apply the knowledge of naturally available food additives for food preservation.	1
3	Investigate the impact of antioxidant and chelating agents on shelf life of food products.	4
4	Formulate optimal level of stabilizer and thickener in various food products.	2
5	Develop suitable formulations for multi-additive mix for preservation of speciality products.	3

Skills

- ✓ *Identify the different sources of food contamination.*
- ✓ *Categorize the contaminants on the basis of severity.*
- ✓ *Prepare quality control charts for a given process.*
- ✓ *Identify different allergens in foods.*
- ✓ *Identify natural toxin present in food.*
- ✓ *HACCP implementation in food industry.*

UNIT - I **L-9**

INTRODUCTION : Introduction to food safety; Food security; Concept of food safety and standards (FSSAI); Licensing and registration(FSSAI); Food hazards and contaminations – physical hazards, chemical hazards (toxic constituents/ hazardous materials, pesticide residues/ environmental pollution/ chemicals), biological hazards (Bacteria, viruses and parasites), trace chemicals.

UNIT - II **L-9**

INDIAN STANDARDS : AGMARK act and rules - title, definitions, certification procedure, laboratory approvals and action on non-compliance, appeals; BIS - evolution of BIS, scope, definitions, power & functions of BIS, licensing procedure, export and import laws and regulations, export (Quality control and Inspection) act, 1963; APEDA - Introduction, act and rules, function , product monitored.

UNIT - III **L-9**

ISO : ISO 9001:2008 - evolution of ISO 9001:2008, PDCA cycle, introduction to contents of the standards, salient features, advantages of implementation of the standard, certification & auditing; Introduction to the family of ISO 22000 standards-FSMS 22000:2005, various elements and clauses included in the standard; Comparison of ISO 9001:2008 vs. ISO 22000:2005.

UNIT - IV **L-9**

INTERNATIONAL FOOD LAWS: Codex alimentarius commission - role of CAC and its committees; Introduction to OIE and IPPC; Introduction of other international food standards; WTO - introduction to WTO agreements, SPS and TBT Agreement, implications on trade in light of SPS and TBT; FAO - overview of organization structure, objectives and functions.

UNIT - V **L-9**

QUALITY CONTROL AND QUALITY ASSURANCE : Quality control vs quality assurance; Introduction to total quality management; Food related hazards; Microbiological considerations in food safety; HACCP - terminology, principles, identification of CCPs, application of HACCP system in industries and the logic sequence involved.

TEXT BOOKS:

1. C. A. Roberts, “The Food Safety Information Handbook”, 2nd edition, CRC Press, Taylor & Francis, 2001.
2. R. H. Schmidt and G. E. Rodrick, “Food Safety Handbook”, 3rd edition, John Wiley & Sons, 2005.

REFERENCE BOOKS:

1. N. Rees and D. Watson, “International Standards for Food Safety”, 1st edition, Aspen publishers, 2000.
2. P. L. Knechtges, “Food Safety: Theory and Practice”, 1st edition, CRC Press, UK, 2012.

19FT402 FOOD PLANT LAYOUT AND EQUIPMENT DESIGN

Source:
http://ecoursesonline.iasri.res.in/course/view.php?id=29

Hours Per Week :

L	T	P	C
3	1	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE: Food Processing Operations.

COURSE DESCRIPTION AND OBJECTIVES:

One of the main objectives of the course is to familiarize the students with the fundamental concepts of engineering food process operations and plant layout which will be used as background knowledge for the understanding of specialized courses in the field of Food Technology with prime focus on Plant layout design, plant economics, machine designing for food processing and its cost estimation.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Formulate layout for various type of food processing units.	1
2	Development food processing project managementskill.	3
3	Analysis the hygiene status of various food process equipment and process economics.	2
4	Design and develop food processing equipment using construction materials of varied strength.	3
5	Investigate and analyse various type of material handling equipment.	4

Skills:

- ✓ *Operate the mass and energy balances for a given food process.*
- ✓ *Soft skills related to design and develop of plant and machine in AutoCAD or solidwork.*
- ✓ *Design and analyze reactor heating and cooling system.*

UNIT - I **L-9**

BASIC CONCEPTS OF PLANT LAYOUT: Basic concepts of plant layout and design including basic understanding of equipment layout ventilation; Reference industry - bakery, fruits and vegetable and dairy industries; Miscellaneous aspects of plant layout and design like provision for waste disposal; Safety arrangements; Optimization of food plant processes.

UNIT - II **L-9**

LOCATION ANALYSIS: Design consideration for location of food plants; ISO, FPO, MPO requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants; Application of program evaluation and review technique (PERT) and critical path method (CPM) in project planning and monitoring.

UNIT - III **L-9**

BASIC PRINCIPLES FOR HYGIENIC DESIGN: Basic principles for hygienic design of food equipment and auxiliary systems in contact with foods; External design of processing equipment and auxiliary systems; CIP system design; Process engineering economics-money flow in food business enterprise, capital cost, manufacturing cost, cash flow analysis, plant profitability, sensitivity analysis; Solve some numericals.

UNIT - IV **L-9**

DESIGN OF FOOD PROCESSING EQUIPMENTS: Design considerations of food processing equipments and food processing facilities - materials of construction, strength of materials, factor of safety, theories of failure, allowable stresses, and minimum thickness after forming; Solve some numericals.

UNIT - V **L-9**

CONVEYOR DESIGN: Design consideration of material conveying equipment - belt conveyor, screw conveyor, bucket elevator; Solve some numericals.

TEXTBOOKS:

1. A. Lopez-Geomez and G. V. Barbosa-Canovas, “Food Plant Design”, 2nd edition, CRC press, Taylor & Francis, New York, 2000.
2. B. Zacharias and Maroulis and D. G. Saravacos, “Food Plant Economics”, 3rd edition, CRC press, Taylor & Francis, New York, 1998.

REFERENCE BOOK:

1. M. S. Peter and K. D. Timmerhaus, “Plant Design and Economics for Chemical Engineers”, 2nd edition, McGraw Hill, 2001.
2. R. L. Earle., “Unit Operations in Food Processing”, 2nd edition, CRC press, 1999.

LABORATORY AND EXPERIMENTS

LIST OF EXPERIMENTs **TOTAL HOURS: 30**

1. Determination of particle size using screen analysis.
2. Effectiveness of screen.
3. Verification of size reduction laws using jaw crusher.
4. Verification of size reduction laws using ball mill.
5. Verification of size reduction laws using roll crusher.
6. Determination of compressibility coefficient using sedimentation process.
7. Determination of filter medium resistance and cake resistance using plate and frame filter press.
8. Determine the efficiency of cyclone separator.
9. Drying characters of food material.
10. Determination of percentage recovery of coal from coal sand mixture using Froth Floatation cell.
11. Introduction with different design-oriented software
12. Determination of energy consumption in size reduction (crushability test (roll or jaw crusher), Ball mill grindability indices.
13. Sampling of materials (Riffle sampling and cone quartering sampling).
14. Size separation: tabling, froth flotation.
15. Introduction to auto-cad and solidworks for equipment design.

19FT403 FOOD PACKAGING

Source:
https://printcosmo.com/boxes/food-boxes/

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
25	-	-	5	5	5

COURSE DESCRIPTION AND OBJECTIVE:

This course deals with types and functions of packaging material along with its various methods and equipment used for packaging. The objective of this course is to impart knowledge to students on applications of food packaging materials and methods effectively in accordance with relevant standard regulations, environment protection and ethical principles.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Identify various methods of food packaging and factors affecting the shelf life of the packaged foods.	2
2	Apply the knowledge of hazards and toxicity associated with packaging and to design safe packaging for food products.	1
3	Investigate the properties of various packing material.	4
4	Formulate labelling information to develop knowledge on laws and regulation involved in safety and labelling of foods.	3
5	Identify various biodegradable and eco-friendly packaging materials.	1

Skills

- ✓ *Measure and evaluate properties of packaging materials.*
- ✓ *Define the packaging requirements for a given food product.*
- ✓ *Suggest suitable labeling requirements for a food package.*
- ✓ *Suggest packaging material for any given food materials.*

UNIT - I **L-9**

INTRODUCTION TO FOOD PACKAGING : Importance and functions of food packaging; Need for packaging; Packaging and packing; Ideal characteristics of packaging material-selection and rejection criteria for different packaging materials; Role of packaging in food industries - package functions, package design consideration; Factors need to be considered to produce successful package - transport hazards, marketing facts and cost considerations; Packaging requirements for cereals, meat, poultry, fish, milk, vegetables, fruits, plantation crop-based products and carbonated beverages; Types of packaging materials.

UNIT - II **L-9**

FOOD PACKAGING MATERIALS : Packaging materials - plastic as packaging material (flexible, hard and laminate) flexible packages; Polymer films–polymers, physical, chemical and permeability properties, manufacturing methods, testing and identification, permeability modeling, migration of chemicals; Paper-manufacturing process and applications, properties and applications of corrugated paperboard and paperboard, on machine and off machine process; Metal containers: strength requirement, seaming and coating properties, contamination from lacquers; Glass containers and closures.

UNIT - III **L-9**

BIODEGRADABLE FOOD PACKAGING MATERIALS : Edible packaging materials; Biodegradable packaging materials; Environmental aspects; Future trends.

TESTING OF PACKAGING MATERIAL : Destructive & non-destructive test; Testing of rigid, semi rigid and flexible packaging material**;** Shelf life study; Corrosion and toxicity of packaging material.

UNIT - IV **L-9**

PACKAGING MACHINERY : Machineries for weighing, filling, sealing and wrapping operations; Form-fill-seal (FFS) machines - horizontal FFS machine, its mode of operation for sachet and pouch for different food products, vertical FFS machine, its mode of operation for sachet and pouch for different food products, wrapping, cartooning, labelling, bar-coding, marking and strapping; Packing for physical distribution; Industrial packaging - material handling, cushioning, unit palletizing, stacking and containerization.

UNIT - V **L-9**

SPECIAL PACKAGING AND STANDARDS : Special packing - gas, vacuum and aseptic packaging, shrink packaging, microwave packaging; Advances in food packaging - smart packaging, intelligent packaging, active packaging, antimicrobial packaging; Standards of packaging materials according to FSSAI and BIS.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Determination of GSM of packaging materials.
2. Determination of bursting strength of packaging materials.
3. Determination of tensile strength of packaging materials.
4. Determination of WVTR.
5. Determination of GTR.
6. Puncture testing of packaging materials.
7. Torque testing of packaging materials.
8. Determination of cobb Value.
9. Determination of edge crush strength of a food package.
10. Determination of transport worthiness of a food package.
11. Study on vacuum packaging.
12. Study on MAP of fresh fruits and vegetables.
13. Industrial tour on cnning industry.
14. Determination of tearing strength of packaging material.
15. Identification of different kind of polymers used in food industry.

TEXT BOOKS:

1. G. L. Robertson, “Food Packaging - Principles and Practices”, 3rdedition, Marcel Dekker, 1992.
2. R. Ahvenainen, “Novel Food Packaging Techniques”, 3rd edition, Blackwell, CRC Press, 2001.

REFERENCE BOOKS:

1. R. Coles, “Food Packaging Technology”, 2nd edition, Blackwell, CRC Press, 2003.
2. N. Khetarpaul and D. Punia, “Food Packaging” 2nd edition, Daya Publishing House, 2003.

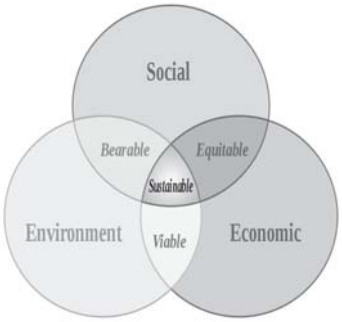
19PC015 SOCIETAL-CENTRIC AND INDUSTRY RELATED PROJECTS

Hours Per Week :

L	T	P	C
-	-	6	3

Total Hours :

L	T	P
-	-	90



Source:

https://www.google.com/search?q=8.+Socio-centric+and+Industry+related&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&=0ahUKEwiKyvfr96TjAhVKs48KHS2AAEsQ_AUIECgB&biw=1366&bih=625#imgrc=YwHIE84GREENVM:

COURSE DESCRIPTION AND OBJECTIVES:

The major objective of the societal-centric projects is to connect students to society through their technical knowledge. The prerequisite to start the project is to submit a report pertaining to the Societal-centric or industry related problem in the preceeding semester.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Study the problems which are related to the society in their production / occupational activities	2
2	Work on technology applications which can either solve the problems or make the activities less stenuous	3
3	Design an implement or process to achieve the second outcome	4

LIST OF SOCIETAL-CENTRIC AND INDUSTRY RELATED PROJECTS

- Physico-chemical standardization of selected Ayurveda preparations – Nutraceuticals and Functional Foods
- Assessing Policy and Institutional Barriers to Dissemination of Solar Technologies in India. – Heat and Mass Transfer
- Understanding Reluctance of Small and Marginal Farmers to Undertake Processing of Their Agricultural / Horticultural Produce – Agricultural Engineering, Cereals, Legumes, Pulses Processing
- Scaling up evaluation and techno-economic analysis of fruit processing waste biorefinery – Fruits and Vegetable Processing, Petroleum technology
- Development of a multi-feedstock biorefinery: Techno-economic analysis and life cycle assessment – Petroleum Engineering, Statistics
- Development of sustainable stand-alone water filtration system for rural house-hold applications - Food Process Equipments
- Retention of nutrients in earthen pots while cooking – Food Safety and Analysis
- Development of low-cost portable solar refrigerator – Food Process Equipments
- Standardization and development of procedure for red chili powder processing. – Spice Processing Technology

- Development of procedure for banana wafer making – Product development and Analysis
- Design and standardization of method for Coconut Milk Powder Production – Product Dvelopment
- Development of high efficiency solar cookers – Public health
- Development of modified storage bins for marginal farmers – Grain Storage Technology
- Development of smart storage seed bags from indigenous sources – Grain storage Technology
- Development of low-cost machine for tender coconut cutting – Machine Designing
- Valorization of less known aromatic plants in rural areas – Food Chemistry
- Design and development of low cost and efficient tamarind destoner – Machine Design
- Development of process for fermented beverage from Banana – Beverage Technology
- Valorization of less known medicinal plants in rural areas – Nutraceuticals and Functional Foods
- New value added products from Jackfruit stones – Functional Foods
- Development of coagulated products from Coconut milk – Product Development
- Development of yoghurt from blend of coconut and peanut milk - Product Development
- Development of high efficiency and low cost solar dryers for regional spice - Machine Designing
- Standardization of processes for value added products from Jackfruit stones – Product Development
- Standardization of processes for value added products from Jackfruit bulbs - Product Development and analysis
- New value added products from Jackfruit bulbs – Nutraceuticals and Functional Foods
- Evaporating cooling chambers for locally grown vegetables- Refrigeration and Machine design
- Development of production methods of paste from Moringa leaves and its storage study – Nutraceuticals and Functional Foods
- Evaporating cooling vans for transporting locally grown produce – Automobile Engineering
- Design and development of efficient, higher capacity and manually operated pulse grinders- Food Process Equipments
- Development of production methods of paste from curry leaves and its storage study- Product development
- Development of low cost iron rich candies from locally available product – Nutraceuticals and Functional Foods
- Development of high capacity and geo-energy portable water purifiers – Chemical Engineering
- Utilization of essential oils from citrus peel for aroma. - Nutraceuticals and Functional Foods
- Development of process for fermented beverage from Jackfruit - Nutraceuticals and Functional Foods
- Development of process for fermented beverage from watermelon - Nutraceuticals and Functional Foods
- Development of process for fermented beverage from tender coconut - Nutraceuticals and Functional Foods
- Caramelized products from watermelon seeds - Nutraceuticals and Functional Foods
- Isolation of phytochemicals from indigenous herbs - Nutraceuticals and Functional Foods
- Development of marketing and promotion strategies of local desserts – Management Science
- Development of low cost environmentally controlled ripening chamber for banana – Food Process Equipments
- Development of eco-friendly paper from pine apple peels. – By product Utilization Fruits and Vegetable Processing

- Development of higher load carrying capacity bicycles for local vendors – Mechanical Engineering
- Valorization of less known spices in rural areas- Spices Processing Technology
- Ergonomically designed higher load carrying capacity tricycles for fruits and vegetables sellers – Food Process Equipments
- AutoCad design of mobile tomatopulp processing units – Computer Programming
- AutoCad design of mobile chilli grading units – Computer Programming
- Standardization and improvement of traditional practices for processing of meat, fish and poultry products – Meat Food Processing Technology
- Standardization and improvement of traditional practices for processing of dairy puddings – Dairy Technology
- Standardization and improvement of traditional practices for prashadam from temples – Food Safety and Quality
- Design and development of manually operated size grading of lemons – Fruits and Vegetables Processing
- AutoCad design of mobile Jackfruit processing units – Computer Programming
- AutoCad design of wholesome Jackfruit harvesting robots – Computer Programming
- AutoCad design of Jackfruit destoner – Computer Programming
- Development of protocols for street vendors to ensure good handling practices for agricultural commodities – Food Safety and Hygiene
- Development of marketing and promotion strategies of local spices – Management Science
- Development of protocols for street vendors to ensure good handling practices for dairy products – Food Safety and Quality
- Development of protocols for street vendors to ensure good handling practices for meat, fish and poultry products – Meat Foods Processing Technology
- Development of protocols for street vendors to ensure sanitation near place of consumption and sale – Food Safety and Quality
- Standardization and improvement of traditional practices for making lemon vinegars – Fruits and Vegetable Processing
- Minimal processing units for highly perishable banana - Fruits and Vegetable Processing
- Minimal processing units for highly perishable lemon - Fruits and Vegetable Processing
- Standardization and improvement of traditional practices for making lemon pickles - Fruits and Vegetable Processing
- Utilization of pomegranate peels for extraction of colour - Fruits and Vegetable Processing
- Production of bioethanol by utilizing wastes generated from vegetable market- Fruits and Vegetable Processing
- Production of compressed gasses from Pongamiapinnata or Karanj - Fruits and Vegetable Processing
- Biogsas production from wastes generated from vegetable market - Fruits and Vegetable Processing
- Study and develop of methods for minimizing the post-harvest losses of chilli during storage and transportation. – Spice Processing Technology
- Standardization and improvement of traditional practices for making lemon and chilli vinegars - Fruits and Vegetable Processing
- Study and develop of methods for minimizing the post-harvest losses of onion and garlic during storage and transportation - Fruits and Vegetable Processing
- Development of production methods of paste from Moringa seeds and its storage study - Fruits and Vegetable Processing
- Value added feed for castles from waste of various agricultural communities – Agricultural Engineering

- Calorific and smokeless briquettes from sugar cane bagasse – Sugar and Jaggery Processing Technology
- Development of ropes for sugarcane bagasse for handling of oil and greases - Sugar and Jaggery Processing Technology
- Design and development of improved wood fired challahs with high heat retention for rural community – Management Science
- Development of low cost environmentally controlled ripening chamber for mango – Fruits and Vegetable Processing
- Development of eco-friendly paper from water melon peels. – Fruits and Vegetables Processing
- Design of GPRS enabled sensors for checking moisture migration traditional storage bins. – Electrical Engineering
- Extraction of mangiferin from mango stones. – Fruits and Vegetable Processing
- New product development (plant based cheese) from pumpkin seeds.- Product Development
- Standardization of process for controlled alcoholic fermentation in palm.- Food Microbiology
- New product development of calcium rich finger millet beverage – Beverage Technology
- Development of value added products from baby corn and other locally available produce.- Nutraceuticals and Functional Foods
- Development of automatic surveillance and reporting assisted system for fruit and vegetable orchards - Fruits and Vegetables processing
- Development of ready-to-serve beverage from custard apple. – Beverage Technology
- Design and development of efficient and manually operated rice dehuskers- Cereal, legumes and Oil seeds processing Technology
- Design and development of efficient and manually operated rice flakes – Food Process Equipments
- AutoCad design of mobile tender coconut processing units – Computer Programming
- Development of ready-to-serve beverage from water melon. – Beverage Technology
- Design of foldable and mechanical shock proof packaging boxes for transportation of perishables. – Food Process Equipments
- Study of storage of ginger in mud storage bins – Agricultural engineering
- Design and development of manually operated papad sheeting equipment- Food process Equipments
- Design and development of manually operated samosa folding equipment for local venders – Product Development
- Development and fortification of millets based energy bars – Nutraceutical and Functional Foods
- Study of prospects of fortification of salt with iron and iodine – Nutraceuticals and Functional foods
- Development of fermented beverages from pumpkin- Beverage technology
- Standardization and improvement of traditional practices for purification of honey – Nutraceuticals and Functional Foods
- Development and fortification of nata de coco based flavoured drinks – Beverage Technology
- Development and fortification of millet based lassi drinks – dairy technology
- Design and development of puffing machines for locally grown cereals. – Creals, legumes and Oil seeds Processing technology

NOTE: The afore - mentioned list is not exhaustive and the objective is to provide an idea of some of the projects that can be executed by students pertaining to societal or indus try related problems. Students are given full flexibility to choose any project of their choice under the supervision of faculty mentor.

DEPT. ELECTIVES AND ONLINE COURSES

B.Tech.

FOOD TECHNOLOGY

ELECTIVE -I

- 19FT331 - Refrigeration Engineering and Cold Chain
- 19FT332 - Engineering Properties of Food Materials
- 19FT333 - Introduction to Biochemical Engineering and Enzyme Technology
- 19FT334 - Instrumentation and Process Control
- 19FT335 - Instrumental Methods of Food Analysis
- 19FT336 - Emerging Trends in Food Processing

ELECTIVE -II

- 19FT337 - Nutraceuticals and Functional Foods
- 19FT338 - Grain Storage Technology
- 19FT339 - Maintenance of Food Equipment
- 19FT340 - Food toxicology and Agrochemical Residues in Food
- 19FT341 - Strategy and Marketing of Food Products
- 19FT342 - Extrusion Technology

ELECTIVE -III

- 19FT430 - Food Biotechnology
- 19FT431 - Bioprocess Engineering
- 19FT432 - Food Plant Layout Management and Utilities
- 19FT433 - Post Harvest Management of Fruits and Vegetables

ELECTIVE -IV

- 19FT434 - Project Planning, Preparation and Management
- 19FT435 - Waste Management and Byproduct Utilization
- 19FT436 - Dairy and Food Processes
- 19FT437 - Nano Technology

COURSE CONTENTS

I SEM AND II SEM

19FT331 REFRIGERATION ENGINEERING AND COLDCHAIN

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
https://www.shipabco.com/the-importance-of-cold-chain-logistics/

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with refrigeration process, equipment and cold chain management for food. The objective of this course to make students understand the refrigeration process, concepts of freezing and its application in processing; cold chain design and storage for increasing shelf life of food.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse refrigeration and air conditioning systems.	2
2	Design refrigeration process and equipment.	3
3	Evaluate refrigeration systems performance.	4
4	Apply the knowledge of refrigeration in food processing.	1
5	Formulate cold supply chain management plan.	3

SKILLS:

- ✓ *Suggest a system, component or process to meet desired refrigeration needs.*
- ✓ *Estimate freezing time for different food products.*
- ✓ *Design the layout of warehouse unit.*

UNIT - I **L-9**

GENERAL INTRODUCTION : Refrigeration and refrigeration systems - refrigerants, properties and characteristics of refrigerants, phase-out of ozone depletion refrigerants, classification of refrigerants; Refrigeration processes and refrigeration cycles; Cold chain-definition need for the chain for chilled / frozen food item; Various links of the chain; Importance of shelf-life; Just-in-time deliveries; Temperature limits.

UNIT - II **L-9**

REFRIGERATION : Refrigeration systems - vapor compression and absorption refrigeration systems, system components, refrigeration loads, sizing of refrigeration systems and components, cold storages; Freezing - slow and rapid, plank's law and estimation of freezing time of foods, equipment used for freezing water in foods; Production of crystalline foods - sucrose and lactose; Freeze concentration of liquid food.

UNIT - III **L-9**

DESIGN AND PERFORMANCE OF REFRIGERATION : Calculation of heat loads; Principles of aeration and ventilation; Design features; Performance characteristics and application of blowers.

UNIT - IV **L-9**

APPLICATION OF REFRIGERATION : Examples of food processing by refrigeration and storage - fruits and vegetables, meat products, fish, poultry products, dairy products.

UNIT - V **L-9**

COLD CHAIN MANAGEMENT : Stages and points of control in cold storages and structures; Functions in cold storages; Pallet layout and stacking options; Flexible storage systems; Cold chain transportation in land and export; Retail, supermarket cold chain and display systems - 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.

TEXT BOOKS:

1. C. P. Arora, "Refrigeration and Air Conditioning", 3rd edition, Tata Mcgraw Hill Education, 2006
2. M. L. Anand, "Refrigeration& Air-Conditioning", 1st edition, Asian Books Pvt., Ltd., 2002.

REFERENCE BOOKS:

1. Da-Wen Sun, "Advances in Food Refrigeration", 1st edition, Leatherhead, 2001.
2. K. J. Christopher, "Managing Frozen Foods", 1st edition, CRC Press, 2000.

19FT332 ENGINEERING PROPERTIES OF FOOD MATERIALS

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
https://www.foodengineeringmag.com/articles/97799-food-engineerings-2018-state-of-food-manufacturing-survey?v=preview

PRE-REQUISITE COURSE: Food Chemistry

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the evaluation and application of engineering properties of food materials under different conditions. The objective of this course is to enable the students to understand physical, chemical, gravimetric and mechanical properties of food and their application in designing of engineering processes and equipments.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge of various physical properties to analyse material specific characteristics.	1
2	Analyse the moisture sorption behaviour in various food.	2
3	Investigate the mechanical properties of food and apply the knowledge for various food application.	4
4	Analyse thermal properties of food material and design heat transfer equipment.	2
5	Apply the knowledge of aerodynamic properties for design of separation and handling equipment.	3

SKILLS:

- ✓ *Measure the physical, thermal, aerodynamic properties of food materials.*
- ✓ *Suggest equipment design based on the properties of food material.*
- ✓ *Analyze and interpret textural profile of various foods.*

UNIT - I **L-9**

INTRODUCTION: Engineering properties of food and biomaterials - structure and chemical composition of foods; Physical properties - shape, surface area, volume, density, sphericity, porosity, specific gravity and color.

UNIT - II **L-9**

PROPERTIES OF POWDERY MATERIALS: Moisture in food and biological materials; Water activity - food stability sorption and desorption isotherm of food materials.

UNIT - III **L-9**

MECHANICAL PROPERTIES: Strain and stress; Viscosity; Elasticity; Visco-elasticity; Newtonian and Non-Newtonian fluid; Time dependent fluids; Creep and relaxation phenomena; Texture profile analysis.

UNIT - IV **L-9**

THERMAL PROPERTIES: Specific heat capacity; Thermal conductivity; Thermal diffusivity; Convective heat transfer coefficient; Cooling and phase change; Electrical and magnetic properties.

UNIT - V **L-9**

AERO- AND HYDRODYNAMIC PROPERTIES: Application of frictional properties - grain handling, processing and conveying.

TEXT BOOKS:

1. M. J. Lewis, “Physical Properties of Foods and Food Processing Systems Cambridge” 1st edition, Woodhead Publishing Limited, UK, 1990.
2. N. N. Mohesenin, “Physical Properties of Plant and Animal Materials”, 2nd edition, Gordon & Breach Science Publishers, 1986.

REFERENCE BOOKS:

1. M. A. Rao, and S. S. H. Rizvi, “Engineering Properties of Foods”. 3rd edition. Marcel Dekker, New York, 2007.
2. S. Sahin and S. G. Sumnu, “Physical Properties of Foods”, 1st edition, CRC press, USA, 2006.

19FT333 INTRODUCTION TO BIOCHEMICAL ENGINEERING AND ENZYME TECHNOLOGY

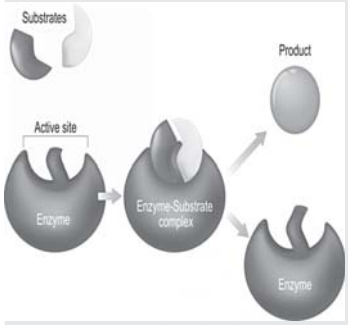
Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5



Source:
https://www.medicalnewstoday.com/articles/319704.php

PRE-REQUISITE COURSES : Food Chemitry; Food Biochemistry and Nutrition.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with various biochemical reactions involved in food processing and enzyme technology. The objective of this course is to impart knowledge to students on mass and energy balance in biological system; enzyme kinetics; design and scale up in bioreactors; upstream and downstream processing techniques used in food industry

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the kinetics parameter of various biochemical reaction.	2
2	Apply the knowledge of enzyme catalysed reactions.	1
3	Identify various up stream processing methods applicable in Food and biochemical processing.	1
4	Analyse and design various reactors.	3
5	Investigate the enzyme kinetics and cell immobilizations applications.	4

SKILLS:

- ✓ *Identify, formulate, and solve engineering problems.*
- ✓ *Control the bioprocess parameter during processing.*
- ✓ *Optimize upstream and downstream processes.*
- ✓ *Monitor and control activities of enzymes*

UNIT - I **L-9**

INTRODUCTION : Evolution and role of bio-chemical engineering; Chemical thermodynamics; Conditions for spontaneity of reaction; Kinetics of bio-chemical reactions.

UNIT - II **L-9**

INDUSTRIAL MICROBIOLOGY : Enzyme catalyzed reactions; Batch and continuous system; Calculation of thermal effects and adequacy of treatments.

UNIT - III **L-9**

UPSTREAM PROCESSING : Removal of microbial cells and solid matter; Foam separation; Separation techniques - precipitation, filtration, centrifugation, cell disruptions liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

UNIT - IV **L-9**

FERMENTATION AND DOWNSTREAM PROCESSING : Biochemical changes caused due to microorganism; Bio-reactors - pulse, photo bioreactors; Measurement and Control of bioprocess parameters; Product recovery.

UNIT - V **L-9**

ENZYMES : Enzyme kinetics - michaelis menten equation; Whole cell immobilization and their industrial application.

TEXT BOOKS:

1. M. Shuler, F. Kargi, “Bioprocess Engineering Basic Concepts”, 2nd edition, Prentice-Hall India, 2006.
2. P. M. Doran, “Bioprocess Engineering Principles”, 1st edition, Elsevier Science & Technology Books, 2002.

REFERENCE BOOKS:

1. W. R. Vieth, “Bioprocess Engineering: Kinetics, Mass Transport, Reactors and Gene Expression”, 1st editon, Wiley-Interscience Publication, 2001.
2. P. F. Stanbury, A. Whitaker and S. J Hall, “Principles of Fermentation Technology”, 2nd edition, Pergamon, 2002.

19FT334 INSTRUMENTATION AND PROCESS CONTROL IN FOOD PROCESSING

Source:
https://www.earthres.com/services/process-control-instrumentation/

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSES : Engineering Physics; Engineering Mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the principles, handling and control of various equipments used in food industry. The objective of this course is to enable students to gain knowledge about different process instruments, various control systems and application of these control system in various processes.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Identify process variables in food processing.	1
2	analyze the principle behind operation of process control equipment's.	2
3	Investigate application of different control processes for parameter monitoring.	4
4	Design of specific control measures for food processing.	3

SKILLS:

- ✓ *Identify the process variables.*
- ✓ *Handle refractometer, electronic noise, bio sensor, enzyme sensors.*
- ✓ *Calculate moisture content of food using different methods.*
- ✓ *Measure turbidity, color, viscosity of food material*

UNIT - I **L-9**

INTRODUCTION : Definitions; Instrument; Controller and recorder; Principle of measurement; Static and dynamic characteristics of instrument; Error analysis and its calibration; Transducers - types & classification and selection criteria, basic principles, construction and applications of transducer elements; Strain gauge with bridge circuits and calibration procedures.

UNIT - II **L-9**

MOISTURE CONTENT MEASUREMENT : Role of moisture content in food; Weight and dry method; Microwave absorption method; RF technique; IR technique; DC resistance technique; Moisture release measurement; Humidity measurement - definitions, role in food processing, classification and types, wet and dry bulb hygrometer, Electronic methods; Temperature Measurement - mercury thermometers, bimetal thermometers, capillary type thermometers, recording thermometers, thermocouples, resistance thermometers, thermistor.

UNIT - III **L-9**

TURBIDITY AND COLOUR : Definition and role; Standards and Units; Basic turbidity meter - light scattering type, absorption type, reflectance type color measurement, digital image processing method; Pressure measurement-pressure gauge, elastic deformation elements, basic concept of pneumatic pressure transmitter, pressure current and pressure resistance transducers.

UNIT - IV **L-9**

FLUID FLOW AND VISCOSITY : Flow measurement - magnetic flow meter, digital flow meter, turbine flow meter, gravimetric feeder; Definition of viscosity; Newtonian and Non-Newtonian flow; Various types of viscometers.

UNIT - V **L-9**

BIOSENSORS : Types of biosensors - principle and application; Controllers and indicators basic control concept; Temperature controller in dryer; Ratio control in food pickling; Head space gas control in food preservation; Timers and indicators.

TEXTBOOKS:

1. M. Bhuyan, “Measurement and Control in Food Processing”, 1st edition, CRC Press, 2007.
2. R. G Moreira and T. P Coultate, “Automatic Control for Food Processing System”, 1st edition, 2001.

REFERENCE BOOKS:

1. D. Patranabis, “Industrial Instrumentation”, 1st edition, McGraw Hill, 1990.
2. B. G. Liptak, “Instrument Engineers Handbook: Process Measurement and Analysis”, 1st edition, Butterworth and Heinemann, 1995.

19FT335 INSTRUMENTAL METHODS OF FOOD ANALYSIS

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
http://www.lanphan.comnews/IndustryAnalysisonFoodTestingLaboratoryInstrumentsinChina-282.html

PRE-REQUISITE COURSES : Basic Food chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with different instrumental techniques in food analysis. The objective of the course is to impart knowledge to students on principles and techniques of food analysis by using physical, chemical, biological methods and to apply their knowledge and skills acquired to solve real-world problems associated with food analysis.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the concepts of various analytical techniques in food analysis.	1
2	Develop a technique to determine errors and uncertainty of analytical results.	3
3	Analyse issues in public health protection related to chemical analysis.	2
4	Investigate proximate composition of food.	4

SKILLS:

- ✓ *Proficiency on analytical methods of food analysis.*
- ✓ *Suggest relevant test methods for food component.*
- ✓ *Perform qualitative and quantitative estimation of compound present in food.*
- ✓ *Propose equipment limitations, costs, advantages, disadvantages for analysis of food.*
- ✓ *Interpret the result from sophisticated instrument (HPLC, GC-MS) techniques.*

UNIT - I **L-9**

INTRODUCTION TO THE CHEMICAL ANALYSIS OF FOOD : Definitions of food analysis; Quality control and quality assurance; Official methods of food analysis; Association of Official Analytical Chemists; American Association of Cereal Chemists; American Oil Chemists Society Rules and Regulations of Food Analysis; Nutritional labelling; Food inspection and grading; Food safety; Sampling and sampling techniques-introduction, definitions of population, laboratory sample, sample, precision, accuracy, sensitivity, reproducibility.

UNIT - II **L-9**

ANALYSIS OF CARBOHYDRATES : Introduction; Importance of carbohydrate analysis; Methods of analysis; Sample preparation; Extraction of sugar-monosaccharides, oligosaccharides; Chemical methods for carbohydrate analysis - gravimetric methods, titration methods, colorimetric methods, phenol sulphuric acid; Enzymatic methods; Physical methods - polarimetric method, refractive index measurements, density, Infrared radiation, immuno assays; Analysis of starch and crude fibre.

UNIT - III **L-9**

ANALYSIS OF PROTEIN : Protein estimation by different methods - protein concentration by Kjeldhal method, enhanced dumas method, using UV Visible spectroscopy, direct measurement at 280 nm, biuret method, lowry method, dye binding method, turbido metric method; Protein and characterization; Chromatography - basic principles of chromatography, types of chromatography and its applications.

UNIT - IV **L-9**

ANALYSIS OF LIPIDS: Introduction - Importance of analysis of lipids; Determination of total lipid concentration - solvent extraction; Extraction of lipids - solvent, non-solvent extraction methods, instrumentation methods; Determination of lipid composition by chromatography - separation and analysis by chromatography, lipids fractions of TLC, fatty acid methyl esters by GC; Chemical techniques - iodine value, acid value, peroxide value.

UNIT - V **L-9**

ANALYSIS OF MINERALS: Introduction - importance of mineral analysis, Ash determining methods - dry ashing, wet ashing, low plasma ashing, Atomic Absorption Spectroscopy, FTIR, near infrared spectroscopy; Texture profile analysis; Viscometer; Elisa; Ria; Basic principles of spectrophotometer, colorimeter and its application; SDS-PAGE.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Paper chromatographic separation of amino acids, carbohydrates.
2. Thin Layer chromatographic separations of sugars and lipids
3. Separation of proteins through gel filtration & ion exchange chromatography
4. Separation of proteins using HPLC
5. Extraction of theophylline from tea leaves and estimation.
6. Estimation of starch.
7. Estimation of crude fibre.
8. Determination of calorific value of food by bomb calorie meter.
9. Determination of vitamin c by titration method.
10. Determination of pigment.
11. Estimation of protein content by Lowry method.
12. Estimation of cholesterol.
13. Test for adulterants in sugar, jaggery, honey, milk, ghee, tea, coffee, turmeric, spices (cardamom, cloves, pepper).
14. Estimation of total carbohydrates by Anthrone method.
15. Determination of total crude protein content by Kjeldhal method.
16. Estimation lycopene from tomato By-products.
17. Extraction of anthocyanins from food waste.

TEXTBOOKS:

1. K. Wilson, and J. Walker, "Practical biochemistry Principles and Techniques", 5th edition Cambridge press, 1994 .
2. M. Kalia, "Food Analysis and Quality Control," 1st edition. Kalyani Publishers, 2002.
3. S. S. Nielsen, "Food Analysis," 3rd edition, Aspen Publishers, 1998.

REFERENCES BOOKS:

1. AOAC International, "Official methods of analysis," AOAC International, 18th edition, 2007.
2. Y. Pomeranz and C.E. Meloan, "Food Analysis: Theory and practice," 3rd edition, A.V.I Publish ing company, USA, 2013.
3. J. Jayaraman, "Laboratory Manual in Biochemistry," 3rd edition, Wiley Eastern Publishers, New Delhi, 1980.
4. D. T. Plummer, "An introduction to practical biochemistry, "2nd edition, Tata Mc Graw-Hill Publishing co., New Delhi, 1979.
5. S. Sadasivam and A. Manickam, "Biochemical methods for Agricultural Sciences," 2nd edi tion, New Age International Pubisher, New Delhi, 1996.

19FT336 EMERGING TRENDS IN FOOD PROCESSING

Source:

https://www.google.com/search?q=hpp&rlz=1C1GCEB_enIN833IN833&source=lnms&tbmisch&sa=X&ved=0ahUKEwja1seLKTjAhUlmeYKHQ2yA5gQ_AUIESgC&biw=1366&bih=625#imgrc=M_xy8H4fdclL2M:

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with recent novel food process technology, included operation and principles.The objective of this course to make students understand the recent novel advances in food processing,concepts of high pressure, pulsed electric field and its application in processing.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes.

COs	Course Outcomes	POs
1	Apply the concepts of various emerging trends in food processing.	1
2	Develop a technique to determine least affecting technology on colour of food.	3
3	Analyse issues in public health protection related to emerging food processing.	2
4	Investigate effect of emerging processing techniques on chemical composition of food.	4

SKILLS:

- ✓ *Suggest a system, component or process to effect zero color change after processing*
- ✓ *Estimate osmotic dehydration time for different food products.*
- ✓ *Design the processing line for HPP.*

UNIT - I **L-9**

HIGH PRESSURE PROCESSING : Principles of high-pressure processing; Use of high pressure to improve food safety and stability; Effects of high pressure on food quality - pressure effects on microorganisms, enzyme, texture and nutrients of food; Modelling HP processes; Other applications of high-pressure processing.

UNIT - II **L-9**

PULSED ELECTRIC FIELD PROCESSING : Historical background; PEF treatment systems; Main processing parameters; Mechanisms of action - mechanisms of microbial and enzyme inactivation; PEF for processing of liquid foods and beverages; PEF processing for solid foods; Food safety aspects of pulsed electric fields; Pulsed electric field and high-pressure processing.

UNIT - III **L-9**

OSMOTIC DEHYDRATION : Mechanism of osmotic dehydration; Effect of process parameters on mass transfer; Determination of moisture and solid diffusion coefficient; Application of osmotic dehydration; Thermal membrane concentration of liquid foods and colors; Osmotic membrane distillation; Direct osmosis; Membrane modules; Applications of membrane concentration.

UNIT - IV **L-9**

PROCESSING BY RADIO FREQUENCY ELECTRIC FIELDS : Radio frequency electric fields equipments; RFEF non-thermal inactivation of yeasts, bacteria and spores; Electrical costs; Ultrasound processing - fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties.

UNIT - V **L-9**

ALTERNATE THERMAL PROCESSING : Microwave heating - dielectric properties of foods, application of microwave processing for foods; Radiofrequency processing - dielectric heating, material properties, radio-frequency heating and drying applications; Ohmic heating - fundamentals of ohmic heating, electrical conductivity; Modeling.

TEXT BOOKS:

1. D. W. Sun, “Emerging Technologies for Food Processing”, Academic Press, 2005.
2. G. V. Barbosa-Canovas, M. S. Tapia, and M. P. Cano, “Novel Food Processing Technologies”, CRC Press, 2004.

REFERENCE BOOK :

1. T. Ohlsson, and N. Bengtsson, “Minimal Processing Technologies in the Food Industry”, Woodhead Publishing Limited, 2002.

19FT337 NUTRACEUTICALS & FUNCTIONAL FOODS

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
https://www.thehindu.com/business/Industry/nutraceuticals-global-market-to-touch-2629-b-by-2020/article7562397.ece

PRE-REQUISITE COURSE : Food Bio Chemistry and Nutrition.

COURSE DESCRIPTION AND OBJECTIVE:

This course deals with the functional foods and nutraceuticals (NFF) products and their bioavailability and health benefits. The objective of the course is to impart knowledge to students on basics of functional foods and nutraceuticals, their significance, regulatory standards androle in disease prevention.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the function of foods and Nutraceutical elements.	2
2	Investigate the chemistry and physiological effects on NFF.	4
3	Identify the role of selected NFF in health promotion and disease prevention and treatment.	1
4	Apply new tools to control parameters the of fermentation for functional food development.	5

SKILLS :

- ✓ *Identify the bioactivities of the main functional ingredients and their health benefits, sources and safety issues.*
- ✓ *Proficiency in formulation, delivery and regulatory compliance related to NFF products.*

UNIT - I **L-9**

GENERAL INTRODUCTION : Defining nutraceuticals and functional foods - nature, type and scope of nutraceutical and functional foods; Nutraceutical and functional food applications and their health benefits; Nutraceutical a compound and their classification based on chemical and biochemical nature with suitable and relevant descriptions.

UNIT - II **L-9**

NUTRACEUTICALS FOR SPECIFIC DISEASES : Diseases to be cured by NFF - cancer, heart disease, stress, osteoarthritis and hpertension; Antioxidants, phytochemicals (isoflavones and lycopenes) and their role as nutraceuticals and functional foods; Food recommended and restricted in metabolic disorders and disturbances - gastrointestinal disorders, fever and infection; liver, gall, bladder and pancreatic disturbances.

UNIT - III **L-9**

FUNCTIONAL ROLE OF FOOD COMPONENTS : Dietary fibre and complex carbohydrates as functional food ingredients; Protein as a functional food ingredient; Prebiotic, probiotic foods and their functional role; Herbs as functional ingredients and health promoting activity of common herbs; Functional algae compounds; Essential and functional oils.

UNIT - IV **L-9**

FUNCTIONAL FOODS : Cereal products as functional foods - oats ,wheat bran ,rice bran etc; Functional vegetables products; Oil seeds and sea foods; Coffee, tea and other beverage as functional foods / drinks and their protective effects.

UNIT - V **L-9**

STORAGE AND STANDARDS : Effects of processing, storage and interactions of various environmental factors on the potentials of such foods; Marketing and regulatory issues for functional foods and nutraceuticals; Recent development and advances in the areas of nutraceutical and functional. foods.

TEXT BOOKS:

1. B. T. Burton, Human nutrition, " A Textbook of Nutrition in Health and Disease", Mc Graw Hill, 3rd edition, 2002.
2. R. E. C. Wildman, "Handbook of Nutraceuticals & Functional Foods, CRC Press, 2nd edition, 2006.

REFERENCE BOOK:

1. P. Manson, "Dietary supplements", 4th edition, Pharmaceutical Press,2001.

19FT338 GRAIN STORAGE TECHNOLOGY

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:

https://www.world-grain.com/articles/11930-companies-merge-to-improve-grain-storage

PRE-REQUISITE COURSE : Cereals Legumes Oilseeds Processing Technology.

COURSE DESCRIPTION AND OBJECTIVES:

Deals with properties, handling and storage methods of cereal grains and legumes. Understand about production, processing, distribution of grain. Gain knowledge about storage and control measure to avoid losses of grains. Gain knowledge about the physico-chemical and thermal properties and drying technology of grains.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Analyse the production, distribution and storage of grains.	2
2	Investigate the physicochemical properties of grains.	4
3	Design grain drying process.	3
4	Apply different tools to determine different modes of physical and mechanical damage to grain during storage.	5

SKILLS:

- ✓ *Identify drying parameters and storage conditions for different crops.*
- ✓ *Design and develop crops specific dryers and storage structure.*
- ✓ *Select storage structure according to requirements.*
- ✓ *Identify the quality changes during storage.*

UNIT - I **L-9**

INTRODUCTION: The role of storage in the economy; Costs and incentives to store; Improvements in large-scale storage and handling; Improvements storage on the form; Food grains policy and management in India; Food corporation of India.

UNIT - II **L-9**

PHYSICO-CHEMICAL AND THERMAL PROPERTIES OF GRAINS: Basic properties - grain dimensions, bulk density, true density, porosity, coefficient of friction, angle of repose, thermal conductivity and aerodynamic properties; Psychrometry - humidity, relative humidity, humid heat, deterioration index, wet bulb temperature, use of psychometric charts.

UNIT - III **L-9**

GRAIN DRYING: Moisture content; Equilibrium moisture content; Free and bound water; Rate of drying - constant and falling state of drying rate, factors affecting rate of drying process, types of dryers used for drying of grains.

UNIT - IV **L-9**

GRAIN STORAGE: Principles of storage; Moisture movement during bulk storage of grains; Pressure distribution in storage bins; Methods of aeration; Various theories; Changes during storage - physical, chemical, microbiological and sensory changes occurring during storage; Grain storage structures - location and material selection for storage building, traditional, modern, temporary and permanent storage structures, design considerations.

UNIT - V **L-9**

LOSSES DURING STORAGE: Types and extent of losses; Causes and control measures - Insecticides, toxicity, resistance to cure by spoilage agents, new curing techniques, fumigants, chemicals.

TEXT BOOKS:

1. B. S. David, “Storage of Cereal Grains and their Products”, 4th edition, AACC, 2004.
2. A. Chakraverty, “Post-Harvest Technology of Cereals”, 3rd edition,CRC Press, 1995.

REFERENCE BOOKS:

1. R. T. Toledo, “Fundamentals of Food Process Engineering”, 3rd edition, Springer Science & Business Media, 2007.
2. T. P. Ojha and A. M. Michael, “Principles of Agricultural Engineering”, Volume 1, Jain Brother, 2006.

19FT339 MAINTENANCE OF FOOD EQUIPMENT

Source:
https://www.commercialkitchenrepairs.com/

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE : Food Processing Operations.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with maintenance of food processing equipment. The objective of this course is to enable the students to plan and implement various maintenance methods to increase the efficiency of equipment by minimizing the waste production and maximizing the profit.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the principals and strategies for equipment maintenance.	1
2	plan the schedule and preventive maintenance requirement.	1, 2
3	Develop the knowledge of food safety concepts to food manufacturing processes.	3
4	Formulate and investigate maintenance schedule for better maintenance.	4

SKILLS:

- ✓ *Suggest a plan and implement the techniques in maintenance of equipment.*
- ✓ *Demonstrate the installation of food equipment.*
- ✓ *Execute energy minimization policy plans.*
- ✓ *Identify and implement cost reduction strategies.*

UNIT - I **L-9**

INTRODUCTION : Maintenance systems - maintenance objectives and scopes, maintenance strategies and organizations, maintenance works, life cycle costs; Preventive Maintenance - principles of preventive maintenance, procedures and selection, preventive maintenance planning, scheduling and control, forms and resources, maintenance work measurement.

UNIT - II **L-9**

MAINTENANCE MANAGEMENT SYSTEM : Modelling and analysis techniques in PM and inspections; Predictive maintenance; Computerized maintenance management systems - benefits and applications, work order systems and plant registers, maintenance reports, analysis and monitoring, introduction to commercial packages.

UNIT - III **L-9**

EQUIPMENT MAINTENANCE : Installation and checks - commissioning and testing of plant equipment, checking for alignment, lubrication and lubrication schedule; Maintenance of typical rotating and process equipment systems like turbines, pumps and fans, centrifuges, heat exchangers, boilers and pressure vessels; Case studies interfacing areas with maintenance planning and scheduling of process equipment into PM and predictive maintenance.

UNIT - IV **L-9**

RELIABILITY CONCEPTS : Basic concepts of probability theory and distributions; Definition - reliability, failure probability, reliability and hazard rate function; MTBF and MTTR; System reliability; Series and parallel system; Redundancy.

UNIT - V **L-9**

MAINTAINANCE MANAGEMENT STRATEGIES : Seven basic questions for RCM; RCM procedures; Benefits of RCM; Goals of TPM and methodology; TPM improvement plan and procedures.

TEXT BOOKS:

1. R. E. Greaves, “The Commercial Food Equipment Repair and Maintenance Manual”, 1st edition. Cbi Pub Co. 1987.
2. M. M. Cramer “Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices”, CRC Press, 2006.

REFERENCE BOOKS:

1. S. Riccetti, “Designing Food Safety and Equipment Reliability Through Maintenance Engineering, Productivity”, 2nd edition, CRC Press. 2013.
2. R. K. Mobley, “Maintenance Engineering Handbook”, 8th edition, McGraw-Hill Professional, 2014.
3. L. H. Lelieveld, H. John, and N. David, “Hygiene in Food Processing: Principles and Practice”, 1st edition, Elsevier, 2014.

19FT340 FOOD TOXICOLOGY AND AGROCHEMICAL RESIDUES IN FOOD

Source:
http://foodtechnology.alliedacademies.com/2018/events-list/food-toxicology

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE : Food Bio Chemistry and Nutrition.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the field of examining the interaction of toxins with food constituents and its risk assessment, risk communication and risk management. The objective of this course is to enable the student to learn about the source, classification, effects of processing alteration, toxicity levels and its eradication methods of different food toxins and agrochemical residues.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the basic concepts and principles of toxicology to ensure safe food.	1
2	Analyse the knowledge in multiuse of disciplines of food processing.	2
3	Investigate the presence of toxins in the food samples.	4
4	Formulate techniques to quantify the level of toxins.	3
5	Identify various agrochemical and toxicants in food.	1, 2

SKILLS:

- ✓ *Identify various sources of food toxin.*
- ✓ *Analyze and predict the toxic levels of contaminants in food.*
- ✓ *Suggest the permitted levels of agrochemical usage in food processing.*
- ✓ *Estimate the permissible limits of toxins and agrochemical residues.*

UNIT - I **L-9**

INTRODUCTION: Definition, Scope, General principles of food toxicology; Manifestation of toxic effects; Classification of food toxicants; Factors affecting toxicity of compounds; Toxicants and allergens in foods derived from plants; Animals, Marine, Algae and Mushroom, Microbial toxins; Food poisoning; Food borne infections and disease.

UNIT - II **L-9**

TOXINS IN FOOD PROCESSING: Derived food toxicants- processing & packaging; Toxicants generated during food processing such as nitrosamines, acrylamide, benzene, dioxins and furans, persistent organic pollutants; Toxicological aspects of nutrient supplements; Chemicals from processing such as fumigants; Chlorinated solvents; Autoxidation products; Carcinogens in smoked foods and pyrolysis.

UNIT - III **L-9**

AGROCHEMICALS: Agrochemicals in agriculture including growth regulators- Purpose, classification, methods of dispensing agrochemical, characteristics, methods of estimations of agrochemical; Agrochemical residues- pesticides, fungicides, herbicides, permitted levels of pesticides, fungicides, herbicides, toxicity details, methods of removal of agrochemical residues.

UNIT - IV **L-9**

RIPENING AGENTS: Types, Uses, Effects, Residue evaluation; Veterinary drugs including antibiotics and hormones- purpose of use, classification, associated hazards and toxicity.

UNIT - V **L-9**

LEACHING OF TOXINS: Uptake of agrochemicals from soil, water, environment, packaging by plant foods; Concept of organic farming and systems.

TEXT BOOKS:

1. A. L. Branen, P.M. Davidson and S. Salminon, “Food Additives”, 2nd edition, Marcel Dekker, 1990.
2. J. M. Concon, “Food Toxicology - Principles & Concepts”, 8th edition, Marcel Dekker, 1988.

REFERENCE BOOKS:

1. J. N. Hathcock, “Nutritional Toxicology”, 1st edition, Academic Press, 1982.
2. M. Rechcigl, “Handbook of Naturally Occurring Food Toxicants”, 2nd edition, CRC Press, 1983.

19FT341 STRATEGY AND MARKETING OF FOOD PRODUCTS

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:

httpswww.business2 community.com healthwellness dieterssusceptible-to-food marketing-tricks-025774

PRE-REQUISITE COURSE: Principles of Management & Organizational Behaviour.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the strategies for production and marketing of new product. To train students in the different aspects of marketing such as, planning process, channel organization, and channel strategy. Enhance customer relationships. Improve internal communications. Increase profit.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply different marketing strategy for enhanced market trend.	1
2	Analyse and understand principle of supply chain management.	1,2
3	Evaluate the segment and positioning of various food products.	4
4	Create new product pricing model for food products.	3
5	Analyse market trend through market research.	2

SKILLS:

- ✓ *Formulate marketing strategy for food products.*
- ✓ *Implement the planning strategy for food products.*
- ✓ *Evaluate the marketing planning for food products.*
- ✓ *Develop good customer relationships.*

UNIT - I **L-9**

AGRICULTURAL AND FOOD MARKETING : Marketing sub-systems; Marketing functions; Links between agriculture and the food industry; Agricultural and food marketing enterprises; Marketing boards in developing countries; Co-operatives in the agriculture and food sectors; Control and management of secondary co-operatives; The weakness of co-operatives.

UNIT - II **L-9**

MARKET LIBERALIZATION : Economic structural adjustment programs; Macro-economic stabilization; Role of the state in liberalized markets; Dealing with accumulated deficits; Government action to improve private sector performance; Marketing, strategy, planning and control- strategy, policy and planning, strategic business units, marketing, planning, process & control.

UNIT - III **L-9**

NEW PRODUCT DEVELOPMENT : Definition and importance of new product development; New product development process; Adoption process; Effect of product characteristics on the rate of adoption.

UNIT - IV **L-9**

PRICING DECISIONS : Pricing objectives; The laws of supply and demand; Elasticity of demand - cross-price elasticity of demand; Practical problems of price theory; Cost - revenue – supply relationships; The meaning of price to consumers; Price as an indicator of quality; Cost-plus methods of price determination; Breakeven point analysis; Pricing - market-oriented pricing, psychological pricing.

UNIT - V **L-9**

MARKETING RESEARCH : Brief on market research; Purpose of research; Research proposal;. Marketing costs and margins - assessing the performance of a marketing system, pricing efficiency, identifying marketing costs and margins, reference product concept, handling costs, packaging costs, transport costs, storage costs, processing costs, capital costs.

TEXT BOOK :

1. I. M. Crawford, “Agricultural and Food Marketing Management (Marketing & Agribusiness Texts)”, 1st edition, Food & Agriculture Organization of the United Nations (FAO), 1997.

REFERENCE BOOK :

1. S. Andrews, “Textbook of Food and Beverage Management”, 1st edition, McGraw Hill, 2010.

19FT342 EXTRUSION TECHNOLOGY

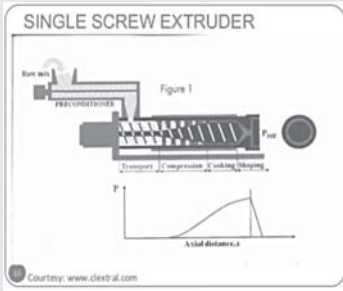
Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50			5	5



Source:
https://www.google.com/search?q=10.+Extrusion+Technology&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi4y8Cf-KTjAhWe73MBHRFTBB4Q_AUIESgC&biw=1366&bih=625#imgrc=npHvcOltJHe9-M:

PRE-REQUISITE COURSES : Cereals Legumes Oilseeds Processing Technology, Food Chemistry.

COURSE DESCRIPTION & OBJECTIVES:

To impart knowledge to the students about extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the knowledge of extrusion processing for product development.	1
2	Analyse and design extrusion process condition.	2
3	Design extruder features and analyse product characteristics.	3
4	Development of food with various shape texture and sensory acceptance.	3
5	Investigate and analyse quality parameters of breakfast cereals, textured V protein and third generation snacks.	4

SKILLS:

- ✓ *Formulate Different extruded food products.*
- ✓ *Implement the planning strategy for production of extruded food products from carbohydrate sources.*
- ✓ *Evaluate the marketing planning for food products.*

UNIT I **L-9**

EXTRUSION : definition, introduction to extruders and their principles; Types of extruders; Extruders in the food industry - history and uses of extruders in the food industry; Single screw extruder - principle of working, net flow, factors affecting extrusion process, co-kneaders; Twin screw extruder - counter rotating and co-rotating twin screw extruder.

UNIT II L-9

TWIN SCREW EXTRUDER: Process characteristics of the twin screw extruder - feeding, screw design, screw speed, screw configurations, die design; Twin screw extruder processes - barrel temperature and heat transfer, adiabatic operation, heat transfer operations and energy balances; Problems associated with twin screw extruder

UNIT III **L-9**

UNIT OPERATION IN EXTRUSION : Pre-conditioning - pre-conditioning of raw materials used in extrusion process, pre-conditioning operations and benefits of preconditioning and devolatilization; Interpreted flight expanders - extruders, dry extruders; Chemical and nutritional changes in food during extrusion.

UNIT IV **L-9**

MATERIAL HANDLING : Practical considerations in extrusion processing - pre-extrusion processes, cooker extruder profiling; Practical considerations in extrusion processing - addition and subtraction of materials, shaping and forming at the die, post extrusion processes; Breakfast cereals - introduction, type of cooking, high shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands.

UNIT V **L-9**

PROCESSING OF BREAKFAST CEREAL : Breakfast cereal processes - traditional and extrusion methods; Classification of breakfast cereals - flaked cereals, oven puffed cereals, gun puffed cereals, shredded products; Texturized vegetable protein - definition, processing techniques, and foods; Snack food extrusion: direct expanded (DX);Tthird generation (3G) snacks - types, available brands, co- extruded snacks and indirect-expanded products.

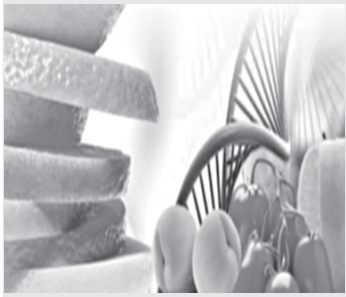
TEXT BOOKS:

1. P. Richardson, “Thermal Technologies in Food Processing”, Wood Head Publishers, Cambridge, 1994.
2. R. Guy, “Extrusion Cooking: Technologies and Applications”, Wood Head Publishing Limited, Abington, Cambridge, 1996.

REFERENCE BOOKS:

1. R. B. Fast and E. F. Caldwell , “Breakfast Cereals and How They are Made”, American Association of Cereal Chemists., St. Paul, Minnesota, 2000.
2. N. D. Frame, “The Technology of Extrusion Cooking”, Blackie Academic & Professional, New York, 1994.

19FT430 FOOD BIOTECHNOLOGY



Source:
https://pakissan.com/biotech/index.shtml

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE : Food Microbiology.

COURSE DESCRIPTION AND OBJECTIVES

This course introduces the fundamentals of genetics. It discusses the basics laws of chromosome structure sex linked chromosomes and inherited disorders, identification of genetic material and genetic transfer.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental laws of genetics in food biotechnology.	1
2	Analyse types of genetically groups of antigen.	2
3	Concept of sex chromosome, links, disorders and gene mapping.	1
4	Investigate growth behaviour of microorganism.	4
5	Design the media composition for microbial growth.	3

SKILLS:

- ✓ *To design different form of genetical material for development of the new kind.*
- ✓ *Genetical mapping of the gene.*
- ✓ *Design of new genetical foods.*

UNIT - I **L-9**

I**NTRODUCTION TO BIOPROCESS :** Historical development of bioprocess technologies; Role of bioprocess engineer in the biotechnology industry; Concept of bioprocess; Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses; Generalized process flow sheets; A brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology.

UNIT - II **L-9**

FERMENTATION : General requirements of fermentation processes; Isolation, preservation and improvement of industrially importantmicro organisms; Development of inoculum for industrial fermentations; Different types of fermentations; Basic design and construction of fermenter and ancillaries; An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry; Solid-substrate fermentation and its applications.

UNIT - III **L-9**

METABOLIC STOICHIOMETRY AND ENERGETICS : Stoichiometry - for growth and product formation, elemental balances, degrees of reduction of substrate and biomass available, electron balances; Yield coefficient of biomass and product formation; Maintenance coefficients; Energetic analysis of microbial growth and product formation; Oxygen consumption and heat evolution in aerobic cultures; Thermodynamic efficiency of growth.

UNIT - IV **L-9**

MEDIA DESIGN AND STERILIZATION FOR FERMENTATION PROCESS : Designing of media for fermentation processes; Types of media - design and usage of various commercial media for industrial fermentations; Thermal death kinetics of microorganisms; Batch and continuous heat sterilization of liquid media; Filter sterilization of liquid media, air; Design of sterilization equipment.

UNIT - V **L-9**

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION : Phases of cell growth in batch cultures; Simple unstructured kinetic models for microbial growth - monod model, growth of filamentous organisms; Growth associated (primary) and non-growth associated (secondary) product formation kinetics - leudking – piret models; Substrate and product inhibition on cell growth and product formation.

TEXT BOOK:

1. P. M. Doran, “Bioprocess Engineering Principles”, 2nd edition, Academic Press, 1990.

REFERENCE BOOK:

1. F. Peter, “Principles of Fermentation Technology”, 3rd edition, Academic Press, 2001.

19FT431 BIOPROCESS ENGINEERING

Source:
aen.wikipedia.org/wiki/Bioprocess_engineering

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE: Enzyme Technology.

COURSE DESCRIPTION AND OUTCOMES

Provides an opportunity to understand the theoretical concepts of enzyme technology principles in a more explicit andconcentrated manner

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental biological understanding to develop kinetics for microbial cells.	1
2	Analyse types of Immobilized enzymes and their functions.	2
3	Create different models for enzyme kinetics.	3
4	Investigate kinetics of receptor ligand binding.	4
5	Design the media composition for microbial growth.	3

SKILLS:

- ✓ *To handle enzymes.*
- ✓ *To process enzymes.*
- ✓ *To understand the kinetics of enzymatic action.*

UNIT - I **L-9**

OVERVIEW : Basics of biology; Overview of biotechnology; Diversity in microbial Cells; Cell constituents; Chemicals for life; Kinetics of enzyme catalysis.

UNIT - II **L-9**

IMMOBILIZED ENZYMES : Effects of intra and inter-phase mass transfer on enzyme kinetics; Major metabolic pathways-bioenergetics, glucose metabolism, biosynthesis.

UNIT - III **L-9**

MICROBIAL GROWTH: Continuum and stochastic models; Design, analysis and stability of bioreactors.

UNIT - IV **L-9**

KINETICS OF RECEPTOR: Ligand binding; Receptor-mediated endocytosis.

UNIT - V **L-9**

MULTIPLE INTERACTING MICROBIAL POPULATION : Prey-predator models; Bio-product recovery & bio-separations; Manufacture of biochemical products.

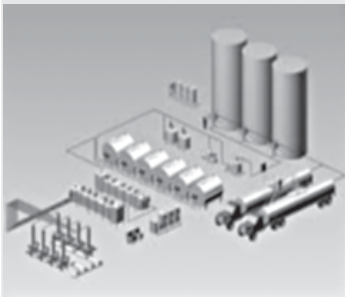
TEXT BOOKS:

1. J. E. Bailey & D. F. Ollis,"Biochemical Engineering Fundamentals, 1st edition, Mc Graw Hill Book Company, 1986.
2. H. W. Blanch & D. S. Clark, "Biochemical Engineering", Marcel Dekker, Inc., 1997.

REFERENCE BOOK:

1. G. A. Truskey, F. Yuan and D. F. Katz,"Transport Phenomena in Biological Systems" Pearson Prentice Hall, 2004.

19FT432 FOOD PLANT LAYOUT MANAGEMENT AND UTILITIES



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Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OUTCOMES

This subject will lead the students to learn the one of the most important aspect of the food industry, it will help them in find a suitable and ideal arrangement of the equipments and their importance with respect to plant layout.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental knowledge of plant layout in smooth conduction of processing.	1
2	Analyse types of types of layout and their benefits.	2
3	Create different efficient layout system for same processing according to space availability.	3
4	Investigate efficiency of different kinds of plant.	4
5	Design new required services for smooth operation of plants.	3

SKILLS:

- ✓ *To design plant layout.*
- ✓ *Doing consultancy regarding plant layout and design.*
- ✓ *create more chances of getting job by knowing all these tools and techniques.*

UNIT - I **L-9**

INTRODUCTION TO PLANT DESIGN: Special features of food processing industry- plant location, location factors, site selection, location theory and models.

UNIT - II **L-9**

LAYOUT : Objectives; Classical and practical layout- preparation of layout, project specific planning of the layout.

UNIT - III **L-9**

FRUIT JUICE PROCESSING PLANT : Different plant utilities setup-reduction unit, evaporation plant, drying plant, bake ovens and frying plant, thermal processing plant.

UNIT - IV **L-9**

PLANTS AND EQUIPMENTS : Refrigeration and air conditioning plant- packaging plant, ancillary equipments, building materials, water supply and drainage, illumination, ventilation.

UNIT - V **L-9**

E**STIMATION OF SERVICES :** Peak and critical load; Electrical installations- installation, operation and maintenance for food processing industry.

TEXT BOOKS:

1. T. Ahmad, "Dairy Plant Engineering and Management", Kitab Mahal, 2009.
2. V. S. Sheth, "Facilities Planning and Materials Handling; Method and Requirements", Mercel Dekker, 1995.
3. A. L. Gomez, and G. V. Barbosa, "Food Plant Design", CRC Press, 2003.

REFERENCE BOOK:

1. R. Turton, R. C. Bailie, and W. B. Whiting, "Analysis, Synthesis and Design of Chemical Processes", Prentice Hall of India, 2008.

19FT433 POST-HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:

httpswww.wur.nlen Research-ResultsResearch-Institutesfood-biobased-researchResearch-themesSustainable-Food-ChainsPost-harvest-technologyPostharvest-fruit-and-vegetables

PRE-REQUISITE COURSES : Fruits & Vegetable Processing Technology.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with post-harvest handling and changes of fruits and vegetables. The objective of this course is to impact knowledge to students on physico-chemical properties, handling, processing, preservation and storage of fruits and vegetables.

COURSE OUTCOMES :

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental physico-chemical properties in processing.	1
2	Analyse the harvesting and handling for maximum shelf-life.	2
3	Create system to minimize post-harvest changes.	3
4	Investigate effect of pre-treatments on shelf-life and final products.	4
5	Design new required packaging system to inhibit any mechanical damage.	3

SKILLS:

- ✓ *Extend the green life and freshness of fruits and vegetables.*
- ✓ *Identify and develop processing technology for specific fruits and vegetables.*
- ✓ *Handle fruits and vegetable processing equipment.*
- ✓ *Suggest suitable storage conditions for fruits and vegetables.*

UNIT - I **L-9**

GENERAL INTRODUCTION : Importance & scope of post-harvest management of fruits and vegetables in Indian economy; Morphology, structure and composition and physical properties of fruits and vegetables; Maturity indices - standards for selected fruits and vegetables, methods of maturity determinations.

UNIT - II **L-9**

HARVESTING AND HANDLING : Harvesting tools and their design aspects; Field heat of fruits and vegetables; Primary processing for sorting and grading at farm and cluster level; Factors affecting post-harvest losses; Standards and specifications for fresh fruits and vegetable.

UNIT - III **L-9**

POST-HARVEST CHANGES : Post-harvest physiological and biochemical changes in fruits and vegetables; Ripening of climacteric and non-climacteric fruits; Regulations; Methods and storage practices - CA and MA, hypobaric storage, pre-cooling and cold storage, zero energy cool chamber.

UNIT - IV **L-9**

PRE-TREATMENTS : Chemicals; Wax coating; Prepackaging; VHT and irradiation; Physiological postharvest disorders - chilling injury and disease; Prevention of post-harvest diseases and infestation; Handling and packaging of fruits - post-harvest handling system for fruits of regional importance such as citrus, mango, banana, pomegranate, papaya, etc.

UNIT - V **L-9**

PACKAGING : Packaging and handling system for vegetables of regional importance such as - tomato, onion and carrot, pack house operations; Principles of transport and commercial transport operations.

TEXT BOOKS:

1. A. A. Kadar, “Post-Harvest Technology of Horticultural Crops”, 2nd edition, University of California, 1992.
2. R. P. Srivastava and S. Kumar, “Fruit and Vegetable Preservation: Principles and Practices”, 3rd edition, 2015.

REFERENCE BOOKS:

1. D. K. Salunkhe, H. R. Bolia and N.R Reddy, “Storage, Processing and Nutritional Quality of Fruits and Vegetables”, Volume 1, Fruits and Vegetables. CRC, 1991.
2. R. M. Shafiur,” Handbook of Food Preservation”, 2nd edition, CRC Press, 2007.

19FT434 PROJECT PLANNING, PREPARATION AND MANAGEMENT

Source:
https://project-management.com/setting-the-course-for-proper-project-planning/

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

PRE-REQUISITE COURSE: Food plant Equipment Design.

COURSE DESCRIPTION AND OBJECTIVES:

The main objectives of the course are to:

Learning of different project management methods, tools and techniques. Planning, executing, monitoring and controlling of projects from beginning to the end.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental knowledge of project planning and implementation.	1
2	Analyse types of strategy and their effect on plant management.	2
3	Create a continuous system to evaluate project.	3
4	Investigate project planning and execution relation in food.	4
5	Design new projects and analysis.	3

SKILLS:

- ✓ *Determining project objectives and target groups.*
- ✓ *Define project goals, outputs, estimate barriers.*
- ✓ *Perform cost-benefit analysis of the proposed project.*
- ✓ *Identify and utilize suitable sources of information in defining problem solutions.*

UNIT - I **L-9**

INTRODUCTION : Project **-** definition of project, the project lifecycle, projects in the context of strategic management; Organization - structure and culture, stakeholders and roles, challenges and opportunities

UNIT - II **L-9**

PROJECT PREPARATION AND DESIGN : Goal hierarchy; Logical framework; Project strategy - technology strategy, organizational strategy; Scheduling; Budgeting/cost estimation; Reducing project duration and risk assessment.

UNIT - III **L-9**

PROJECT EVALUATION : The project proposal / authorization; Resource scheduling; Standards; Project selection methods - integrated selection and evaluation using multiple-attribute decision making technique

UNIT - IV **L-9**

PROJECT EXECUTION : Contract management reviewing and outsourcing; Practices and leveraging knowledge capabilities; Managing implementation; Improving R & D decisions and execution.

UNIT - V **L-9**

MONITORING AND EVALUATION: Progress & performance measurement and evaluation; Project audit and closure; Project oversight - monitoring and evaluation process and its importance; Presentation of data for analysis.

TEXT BOOKS:

1. H. R. Kerzner, “Project Management: A Systems Approach to Planning, Scheduling, and Controlling”, 11th edition, John Wiley & Sons, 2013.
2. D. I. Cleland, “Project Management: Strategic Design and Implementation”, 5th edition, Mc Graw-Hill: New York, 2007.

REFERENCE BOOKS:

1. E. Larson and C. Gray, “Project Management: The Managerial Process”, 6th edition, McGraw Hill, New York. 2014.
2. P. Chandra, “Projects: Planning – Analysis”, 7th edition, Mc Graw Hill, New York. 2009.

19FT435 WASTE MANAGEMENT AND BY PRODUCT UTILIZATION

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:

https://www.google.com/search?q=11.+Waste+management+and+bi-product+utilization&rlz=1C1GCEB_enIN833IN833&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjZ2OuKTjAhVc4nMBHUCnCdUQ_AUIESgC&biw=1366&bih=625#imgrc=Pu9Hnhg-tD_UcM:

COURSE DESCRIPTION AND OBJECTIVES:

Deal with understanding various types of by-products and waste produced from food industry, their management and minimization. Impart knowledge to the students about waste minimization, utilization and development of various techniques to get best out of food industry waste. Gain knowledge about the advanced waste management system.Gain knowledge about the various alternative way of waste management.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental knowledge to reduce waste creation.	1
2	Analyse types operation in wastewater treatment.	2
3	Create alternative approach to reduce food waste.	3
4	Investigate efficiency of anaerobic digestion.	4
5	Design new composite materials from food waste.	3

SKILLS:

- ✓ *Treatment of waste according to standards.*
- ✓ *Design procedure for waste treatment.*
- ✓ *Design alternative techniques for waste treatment.*
- ✓ *Ability to utilize by product from food industry.*

UNIT - I **L-9**

FOOD WASTE MANAGEMENT: Food industry wastes; Food waste treatment; ISO 14001 standards; Necessity of food waste utilization; Environmental legislation; Treatment according to established standards and directives; Environmental best practice technologies for waste minimization.

UNIT - II **L-9**

OPERATIONS IN WASTE WATER TREATMENT: Advanced waste water treatment practices - removal and recovery of solids in process water and reuse water within the processing plant; Water stream segregation of dissolved and particulate solids; Use of efficient membranes.

UNIT - III **L-9**

ALTERNATIVE TECHNIQUES TO REDUCE FOOD WASTE: Use of chlorine for water treatment; Zero discharge system; Zero-emission system; Anaerobic digestion of organic residues and wastes; Effluent treatment - BOD and COD treatment and disposal of effluents.

UNIT - IV **L-9**

ANAEROBIC DIGESTION OF FOOD INDUSTRY WASTE: Waste water treatment of brewery, Winery and distillery; Anaerobic degradation of animal by- products and utilization of whey.

UNIT - V **L-9**

USES OF BY PRODUCTS: Utilization of plant by products - for the recovery of proteins, dietary fibers, anti-oxidants and their use as nutraceuticals; Utilization of by products of food industries - composting and incineration of food plant waste.

TEXT BOOKS:

1. V. Oreopoulou and W. Russ, "Utilization of By-Products and Treatment of Waste in the Food Industry", 3rd Volume, Springer, 2007.
2. K. Waldron, "Handbook of Waste Management and Co-Product Recovery in Food Processing",1st Edition, CRC, 2007.

REFERENCE BOOK:

1. R. Smith, J. Klemes and J. Kim, "Handbook of Water and Energy Management in Food Processing", 1st Edition, CRC, 2008.

19FT436 DAIRY AND FOOD PROCESSES

Source:
http:// www.rpwyzibility.com/ processed-food-dairy-products/

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES

This course will cover basics of dairy (liquid food) food processing and preservation technologies required in any dairy and food processing industries.

COURSE OUTCOMES

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental knowledge of dairy in different product preparation.	1
2	Analyse major problems of dairy industry.	2
3	Create different efficient sampling system without any cross contamination.	3
4	Investigate several common processing steps in food process.	4
5	Design and development of new novel processing and preservation methods.	3

SKILLS:

- ✓ *The basic knowledge on dairy food processing is intermingled with most of the unit operations at some or other stage of processing.*
- ✓ *This basic aspect of food processing and preservation is not taught in most of the Agricultural engineering institutions elaborately.*
- ✓ *A comprehension of these aspects of processing and preservation will enrich the knowledge base of the students in general.*

UNIT - I **L-9**

BASIC PRINCIPLES AND METHODS OF FOOD PROCESSING AND PRESERVATION: Emerging technologies in food processing; Food additives and preservatives; Food laws and standards; Effect of processing on acceptability and nutritive value of food; Physico-chemical properties and structure of milk and milk constituents.

UNIT - II **L-9**

CHEMICAL AND MICROBIAL SPOILAGE OF MILK AND MILK PRODUCTS : Fluid milk Processing, packaging and distribution; Common dairy processes - cream separation (standardization), pasteurization, sterilization and homogenization; Process technology for manufacture of evaporated milk, condensedmilk, dried milk, malted milk, infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products.

UNIT - III **L-9**

METHODS AND STANDARDS : Methods and procedures for sampling and testing of milk and milk products; Laws and standards for milk and milkproducts; Technological processes for industrially manufactured foods of commercial importance, from plant and animal origin.

UNIT - IV **L-9**

C**EREALS, VEGETABLES, FRUITS, MEATS, POULTRY AND EGG PRODUCTS :** Bakery, pasta and confectionary products; Ready to eat foods; Fermented foods; Alcoholic and non- alcoholic beverages- tea, coffee and cocoa; Fabricated foods; Packaging materials - characteristics, properties and their design; Packaging requirement for different processed and unprocessed foods.

UNIT - V **L-9**

WORKING PRINCIPLES OF VARIOUS TYPE OF FILLERS: Form-fill- seal machine; Gas packaging and modified atmosphere package design; Shelf life prediction of foods in packages; Quality control in food packaging; Product safety and packaging regulations.

TEXTBOOKS :

1. S. De, “Outlines of Dairy Technology”, 1st edition, Oxford University Press, 1980.
2. J. N. Warner, “Principles of Dairy Processing”, 3rd edition, Wiley Eastern Ltd., Delhi, India, 1976.

REFERENCE BOOKS:

1. K. S. Bangarappa and K. L. Acharya, “Indian Dairy Products”, 2nd edition, Asia Publishing House, Bombay,1974.
2. P. Walstra, “Dairy Science and Technology”, 2nd edition, Taylor & Francis, 2006.

19FT437 NANO TECHNOLOGY

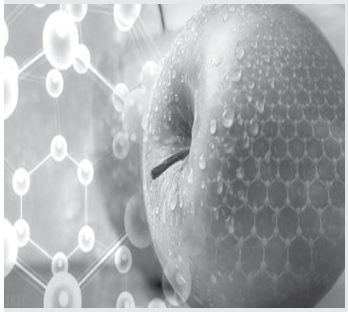
Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5



Source:

https://steemit.com/steemstem/@noirac/nanotechnology-and-its-application-in-the-food-industry

COURSE DESCRIPTION AND OBJECTIVES

Characterization and Properties will provide an overview of nanostructures evincing their fascinating properties (mechanical, optical, electromagnetic, chemical, and biological) unseen otherwise. The hierarchical development from Nano to macro length scale, and its adoption in nature (biomimicking) will also be discussed. Understanding the change in crystal structure and defects therein as one goes from bulk to Nano length scale will be utilized to construct structure-mechanism-property-performance maps. Thermodynamics resulting from the size effects at Nano-length scales will also be considered. Structural, phase, microstructural and mechanical characterization techniques will be dealt in detail.

COURSE OUTCOMES

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	To apply the fundamental knowledge of Nanotechnology in food processing.	1
2	Analyse effect of nanostructures on shelf life of food.	2
3	Create different surfaces and interfaces using nanotechnology to enhance processing operations.	3
4	Investigate properties of nanostructures and nanomaterials.	4
5	Design and development of nanomaterials using BET technique.	3

SKILLS:

- ✓ *To quality determination of Nano materials.*
- ✓ *Apply the new generation materials.*
- ✓ *To understand the future of Nano-materials.*

UNIT - I **L-9**

OVERVIEW OF NANOSTRUCTURES AND NANOMATERIALS : Classification- crystalline nanomaterials and defects therein; Hybrid nanomaterials; Multiscale hierarchical structures built out of nanosized building blocks (Nano to macro); Nanomaterials in nature - nacre, gecko, teeth.

UNIT - II **L-9**

NANOSTRUCTURES: Carbon nanotubes- fullerenes, nanowires, quantum dots; Applications of nanostructures - reinforcement inceramics, drug delivery, giant magnetoresistance; Cells response to nanostructures.

UNIT - III **L-9**

SURFACES AND INTERFACES IN NANOSTRUCTURES : Ceramic interfaces; Superhydrophobic surfaces; Grain boundaries in nanocrystalline materials; Defects associated with interfaces; Thermodynamics of nanomaterials.

UNIT - IV **L-9**

OVERVIEW OF PROPERTIES OF NANOSTRUCTURES AND NANOMATERIALS : How the performance of nanomaterials come about; Size structure-mechanism-property-performance pathway; Overview of characterization of nanostructures and nanomaterials.

UNIT - V **L-9**

ANALYTICAL TECHNIQUES : Brunauer-emmett-teller (BET) technique; Transmission electron microscopic techniques; Auger electron spectroscopy; X-ray photoelectron spectroscopy; Electron energy loss spectroscopy; Deformation behavior of nanomaterials; Fracture and creep; Nano mechanics and nanotribology; Properties - electrical, magnetic and optical properties.

TEXT BOOKS:

1. D. M. Ashby, P. Ferreira, L. Daniel, “Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects”, Schodek, Butterworth-Heinemann, 2009.
2. Z. L. Wang, Y. Liu, Z. Zhang, “Handbook of Nanophase and Nanostructured Materials (in four volumes)”, Eds: Kluwer Academic/Plenum Publishers, 2003.

REFERENCE BOOK:

1. Encyclopedia of Nanoscience and Nanotechnology, Ed.: Hari Singh Nalwa, American Scientific Publishers, 2004.