



SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)



Approved by AICTE, Recognized by UGC & Affiliated to Anna University
Accredited by NBA-AICTE, NAAC-UGC with 'A++' Grade
Saravanampatti, Coimbatore – 641035.

REGULATION 2023 CURRICULUM
I – VIII SEMESTER

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF FOOD TECHNOLOGY

B.Tech – FOOD TECHNOLOGY



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF FOOD TECHNOLOGY

R 2023 – SUGGESTED CURRICULUM

B.Tech – FOOD TECHNOLOGY



Description / Semester	AICTE	SNSCT – Suggested	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8
Humanity, Social Science & Mandatory (HSMC)	12	11	3	4	2				2	
Basic Science (BSC)	25	28	8	8	5	5				
Engineering Sciences (ESC)	24	22.5	8	8	2	4.5				
Programme Core (PCC)	48	55.5		2	12	10.5	12	14	5	
Programme Elective (PEC)	18	15					3	3	3	6
Open Elective (OEC)	18	9					3	3	3	
Project/Seminar/Internship (EEC)	15	28	3	1	1	3	5	3	2	12
Mandatory Courses (MC)	(Non Credit)									
TOTAL	160	169	22	23	22	23	23	23	15	18

SEMESTER I										
S.No.	CourseCode	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	
Theory Courses										
1.	23MAT101	Matrices and Calculus	3	1	0	4	4	40/60	BSC	
2.	23PYT101	Engineering Physics	3	0	0	3	3	40/60	BSC	
3.	23MET101	Engineering Mechanics	3	0	0	3	3	40/60	ESC	
4.	23EET101	Basics of Electrical and Electronics Engineering	3	0	0	3	3	40/60	ESC	
5.	23GET103	Heritage of Tamils	1	0	0	1	1	40/60	HSMC	
Theory Integrated Practical Courses										
6.	23GEB101	Design Thinking and Innovation	1	0	4	5	3	50/50	EEC	
Practical Courses										
7.	23PYP101	Physics Laboratory	0	0	2	2	1	60/40	BSC	
8.	23ENP101	Professional Communication Laboratory	0	0	4	4	2	60/40	HSMC	
9.	23GEP101	Workshop Practices Laboratory	0	0	4	4	2	60/40	ESC	
Mandatory Course										
10.	23CHT103	Environmental Science and Sustainability	2	0	0	2	0	100/0	MC	
Total			16/1/14			31	22			

SEMESTER II									
SNo.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category
Theory Courses									
1.	23MAT102	Complex Analysis and Laplace Transforms	3	1	0	4	4	40/60	BSC
2.	23CHT102	Chemistry of Engineering Materials	3	0	0	3	3	40/60	BSC
3.	23ENT101	Communicative English	3	0	0	3	3	40/60	HSMC
4.	23ITT101	Programming In C and Data Structures	3	0	0	3	3	40/60	ESC
5.	23MET102	Engineering Drawing	1	0	4	5	3	40/60	ESC
6.	23FTT101	Introduction to Food Technology	2	0	0	2	2	40/60	PCC
7.	23GET104	Tamils and Technology	1	0	0	1	1	40/60	HSMC
Practical courses									
8.	23CHP101	Chemistry Laboratory	0	0	2	2	1	60/40	BSC
9.	23ITP101	Programming In C and Data Structures Laboratory	0	0	4	4	2	60/40	ESC

10.	23FTP101	Internship-I	2 Weeks			-	1	100/0	EEC
Mandatory Course									
11.	23HST103	Indian Constitution	2	0	0	2	0	100/0	MC
Total			18/1/10			29	23		

SEMESTER III										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
Theory Courses										
1.	23MAT201	Partial Differential Equations and Transforms	3	0	0	3	3	40/60	BSC	
2.	23AGT203	Thermodynamics and Heat Transfer	3	0	0	3	3	40/60	PCC	
3.	23FTT202	Fluid Mechanics for Food Technology	3	0	0	3	3	40/60	PCC	
4.	23FTT203	Processing Technology of Cereals, Legumes and Oilseeds	3	0	0	3	3	40/60	PCC	
5.	23FTT204	Biochemistry and Nutrition	2	0	0	2	2	40/60	PCC	
6.	23GET275	VQAR-I	2	0	0	2	2	40/60	BSC	
Theory Integrated Practical Courses										
7.		Language Elective	1	0	2	3	2	50/50	HSMC	
Practical Courses										
8.	23FTP201	Computer Aided Design Laboratory	0	0	2	2	1	60/40	PCC	
9.	23ITP204	Programming in Python	0	0	4	4	2	50/50	ESC	
10.	23FTP202	Mini Project - I	0	0	2	2	1	100/0	EEC	
Total			17/0/10			27	22			

SEMESTER IV										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
Theory Courses										
1.	23MAT204	Statistics and Numerical Methods	3	0	0	3	3	40/60	BSC	
2.	23FTT205	Food Microbiology	2	0	0	2	2	40/60	PCC	
3.	23FTT206	Food Processing and Preservation	2	0	0	2	2	40/60	PCC	
4.	23FTT207	Refrigeration and Cold Chain	2	0	0	2	2	40/60	PCC	
5.	23GET276	VQAR-II	2	0	0	2	2	40/60	BSC	
6.	23CST205	Object Oriented Programming using Java	3	0	0	3	3	40/60	ESC	
Theory Integrated Practical Courses										
7.	23FTB201	Unit Operations in Food Process Engineering	2	0	2	4	3	50/50	PCC	

Practical Courses										
8.	23FTP203	Food Microbiology Laboratory	0	0	3	3	1.5	60/40	PCC	
9.	23CSP205	Object Oriented Programming using Java Laboratory	0	0	3	3	1.5	60/40	ESC	
10.	23GEP275	Personal Branding	0	0	4	4	2	60/40	EEC	
Mandatory Course										
11.	23FTP204	Internship-II	2 Weeks				1	100/0	EEC	
Total			17/0/10	28	23					

SEMESTER V										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
Theory Courses										
1.	23FTT301	Fruit and Vegetable Processing Technology	3	0	0	3	3	40/60	PCC	
2.	23FTT302	Heat and Mass transfer in Food Processes	2	0	0	2	2	40/60	PCC	
3.	23FTT303	Processing Technology of Meat and Poultry Products	3	0	0	3	3	40/60	PCC	
5.		Professional Elective - I	3	0	0	3	3	40/60	PEC	
6.		Open Elective - I	3	0	0	3	3	40/60	OEC	
Theory Integrated Practical Courses										
7.	23FTB301	Processing of Dairy Products	2	0	2	4	3	50/50	PCC	
8.		Career Course -I	2	0	4	6	4	50/50	EEC	
Practical Courses										
9.	23FTP301	Fruit and Vegetable Processing Technology Laboratory	0	0	2	2	1	100/0	PCC	
10.	23FTP302	Mini Project – II	0	0	2	2	1	100/0	EEC	
Total			18/0/10	28	23					

SEMESTER VI										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
Theory Courses										
1.	23FTT304	Baking and Confectionery Technology	3	0	0	3	3	40/60	PCC	
2.	23FTT305	Food Processing Plant Design and Layout	2	0	0	2	2	40/60	PCC	
3.	23FTT306	Food Safety and Quality	2	0	0	2	2	40/60	PCC	
4.		Professional Elective - II	3	0	0	3	3	40/60	PEC	
5.		Open Elective - II	3	0	0	3	3	40/60	OEC	
Theory Integrated Practical Courses										
6.	23FTB302	Post-Harvest Technology	2	0	2	4	3	50/50	PCC	
7.	23FTB303	Food Packaging Technology and Equipment	2	0	2	4	3	50/50	PCC	

8.		Career Course -II	1	0	2	3	2	50/50	EEC	
Practical Courses										
9.	23FTP303	Baking and Confectionery Technology Laboratory	0	0	2	2	1	60/40	PCC	
Mandatory Course										
10.	23HST105	Essence of Indian Traditional Knowledge	2	0	0	2	0	100/0	MC	
11.	23FTP304	Internship-III	2 Weeks				1	100/0	EEC	
Total			20/0/8			28	23			

SEMESTER VII										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
Theory Courses										
1.	23FTT401	Food Waste Management	3	0	0	3	3	40/60	PCC	
2.	23FTT402	Food Auditing	2	0	0	2	2	40/60	PCC	
3.	23GET401	Universal Human Values	2	0	0	2	2	40/60	HSMC	
4.		Professional Elective - III	3	0	0	3	3	40/60	PEC	
6.		Open Elective - III	3	0	0	3	3	40/60	OEC	
Practical courses										
7.	23FTP401	Project - I	0	0	4	4	2	60/40	EEC	
Total			13/0/4			17	15			

SEMESTER VIII										
S No.	Course Code	Course	L	T	P	Contact hrs/week	Credit	Int/Ext	Category	PRE-REQUISITES
1.	23FTP402	Project - II	0	0	24	24	12	60/40	EEC	
2.		Professional Elective – IV	3	0	0	3	3	40/60	PEC	
3.		Professional Elective - V	3	0	0	3	3	40/60	PEC	
Total			6/0/24			30	18			

ADDITIONAL LANGUAGE COURSES

S.No	Course Code	Courses Offered	L	T	P	C
1	23GEB202	HINDI	1	0	2	2
2	23GEB203	JAPANESE	1	0	2	2
3	23GEB204	GERMAN	1	0	2	2
4	23GEB205	FRENCH	1	0	2	2

CAREER COURSES (UG)

S.No	Course Code	Courses Offered	Sem	L	T	P	C
Track 1 Job (6 Credits)	23GEB375	Personnel Psychology and Technical Interviewing	V Semester	2	0	4	4
	23GEB379	Employable Skill Development	VI Semester	1	0	2	2
Track 2 Entrepreneurship (6 Credits)	23GEB376	Entrepreneurship and Business Canvas Model	V Semester	2	0	4	4
	23GEB382	Economics, Finance and Accounting and Intellectual Property Rights	VI Semester	1	0	2	2
Track 3 Higher Education (6 Credits)	23GEB377	Advanced Verbal Quantitative Aptitude and Reasoning and Networking	V Semester	2	0	4	4
	23GEB380	Higher Studies in Abroad and India	VI Semester	1	0	2	2
Track 4 Govt. /RRB/ Bank (6 credits)	23GEB378	Foundation Course on Competitive Exams	V Semester	2	0	4	4
	23GEB381	Personnel Psychology for Government Jobs	VI Semester	1	0	2	2

Mandatory Courses (UG)

Course Code	Course Title	L	T	P	C
23CHT103	Environmental Sciences and sustainability	2	0	0	0
23HST103	Indian Constitution	2	0	0	0
23HST105	Essence of Indian Traditional Knowledge	2	0	0	0

Other Special Courses (UG)

Course Code	Course Title	L	T	P	C
23GEB101	Design Thinking and Innovation	1	0	4	3
23GET275	VQAR – I	2	0	0	2
23GET277	Biology for Engineers	2	0	0	2
23GEP275	Personal Branding	0	0	4	2
23GET276	VQAR - II	2	0	0	2
23GET201	Professional Ethics and Human Values	2	0	0	2

Professional Electives

S.No	Course Code	COURSES OFFERED	L	T	P	C	Sem
1.	23FTE301 – 23FTE305	Professional Elective – I	3	0	0	3	V
2.	23FTE306 – 23FTE310	Professional Elective – II	3	0	0	3	VI
3.	23FTE401 – 23FTE405	Professional Elective – III	3	0	0	3	VII
4.	23FTE406 – 23FTE410	Professional Elective – IV	3	0	0	3	VIII
5.	23FTE411 – 23FTE415	Professional Elective – V	3	0	0	3	VIII
		TOTAL	15	0	0	15	

S. No	Course Code	Courses Offered	L	T	P	C
Professional Elective - I						
1.	23FTE301	Design of Food processing machinery	3	0	0	3
2.	23FTE302	Food Biotechnology and its Applications	3	0	0	3
3.	23FTE303	Milling Technology	3	0	0	3
4.	23FTE304	Food Sensors	3	0	0	3
5.	23FTE305	Instrumentation and Process Control	3	0	0	3
6.	23MEE305	Principles of Management	3	0	0	3
Professional Elective – II						
1.	23FTE306	3D Printing of Foods	3	0	0	3
2.	23FTE307	Food Adulteration and its Control	3	0	0	3
3.	23FTE308	Processing Technology of Beverages	3	0	0	3
4.	23FTE309	Processing of Spices and Plantation crops	3	0	0	3
5.	23FTE310	Application of Nanotechnology and Cryogenics in Food Processing	3	0	0	3
6.	23MEE310	Engineering Economics and Cost Analysis	3	0	0	3

Professional Elective – III						
1	23FTE401	Technology of Fats and Oils	3	0	0	3
2	23FTE402	Enzyme Technology	3	0	0	3
3	23FTE403	Food Product Development	3	0	0	3
4	23FTE404	Bioprocess Technology	3	0	0	3
5	23FTE405	Food Supply Chain Management Logistics	3	0	0	3
6.	23MEE405	Total Quality Management	3	0	0	3

Professional Elective – IV

1.	23FTE406	Traditional Foods	3	0	0	3
2.	23FTE407	Cane Sugar Technology	3	0	0	3
3.	23FTE408	Waste Management and By-Product Utilization in Food Industries	3	0	0	3
4.	23FTE409	Analytical Instruments in Food Industries	3	0	0	3
5.	23FTE410	Next Generation Packaging	3	0	0	3

Professional Elective – V

1.	23FTE411	Fermentation Technology	3	0	0	3
2.	23FTE412	Food Additives and Nutraceuticals	3	0	0	3
3.	23FTE413	Technology of Snack and Extruded Foods	3	0	0	3
4.	23FTE414	Processing of Fish and Marine Products	3	0	0	3
5.	23FTE415	Genetic Engineering and Genetically Modified Foods	3	0	0	3

S.No	Course Code	Open Elective Courses Offered	L	T	P	C
(To Other Department Students)						
1.	23FTO301	Principles of Food Safety	3	0	0	3
2.	23FTO302	Processing of Fruits and Vegetables	3	0	0	3
3.	23FTO303	Sensory Evaluation of Food Products	3	0	0	3
4.	23FTO304	Baking Technology	3	0	0	3
5.	23FTO305	Safety and Hazard management in Food Industries	3	0	0	3

SEMESTER I

23MAT101	MATRICES AND CALCULUS	L	T	P	C	
	(Common to all B.E. / B. Tech. Courses)	3	1	0	4	
UNIT I	MATRIX EIGENVALUE PROBLEM					9+3
Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton Theorem (statement only) and its applications – Eigenvalue problems arising from population models (Leslie model).						
UNIT II	ORTHOGONAL TRANSFORMATION OF A REAL SYMMETRIC MATRIX					9+3
Diagonalization of a real symmetric matrix – Quadratic form – Canonical form – Nature of the quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation – Applications: Stretching of an elastic membrane.						
UNIT III	DIFFERENTIAL CALCULUS					9+3
Curvature – Radius of Curvature in Cartesian co-ordinates – Centre of curvature and circle of curvature in Cartesian Co-ordinates – Evolutes – Envelopes.						
UNIT IV	FUNCTIONS OF SEVERAL VARIABLES					9+3
Partial derivatives – Homogeneous functions and Euler’s theorem – Jacobians – Taylor’s series for functions of two variables – Applications: Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.						
UNIT V	MULTIPLE INTEGRALS					9+3
Double integrals (Cartesian co-ordinates) – Change of order of integration – Applications of double integrals (Area) – Triple integrals (Cartesian co-ordinates) – Applications: Volume of solids.						
L : 45		T:15	P: 0	J: 0	Total: 60 PERIODS	
TEXT BOOKS						
1	Kreyszig.E, Advanced Engineering Mathematics, John Wiley and Sons, 10 th Edition, New Delhi 2016.					
2	James Stewart, Calculus, Cengage Learning, 8 th Edition, New Delhi 2015.					
REFERENCES						
1	Grewal.B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44 th Edition, 2018.					
2	Bali. N.P, Goyal. M. and Watkins. C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7 th Edition, 2009.					
3	Jain. R.K. and Iyengar. S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 5 th Edition, 2016.					
4	Ramana. B.V., Higher Engineering Mathematics, McGraw Hill Education Pvt. Ltd, New Delhi, 2016.					
5	Thomas. G. B., Hass. J, and Weir. M.D, Thomas Calculus, 14 th Edition, Pearson India, 2018.					
COURSE OUTCOMES						
At the end of the course students should be able to						
CO1	Know about Eigen values and Eigen vectors and its role in the system of equations.					
CO2	Transform the real symmetric matrix from quadratic form to canonical form by means of orthogonal transformation.					
CO3	Determine the radius, centre and circle of curvature of any curve.					
CO4	Use differential calculus ideas on several variable functions.					
CO5	Apply multiple integral ideas in solving areas, volumes and other practical problems.					

23PYT101	ENGINEERING PHYSICS	L	T	P	C
	(Common for AEROSPACE, AGRI, AUTO, CIVIL, FT, MECH & MCT)	3	0	0	3
UNIT I	CRYSTAL STRUCTURE				9
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystals systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP structures; Crystal imperfections – point, line, surface and volume imperfections.					
UNIT II	QUANTUM PHYSICS				9
Black body radiation – Planck’s theory (derivation) – Deduction of Wien’s displacement law and Rayleigh – Jean’s Law from Planck’s theory — Properties of Matter waves –Physical significance of wave function-Schrödinger’s wave equations: Time independent and time dependent equations– Particle in a one dimensional box–Electron microscope-Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM).					
UNIT III	ELASTICITY				9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders					
UNIT IV	PHYSICS OF ADVANCED MATERIALS				9
Conductors: classical free electron theory (Lorentz –Drude theory) – electrical conductivity. Superconductors: definition – Meissner effect – type I & II superconductors – BCS theory. Nanomaterials: introduction and properties – synthesis – top-down process: Ball milling method - bottom-up approach: Physical Vapour deposition – applications.					
UNIT V	NON-DESTRUCTIVE TESTING				9
Introduction- Types of defects-Methods of NDT-Visual inspection- Liquid / Dye penetrant testing- Magnetic particle testing-Eddy current testing-Ultrasonic inspection method- Advantages-X-Ray radiography- X-ray fluoroscopy-Comparison of conventional and real timeradiography.					

L: 45 T: 0 P: 0 T: 45 PERIODS

TEXTBOOKS	
1.	Gaur R.K. And Gupta S.L, “Engineering Physics”, Dhanpat Rai publishers, 2013 (Unit I, II, III)
2.	Dr. M.N. Avandhanulu, Dr. P.G. Kshirsagar, “A Textbook of Engineering Physics”, S.Chand, 2014 (Unit I, II & V)
3.	Murugesan R And Kiruthika Sivaprasath, “Modern Physics” 18 th edition, S.Chand 2016 (Unit I, II, IV)
REFERENCES	
1.	Rajendran. V, Engineering Physics, Tata Mcgraw-Hill Publishing Company Limited, New Delhi. 2017. (Unit I, II, III, V)
2.	“Engineering Physics”, Wiley, 2013 (Unit I, II, III, V)
3.	A.S. Vasudeva, “Modern Engineering Physics”, S.Chand, 2001 (Unit I, II, III & V)
4.	B.K. Pandey Chaturvedi, “Engineering Physics”, Cengage Learning, 2012 (Unit I, II & IV)
5.	Charles Kittel, “Solid State Physics”, Wiley (2009), Unit (I & II)
6.	Arthur Beiser, Concepts of Modern Physics, Tata McGraw-Hill, New Delhi, 2010. (Unit I, IV, V)
7.	C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley, New Delhi, 2007 (Unit V)

COURSE OUTCOMES

At the end of the course students should be able to

Co1: Understand the properties of Crystalline Materials.

Co2: learn the basic concepts of Quantum Mechanics

Co3: Analyze the elastic properties of materials.

Co4: Utilize the knowledge to identify and develop the materials for specific applications.

Co5: Make use of Knowledge on different Non-Destructive testing techniques.

23MET101	ENGINEERING MECHANICS				L	T	P	C	
	(Common to All Non Circuit Branches)				3	0	0	3	
UNIT I	BASICS & STATICS OF PARTICLES							9	
Introduction - Units and Dimensions - Vectorial representation of forces and moments –Coplanar Forces - Laws of Mechanics - Lamé's theorem, Resolution and Composition of forces -Equilibrium of a particle - Principle of transmissibility –Free body diagram									
UNIT II	EQUILIBRIUM OF RIGID BODIES							9	
Types of supports and their reactions -requirements of stable equilibrium -Moments and Couples- - Vectorial representation of moments and couples --Varignon's theorem and applications–Forces in space -Equilibrium of a particle in space - Equilibrium of Rigid bodies in three dimensions									
UNIT III	PROPERTIES OF SURFACES AND SOLIDS							9	
Determination of centroid of areas, volumes and mass – moment of inertia of plane - Parallel axis theorem and perpendicular axis theorem-product of inertia- mass moment of inertia.									
UNIT IV	DYNAMICS OF PARTICLES							9	
Displacements, Velocity and acceleration, their relationship - Relative motion –Curvilinear motion- Newton's law-Work Energy Equation of particles									
UNIT V	FRICTION AND RIGID BODY DYNAMICS							9	
Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction - wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies –Velocity and acceleration									
L :45					T: 0		P: 0		T: 45 PERIODS
TEXT BOOKS									
1	Beer, F.P and Johnston Jr. E.R. “Vector Mechanics for Engineers”, McGraw-Hill Education 11th Edition (India) Pvt Ltd. (2016).								
2	J.L.Meriam& L.G. Karidge, Engineering Volume I) and Engineering Mechanics: Dynamics, 8th edition, Wiley student edition, 2016								
REFERENCES									
1	VelaMurali,“EngineeringMechanics”, Oxford University Press (2010)								
2	D.P.Sharma “Engineering Mechanics”, Dorling Kindersley (India) Pvt. Ltd, New Delhi2010.								
3	Dr.I.S.Gujral “Engineering Mechanical” second edition, 2011, Lakshmi Publication (P).Ltd.								
4	Arthur P.Boresi and Richard J.Schmidt, “Engineering Mechanics: Staticsand Dynamics”, Thomson Asia Private Limited, Singapore, 2010.								
5	Hibbeller, R.C., “Engineering Mechanics”, 14th edition, Prentice hall (2016).								

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1	recognize the basics of equilibrium of particles in 2D and 3D
CO2	review the requirements of equilibrium of rigid bodies in 2D and 3D
CO3	compute the center of mass and moment of inertia of surfaces and solids
CO4	predict displacement, velocity and acceleration of dynamic particles
CO5	solve for friction force and rigid body dynamics

23EET101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
	(Non circuit branches)	3	0	0	3
UNIT I	ELECTRICAL CIRCUITS				9
DC Circuits: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchoff’s Laws – Simple problems: Nodal analysis, Mesh analysis with Independent sources only (Steady state)					
AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor (Simple problems only)					
UNIT II	ELECTRICAL MACHINES				9
Construction, Principle of operation, Basic equations and applications of DC Generator, DC Motor- Elementary treatment of Single phase Transformer, Single and three phase Induction Motors, Synchronous Generator					
UNIT III	WIRING, GROUNDING AND SAFETY				9
Wiring: General Rules, materials and accessories, Types of wiring - Conduit wiring –Wiring layout of Residential building, Grounding: Importance of grounding, Types of grounding - Safety: Causes of accidents, Accident prevention.					
UNIT IV	ANALOG ELECTRONICS				9
Construction, working principle and VI characteristics of Diode, Zener diode, BJT, MOSFET, Applications: Bridge Rectifier, Voltage regulators, UPS, SMPS					
UNIT V	DIGITAL ELECTRONICS AND MEASURING INSTRUMENTS				9
Boolean Algebra-Logic Gates - Half Adder and Full Adders - A/D and D/A Conversion (Any one concept) Functional elements of an instrument, Construction and Operating Principle: Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Data acquisition					
		L :45	T: 0	P: 0	T: 45 PERIODS

TEXT BOOKS

1	Muthusubramanian R, Salivahanan S, “Basic Electrical and Electronics Engineering”, TataMcGrawHillPublishers,2010
2	Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020

REFERENCES

1	V.Mittle, “Basic Electrical Engineering”, Tata McGraw Hill Publishers,2017
2	Mehta VK, Mehta Rohit, “Principles of Electrical Engineering and Electronics”, S.Chand&CompanyLtd,2010
3	Black & Decker , “The complete guide to Electrical Wiring”, S.Chand& Company Ltd,2012
4	Nagrath. I.J, “Electronics: Analog and Digital”, Prentice Hall India Pvt. Ltd., 2013
5	Mehta V K, Mehta Rohit, “Principles of Electronics”, S.Chand& Company Ltd, 2005

COURSE OUTCOMES :	
At the end of the course student should be able to:	
CO1	Familiarize the elementary concept of electric circuits
CO2	Understand the construction, operation and applications of electrical machines
CO3	Apply the concept of wiring and acquire the importance of grounding and safety
CO4	Gain knowledge on electronic devices and its applications
CO5	Acquire knowledge on basics of digital electronics and measurements

23GET103	HERITAGE OF TAMILS	L	T	P	C
			1	0	0
UNIT I	LANGUAGE AND LITERATURE				3
Language Families in India - Dravidian Languages –Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil and – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry –Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.					
UNIT II	HERITAGE-ROCK ART PAINTINGS TO MODERN ART–SCULPTURE				3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.					
UNIT III	FOLK AND MARTIAL ARTS				3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.					
UNIT IV	THINAI CONCEPT OF TAMILS				3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.					

UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE				3
Contribution of Tamils to Indian Freedom Struggle-The Cultural Influence of Tamil over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.					
TOTAL : 15 PERIODS					
TEXT BOOKS					
1.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ES Cand RMRL–(inprint)				
2.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).				

TOTAL:15 PERIODS

REFERENCES	
1.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
2.	Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:

	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
3.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1: Know about the language families of India CO 2: summarize the rock art paintings and sculptures CO 3: describe the folk and marital arts of tamils CO 4: demonstrate the thinai concepts of Tamil CO 5: have knowledge on the contribution of tamils in Indian National Movement	

23GEB101		DESIGN THINKING AND INNOVATION			
		L	T	P	C
		1	0	4	3
UNIT I	INTRODUCTION TO DESIGN THINKING				3+12
A brief in sight to Design Thinking and Innovation –People Centered Design & Evoking the ‘right problem’ – Purpose of Design Thinking – Design Thinking Framework					
UNIT II	PROCESS IN DESIGN THINKING (EMPATHY, DEFINE)				3+12
Design Thinking Process – Empathy – Uncovering and Investigating Community Concerns - Define: Examine and Reflect on the problem					
UNIT III	CONCEPTING AND BUILDING (IDEA, CREATE)				3+12
Generating Ideas – Identifying top three ideas – Bundling the Ideas and create concepts- Rapid Prototyping					
UNIT IV	TESTING, REFINING AND PITCHING THE IDEAS				3+12
Importance & Testing the Design with People – Re test and Redefine Results – Creating a Pitch for the design					
UNIT V	VALUE PROPOSITION DESIGN				3+15
Business Vs Startup –Briefing the Problem – Problem Validation and User Discovery - Challenge Brief					
L:15T:0 P:60 TOTAL : 75PERIODS					
REFERENCE BOOKS					
1.	Robert A Curedale, Design Thinking Process & Methods 4thEdition, December2017, Design Community College Inc.				
2.	Andrew Pressman, DesignThinking : A Guide to Creative Problem Solving for Everyone, First Edition, Nov 2018, Routledge.				
3.	Brown,Tim, and Barry Katz. Change by Design : How Design Thinking Transforms Organizations And Inspires Innovation, 2009, Harper Business				
4.	Idris Mootee, Design Thinking for Strategic Innovation – What They Can't Teach You at Business Or Design School, First Edition,2017, Wiley				

5.	Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadacos Alex Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want, 2015, Wiley
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COURSE OUTCOMES

At the end of the course students should be able to

CO1: Learn new approach –design thinking—that enhances innovation activities in terms of market impact, value creation, and speed.

CO2: Feel the Empathy and can define their problems based on the Community Concerns

CO3: Strengthen their individual and collaborative capabilities to identify customer needs, create sound concept hypotheses, collect appropriate data, and develop a prototype that allows for meaningful feedback in a real-world environment

CO4: Translate broadly defined opportunities into actionable innovation possibilities and recommendations for client organization

CO5: Become an Entrepreneurs

23PYP101	PHYSICS LABORATORY (Common to All Branches)	L	T	P	C
		0	0	2	1
BASIC MEASURING INSTRUMENT					
<ol style="list-style-type: none"> 1. Screw Gauge 2. Vernier Caliper 3. Travelling Microscope 4. Spectrometer 					
LIST OF EXPERIMENTS (ANY EIGHT) 30 hours					
<ol style="list-style-type: none"> 1. Determination of wavelength of mercury spectrum – Spectrometer grating. 2. Determination of Young’s modulus of the material – uniform bending. 3. Determination of viscosity of liquid – Poiseuille’s method. 4. (a) Particle size determination using Diode Laser. (b) Determination of Laser parameters – Wavelength. 5. Determination of the Numerical Aperture and the acceptance angle of an optical fiber. 6. Determination of thickness of a thin wire – Air wedge method. 7. Determination of dispersive power of a prism using spectrometer. 8. Determination of Young’s modulus of the material – non uniform bending. 9. Torsional Pendulum - determination of rigidity modulus of wire and moment of Inertia of disc. 10. Determination of Band gap of semiconductor material. 					

L :0 T: 0 P: 30 T: 30 PERIODS

TEXT BOOK	
1.	Physics Laboratory Manual, Department of Physics, SNSCT, 2019.
REFERENCE BOOK	
1.	R.Jayaraman, V.Umadevi, S.Maruthamuthu, B.Saravanakumar “Engineering Physics Laboratory Manual”, Pearson Education India, 2013.

COURSE OUTCOMES
At the end of the course students should be able to
CO1: Evaluate the young's and Rigidity Modulus of the given material.
CO2: Utilize the concept of diffraction to determine the wavelength of given light source
CO3: Extend the knowledge on applying the principles of laser, fiber optics, viscosity and Band Gab ofthe Materials.

23ENP101	PROFESSIONAL COMMUNICATION	L	T	P	C
		0	0	4	2

UNIT I	LISTENING SKILLS	10
The process of Listening & Barriers of listening, Listening to TED Talks and note taking, – Listening to conversations for specific information, Listening to classroom lectures/ talks/ documentaries.		
UNIT II	READING	10
Cloze exercises, Picture perception, Reading and paraphrasing, Reading and interpreting.		
UNIT III	PROFESSIONAL WRITING	10
Cover letter & Resume preparation, Email writing – formal & Informal, Content writing- planning- writing- editing and proof reading, Report writing- types of report, report format - Fire Accident & Road Accident.		
UNIT IV	COMMUNICATION & SOFT SKILLS	15
Communication & Barriers of Communication- Verbal & Nonverbal Communication, Time Management, Stress Management, Inter & Intra personal skills, Professional ethics, Basic Etiquettes- Social Etiquette- Telephone Etiquettes- Corporate Etiquette.		
UNIT V	SPEAKING	15
Introduction of self and others, Extempore Speech, Public Speaking, Art of Storytelling- Describing and Narrating, Presentation Skills- preparing PPT and Oral presentation, – Group Discussion – Team building- Mock GD, Interview skills- resume based questions- competency based question- Mock Interview.		
L: 0 T: 0 P: 60		TOTAL:60 Periods

TEXT BOOKS	
1.	Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2011.
2.	Rizvi, Ashraf. M. Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
REFERENCES	
1.	Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011

2.	Mitra K. Barun, —Effective Technical Communication – A Guide for Scientists and Engineersl, Oxford University Press, New Delhi, 2006.
3 .	Leo Jones, Richard Alexander, New International Business English, updated Edition, Cambridge University Press, NY, USA.
4 .	Smith—Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA.
5 .	Sharon J. Gerson, Steven M. Gerson, —Technical Writing – Process & Productl. 3rd Edition, Pearson Education (Singapore) (P) Ltd., New Delhi.

COURSE OUTCOME

At the end of the course students should be able to

CO1: Make use of listening skills in both formal and informal contexts

CO2: Develop reading skill to comprehend ambiguity and complexity, and can articulate their own interpretations.

CO3: Demonstrate their writing skills for effective communication in both formal and informal situations

CO4: Discuss clearly, confidently, comprehensibly and communicate with one or many listeners using appropriate communicative strategies

CO5: Apply the various principles of communication in the work place environment

23GEP101	WORKSHOP PRACTICES (Common to All Branches)	L	T	P	C
		0	0	4	2
GROUP A (CIVIL & MECHANICAL)		30			
CIVIL ENGINEERING 12					
Study of plumbing tools and Components Preparation of threads in pipes					
Preparation of single and multi-tap connections for domestic					
Study of carpentry tools and its applications					
Preparation of Cross Lap and Dove Tail Joints.					
MECHANICAL ENGINEERING 18					
Study of different types of Welding and its applications					
Preparation of Butt, Lap and Tee joints					
Study of sheet metal and its applications					
Preparation of Rectangular, Square Trays and Funnel					
Demonstration of Lathe and Drilling Operations					
Demonstration of Smithy, Foundry tools and Power Tool Operations					
Plastic Moulding and Glass Cutting					
GROUP B (ELECTRICAL AND ELECTRONICS) 30					
ELECTRICAL ENGINEERING PRACTICE 18					
Residential house wiring using switches, fuse, miniature circuit breaker, indicator, Lamp and energy meter.					
Fluorescent lamp wiring.					
Stair-case wiring.					
Measurement of electrical quantities –voltage, current, power & power factor in RL Circuit.					
Measurement of energy using single phase energy meter.					
Measurement of insulation resistance to earth of electrical equipment.					
Measurement of single and three phase voltages.					
Study of Iron Box, Emergency Lamp and Fan.					
ELECTRONICS ENGINEERING PRACTICE 12					
Study of Electronic components and equipments –Resistor, color coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.					
Verification of logic gates: AND, OR, Ex-OR and NOT.					
Generation of Clock Signal.					
Soldering practice–Components Devices and Circuits Using general purpose PCB.					
Characteristics of a PN Junction diode					

L :0 T: 0 P: 60: Total:60 PERIODS

COURSE OUTCOMES
At the end of the course students should be able to
CO1: Demonstrate plumbing system and Carpentry for the required applications.
CO2: Relate the basic machining operations with engineering problems.
CO3: Apply different types of Welding processes and Sheet metal processes for the Industrial applications.
CO4: Illustrate Residential House wiring and simple wiring circuits.
CO5: Employ knowledge on measuring electrical quantities and usage of energy meters

23CHT103	ENVIRONMENTAL SCIENCE & SUSTAINABILITY	L	T	P	C
	(Common to all B.E / B.Tech)	2	0	0	2
UNIT I	ENVIRONMENT AND BIODIVERSITY				6
Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Introduction to biodiversity– Values of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex- situ conservation of biodiversity. Field visit on Biodiversity.					
UNIT II	ENVIRONMENTAL POLLUTION				6
Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.					
UNIT III	RENEWABLE SOURCES OF ENERGY				6
Energy management and conservation, New Energy Sources: Need of new sources. Solar energy, Wind energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Case study on Present Energy resources in India and its sustainability.					
UNIT IV	SUSTAINABILITY PRACTICES				6
Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Energy Cycles carbon cycle, emission and Sequestration, Sustainable urbanization and technological change.					
UNIT V	SUSTAINABILITY AND MANAGEMENT				6
Development, GDP, Sustainability - concept, needs and challenges-economic and social aspects of sustainability - millennium development goals and protocols Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry- A case study.					
		L :30	T: 0	P: 0	T: 30 PERIODS
TEXT BOOKS					
1	Anubha Kaushik and C. P. Kaushik’s “Perspectives in Environmental Studies”, 6th Edition, New Age International Publishers ,2018.				
2	Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi,2016.				
3	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.				
REFERENCES					
1	G.Tyler Miller, “Environmental Science” Cengage Learning India Pvt.Ltd.New Delhi.2011				
2	R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’,Vol. I and II, Enviro Media. 38 . Edition 2010.				
3	Gilbert M. Masters and Wendell. P.Ela, “Introduction to EnvironmentalEngineering and Science” PHI Learning Pvt. Ltd. New Delhi.2010.				
4	Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press, Third Edition, 2015.				
5	Erach Bharucha “Textbook of Environmental Studies for Undergraduate Courses” Orient Blackswan				

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1	Understand the ecological balance and preservation of bio diversity.
CO2	Know the role of human in prevention of pollution and making a clean environment.
CO3	Explore the environmental impact of various energy resources and also get knowledge about conservation of non-conventional energy resources.
CO4	Recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5	Demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

SEMESTER II

23MAT102	COMPLEX ANALYSIS AND LAPLACE TRANSFORMS	L	T	P	C
	(Common to AEROSPACE,AGRI,AUTO,BME,CIVIL,ECE,EEE,FT,MECH,MCT)	3	1	0	4
UNIT I	VECTOR CALCULUS				9+3
Derivatives: Gradient and Directional derivatives – Divergence and Curl of a vector field – Solenoidal and Irrotational of a vector – Green’s, Gauss divergence and Stoke’s theorems (statements only) – Verification of theorems and application in evaluating line, surface and volume integrals.					
UNIT II	ORDINARY DIFFERENTIAL EQUATIONS				9+3
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Homogenous equation of Euler’s and Legendre’s type – Solution of system of simultaneous linear first order differential equations with constant coefficients.					
UNIT III	COMPLEX DIFFERENTIATION				9+3
Derivatives of $f(z)$ – Analytic function – Cauchy-Riemann Equations – Harmonic function – Harmonic conjugate – Construction of Analytic function – Conformal Mapping – Mapping by functions: $w = z + c$, cz , $1/z$ – Bilinear transformations – Application to flow problems.					
UNIT IV	COMPLEX INTEGRATION				9+3
Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s series – Zeros of an analytic function – singularities – Laurent’s series – Residues – Cauchy Residue theorem .					
UNIT V	LAPLACE TRANSFORMS				9+3
Definition, properties, existence conditions – Transforms of elementary functions – Shifting theorem – Transforms of derivatives and integrals – Periodic functions – Initial and final value theorem – Inverse transforms – Application to solution of linear second order ordinary differential equations with constant coefficients.					
L : 45	T:15	P: 0	Total: 60 PERIODS		
TEXT BOOKS					
1.	Kreyszig.E, Advanced Engineering Mathematics, John Wiley and Sons, 10 th Edition, New Delhi 2016.				
2.	Grewal.B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44 th Edition, 2018.				
REFERENCES					
1.	Bali. N.P, Goyal. M. and Watkins. C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7 th Edition, 2009.				
2.	G.B.Thomas, Calculus, 12 th Edition, Pearson Education India, 2015.				
3.	Jain. R.K. and Iyengar. S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 5th Edition, 2016.				
4.	Peter V.O Neil, “Advanced Engineering Mathematics”, 7 th Edition, Cengage learning India Pvt Ltd, New Delhi, 2012.				
5.	Srimanta Pal, Subodh C Bhunia, “Engineering Mathematics”, Oxford University Press,2015.				
COURSE OUTCOMES					
At the end of the course students should be able to					
CO1	Evaluate gradient, divergence and curl and solve engineering problems involving cubes, rectangular parallelepipeds by applying various integral theorems.				
CO2	Solve the higher order linear differential equations with various methods and apply them in some physical situations.				
CO3	Test the analyticity, construct the analytic function and transform complex functions from z-plane to w-plane graphically by using conformal mapping.				
CO4	Evaluate real and complex integrals over suitable closed path using various integral theorems.				
CO5	Understand the mathematical principles on Laplace transforms and would provide them the ability to formulate and solve some of the physical problems of engineering.				

23CHT102	CHEMISTRY OF ENGINEERING MATERIALS	L	TP	C
	(Common to MECH, MCT, AUTO, AERO, AGRI, CIVIL & FT)	3	0 0	3
UNIT I	CORROSION AND ITS CONTROL	9		
Corrosion - Chemical corrosion (Oxidation corrosion)-Electrochemical corrosion-Types of electrochemical Corrosion -Corrosion control-Corrosion inhibitors- Cathodic protection (Sacrificial anodic protection and Impressed current Cathodic protection) – Protective coating-Paints and its constituents -Fire Retardant paint - Electroplating (Au)				
UNIT II	NANOMATERIALS	9		
Nano materials and Bulk materials - Size dependent properties (Optical, Electrical and Mechanical) –Synthesis - Sol gel method - Chemical Vapour Deposition, Solvothermal, laser ablation - Types of nanomaterials - Carbon nanotubes – Properties and uses - Application of Nanotechnology in Electronics Energy science and Medicine.				
UNIT III	FUELS AND COMBUSTION	9		
Fuels- Solid Fuel-Coal-classification-manufacture of metallurgical coke by Otto-Hoffmann method- Liquid Fuel–Synthetic petrol-Fischer and Bergius method- - Gaseous fuels- CNG and LPG.- Bio fuels: Categories, Types –Biodiesel, Biogas.Combustion-Calorific value-Gross and Net calorific value - Definition -Flue gas analysis by Orsat Apparatus.				
UNIT IV	WATER TECHNOLOGY	9		
Introduction-Hard water and Soft water-Hardness-Types-Boiler Troubles- Water Softening – External treatment-Demineralization-Internal Treatment- Water Quality parameters(pH,TDS,Chloride, Fluoride, Sulphate, Iron, BOD ,COD and Heavy metals)-Municipal water treatment - Desalination –Reverse osmosis.				
UNIT V	ALLOYS AND ENGINEERING MATERIALS	9		
Alloys-classification -Ferrous alloys (Nichrome and stainless steel only)-Non-ferrous alloys (brass and bronze) Heat treatment of steel- Definition of light metals, Characteristics and applications of light metals-Super alloys - Lubricants –Solid lubricants (Graphite and Molybdenum disulphide)-Mechanism of Lubrications. Cement – Portland cement-Chemical composition of Portland cement. Functions and limitations of cement ingredients.				
L :45 T:0 T : 45 PERIODS				
TEXT BOOKS				
1	P.C.Jain&Monicka Jain, “Engineering Chemistry”, Dhanapat Rai Publishing Company Pvt.Ltd. 2017.			
2.	Wiley, “Engineering Chemistry”, John Wiley &Sins.InC,USA (2014]			
REFERENCES				
1	B. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2009).			
2	Shikha Agarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, Second Edition, 2019.			
3	Dr.Sivanesan and Nandagopal, “Engineering Chemistry-I” V.K.Pub.Pvt.Ltd. 2011.			
4	O.G.Palanna, “Engineering Chemistry”Tata McGraw-Hill Pub.Co.Ltd, New Delhi.2017.			
5	Dara, S.S.; A Text Book of Engineering Chemistry (Tenth edition); S. Chand, 2003			

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1	Develop new strategy for protection of metals and to improve engineering design
CO2	Design environmentally benign method for nanoparticle synthesis
CO3	Acquire knowledge on various types of fuels .
CO4	Develop innovative and eco-friendly method for water purification .
CO5	Gain skill sets and usage of various engineering materials.

23ENT101	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

UNIT I		9
Grammar - Tenses - Verb forms, Spelling and Importance of Punctuation, Vocabulary - Word formation- Prefixes & Suffixes, One word Substitution, Reading -Reading and understanding the Context, Writing - Sentence completion- filling the gap, Instructions-Imperative Instructions		
UNIT II		9
Grammar - Uses of Preposition, Active & Passive Voice- impersonal passive, Vocabulary - Technical Vocabulary- Synonyms-Antonyms-Compound words, Reading -Transfer of information (chart, pictures), Writing - Recommendations- writing suggestions, Preparing Checklist.		
UNIT III		9
Grammar -Concord (Subject & Verb agreement), Definite & Indefinite Article, Vocabulary -Uses of Connectives and Linking words, Reading - Summarizing the given passage - Précis writing, Writing - Paragraph writing – Process writing, Analytical, Argumentative paragraphs.		
UNIT IV		9
Grammar - Direct and Indirect speech, Cause and Effect Expression, Vocabulary - Logical sequence of words, Reading -Note-making using Linear method, Writing - Formal Letterwriting- Permission letter for Industrial Visit & In-plant training.		
UNIT V		9
Grammar - Clauses -If Conditionals, Vocabulary - Words often confused - Verbal Analogy, Reading - Writing a Book Review Writing - Business Letters- Letter of Quotations,Clarification, Placing orders & Complaint letter.		
L: 45 T: 0 P: 0		TOTAL:45 Periods

TEXT BOOKS

1.	Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2011.
2.	Rizvi, Ashraf. M. Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
REFERENCES	
1.	Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011

2.	Mitra K. Barun, —Effective Technical Communication – A Guide for Scientists and Engineers, Oxford University Press, New Delhi, 2006.
3.	Leo Jones, Richard Alexander, New International Business English, updated Edition, Cambridge University Press, NY, USA.
4.	Smith—Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA.
5.	Sharon J. Gerson, Steven M. Gerson, —Technical Writing – Process & Product. 3rd Edition, Pearson Education (Singapore) (P) Ltd., New Delhi.

COURSE OUTCOME

At the end of the course students should be able to

CO1: **Use** their active and passive vocabulary and construct basic sentence structures

CO2: **Develop** reading skill to comprehend ambiguity and complexity, and can articulate their own interpretations

CO3: **Mark** effectively and flawlessly avoiding grammatical errors for a variety of professional and social settings

CO4: **Make use of** their letter writing skills for effective communication in formal situations

CO5: **Build** their communication skills and enable to articulate with confidence

23ITT101	PROGRAMMING IN C AND DATA STRUCTURES	L	T	P	C
		(Common to BME, ECE and All Non Circuit Branches)	3	0	0
UNIT I	INTRODUCTION TO C				8
Basic blocks of computers – Algorithm, Pseudo code, Flowchart - Structure of C program- Data types - Variables - Constants, Operators - Input and Output Statements					
UNIT II	DECISIONS STATEMENTS AND FUNCTIONS				11
Decision making and Branching statements - Looping statements, Functions, Call by value, Call by reference					
UNIT III	ARRAYS AND INTRODUCTION TO DATA STRUCTURES				10
Arrays - One dimensional arrays - Two dimensional Arrays - Structures – Pointers Introduction to Data structures - Types of Data structures - ADT					
UNIT IV	STACK AND QUEUE				9
Stack ADT - Queue ADT - Array implementation of Queue and Stack ADT - Infix to Postfix conversion - Postfix expression evaluation					
UNIT V	TREES				7
Trees - Binary Tree - Binary Search Tree - Insertion and Deletion Operation - Tree Traversal					
TOTAL : 45 PERIODS					
TEXT BOOKS					
1.	Kamthane Ashok, “Programming in C, Pearson Education India 3/e, 3rd Edition, 2015.				
2.	Aaron M. Tenenbaum, Yedidyah Langsam, Moshe Augenstein, “Data Structures Using C”, Prentice-Hall of India, 2003				
REFERENCES					
1.	A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2nd Edition, 2007. (Unit III-V)				
2.	E.Balagurusamy “Data Structures Using”, McGraw-Hill Education (India) , 2013 (IV-V)				

3.	E.Balagurusamy, “Fundamentals of Computing and Computer Programming”, Tata McGraw-Hill Publishing Company Limited, (2011). (UNIT I, II)
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1: develop algorithms and draw flow chart for solving real world problems CO 2: summarize decision making branching and looping statement. CO 3: demonstrate functions, arrays and data structure. CO 4: describe stack and queue data structure. CO 5: have knowledge in tree and its operation.	

23MET102	ENGINEERING DRAWING				L	T	P	C
	(Common to all Non-Circuit Branches)				1	0	4	3
UNIT I	PROJECTION OF POINTS, LINES AND PLANE SURFACES							3+12
Projection of points-Projection of straight lines located in the first quadrant-Determination of true Lengths and true inclinations Projection of polygonal surface and circular lamina inclined to both reference planes.								
UNIT II	PROJECTION OF SOLIDS							3+12
Projection of simple solids like prisms,pyramids,cylinder and cone when the axis is inclined to one reference plane by change of position method								
UNIT III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES							3+12
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other-Obtaining true shape of section. Development of lateral surfaces of Simple and truncated solids -Prisms, pyramids, cylinders and cones.								
UNIT IV	PICTORIAL PROJECTIONS AND FREE HAND SKETCHING							3+12
Principles of isometric projection -isometric scale -isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Free hand sketching: Representation of Three-Dimensional objects Need for importance of multiple views and their placement -First angle projection -layout views -Developing visualization skills through free hand sketching of multiple views from pictorial drawing. Perspective projection of prisms,pyramids and cylinders by visual ray method (Not for Examination).								
UNIT V	BUILDING DRAWING							3+12
Drawing of a plan, Elevation and sectioning of security room and residential building (Two bedrooms, kitchen, hall, etc.) Practicing design in the CAD Software (Not for Examination).								
				L:15	T: 0	P:60	Total:75 PERIODS	
TEXTBOOKS								
1	N.D.Bhattand V.M.Panchal,“Engineering Drawing”,Charotar Publishing House,53 rd Edition,2016							
2	K.R.Gopalakrishnan, “Engineering Drawing”(Vol.I&II),Subhas Publications,2014							
REFERENCES								
1	K.V.Natarajan,“A textbook of Engineering Graphics”,Dhanalakshmi Publishers,Chennai, 2015							
2	M.S.Kumar,“Engineering Graphics”,D.D.Publications,2011							
3	Venugopal & V.PrabhuRaja,“Engineering Graphics”,New Age International (P) Limited,2014							
4	M.B.Shahand B.C.Rana,“Engineering Drawing”, Pearson Education,2011.							
5	K.L.Narayanan and P.Kannaiah,“Engineering Drawing”SciTech Publications,2 nd edition,2012.							

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Sketch the projections of a points, straight lines and plane surfaces
CO2	Illustrate top view and front view of the solids
CO3	Sketch sectioned views and develop area required
CO4	Demonstrate knowledge about isometric, Perspective and orthographic projections
CO5	Design simple buildings with detailed plan and sectional elevation

INTRODUCTION TO FOOD TECHNOLOGY		L	T	P	C
23FTT101		2	0	0	2
COURSE OBJECTIVES:					
1. Develop the knowledge in the basic area of Food Chemistry such as the composition and properties of food and the chemical changes of nutrients during handling, processing, and storage.					
2. Effectively understand food processing and technology aspects in regard to preservation of foods.					
UNIT I	FOOD GROUPS AND FUNCTIONS				6
Food and its function, Physio-chemical properties of foods. Classification of Foods: Cereals and Pulses, Milk and Animal Products, Vegetables and Fruits, Oils, Fats, Nuts and Sugars. Food Pyramid. Food in Relation to Health. Population and Food Production: Populations Growth, Food Production. Food and the Future: Genetically Modified Foods and Organic Foods.					
UNIT II	CONCEPTS OF FOOD PREPARATION				6
Objectives of cooking, Preliminary Preparation, Methods of Cooking: Dry Heat, Moist Heat, Combination Methods. Microwave Cooking. Effect of Cooking on Nutritive Value: Changes in Proteins, Carbohydrates, Lipids, Vitamins and Minerals, Colour.					
UNIT III	UNIT OPERATIONS IN FOOD PROCESSING				6
Heat Exchange, Evaporation, Size Reduction, Sedimentation, Filtration, Centrifugation. Drying and Dehydration: Drying Rate, Changes during Drying, Methods of Drying, EMC. Concentration: Methods of Concentration.					
UNIT IV	PRESERVATION TECHNIQUES				6
Major Causes of Food Deterioration. Food Preservation, Types of Food Preservation: Traditional and Modern Methods. Principles of Food Preservation: Blanching, Pasteurization, Sterilization, Canning and Freezing. Enzymes: Control of Enzymes and Other Factors.					
UNIT V	ROLE OF TECHNOLOGIES				6
Role of Technologies: Principles of Pulsed Electric Field, Ohmic Heating, Dielectric Heating, Infrared Heating, Irradiation. Fermentation: Types of Fermenters, Benefits of Fermentation, Control of Fermentation in Food.					
TOTAL : 30 PERIODS					
TEXT BOOKS					
1.	Paul Singh R. and Dennis R. Heldman, -Introduction to Food Process Engineering, 5th Edition, Academic Press, USA,2014				
2.	James G Brennan – Food Processing Handbook 2nd Edition, Wiley VCH, Weinheim 2011				
REFERENCES					
1.	R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York,1989				

2.	Norman N. Potter and Joseph H. Hotchkiss. 1995. Food Science, 5th Ed. Chapman & Hall, NY, USA
3.	Gaurav Tewari and Vijay K. Juneja. 2007. Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA

COURSE OUTCOMES

At the end of the course students should be able to

CO 1: Gain Knowledge on Concepts of Food

CO 2: Brief Ideas on technologies of food processing.
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CO 3: Infer the concepts of food preparation

CO 4: Knowledge on Unit Operations involved in Food Processing

CO 5: Appraises the techniques of food preservation
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23GET104	TAMILS AND TECHNOLOGY				L	T	P	C
					1	0	0	1
UNIT I	WEAVING AND CERAMIC TECHNOLOGY						3	
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries								
UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY						3	
Designing and Structural construction House & Designs in house hold materials during Sangam Age Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram- Sculptures and Temples of Mamallapuram –Great Temples of Cholas and other worship places-Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - ChettiNadu Houses, Indo-Saracenic architecture at Madras during British Period.								
UNIT III	MANUFACTURING TECHNOLOGY						3	
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history-Minting of Coins–Beads making-industries Stone beads – Glass beads Terracotta beads-Shellbeads/bonebeats-Archeologicalevidences-Gemstonetypesdescribed in Silappathikaram.								
UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY						3	
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry- Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society								
UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING						3	
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.								
TOTAL : 30 PERIODS								
TEXT BOOKS								
1.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (In print)							
2.	Social Life of the Tamils -The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.							
REFERENCES								
1.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publishedby: International Institute of Tamil Studies).							
2.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: DepartmentofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)							
3.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)							
4	Studies in the History of India with Special Reference toTamil Nadu (Dr.K.K.Pillay) (Published by: The Author							
COURSE OUTCOMES								
At the end of the course students should be able to								

- CO 1:** Describe about weaving and ceramic technology during sangam age
CO 2: Display about the construction details of hindu temples
CO 3: Describe the art of ship building
CO 4: Explain about the agriculture and irrigation methods of ancient tamil people
CO 5: Summarize the scientific tamil and computing methods

23CHP101	CHEMISTRY LABORATORY (Common to All Branches)	L	T	P	C
		0	0	2	1
LIST OF EXPERIMENTS (ANY EIGHT) 30 hours					
1. Estimation of alkalinity of water sample by indicator method.					
2. Determination of hardness of water sample by EDTA method.					
3. Estimation of Dissolved oxygen in water sample by Winkler's method.					
4. Estimation of Chloride in water sample by Argentometric method.					
5. Estimation of copper in brass by EDTA method.					
6. Determination of strength of HCl and CH ₃ COOH present in a mixture conductometrically.					
7. Estimation of strength of iron by potentiometric titration.					
8. Determination of molecular weight of given polymer by Ostwald's viscometer.					
9. Determination of Strength of HCl by pH metry.					
10. Determination of corrosion rate of mild steel by weight loss method.					
Demo Experiments					
11. Synthesis of nanomaterials by chemical precipitation method.					
12. Estimation of strength of iron by spectrophotometry.					

L :0 T: 0 P: 30 T: 30 PERIODS

TEXT BOOKS	
1.	Department of Chemistry "Chemistry Laboratory Manual",2019
REFERENCE BOOKS	
1.	Vogel's "Text book of Quantitative Analysis", Jeffery G H,Basset J.Mentom J,Denney R.C.,6 th edition,EBS,2009.
COURSE OUTCOMES	
At the end of the course students should be able to	
CO1: Analyze the quality of water samples through basic techniques.	
CO2 Estimate the amount of metal ions in domestic and industrial waste water.	
CO3: Determine the absolute viscosity and molecular weight of Organic solvents.	
CO4: Interpret the corrosion rate of metals.	

23ITP101	PROGRAMMING IN C AND DATA STRUCTURES LABORATORY (Common to BME, ECE and All Non Circuit Branches)	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS	
1	Algorithms and Flow Chart i) Sequential ii) Branching and Looping
2	Operators & Expressions i) Arithmetic ii) Logical iii) Relational
3	Condition Statements i) Nested if else ii) Else-if Ladder
4	Looping i) For ii) While iii) Do-while
5	Functions i) With and without arguments ii) With and without return type iii) Call by value and Call by reference
6	Arrays i) Searching element in one dimensional array ii) Matrix multiplication
7	Structures
8	Pointers
9	Implementation of Stack ADT
10	Implementation of Queue ADT
11	Implementation of Tree Traversal
12	Implementation of Binary Search Tree ADT
P: 60	
TOTAL: 60 PERIODS	

HARDWARE / SOFTWARE REQUIRED (For a Batch of 30 Students)	
Hardware	<ul style="list-style-type: none"> • 30 PCs with Processor-2.0 GHz or Higher • RAM-1 GB or Higher • Hard disk-20 GB or Higher
Software	<ul style="list-style-type: none"> • TURBO C version 3 (or) GCC version 3.3.4 • OS-Windows2000/Windows XP/NT
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1: develop algorithm and draw flow chart to solve problem. CO 2: write simple programs using basic concepts and control statements in C language. CO 3: write programs using arrays, structures and pointers. CO 4: implement stack and queue data structure CO 5: implement binary search tree ADT	

23FTP101	INTERNSHIP -I	L	T	P	C
		-	-	-	1
<ol style="list-style-type: none"> The Internship is provided for the students to update themselves with the recent Technologies and professional skills for better prospects in the future. Internship in industry subjected to permissions from Government and concern Industry subject to the conditions of following the SOP issued by the concern and written consent of the student and parents. Student is supposed to produce joining letter and relieving letter once the internship is over in case of offline internship in any industry. Online internship in industry/ other agencies. Seminar by student under mentorship of a faculty. A detailed report shall be submitted based on his Internship and shall be done by only one student. A Mini Project- on some suitable topic related to the branch of study. It can be small fabrication / experimental results/ simulations / Programmes/ application development etc., depending on the branch of the student. Preferably a single student should do it. <p>Student has to prepare detailed report and submit to his / her college.</p> <ol style="list-style-type: none"> A copy of report can be kept in the departments for record. Each student must be assigned a faculty as a mentor from the college and an Industry expert as co-mentor. The evaluation of the work done by students will be carried by the internal and external examiner. External examiner will evaluate for 80marks and internal examiner will evaluate for 20 marks. The presentation by student in the presence of all students is desirable. Student should produce successful completion certificate in case of offline/online internship in industry 					
					2 Weeks

23HST103	INDIAN CONSTITUTION	L	T	P	C
	(Common to All B.E./B.Tech.Courses)	2	0	0	0
UNIT I	INTRODUCTION				6
Historical Background–Constituent Assembly of India–Philosophical foundations of the Indian Constitution–Preamble–Fundamental Rights–Directive Principles of State Policy–Fundamental Duties–Citizenship–Constitutional Remedies for citizens.					

UNIT II	STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT	6
Union Government– Structures of the Union Government and Functions– President–Vice President – Prime Minister– Cabinet –Parliament –Supreme Court of India –Judicial Review.		
UNIT III	STRUCTURE AND FUNCTION OF STATE GOVERNMENT	6
State Government–Structure and Functions– Governor–Chief Minister–Cabinet–State Legislature – Judicial System in States – High Courts and other Subordinate Courts.		
UNIT IV	CONSTITUTION FUNCTIONS	6
Indian Federal System–Center –State Relations–President’s Rule–Constitutional Amendments– Constitutional Functionaries – Assessment of working of the Parliamentary System in India.		
UNIT V	ELECTION COMMISSION	6
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.		
L :30	T: 0	P:0
T:30 PERIODS		
TEXT BOOKS		
1	DurgaDasBasu, “Introduction to the Constitution of India”, Prentice Hall of India, NewDelhi.	
2	R.C.Agarwal,“Indian Political System”, S.Chandand Company, New Delhi.(1997)	
REFERENCES		
1	Maciver and Page, “Society: An Introduction Analysis“, Mac Milan India Ltd., New Delhi.	
2	K.L.Sharma,“Social Stratification in India:Issues and Themes”, Jawaharlal Nehru University, NewDelhi. (1997)	
3	Sharma, BrijKishore,“Introduction to the Constitution of India”,Prentice Hall of India, NewDelhi.	
4	U.R.Gahai,“Indian Political System”, New Academic Publishing House, Jalaendhar.	
5	R.N.Sharma,“Indian Social Problems”,Media Promoters and Publishers Pvt.Ltd.	
COURSEOUTCOMES:		
Atthe end of the course students should be able to		
CO1	Understand the functions of the Indian government.	
CO2	Know the structure and functioning of central government.	
CO3	Understand functioning of Indian constituent.	
CO4	Analyze the functions of the Indian government	
CO5	Summarize the functioning of election commission.	

SEMESTER III

23MAT201	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
	(Common to AEROSPACE,AGRI,AUTO,BME,CIVIL,ECE,EEE,FT,MECH,MCT)	3	0	0	3
UNIT I	PARTIAL DIFFERENTIAL EQUATIONS				9
Formation of partial differential equations – Solutions of standard types of first order partial differential equations – Lagrange’s linear equation – Linear partial differential equations of second order with constant coefficients of homogeneous types – Applications.					
UNIT II	FOURIER SERIES				9
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.					
UNIT III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS				9
Classification of PDE – Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).					
UNIT IV	FOURIER TRANSFORMS				9
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.					
UNIT V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS				9
Z-transforms – Elementary properties – Initial and final value theorems – Inverse Z-transform using partial fraction and convolution theorem – Formation of difference equations – Solution of difference equations using Z - transforms.					
L : 45		T:0	P: 0	Total: 45 PERIODS	
TEXT BOOKS					
1.	Kreyszig.E, Advanced Engineering Mathematics, John Wiley and Sons, 10 th Edition, New Delhi 2016.				
2.	Grewal.B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44 th Edition, 2018.				
REFERENCES					
1.	Bali. N.P, Goyal. M. and Watkins. C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7 th Edition, 2009.				
2.	James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.				
3.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.				
4.	Wylie. R.C. and Barrett . L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.				
5.	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.				

COURSE OUTCOMES

At the end of the course students should be able to

CO1	Understand how to solve the given standard partial differential equations.
CO2	Solve differential equations using Fourier series analysis which plays a vital role in Engineering applications.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
CO4	Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some physical problems of engineering.
CO5	Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

23AGT203	THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
1. Impart knowledge on the basics and application of zeroth and first law of thermodynamics, second law of thermodynamics in analyzing the performance of thermal devices. 2. Teach the various properties of steam through steam tables and Mollier chart and impart knowledge on the macroscopic properties of ideal and real gases.					
UNIT I	BASIC CONCEPTS OF THERMODYNAMICS	9			
Thermodynamics and Energy – Systems – Types and properties - State and Equilibrium - Processes and Cycles – Forms of Energy – Temperature and Zeroth law of Thermodynamics – Pure substances – Phase change processes of pure substances – Property diagrams – Internal energy – Enthalpy – Energy transfer by Heat, Work and Mass – Applications.					
UNIT II	FIRST AND SECOND LAW OF THERMODYNAMICS	9			
First law of thermodynamics – Energy balance for closed systems and steady flow systems – Applications of First law of Thermodynamics – Energy balance for Unsteady flow processes Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility - Applications.					
UNIT III	HEAT ENGINES	9			
Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines - Boilers – Fire Tube Boiler & Water Tube Boilers , Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine , Turbine Components - Refrigeration Cycle – Vapour Compression & Vapour Absorption System ,Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.					
UNIT IV	GASES AND VAPOUR MIXTURES	9			
Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart - Properties of mixture of gases – Dalton’s law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.					
UNIT V	HEAT TRANSFER	9			
Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flowthrough Pipes – Radiation – Black Body, Grey Body Radiation					
		L : 45	T: 0	P: 0	Total: 45 PERIODS
TEXT BOOKS					
1.	Yunus A. Cengel and Michael A.Boles, “Thermodynamics: An Engineering Approach”,Fourth Edition, Tata McGraw-hill, 2004.				
2.	Michael J.Moran, Howard N.Shapiro, “Fundamentals of Engineering Thermodynamics”,Fourth Editon, John wiley & Sons, 2000.				
REFERENCES					

1.	R.K.Rajput, "A Text book of Engineering Thermodynamics", Third Edition, Laxmipublication (P) Ltd., 2007.
2.	Nag.P.K., "Engineering Thermodynamics", Third Edition, Tata McGraw hill, 2005.
3.	Domkundwar.S., C.P.Kothandaraman "A course in Thermal engineering", Fifth Edition,Dhanpat rai & co (p) Ltd, 2000.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Know about the basic concepts of thermodynamics
CO2	Understand the first and second law of thermodynamics and its applications
CO3	Know about the basics of Heat Engines
CO4	Understand the concepts of gases and vapour mixtures
CO5	Familiarise the modes of heat transfer

23FTT202	FLUID MECHANICS FOR FOOD TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. The mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
2. Applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.

UNIT I	PROPERTIES OF FLUIDS	9
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Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - Viscosity – Thermodynamic properties– compressibility and elasticity - surface tension- Dimensional analysis – Fundamental dimensions – dimensional homogeneity – Rayleigh’s method and Buckingham Pi-Theorem - concept of geometric, kinematic and dynamic similarity. Important non-dimensional numbers – Reynolds, Froude, Euler, Mach and Weber

UNIT II	PRESSURE MEASUREMENT	9
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Fluid pressure at a point- Hydro static forces on surfaces- Total pressure and centre of pressure- Application of Pascal’s law- Pressure variation in a fluid at rest-Absolute, Gauge, Atmospheric and vacuum pressures- Archimedes Principle- Buoyancy- Application in fluid foods- Measurement of pressure-Simple manometers- Differential manometers.

UNIT III	FLUID FLOW ANALYSIS	9
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Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Viscous Flow and Turbulent flow of fluids- Flow pattern – stream line – equipotential line – stream tube path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.

UNIT IV	FLOW MEASUREMENT	9
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Bernoulli's equation – applications - Venturimeter – orifice meter -pitot tube – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen- William’s formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line- Flow through parallel pipes- Flow through branched pipes-Power transmission through pipes- Water hammer in pipes- Flow through nozzles- Pipe network

UNIT V	PUMPS	9
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Pump terminology –suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves. Submersible pumps -Air lift pump - reciprocating pump - sludge pump and vacuum pump- Hydraulic ram.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1.	Bansal, R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines". 10th edition, Laxmi Publications, New Delhi, 2018. .
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2.	Modi, P.N. and Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”. 22 nd Edition, Standard Book House, New Delhi, 2017.
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REFERENCES

1.	S K Som, Gautam Biswas, S Chakraborty, “Introduction to Fluid Mechanics and Fluid Machines”. 3 rd edition, Tata McGraw Hill, 2017.
2.	Agarwal, S.K., “Fluid Mechanics and Machinery”, Tata Mc Graw Hill Co. New Delhi, 2006.
3.	McCabe W.L., Smith J.C., and Harriot P., “Unit Operations of Chemical Engineering”, 7 th Edition, McGraw Hill, New York, 2017.
4.	Michael A.M. Irrigation Theory and Practice, Vikas Publishing House, New Delhi, 2008.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Acquire knowledge properties of fluids
CO2	Know the various methods of pressure measurement
CO3	Identify the type of flow and its analysis
CO4	Analyze and calculate major and minor losses associated with pipe flow in piping networks.
CO5	Predict the performance of hydraulic pumps.

23FTT203	PROCESSING TECHNOLOGY OF CEREALS, LEGUMES AND OILSEEDS	L	T	P	C
		2	0	0	2
COURSE OBJECTIVES:					
1. To provide the basic understanding of cereals, oilseeds and pulses after harvesting. 2. To make students able to implement their knowledge about detailed manufacturing technologies of cereals, oilseeds and pulses consumed in daily life in food industries.					
UNIT I	INTRODUCTION	6			
Introduction to cereal grains, legumes and oilseeds: Structure and composition of cereal grains, legumes and oilseeds, Supply chain of food grains, Hydrothermal treatment of grains- cereal based fermented products, breakfast cereal foods -flaked, puffed, expanded, extruded and shredded products etc. Corn-milling (wet and dry), cornflakes. Barely-Milling, Malting, Processing of beer. Oats- Milling (oatmeal, oat flour & oat flakes). Sorghum, Pearl Millet, finger millet- Milling.					
UNIT II	RICE PROCESSING	6			
Paddy processing and rice milling; conventional milling; modern milling; milling operations, milling machines, milling efficiency. Quality characteristics influencing final milled products. Milling of rice types; huller mill, sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking, paddy separating, polishing and grading. Factors affecting rice yield during milling.					
UNIT III	WHEAT PROCESSING	6			
Wheat classification, Structure of wheat grain, Wheat milling soft and durum wheat processing - basic concepts, products and by-products, Flour milling, Turbo grinding and air-classification, Quality characteristics of flour and their suitability for baking.					
UNIT IV	PULSE MILLING	6			
Need for pulse milling -unit operations of pulse milling-domestic and commercial scale pulse milling methods - Dry and wet milling, Improved milling method. Pulse milling machineries dehusking in pulse pearler-splitting of pulse in pulse splitter-Mini dhal mill -working principle advantage and disadvantage-pulse milling efficiency-Grinding of split pulses-pulse flour products - their applications and equipments used. Cereal ban fractionation: Processing techniques for the recovery of functions components and their applications to the food industry.					
UNIT V	OIL SEED PROCESSING	6			
Oil seeds processing, Sesame, Coconut, Groundnut, Mustard, Soyabean, Sunflower, Safflower. Oil seeds extraction traditional methods, New Technologies in oil seed processing, Calculation of extraction efficiency, new technologies in oilseed processing, Modification of oil seed process. Hydrogenation, utilizations of oil seed meals of different food use. Desolventization and refining of oils; degumming, neutralization bleaching, filtration, deodorization.					
		T: 30	P: 0	Total: 30 PERIODS	

TEXT BOOKS	
1	Chakraverty A., "Post-Harvest Technology of Cereals, Pulses and Oil Seeds", 3rd Edition, Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, 2017.
2	Technology of Functional Cereal Products (Woodhead Publishing Series in Food Science, Technology and Nutrition)" by B R Hamaker
REFERENCES	
1	Chakrabarthy, M.M. (2003). Chemistry and Technology of Oils and Fats. Prentice Hall. ISBN 1-84127-331-7
2	Dendy, D.A.V., & Dobraszczyk, B.J. (2001). Cereal and Cereal Products. Aspen. ISBN 978-0- 8342-1767-6
3	Kay, D.E. (1979). Food Legumes. Tropical Products Institute. ISBN: 0859540855 9780859540858
4	Kent, N.L. (1994). Technology of Cereals. 4th Ed. Pergamon Press. ISBN: 9781855733619. eBook ISBN: 9781855736603
5	Hoseney, R.S. (1994). Principles of Cereal Science and Technology. 2nd Ed. AACC. ISBN: 978-1-891127-63-2
COURSE OUTCOMES	
At the end of the course student should be able to:	
CO1	Awareness about the structure, composition and processing of major cereals
CO2	Knowledge on milling and handling techniques of rice
CO3	Acquire the processing of wheat and its quality characteristics for baking purposes
CO4	Interpret on processing and milling of pulses
CO5	Analyze the new technologies in oilseed processing

23FTT204	BIOCHEMISTRY AND NUTRITION	L	T	P	C	
		2	0	0	2	
COURSE OBJECTIVES:						
1. Ensure students have a strong grounding in structures and reactions of biomolecules and Introduce them to metabolic pathway of the major biomolecules						
2. Enable the students to understand roles of each nutrients in growth and metabolism						
UNIT I	CARBOHYDRATES					6
Classification; Simple Sugars: mono and disaccharides, Hygroscopicity and solubility, optical rotation, mutarotation; Sweetness: structure-activity relationship and sweetness index; Dextrose Equivalent; Sugar alcohols; Oligosaccharides: structure and occurrence. Polysaccharides: Starch-amylose and amylopectin-properties. Cellulose. Pectins, gums and seaweeds – structure & properties. Dietary fibres - Food sources, functional role.						
UNIT II	LIPIDS					6
Fatty acids - classification. Lipids -, classification - simple and compound lipids, sterols. Food lipids and health. Physical properties of fats and oils: crystal formation, polymorphism, melting point, plasticity. Shortening power of fats, smoke point. Chemical properties of fats – Hydrolysis, saponification, halogenation. Hydrolytic rancidity and oxidative rancidity. Chemical constants.						
UNIT III	PROTEINS					6
Amino acids - Definition, structure and classification. Protein - classification and structural conformation, Food sources and biological role. Properties of proteins in food systems: solubility, hydration, foam formation & stabilization, gel formation, emulsifying effect. Denaturation.						
UNIT IV	METABOLISM OF NUCLEIC ACIDS, VITAMINS AND MINERALS					6
Nucleic acids; physicochemical and metabolic functions, metabolism – metabolism of purine and pyrimidine nucleotides. Metabolism of fat soluble and water soluble vitamins .Metabolism of micro and macro minerals.						
UNIT V	ENZYMES					6
Introduction, Nature, classification and nomenclature of enzymes. Mechanism of enzyme action; active site; Specificity. Enzyme kinetics – Michelis - Menten equation, Factors affecting enzyme action, Immobilization methods, selected application of enzymes in food Industries.						
		T: 30	P: 0	Total: 30 PERIODS		
TEXT BOOKS						
1	Satyanarayana U. and Chakrapani U., "Biochemistry", 5th Edition, Elsevier, New Delhi, 2017.					
2.	John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.					

REFERENCES	
1	Sadasivam, S and Manickam, A. 2009, Biochemical Methods, 3 rd Edn, New Age International.
2	Belitz H. D., Grosch W., and Schieberle P., “Food Chemistry”, 3rd Edition, Springer Verley, Berlin, 2008.
3	Jain J.L., Sunjay Jain and Nitin Jain, “Fundamentals of Biochemistry”, 7th Edition, S. Chand & Co., New Delhi, 2016.
4	Rastogi S.C., “Biochemistry”, 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
5	N Shakuntala Manay& M Shadaksaraswamy, Foods: Facts and Principles, Fifth edition, New Age International Publishers, 2023.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Appraises the structure and properties of carbohydrates
CO2	Interpret the structure and properties of lipids
CO3	Brief details on the structural and functional role of proteins
CO4	Knowledge on Metabolism of Nucleic acid, Vitamins and Minerals
CO5	Analyze and interpret the enzyme action and their immobilization

23GET275	VQAR-I	L	T	P	C
	(Common to All B.E./B.Tech.Courses)	2	0	0	2
UNIT I	QUANTITATIVE ABILITY I				8
Number theory- Shortcuts, Divisibility rule-Unit placed education –LCM & HCF, Square root and Cube Root, Decimal & Fraction Percentage, Profit, loss and discount, Simple and compound interest, Ratio & Proportions, Mixtures & Allegation, Partnership.					
UNIT II	QUANTITATIVE ABILITY II				6
Problems on Ages, Average, Clocks, Calendar, Data Interpretation-Bar chart-Piechart-Linechart-Tables chart.					
UNIT III	VERBAL REASONING I				7
Analytical reasoning–Linear and circular arrangement, Blood relation, Direction Problems, Puzzles. Logical reasoning - Number and Alpha series, Odd man out, Element series and Logical series, Coding and decoding, Analogy, Classification, Logical sequence of words.					
UNIT IV	LINGUISTICS SKILLS I				6
PartsofSpeech-Noun, Verb,Participle,Articles,Pronoun,Preposition,Adverb,Conjunction.Logical Sequence of words, Tense&Voice, Comparison.					
UNIT V	LINGUISTICS SKILLS II				3
Comprehension-Comprehend and understand paragraph, Paragraph writing.					
		L :30	T: 0	P:0	T: 30 PERIODS
TEXTBOOKS					
1	RajeshVarma,“Fast Track Objective Arithmetic”, Arihant Publications.				
2	M.K.Panday,“Analytical Reasoning”, Magical Series.				
3	BSSijwali-InduSijwali, ANewApproach to “Reasoning Verbal, Non-Verbal & Analytical”, Arihant Publications.				
4	John Eastwood,“Oxford Practice Grammar”, Oxford.				
REFERENCES					
1	R.V.Praveen, “Quantitative Aptitude and Reasoning” PHI Publication.				

2	R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited.
3	R.S.Agarwal, "A modern approach to Verbal & Non-verbal reasoning", S.Chand & Company Pvt Limited.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1	Apply the number system for solving application- orientated concepts in quantitative aptitude.
CO2	Apply the financial ability for solving application-orientated concepts in quantitative aptitude and in the data interpretation techniques.
CO3	Analyze the analytical reasoning and logical reasoning in verbal aptitude applications.
CO4	Apply appropriate grammar in both speaking and writing.
CO5	Analyze the given content and write a creative content.

23FTP201	COMPUTER AIDED DESIGN LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Introduction to modeling software: Practicing sketching, Dimensioning and Modelling Tools and Creating simple 3D models by using any CAD Modelling Software
2. Basic concept of simulation and CFD.
3. Create a two dimensional sketch diagrams of simple Food processing machine components
4. Programming and simulation for profile milling operations.
5. Create a three dimensional assembly model of Food processing machine components from detailed orthographic drawings
6. Create a three dimensional assembly model of gear box from detailed orthographic drawings
7. Create a three dimensional assembly model of Food processing machinery from detailed orthographic drawings
8. Create a three dimensional assembly model of valves from detailed orthographic drawings
9. Design and fabrication of a component using extrusion based additive manufacturing.
10. Create a three dimensional assembly model of simple energy conversion/power transmission system and animate its working using modeling software

L : 0 | T : 0 | P: 15 | Total:15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Draw two dimensional drawings of engineering components using standard CAD Modelling package
CO2	Develop a three dimensional assembly model consisting of many components with tolerances.
CO3	Generate animations from three dimensional assembly models by applying various motion constraints.

23ITP204	PROGRAMMING IN PYTHON (Common to All B.E/B.Tech Programme Except CSE, IT and AIML)	L	T	P	C
		0	0	4	2
LIST OF EXPERIMENTS					

1. Program for various base conversion functions.
2. Programs to demonstrate the usage of operators and conditional statements
3. Programs to demonstrate usage of control structures
4. Program using array operation
5. Programs to demonstrate the usage of String functions
6. Program using classes and functions
7. Program to implement recursive function.
8. Program to implement lambda function.
9. Program on file manipulation
10. Programs to demonstrate the usage of lists, sets, dictionaries and tuples.
11. Program to implement function template.
12. Program to implement class template

L: 0 T:0 P:60 TOTAL:60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Write simple programs using built-in data types of Python.
CO2	Apply the conditional statements and loops for solving problems.
CO3	Implement arrays, strings and functions in Python
CO4	Identify the commonly used operations involving lists, sets, dictionaries, tuples and file handling in real time applications.
CO5	Implement exemplary applications related to templates for solving real time problems.

23FTP202	MINI PROJECT - I	L	T	P	C
		0	0	2	1
Guidelines					

<ol style="list-style-type: none"> 1. The scope of the project work is to enable the students in convenient groups (not more than 4 members) involving theoretical and experimental studies through Design Thinking approach. 2. The aim of the project work is to deepen comprehension of principles by applying them to a new problem based on the courses such as Thermodynamics, Fluid Mechanics, Biochemistry and Nutrition, Processing Technology of Cereals, Legumes and Oilseeds and Python programming studied by the students in the current semester of study. 3. Project periods shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. 4. Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement the same. Analyze data, evaluate the results and conclude the appropriate solution, suggestion for future work. 5. The continuous assessment shall be made according to the regulation which is tabulated below. 6. The progress of the project is evaluated based on a minimum of two reviews. 7. The review committee may be constituted by the Head of the Department 8. Each student shall finally produce a comprehensive report covering background information, empathy, problem statement, project work details, result, conclusion and publications. 9. This final report shall be typewritten form as specified in the guidelines. 	L : 0	T: 0	P: 30	Total: 30 PERIODS
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SEMESTER IV

23MAT204	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	(Common to AEROSPACE,AGRI,AUTO,EEE,FT,MECH)	3	0	0	3
UNIT I	TESTING OF HYPOTHESIS				9
Sampling distributions – Tests for single mean, proportion and difference of means (large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.					
UNIT II	DESIGNS OF EXPERIMENTS				9
One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – Applications of ANOVA.					
UNIT III	SOLUTIONS OF EQUATIONS				9
Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting Gauss Jordan methods – Iterative methods of Gauss Jacobi and Gauss Seidal.					
UNIT IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION				9
Lagrange’s interpolation – Newton’s forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single integration using Trapezoidal and Simpson’s 1/3 rules.					
UNIT V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS				9
Single step methods: Taylor’s series method – Euler’s method – Modified Euler’s Method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods: Milne’s predictor-corrector methods for solving first order equations.					
L : 45		T : 0	P : 0	Total: 45 PERIODS	
TEXT BOOKS					
1.	Grewal, B.S., and Grewal, J.S., “Numerical methods in Engineering and Science”, Khanna Publishers, 10th Edition , New Delhi, 2015.				
2.	Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and statistics for Engineers”, Pearson Education Asia, 9th Edition, 2018.				
REFERENCES					
1.	Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., “Probability and Statistics for Engineers and Scientists”,9th Edition, Pearson Education, Asia, 2010.				
2.	Burden, R.L and Faires, J.D, "Numerical Analysis", 9 th Edition, Cengage Learning, 2016.				
3.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8 th Edition, 2014				
4.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7 th Edition, 2007.				
5.	Spiegel,M.R., Schiller, J. and Srinivasan,R.A., "Schaum’s Outlines on Probabilty and Statistics”, Tata McGraw Hill edition, 4th Edition, 2012.				

23FTT205	FOOD MICROBIOLOGY	L	T	P	C
		2	0	0	2
COURSE OBJECTIVES:					
1. The course aims to develop the knowledge of students in the basic area of Food Microbiology.					
2. This course will enable the students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.					
UNIT I	MICROORGANISMS IN FOOD				6
Introduction – Importance of microorganisms in food – primary sources of microorganisms in food – intrinsic and extrinsic parameters of food affecting microbial growth – types of microorganisms in foods like meats, poultry, seafood, vegetables, dairy products, fruits and vegetables.					
UNITII	MICROBIAL SPOILAGE AND ITS CONTROL				6
Microbial spoilage and its control: Types of food spoilage, Microbial spoilage of different types of foods– fruits and vegetables, meat and meat products, bakery products, dairy products, fermented foods and canned foods. Control of microorganisms: Physical agents, Chemical agents and their mode of action. Role of antibiotics. Case study on test to determine the presence of microorganism in various food industry					

UNIT III	INCIDENCE OF MICROORGANISMS	6
Incidence of Microorganisms: Primary sources of microbes in food, Parameters influencing the growth of microorganisms in food- Intrinsic and Extrinsic. Microbial Load assessment: SPC, MPN, DMC, Dye Reduction test, ATP measurement. Immunological methods: PCR, Fluorescent Antibody, ELISA.		
UNIT IV	FERMENTED AND MICROBIAL FOODS	6
Food Fermentations- Role and importance of microorganism in food fermentation– Lactic acid Bacteria and their fermentation products- Fermented Dairy products- Yoghurt, Cheese - Starter cultures in fermentation and their importance. Vegetable Fermentation- sauerkraut and pickle products . Yeast based and other fermentations – Bread, Beer and Wine; Fermented Cereal Products. Probiotics- Characteristic features of probiotic microorganism- prebiotics for symbiotic foods formulation.		
UNIT V	FOOD BORNE DISEASES	6
Food borne infections and intoxication – food poisoning – botulism – salmonellosis – gastroenteritis, food borne pathogens – Clostridium, Bacillus cereus, Staphylococcus aureus, Vibrio, Campylobacter, Yersinia etc., Viruses – food borne illness- Bacteriophages in the Dairy Industry- Beneficial uses of Viruses.		
		L:30 T: 0 P: 0 Total: 30 PERIODS
TEXT BOOKS		
1	James M. Jay, Martin J. Loessner, David A. Golden, “Modern Food Microbiology”, 4th Edition, Springer Netherlands,	
2	Frazier W.C., Westhoff D.C. and Vanitha N.M., “Food Microbiology”, 5th Edition, Tata McGraw Hill, New Delhi, 2014- Unit	
REFERENCES		
1	Adams, M.R and M.O.Moss. 2000. Food Microbiology. Panima Publishing Corporation, New Delhi/Bangalore	
2	Monteville, T.J. K.R.Mathews and K.E.Kniel 2012. Food microbiology -An Introduction-. ASM press Washington, DC	
3	Banwart, G.J., Basic Food Microbiology, 2nd Edition. CBS Publishers, 1998.	
4	Vijaya Ramesh. Food Microbiology. MJP Publishers, Chennai, 2007.	
5	Khetarpaul, Neelam. Food Microbiology, Daya Publishing House, 2006.	
COURSE OUTCOMES		
At the end of the course student should be able to:		
CO1	Knowledge on Microorganism present in Foods	
CO2	Outline on Microbial spoilage in food and its control	
CO3	Techniques involved in identification of various microorganism	
CO4	Interpret Various Fermented Foods	
CO5	Brief Details on Food Borne Disease.	

23FTT206	FOOD PROCESSING AND PRESERVATION	L	T	P	C
		2	0	0	2
COURSE OBJECTIVES:					
1. To expose the students to the principles and different methods of food processing and preservation.					
2. Understand the operations and features of different non-thermal processing techniques and applying to improve the shelf life of product.					
UNIT I	FOOD AND ITS PRESERVATION	6			
General principles of preservation, classification of methods used for preservation, need and importance of preservation at domestic and large scale, Causes of food spoilage; Nature of harvested crop, plant and animal – moisture, pH and water activity of foods.					
UNIT II	PROCESSING AND PRESERVATION OF FOODS BY CHEMICALS	6			
Food preservation by sugar, salt, acid - Principles - mechanism- antimicrobial activity. Preservation by chemicals- type of chemical preservatives- sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc.					
UNIT III	NON THERMAL PROCESSING	6			
Food Irradiation - High Pressure Processing- Pulsed electric field processing, pulsed light treatment and Ultrasound - Theory and Principles - effect on microorganisms- Application in Processing of foods.					
UNIT IV	LOW TEMPERATURE METHODS	6			

Principles of refrigerated gas storage of foods, Gas packed refrigerated dough, Sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers.					
UNIT V	CANNING, RETORT PROCESING, CONCENTRATION				6
Principles of canning and bottling of foods; Types and classification of foods used for canning; spoilage of canned and bottled foods, storage of canned foods; Influence of canning on the quality of food; retort pouch processing. Drying – Traditional and modern methods of drying, types of driers, influence of drying on pigments and enzymes.					
			L:30	T:0	P:0
Total: 30 PERIODS					
TEXT BOOKS					
1	Subbulakshmi, G., and Shobha A. Udipi “Food Processing and Preservation”.New Age Publications, 2006.				
2	HUI, Y.H. “Handbook of Vegetable Preservation and Processing”. Marcel Dekker, 2003.				
REFERENCES					
1	Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge,2003.				
2	Dennis R. Håldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.				
3	Gould, G.W. “New Methods in Food Preservation”. Springer,1995.				
4	Dunne, Daniel F.Farkas and James T.C.Yuan. Non thermal processing Technologies for food, IFT Press, 2011.				
5	Gustavo V. B3arbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press, 1st Edition, 2004.				
COURSE OUTCOME					
At the end of the course student should be able to:					
CO1	To understand the principles of food preservation.				
CO2	To expose the students to the processing and different methods of food preservation.				
CO3	Understand the operations and features of different non-thermal processing techniques and applying to improve the shelf life of product				
CO4	Changes during storage and preservation o Effect of enzymes on spoilage reactions of foods				
CO5	To understand the role of different methods of preservation on different foods.				

23FTT207	REFRIGERATION AND COLD CHAIN				L	T	P	C
		2	0	0	2			
COURSE OBJECTIVES:								
<ol style="list-style-type: none"> To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components. To provide knowledge on design aspects of cold storage systems. 								
UNIT I	REFRIGERATION SYSTEMS						6	
Refrigeration cycle – Vapour Compression and Vapour Absorption cycles. P-V and T – s and p – h diagram. Ton of refrigeration, coefficient of performance. Components of a Refrigeration system – compressor, condenser, evaporator and piping system. Refrigerants – primary and secondary refrigerants, characteristics of different refrigerants and net refrigerating effect.								
UNIT II	AIR CONDITIONING						6	
Psychrometry of air conditioning, Selection of air conditioning system, Transmission of air in air conditioning ducts, Design of air conditioning ducts, Space air distribution, Ventilation for cooling. Air cycle refrigeration Application of refrigeration and air conditioning								
UNIT III	CHILLING AND FREEZING OF FOODS						6	
Evaporative cooling and direct expansion techniques in chilling. Chilling equipment for liquid foods. Secondary refrigerants. Chilled foods transport and retail cabinets – Basics of Chilled foods microbiology, Packaging of Chilled foods. Freezing Curve, Freezing rates, crystal size and its effect on texture and quality of foods. Freezing practice as applied to different food sectors								
UNIT IV	COLD STORAGE						6	

Cold storage – Design and Construction. Cold load estimation. Properties of insulating materials, air diffusion equipment, Doors and other openings. Prefabricated systems, walk-in-coolers, and refrigerated container trucks. Cold Storage practice – Stacking and handling of material. Optimum temperatures of storage for different food materials.						
UNIT V	COLD SUPPLY CHAIN MANAGEMENT					
Cold Chain – Introduction, Components of cold chain. Refrigerated distribution and transport systems, Cold chain in retail, Traceability and barcode – Application of RFID in cold chain. Product Temperature and Moisture monitoring.						
			L: 30	T: 0	P: 0	Total: 30 PERIODS
TEXT BOOK						
1	R.K. Rajput, “Thermal Engineering”, 10 th edition, Laxmi Publications, 2018, ISBN-13: 978- 8131808047					
2	C.P. Arora, “Refrigeration and Air conditioning”, 3 rd Edition, Tata McGraw Hill, 2013. ISBN: 9780074630105					
REFERENCES						
1	Da-Wen Sun, “Handbook of Frozen Food Processing and Packaging”, 2 nd Edition, CRC Press, 2011. ISBN: 9781439836040.					
2	Colin Dennis and Michael Stringer: “Chilled Foods – A Comprehensive Guide”, 2 nd Edition. CRC Press, 2000. ISBN: 9780849308567					
3	Arora and Domkundwar. (2002). A course in Refrigeration and Air Conditioning. Dhanpat Rai & Sons. New Delhi					
4	Roy J. Dossat and T.J. Horan (2002) Principles of refrigeration, , John Wiley & Sons – Prentice Hall Publication, New Jersey					
5	Arora C.P (2008) Refrigeration and Air conditioning. Tata McGraw Hill Publication, New Delhi					
COURSE OUTCOMES						
At the end of the course student should be able to:						
CO1	Recognize the principle of refrigeration and various refrigeration cycles.					
CO2	Calculate the thermal load for the air conditioning system.					
CO3	Analyze freezing and its effect on the texture of food					
CO4	Predict the problems encountered in chilling of foods					
CO5	Design cold supply chain management systems for food sector.					

23GET276	VQAR-II	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	2	0	0	2
UNIT I	QUANTITATIVE ABILITY III				6
Time, speed & distance- Average speed- Relative speed- Train problems- Boats and streams- Races, Chain rule, Time and work – Pipes and cisterns					
UNIT II	QUANTITATIVE ABILITY IV				4
Permutation & Combination, Probability, Mensuration					
UNIT III	VERBAL REASONING II				7
Machine Input and Output, Coded Inequalities, syllogisms, Problems on Cubes, Data sufficiency. Critical Reasoning – Statement and Argument, Statement and Assumption, Statement and Conclusion, Cause and effect, Course of action.					
UNIT IV	NON- VERBAL REASONING				5
Figure series, Odd man out, Mirror Image, Water image, Embedded Image, Cubes and Dices, Insert the Missing Characters, Analytical reasoning.					

UNIT V	LINGUISTICS SKILLS III	8			
Sentences – Simple, Compound, Complex & Mixed sentences, Sentence Rearrangement, Idioms & Phrases, Reading Comprehension at higher level, Word Substitution, Synonyms & Antonyms, Error Spotting.					
		L :30	T: 0	P: 0	T: 30 PERIODS
TEXT BOOKS					
1	Rajesh Varma, “Fast Track Objective Arithmetic”, Arihant Publications.				
2	M.K.Panday, “Analytical Reasoning”, MagicalSeries.				
3	BS Sijwali- Indu Sijwali, A New Approach to “Reasoning Verbal, Non-Verbal & Analytical”, Arihant Publications.				
4	S.P.Bakshi, “Objective English” Arihant Publications.				
REFERENCES					
1	R.V.Praveen, “Quantitative Aptitude and Reasoning” PHI Publication.				
2	R.S.Agarwal, “Quantitative Aptitude for Competitive Examinations”,S.Chand & Company Pvt Limited.				
3	R.S.Agarwal, “A modern approach to Verbal & Non-verbal reasoning”, S.Chand & Company PvtLimited.				
COURSE OUTCOMES :					
At the end of the course students should be able to					
CO1	Learn the time and distance for solving application orientated concepts in quantitative aptitude				
CO2	Apply the financial ability for solving application orientated concepts in quantitative aptitude				
CO3	Analyze the verbal reasoning and the critical reasoning in quantitative aptitude.				
CO4	Analyze the non-verbal reasoning in verbal aptitude applications				
CO5	Apply appropriate LSRW skills				

23CST205	OBJECT ORIENTED PROGRAMMING USING JAVA	L	T	P	C
		3	0	0	3
UNIT I	INTRODUCTION TO OOP				9
Object Oriented Programming concepts–Objects–Classes–Inheritance– polymorphism – Abstraction– Encapsulation, Features of Java, Byte code and Java Virtual Machine, JDK					
UNIT II	INTRODUCTION TO JAVA				9
Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.					
UNIT III	OBJECTS AND CLASS				9
Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference.					
UNIT IV	INHERITANCE AND POLYMORPHISM				9
Inheritance- Super class – Sub class – protected members – constructors in sub class – Overriding –Abstract class- Final methods and classes, Interfaces, Packages.					
UNIT V	MULTI THREADING IN JAVA				9
Multithreading – Thread life cycle and methods, Thread Creation, Thread synchronization, Inter-thread communication,Exception handling with try-catch-finally					
		T:45	P: 0	J: 0	Total: 45 PERIODS
TEXT BOOKS					
1	Herbert Schildt, “Java: The Complete Reference”, 11 th Edition, McGraw Hill Education, New Delhi, 2019.				
REFERENCES					
1	Cay S. Horstmann, “Core Java Fundamentals”, Volume 1, 11 th Edition, Prentice Hall, 2018.				
COURSE OUTCOMES					
At the end of the course student should be able to:					

CO1	Understand the basic concepts of OOP
CO2	Adapt control structures and looping in solving problems
CO3	Apply the concepts of classes and objects in real time applications
CO4	Develop programs using inheritance, packages and interfaces
CO5	Make use of exception handling mechanisms and multithreaded model to solve real world problems

23FTB201	UNIT OPERATIONS IN FOOD PROCESS ENGINEERING	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To provide fundamental knowledge of unit operations and their applications in food processing systems. To develop the ability to design, analyze, and optimize food processing operations for improved product quality and efficiency. 					
UNIT I	INTRODUCTION TO UNIT OPERATIONS IN FOOD PROCESSING	6 + 3			
Overview of unit operations and their significance in food processing. Conservation of mass and energy principles. Dimensions, units, and dimensional analysis. Material and energy balances in food processing systems. Fluid Flow theory - Bernoulli's Equation.					
Lab Experiments:					
1. Experiment on material balance on a Simple Drying Operation					
UNIT II	MECHANICAL OPERATIONS IN FOOD INDUSTRY	6+9			
Size reduction: Principles, Rittinger's, Bond's and Kick's laws for crushing, equipments - crushers, grinding mill, pulverizes, milling / attrition mills, cutting machines. Mixing: Types of mixers for dry, wet and gas, Kneading and agitation. Mechanical separations: Filtration, sedimentation, centrifugation, cyclone separation and sieving.					
Lab Experiments:					
1. Determination of particle size of granular foods by sieve analysis.					
2. Experiment on analysis of particle size distribution using hammer mill, pin mill and ball mill.					
3. Efficiency of separation using centrifuge					
UNIT III	THERMAL PROCESSING EQUIPMENTS	6+6			
Heat transfer mechanisms: Conduction, convection, and radiation. Types, Design and operation of heat exchangers in food processing. Evaporation: Principles of evaporation, Types - single and multiple effect evaporators, Natural and Forced circulation evaporators, Fouling of evaporators and heat exchangers					
Lab Experiments:					
1. Study on performance evaluation of single effect evaporator.					
2. Experiment on the effect of temperature, surface area, and airflow in the rate of evaporation					
UNIT IV	MASS TRANSFER OPERATIONS IN FOOD INDUSTRY	6+6			
Distillation: Principles, types and applications. Extraction: Solid-liquid and liquid-liquid extraction techniques and equipment. Drying: Mechanisms, drying curves, and types of dryers used in the food industry					
Lab Experiments:					
1. Determination of rate of extraction of oil from using soxhlet apparatus.					
2. Experiment on drying characteristics of grains using tray dryer					
UNIT V	ADVANCED SEPARATION PROCESSES	6+6			
Membrane separation processes: Microfiltration, ultra-filtration, nano-filtration, and reverse osmosis. Crystallization: Principles, nucleation, crystal growth, and industrial crystallizers. Adsorption and ion exchange: Fundamentals and applications in food processing.					
Lab Experiments:					
1. Study on leaf filter equipment					
2. Visit a sugar industry and share your insight					
		L:45	T:0	P: 0	Total: 45 Periods

TEXT BOOKS	
T1	Zeki Berk. "Food Process Engineering and Technology." Elsevier/Academic Press, Amsterdam, 2009
T2	Albert Ibarz, Gustavo V. Barbosa-Canovas. "Unit Operations in Food Engineering". 1 st Edition, CARC Press, 2002
REFERENCES	
R1	"Food Processing Technology: Principles and Practice". 4th ed., Woodhead Publishing, 2016.
R2	Transport Processes and Separation Process Principles. 5th ed., Pearson, 2018.
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1	Understand the principles of unit operations and apply material and energy balances to food processing systems.
CO 2	Analyze and select appropriate equipment for size reduction, mixing, and mechanical separation in food processing.
CO 3	Analyze heat transfer mechanisms and optimize thermal processes.
CO 4	Apply the principles of mass transfer to operations such as distillation, extraction, and drying in food processing.
CO 5	Explore advanced separation technologies, including membrane processes and crystallization, for innovative food processing applications

23FTP203	FOOD MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5
LIST OF EXPERIMENTS					
<ol style="list-style-type: none"> 1. Study experiments on microbiology lab equipments and safety practices 2. Identification of microorganisms by Simple staining technique 3. Identification of microorganisms by Gram staining technique 4. Preparation of different culture media and microbial isolation using serial dilution technique 5. Cultivation and enumeration of microorganisms using different plating method(Pour/Spread/Streak) 6. Enumeration of microorganisms in spoiled bakery and confectionery products 7. Enumeration of microorganisms in spoiled Milk and Milk Products 8. Enumeration of microorganisms in spoiled Meat and Meat Products 9. Assessing the load of coliform bacteria as an indicator microorganism using MPN method 10. Sauerkraut fermentation 11. Preparation of Wine 12. Study on Microscope working principle 					
		L : 0	T : 0	P: 23	Total:23 PERIODS
COURSE OUTCOMES					
At the end of the course student should be able to:					
CO1	Knowledge on Various equipment's of microbiology lab				
CO2	Identification of Microorganisms through various techniques				
CO3	Able to Enumerated various microorganism from different food material and preparation of fermented foods.				

23CSP205	OBJECT ORIENTED PROGRAMMING USING JAVA LABORATORY			L	T	P	C
		0	0	3	1.5		
LIST OF EXPERIMENTS							
<ol style="list-style-type: none"> 1. Solving programs with I/O Statements 2. Solving programs using Data types, variables and Operators 3. Solving problems using Control structures 4. Solving problems using arrays 5. Programs using class, methods and objects using overloading 6. Programs using class and constructors 7. Programs employing inheritance 8. Programs employing Polymorphism 9. Programs employing Abstract Class 10. Solving problems using the concept of Exception Handling 11. Solving problems using the concept of Multithreading 							
HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS							
Hardware							
<ul style="list-style-type: none"> ▪ LANSystemwith33 nodes (OR) Standalone PCs–33 Nos. ▪ Printers– 3 Nos. 							
Software							
<ul style="list-style-type: none"> ▪ Java/J2SECompiler,NetBeans 							
L : 0		T: 0		P: 45		Total:45 PERIODS	
COURSE OUTCOMES							
At the end of the course student should be able to:							
CO1	Solve simple problems using data types, variables, operators in Java.						
CO2	Discover the use of control structures and Looping using classes and methods.						
CO3	Infer the use constructors in solving real time applications						
CO4	Apply the concepts of inheritance, polymorphism and packages to solve real world problems.						
CO5	Develop applications using the concept of threads and exceptions.						

23GEP275	PERSONAL BRANDING (PRACTICAL)			L	T	P	C
	0	0	4	2			
UNIT-I	SELF-AWARENESS & PERSONAL DEVELOPMENT						
Self-Awareness: Key Areas -Personality, Values, Habits, Needs & Emotions, Impact of Self-Awareness on Personal Development Personality –Definition, Elements, Determinants, Needs and Benefits, Personality traits. Personality development skills, Positive traits for effective people, SWOT :Analyzing Strength and weakness (SWOT), Building Esteem & Self-Confidence, Working on attitudes (aggressive, assertive, submissive), Self-Motivation							
UNIT-II	BODY LANGUAGE						
Body Language and Gestures, Personal Grooming, Personal Hygiene, Social Effectiveness, Business Etiquette							

UNIT-III	INTERVIEW AND LEADERSHIP SKILLS
Resume Building, Video Resume, Leadership Styles, Leadership Traits, Group Dynamics- Conflict management	
UNIT-IV	SOCIAL IMAGE TRAITS
Social etiquettes -Positive Social Image, Social Graces, Online Etiquettes, Dining Etiquettes, Voice Modulation, – Networking: Case Study and Company website references.	
UNIT-V	PERSONALITY TEST
Big Five Personality Test, <u>Open DISC Assessment Test.</u>	

TEXT BOOKS	
1	Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
2	Stephen P. Robbins and Timothy A. Judge (2014), Organizational Behavior 16th Edition: Prentice Hall.
REFERENCES	
1	Smith, B. Body Language. Delhi: Rohan Book Company. 2004
2	Personality Development and Career management: By R.M.Onkar (S Chand Publications)

Practical-60 Hours, Total 60 Hours

List of Exercises	
1	Swot Analysis
2	Grooming, Dressing and Photo-shoot
3	Body Language, Handshaking
4	Art of Storytelling, Marketing & selling yourself
5	Self-Discipline: Goal setting (Qualitative and Quantitative)
6	Teamwork & Leadership Activity
7	Dealing with Pressure, Failure & Decision Making
8	Psychological/Personality test
9	Video Resume
10	Business Card creation
11	Social Profiling in FB/Insta/Linked In/Personal Website
12	Online Interview
13	Speed Interview
14	Networking Event-Online/Offline

23FTP204	INTERNSHIP - II	L	T	P	C
		0	0	4	2
<ol style="list-style-type: none"> 1. The Internship is provided for the students to update themselves with the recent Technologies and professional skills for better prospects in the future. 2. Internship in industry subjected to permissions from Government and concern Industry subject to the conditions of following the SOP issued by the concern and written consent of the student and parents. 3. Student is supposed to produce joining letter and relieving letter once the internship is over in case of offline internship in any industry. 4. Online internship in industry / other agencies. 5. Seminar by student under mentorship of a faculty. 6. A detailed report shall be submitted based on his Internship and shall be done by only one student. 7. A Mini Project- on some suitable topic related to the branch of study. It can be small fabrication / experimental results/ simulations / Programmes/ application development etc., depending on the branch of the student. Preferably a single student should do it. <p>Student has to prepare detailed report and submit to his/her college.</p> <ol style="list-style-type: none"> 8. A copy of report can be kept in the departments for record. 9. Each student must be assigned a faculty as a mentor from the college and an Industry expert as co-mentor. 10. The evaluation of the work done by students will be carried by the internal and external examiner. 11. External examiner will evaluate for 80 marks and internal examiner will evaluate for 20 marks. 12. The presentation by student in the presence of all students is desirable. 13. Student should produce successful completion certificate in case of offline / online internship in industry 					
					2 Weeks

SEMESTER V

23FTT301	FRUIT AND VEGETABLE PROCESSING TECHNOLOGY	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To help the students to learn about the physiology, pre-processing, postharvest storage and various products of fruits and vegetables • Learn the classification of fruits and vegetables and their nutritional composition, along with the physiological and biochemical changes occurring during pre - harvest and post-harvest stages 					
UNIT I	PHYSIOLOGY AND PRE-PROCESSING OF FRUITS AND VEGETABLES				9
Scope of Fruits and Vegetables Processing Industry in India and World- present status – constraints - prospects Classification of fruits and vegetables. Composition and nutrition aspects. Pre harvest and post-harvest changes. Concept of maturity indices- Factors leading to deterioration of fruits and vegetables. Methods to reduce post-harvest losses. Pre-processing of fruits and vegetables: Precooling, Cleaning, washing, sorting, grading peeling, blanching.					
UNIT II	POSTHARVEST PROCESSING AND STORAGE				9
Ambient conditions. Application of refrigeration and freezing concept in post-harvest storage, Freezing methods-Air Blast Freezer, Immersion Freezer, Cryogenic Freezer. Hypobaric Storage, CAS. Irradiation, Waxing. Trends in Packaging fresh produce-MAP, Inert and Vacuum Packaging. Concentration-freeze drying –osmotic dehydration, brining, syrumping, canning, Case studies related to modern storage practices.					
UNIT III	PROCESSING TECHNOLOGY OF FRUITS AND FRUIT BEVERAGES				9
Unit operations involved in Juice preparation-equipments-screw type juice extractor, pulper, pressing, Rack and cloth press, Hydraulic Press, Filters, clarification and concentration by membranes. Classification of fruit juices- Squash, cordial, nectar, RTS. IMF products -Jam, Jelly, marmalade, candied preserves.					
UNIT IV	PROCESSING TECHNOLOGY OF VEGETABLE PRODUCTS				9
Preparation and processing parameters of vegetable wafers, soup powders, pulp, puree, pastes, sauces, ketchups, chutneys. Preparation of various types of pickles. Dehydrated vegetable and leafy products. Processing parameters of mushroom and baby corn. Crystallized fruit, glazed fruit, fruit toffee, fruit powders, fruit leather and tutti-frutti.					
UNIT V	HURDLE TECHNOLOGY, MINIMALLY PROCESSED FRUITS AND VEGETABLES, EDIBLE COATING:				9
Types of hurdle, aspects of hurdle technology, stress- effect on fresh produce, shelf stable products. Factors affecting the shelf life and the quality of the minimally processed fruits and vegetables, physiology and biochemistry of the fresh cut fruits and vegetables. Processing, quality parameters and biochemical changes in the final quality of the fresh produce, concepts of nanotechnology for fresh produces.					
		L: 45	T: 0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	Srivastava R.P & Sanjeev Kumar, "Fruit and Vegetable Preservation: Principles and Practices", 3rd Edition, CBS Publishers & Distributors, New Delhi, 2014.				
T2	S. Rajarathnam and R.S. Ramteke. "Advances in Preservation and Processing Technologies of Fruits and Vegetables", 1st Edition, New India Publishing Agency, New Delhi, 2011.				

REFERENCES	
R1	Chavan U.D. and Patil J.V., “Industrial Processing of Fruits and Vegetables”, 1st Edition, Astral International Pvt. Ltd., New Delhi, 2013.
R2	Fellows, P J. “Food Processing Technology: Principles and Practice”. 2nd Edition, CRC/Woodhead, 1997.
R3	Kahramanoglu. İ., <i>Postharvest Physiology and Handling of Horticultural Crops</i> (1st ed.). (Ed.). CRC Press. 2023
R4	Kumar, P., & Sharma, S.). <i>Recent Advances in Postharvest Technologies</i> (Vol. 1). Springer.2023.
R5	Kahramanoglu, İ. <i>Sustainable Postharvest Technologies for Fruits and Vegetables</i> . CRC Press. 2023.
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1	Interpret physiological and biochemical changes in fruits and vegetables
CO 2	Select suitable storage and preservation techniques for fruits and vegetables
CO 3	Apply different technology to process fruits into different fruit products
CO 4	Make use of techniques to process different vegetable products and other speciality products
CO 5	Interpret techniques involved in hurdle technology and minimal processing

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1								1			3	1
CO2	3	2	2			2				1			3	2
CO3	3	2	1	1						1			3	1
CO4	3	1	1	1						1			3	1
CO5	3	1	3			2				1			3	2

23FTT302	HEAT AND MASS TRANSFER FOR FOOD PRODUCTS			L	T	P	C
				2	0	0	2
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> Preamble the course enables the students to study the phenomena of modes of heat transfer, heat exchangers, and its application in food processing operations. This course provides an insight to the diffusion process and mechanisms of mass transfer. 							
UNIT I	HEAT TRANSFER OPERATIONS AND CONDUCTIONS						6
Introduction to Heat transfer Operations: Introduction, Modes of Heat Transfer, role in food processing operations. Conduction: Fourier's law of heat conduction - One dimensional steady state heat conduction equation for flat plate, composite wall, hollow cylinder, composite cylinder.							
UNIT II	CONVECTION:						6
Natural and forced convection– Application of dimensional analysis for convection - Equations for forced and natural convection under laminar, transition and turbulent conditions. Individual and overall heat transfer coefficients and its relationship between them. Unsteady state heat transfer.							
UNIT III	RADIATION						6
Black body concept - Radiation Properties–Stefan Boltzmann’s law, emissivity and absorptivity. Concept of grey body – radiation between non-black surfaces –parallel planes, radiation shields.							
UNIT IV	HEAT EXCHANGERS						6
Parallel and counter flow heat exchangers - LMTD - Heat exchangers effectiveness; number of transfer unit – use of correction factor charts - Fouling factor. Types of heat exchanger- working principles and applications: Single pass, multi pass heat exchangers, shell and tube heat exchanger, plate heat exchangers.							
UNIT V	MASS TRANSFER OPERATIONS AND DIFFUSION						6
Introduction to Mass Transfer Operations: Introduction, Classification and role of mass transfer operations in food processing. Diffusion: Ficks law of diffusion. Steady state molecular and eddy diffusion in gases and liquids. Measurement and prediction of diffusivity of gas and liquids, diffusion in solids.							
				L:30	T:0	P: 0	Total: 30 Periods
TEXT BOOKS							
T1	Gavhane K.A., “Heat Transfer SI Units”, 13th Edition, Nirali Prakashan Publications, Pune, 2012						
T2	Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007						
REFERENCES							
R1	Holman J. P., Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009						
R2	Kothandaraman C. P. and Subramanyan S., Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014						
R3	Gangawane, A. K., & Dwivedi, D. Advanced Computational Techniques for Heat and Mass Transfer in Food Processing. CRC Press.2023.						
R4	Anandharamakrishnan, C., & Subramanian, P. (Eds.). Industrial Application of Functional Foods, Ingredients and Nutraceuticals: Extraction, Processing and Formulation of Bioactive Compounds. Academic Press.2023.						
R5	Anandharamakrishnan, C., Sinija, V. R., & Mahendran, R. (Eds.). <i>Non-Thermal Technologies for the Food Industry: Advances and Regulations</i> . CRC Press.2023.						
COURSE OUTCOMES							
At the end of the course students should be able to							
CO 1	Outline the concept of heat conduction						
CO 2	Make use of equations for calculating convective heat transfer coefficients						

CO 3	Apply the concepts of radiation to solve heat transfer problems
CO 4	Select a suitable heat exchanger and analyze the performance
CO 5	Classify, explain and model the diffusion in gas, liquid and solid

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	1					1	1	2	1	
CO2	3	3	1	2	2					1		2	1	
CO3	3	3	1	2	1					1	1	1	1	
CO4	3	3	2	2	2	1	1	1	1	1		3	2	
CO5	3	3	2	2	2	1	1	1	1	1		3	2	

23FTT303	PROCESSING TECHNOLOGY OF MEAT AND POULTRY PRODUCTS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To Understand and Apply Preservation Technologies for Meat and Poultry To Implement Food Safety Systems and Quality Control in Meat Processing: 					
UNIT I	FUNDAMENTALS OF MEAT AND POULTRY PROCESSING				9
Types of meat and poultry. Post-mortem changes, Enzymatic activities, structure of muscle proteins, Function of Collagen and elastin, Effect of aging- Dry and wet Aging. Meat and Poultry Slaughtering Systems - Stunning techniques, Exsanguination, Carcass grading and dressing, Poultry dressing. Poultry and meat cuts. Plant based Meat. Microbiological and Hygienic Considerations - Microbial flora, Surface vs. deep tissue contamination, antimicrobial treatments.					
UNIT II	PRESERVATION TECHNOLOGIES FOR MEAT AND POULTRY				9
Chilling and Freezing - Chilling mechanisms, Freezing kinetics: rate on ice crystal formation, texture, and water-holding capacity (WHC), Cryoprotectants, Storage technologies. Drying - Drying kinetics: Drying types. Smoking techniques - Cold and hot smoking, Curing - action of salt, sodium nitrite/nitrate. Fermentation - Biochemical processes in fermented meat products, starter cultures. Preservation methods of egg – Wet immersion method, Dry method, Thermization and refrigeration.					
UNIT III	PROCESSED MEAT AND POULTRY PRODUCTS DEVELOPMENT				9
Emulsion-Based Products: Role of muscle proteins and fat in the formation of emulsions; shear force, gelation, and binding properties. Sausage types: Emulsified (hot dogs, bologna), coarse (salami), and semi-dry fermented sausages, Binder and filler materials of sausages. Value-Added Meat and Poultry Products - Ready-to-eat (RTE) products, Meat snacks – Jerky, Steak and Bacon. Processing and Egg and its byproducts, Foam-mat Drying of egg					
UNIT IV	SPOILAGE AND PRESERVATION OF EGGS				9
Preslaughter care, handling, Transport and dressing of a poultry bird. Cuts of poultry bird and Indian Standards of a dressed chicken. Microbial spoilage of eggs - types of spoilage in eggs - indications – organisms causing spoilage. Preservation and maintenance of eggs - Preservation of shell eggs - Egg cleaning – Oil Treatment - Cold storage - Thermo stabilization - Immersion in liquids. Preservation of Albumin and yolk-powder production.					
UNIT V	FOOD SAFETY, QUALITY ASSURANCE AND HACCP				9
Grading of meat and poultry, HACCP, GMP, pathogen detection - PCR, ELISA, microbiological indicators - Total Plate Count, E. coli, Salmonella, Listeria spp. Behavior and control of <i>Salmonella</i> , <i>Listeria monocytogenes</i> , <i>Campylobacter</i> , and <i>E. coli O157:H7</i> .					
		L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	Handbook of Meat and Meat Processing by Y. H. Hui, 2 nd Edition, 2012				
T2	Principles of Meat Science by Elton D Aberle, John C Forrest, David E Gerrard, Edward W Mills, 5 th edition, 2012				
REFERENCES					
R1	G Mead, Poultry Meat Processing and Quality.1 st Edition, 2004, ISBN: 978185573903				
R2	San Francisco and W. H. Freeman. The science of meat and meat products, 1971				
R3	Selvamuthukumar, M., & Maqsood, S. (Eds.). <i>Non-Thermal Processing Technologies for the Meat, Fish, and Poultry Industries</i> . CRC Press.2021				
R4	Toldrá, F., & Hui, Y. H. (Eds.). <i>Handbook of Fermented Meat and Poultry</i> (2nd ed.). Wiley-Blackwell.2014.				
R5	Owens, C. M., Alvarado, C. Z., & Sams, A. R. (Eds.). <i>Poultry Meat Processing</i> (2nd ed.). CRC Press.2010				
COURSE OUTCOMES					
At the end of the course students should be able to					

CO 1	Understand the biochemical and microbiological processes involved in meat and poultry post-mortem, focusing on enzymatic activities, protein structure, and microbial contamination control.
CO 2	Apply preservation technologies like chilling, freezing, drying, smoking, and curing for extending the shelf-life of meat and poultry products while maintaining safety and quality.
CO 3	Develop expertise in the formulation of processed meat and poultry products, including emulsified sausages, value-added products, and egg products.
CO 4	Evaluate and apply emerging processing technologies for innovation and sustainability in the meat and poultry industry.
CO 5	Implement food safety systems and develop skills in pathogen detection and quality control.

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2					2			3	2	
CO2	3	3	2		2				2			3	1	1
CO3	3	3	2	2					2			3	3	2
CO4	3	2	2						2			3	2	
CO5	3	2		2					2			3	1	3

23FTB301	PROCESSING OF DAIRY PRODUCTS	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To make students to learn about the basic engineering aspects behind the processing of dairy products To gain knowledge on equipment and application related areas in dairy industry. 					
UNIT I	EVAPORATION & MIXING	6+6			
<p>Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Care and maintenance of evaporators. Mixing and agitation: Theory and purpose of mixing. Equipment's used for mixing solids, liquids and gases. Different types of stirrers, paddles and agitators. Power consumption of mixer-impeller, selection of mixing equipment in dairy industry, mixing pumps.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Determination of efficiency of liquid-solid separation by filtration. 					
UNIT II	DRYING	6+6			
<p>Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Care and Maintenance of drum and spray dryers. Fluidization: Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Study on Performance evaluation of a spray dryer. Determination of drying of fluid entrainment and rate of drying in a drum dryer. 					
UNIT III	PROCESSING EQUIPMENTS	6+6			
<p>Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipment's. Packaging equipment's: Packaging machines for milk & milk products. Membrane Processing: Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Determination of ash content in cheese. Experiment on osmotic dehydration of foods. 					
UNIT IV	MECHANICAL SEPARATION	6+6			
<p>Fundamentals involved in separation. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators, Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers. Homogenization: Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Determination of the separation efficiency of cream separator Studies on measurement of size of fat globule in milk and determination of homogenization efficiency 					
UNIT V	THERMAL PROCESSING AND PACKAGING	6+6			
<p>Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers. Sterilization: Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization and processing for Plant based Milk, Aseptic packaging and equipment. Care and maintenance of Sterilizers. Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and capping machine, Care and maintenance.</p>					

Experiments:			
1. Estimation of thermal processing time and degree of sterilization in canned food using a batch sterilizer.			
2. Visit to Dairy industry.			
L:30		T:0	P: 30
Total: 60 Periods			
TEXT BOOKS			
T1	Chandan, R. C., & Kilara, A. (Eds.). (2017). Dairy Processing and Quality Assurance. John Wiley & Sons.		
T2	Singh, H., & Creamer, L. K. (Eds.). (2017). Encyclopedia of Dairy Sciences (2nd ed.). Academic Press.		
REFERENCES			
R1	Tamime, A. Y., & Robinson, R. K. (Eds.). (2007). Tamime and Robinson's Yoghurt: Science and Technology. Woodhead Publishing Series in Food Science, Technology and Nutrition. Woodhead Publishing.		
R2	Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). Dairy Science and Technology (2nd ed.). CRC Press.		
R3	Kober, A. K. M. H. (2024). <i>Milk and Dairy Foods: Nutrition, Processing and Healthy Aging</i> . CRC Press.		
R4	Anandharamakrishnan, C., & Moses, J. A. (Eds.). (2024). <i>Emerging Technologies for the Food Industry, Volume 1: Fundamentals of Food Processing Technology</i> . Apple Academic Press.		
R5	Anandharamakrishnan, C., & Moses, J. A. (Eds.). (2024). <i>Emerging Technologies for the Food Industry, Volume 2: Advances in Non-Thermal Processing Technologies</i> . Apple Academic Press.		
COURSE OUTCOMES			
At the end of the course students should be able to			
CO1	Understand the basic concepts of Nutritional Fortification.		
CO2	Describe and demonstrate food safety measures and higher standard of hygiene.		
CO3	Learn the specific processing techniques to achieve desired textures, flavors, and nutritional profiles.		
CO4	Design storage for dairy products		
CO5	Summarize the processing facilitates the distribution and availability of dairy products		

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2									3	2	
CO2	3				2							3	1	1
CO3	3			2								3	3	2
CO4	3	3										3		
CO5	3	3										3	1	3

23FTP301	FRUIT AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To impart knowledge about the equipments processing parameters and evaluating the parameters of different fruits and vegetable products <ol style="list-style-type: none"> 1. Study the effect of blanching treatment on the fruits and vegetables. 2. Estimation of efficiency of screw press extractor and pulper. 3. Development and analysis of squash 4. Preparation of fruit bar comparison with commercial product. 5. Formulation of jams and comparison with commercial product. 6. Formulation of jellies / marmalade and comparison with commercial product 7. Preparation of dehydrated leafy vegetables/sauerkraut 8. Preparation of tomato sauce/ketchup and its preservation by chemical preservatives 9. Experiment on determination of sugar content for different fruit based products. 10. Visit to fruit and vegetable processing plant. 					
		L:0	T:0	P: 30	Total: 30 Periods
References					
R1	Wright, K. (2023). <i>Modern Processing Techniques of Fruits and Vegetables</i> .				
R2	FSSAI Manual of Methods of Analysis of Foods Fruit and Vegetable Products, 2016.				
R3	Gordon L. Robertson, "Food Packaging and Shelf Life: A Practical Guide", 1st edition CRC Press, USA, 2009.				
R4	http://www.rpaulsingh.com/learning/virtual/virtual.htm				
R5	NIFTEM-T. (2019). <i>Model Training Course on Processing and Value Addition of Fruits and Vegetables: A Handbook</i> .				
COURSE OUTCOMES					
At the end of the course students should be able to					
CO 1	Assess the changes occurred during fruits and vegetables blanching and also estimate the Efficiency juice extraction equipment.				
CO 2	Prepare and characterize fruit/vegetable based products				
CO 3	Evaluate mechanical and water barrier properties of packaging materials				

23FTP302	MINI PROJECT - II	L	T	P	C
		0	0	2	1
Guidelines					
<p>10. The scope of the project work is to enable the students in convenient groups (not more than 4 members) involving theoretical and experimental studies through Design Thinking approach.</p> <p>11. The aim of the project work is to deepen comprehension of principles by applying them to a new problem based on the courses such as Thermodynamics, Fluid Mechanics, Biochemistry and Nutrition, Processing Technology of Cereals, Legumes and Oilseeds and Python programming studied by the students in the current semester of study.</p> <p>12. Project periods shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.</p> <p>13. Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement the same. Analyze data, evaluate the results and conclude the appropriate solution, suggestion for feature work.</p> <p>14. The continuous assessment shall be made according to the regulation which is tabulated below.</p> <p>15. The progress of the project is evaluated based on a minimum of two reviews.</p> <p>16. The review committee may be constituted by the Head of the Department</p> <p>17. Each student shall finally produce a comprehensive report covering background information, empathy, problem statement, project work details, result, conclusion and publications.</p> <p>18. This final report shall be typewritten form as specified in the guidelines.</p>					
		L : 0	T: 0	P: 30	Total: 30 PERIODS

PROFESSIONAL ELECTIVE COURSES

23FTE301	DESIGN OF FOOD PROCESSING MACHINERY	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • Apply Engineering Principles to Design Food Processing Machines • Analyze and Optimize Food Processing Machinery Designs for Efficiency and Safety 					
UNIT I	INTRODUCTION TO FOOD PROCESSING MACHINERY DESIGN	9			
Overview of food processing industry and machinery design, Types of food processing machines - sorting, grading, conveying, processing, packaging, Design considerations - safety, efficiency, cost, hygiene, Regulatory requirements and industry standards					
UNIT II	MECHANICAL DESIGN OF FOOD PROCESSING MACHINES	9			
Fundamentals of mechanical design - stress, strain, materials, Design of machine elements - gears, bearings, shafts, Application of mechanical design principles to food processing machines - conveyors, pumps, mixers, Case studies of mechanical design of food processing machines					
UNIT III	THERMAL DESIGN OF FOOD PROCESSING MACHINES	9			
Fundamentals of heat transfer - conduction, convection, radiation, Design of thermal processing equipment - heat exchangers, evaporators, dryers, Application of thermal design principles to food processing machines - pasteurizers, sterilizers, cookers, Case studies of thermal design of food processing machines					
UNIT IV	FLUID FLOW AND PNEUMATIC DESIGN OF FOOD PROCESSING MACHINES	9			
Fundamentals of fluid flow - fluid mechanics, pipe flow, Design of fluid handling equipment - pumps, valves, pipelines, Application of fluid flow principles to food processing machines - liquid filling machines, pneumatic conveying systems, Basics of Modelling software and Computational Fluid Dynamics, Case studies of fluid flow and pneumatic design of food processing machines					
UNIT V	SAFETY, CONTROL, AND AUTOMATION OF FOOD PROCESSING MACHINES	9			
Safety considerations in food processing machinery design - hazards, risk assessment, safeguarding, Control systems for food processing machines - sensors, actuators, control algorithms, Automation of food processing machines - PLCs, robotics, computer vision, Case studies of safety, control, and automation of food processing machines					
		L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	"Food Processing Equipment Design" by Rotimi Aluko (CRC Press, 2017) - Covers design principles, mechanical design, thermal design, and fluid flow design of food processing equipment.				
T2	"Design and Development of Food Processing Equipment" by S. S. Desai (Springer, 2019) - Covers design principles, safety considerations, control systems, and automation of food processing equipment.				
REFERENCES					
R1	Food Processing Machinery" by T. J. Moysey (CRC Press, 2018) - Covers design operation, and maintenance of food processing machinery, including conveyors, pumps, and thermal processing equipment.				
R2	Mechanical Design of Food Processing Equipment" by A. K. Datta (CRC Press, 2016) - Covers mechanical design principles, machine elements, and design of specific food processing equipment.				
R3	Anandharamakrishnan, C., & Moses, J. A. (Eds.). (2024). <i>Emerging Technologies for the Food Industry, Volume 1: Fundamentals of Food Processing Technology</i> . Apple Academic				

	Press.
R4	Anandharamakrishnan, C., & Moses, J. A. (Eds.). (2024). <i>Emerging Technologies for the Food Industry, Volume 2: Advances in Non-Thermal Processing Technologies</i> . Apple Academic Press.
R5	Smith, D. S., Cash, J. N., Nip, W., & Hui, Y. H. (Eds.). (1997). <i>Processing Vegetables: Science and Technology</i> . Technomic Publishing Company.
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1	Apply Fundamental Principles to Design Food Processing Machines
CO 2	Analyze and Optimize Food Processing Machinery Designs
CO 3	Design and Develop Food Processing Machines for Specific Applications
CO 4	Evaluate the Safety and Efficiency of Food Processing Machines
CO 5	Communicate Design Solutions and Ideas Effectively

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2									3	2	
CO2	3				2							3	1	1
CO3	3			2								3	3	2
CO4	3	3										3		
CO5	3	3										3	1	3

23FTE302	FOOD BIOTECHNOLOGY AND ITS APPLICATIONS			L	T	P	C
				3	0	0	3
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> Analyze Principles and Applications of Food Biotechnology Analyze the Benefits and Challenges of Food Biotechnology and its Impact on Food Safety and Quality 							
UNIT I	INTRODUCTION TO FOOD BIOTECHNOLOGY						9
Definition and scope of food biotechnology, Historical development of food biotechnology, Principles of biotechnology: genetic engineering, fermentation, enzyme technology, Applications of food biotechnology: food production, processing, preservation, and safety							
UNIT II	GENETIC ENGINEERING AND ITS APPLICATIONS IN FOOD BIOTECHNOLOGY						9
Principles of genetic engineering: DNA, genes, genetic code, Techniques of genetic engineering: gene cloning, gene expression, gene editing, Applications of genetic engineering in food biotechnology: genetically modified crops, genetically modified foods, gene therapy, Regulations and safety assessments of genetically modified foods							
UNIT III	FERMENTATION TECHNOLOGY AND ITS APPLICATIONS IN FOOD BIOTECHNOLOGY						9
Principles of fermentation: microbial metabolism, fermentation processes, Types of fermentation: aerobic, anaerobic, solid-state fermentation, Applications of fermentation technology in food biotechnology: food production (yogurt, cheese, bread), food processing (beer, wine, soy sauce), food preservation (pickling, sauerkraut), Microbial fermentation and its applications in food biotechnology							
UNIT IV	ENZYME TECHNOLOGY AND ITS APPLICATIONS IN FOOD BIOTECHNOLOGY						9
Principles of enzyme technology: enzyme structure, enzyme function, enzyme kinetics, Types of enzymes: industrial enzymes, food-grade enzymes, Applications of enzyme technology in food biotechnology: food production (dairy, baking), food processing (starch, sugar), food preservation (texturizing, stabilizing), Immobilized enzymes and their applications in food biotechnology							
UNIT V	SAFETY AND REGULATORY ASPECTS OF FOOD BIOTECHNOLOGY						9
Safety assessments of genetically modified foods, Regulations and guidelines for food biotechnology: national and international, Labeling and traceability of genetically modified foods, Public perception and acceptance of food biotechnology: social and ethical implications							
				L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS							
T1	"Food Biotechnology" by James D. Metcalfe (CRC Press, 2018) - Covers the principles and applications of food biotechnology, including genetic engineering, fermentation, and enzyme technology.						
T2	Biotechnology in Food Processing" by Ramesh C. Chandan (CRC Press, 2017) - Covers the applications of biotechnology in food processing, including fermentation, enzyme technology, and genetic engineering.						
REFERENCES							
R1	"Food Biotechnology: Principles and Practices" by S. S. Desai (Springer, 2019) - Covers the principles and practices of food biotechnology, including genetic engineering, fermentation, and enzyme technology.						
R2	Enzyme Technology in Food Processing" by P. S. Panesar (CRC Press, 2017) - Covers the principles and applications of enzyme technology in food processing, including food production, processing, and preservation.						
R3	Kumar, A., & Patruni, K. (2023). <i>Recent Advances in Food Biotechnology</i> . Springer.						
R4	Anandharamakrishnan, C., & Subramanian, P. (Eds.). (2023). <i>Industrial Application of Functional Foods, Ingredients and Nutraceuticals: Extraction, Processing and Formulation of Bioactive Compounds</i> . Academic Press.						
R5	Anandharamakrishnan, C., Siniya, V. R., & Mahendran, R. (Eds.). (2023). <i>Non-Thermal Technologies for the Food Industry: Advances and Regulations</i> . CRC Press.						

COURSE OUTCOMES**At the end of the course students should be able to**

CO 1	Analyze the Principles of Food Biotechnology
CO 2	Analyze the Applications of Genetic Engineering in Food Production
CO 3	Design and Develop Fermentation Processes for Food Production
CO 4	Evaluate the Safety and Regulatory Aspects of Food Biotechnology
CO 5	Communicate the Benefits and Risks of Food Biotechnology to Stakeholders

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2									3	2	
CO2	3				2							3	1	1
CO3	3			2								3	3	2
CO4	3	3										3		
CO5	3	3										3	1	3

23FTE303	MILLING TECHNOLOGY			L	T	P	C
				3	0	0	3
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> To understand the various technologies in the field of milling of different grains. To learn the applications of the milling techniques for grains. 							
UNIT I	GRAIN PROPERTIES						9
Importance of cereals and legumes- Grain structure and Composition. Physicochemical properties of grains and nutritional value. Pre-milling operations of grains. Grading. Storage of grains in relation to maintaining grain quality and types of storage structures. Losses during storage and Prevention method.							
UNIT II	RICE AND WHEAT MILLING						9
Traditional rice milling machineries. Modern Rice milling flow chart, operations and equipment's used. Parboiling- Physicochemical changes during Parboiling and effects on rice quality, Methods of Parboiling – CFTRI Method, Processed rice products - Rice flour, puffed rice, Rice flakes, Instant Rice, Fermented Rice Products - Rice, Dosa and Dhokla. Byproducts utilization. Wheat milling soft and durum wheat processing Flour milling, Turbo grinding and air-classification, Quality characteristics of flour and their suitability for baking.							
UNIT III	PULSE AND MILLET MILLING						9
Structure and Importance of Pulses and Millets. Unit operations of pulse and Millet milling. Dehulling losses and effect on nutritive value. Milling Methods of pulses and Millets. Problems of Pulse milling industry. Factors affecting Pulse milling outturn. Efficiencies of Pulse and Millet milling.							
UNIT IV	BARLEY						9
Production and Trade Barley production and global trade dynamics, Composition and Structure, Detailed composition and structural characteristics of barley, Malting Process, Preparation and storage of barley, Steeping techniques and germination processes, Enzymatic and chemical changes during malting, Role of gibberellic acid, Techniques and Suitability, Techniques of malting different cereals, Suitability and characteristics for malting and brewing.							
UNIT V	APPLICATIONS OF MALT IN FOOD AND BREWERY BY PRODUCTS						9
Food Applications, uses of malt in baking, infant food, and other products, Brewing Operations, Constituents of hops and brewing adjuncts, Quality aspects of beer: flavor, taste, alcohol content, and chemical constituents. By Products Utilization, Applications in the food industry, Advantages and disadvantages of malting and brewing technologies, Enzyme Applications, Role and applications of enzymes in the malting process.							
				L:45	T:0	P: 45	Total: 45 Periods
TEXT BOOKS							
T1	KM. Sahay and KK. Singh : *Unit Operations of Agricultural Processing*, Vikas Publishing House Pvt Ltd, Delhi, 2014						
T2	Chakraverty, A. : *Post Harvest Technology of Cereals, Pulses and Oilseeds*, Oxford and IBH Publishing Co, Calcutta, 2014.						
REFERENCES							
R1	M.J. Lewis and T.W. Young : *Malting and Brewing Science Vol. I*, Springer Science & Business Media, Germany.						
R2	Khader, Vijaya and Vimala, V., - Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007						
R3	Walker, J. R. (2023). <i>Machining Fundamentals</i> (11th ed.). Goodheart-Willcox.						
R4	Valentino, J. V., & Goldenberg, J. (2023). <i>Virtual Machining Using CAMWorks 2023</i> . SDC Publications.						
R5	Kibbe, R. R., Neely, J. E., Meyer, R. O., & White, W. T. (2023). <i>Technology of Machine Tools</i> (8th ed.). McGraw-Hill Education.						
COURSE OUTCOMES							

At the end of the course students should be able to	
CO1	Assess the structure, nutritional value and storage of cereals and legumes
CO2	Apply the milling techniques, parboiling methods and equipment used in rice milling
CO3	Compare the efficiency of dry and wet milling techniques in pulse milling
CO4	Understand the technology of production of alcoholic beverages
CO5	Comprehend the applications of the malting process in the food processing industry.

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2					2			3	2	
CO2	3	3	2		2				2			3	1	1
CO3	3	3	2	2					2			3	3	2
CO4	3	2	2						2			3	2	
CO5	3	2		2					2			3	1	3

23FTE304	FOOD SENSORS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To provide fundamental knowledge on sensors and their applications in food processing To understand the function of biosensors and sensor-based instruments in food Processing and packaging technology. 					
UNIT I	INTRODUCTION TO SENSORS	9			
Definition-basic principles of sensing- Transduction principles: electrical, optical, mechanical, thermal, and chemical. Characteristics - Sensitivity, Selectivity, Accuracy, Precision, Response time, Range, and Stability - Calibration and drift. Importance and role of sensors in the food processing industry.					
UNIT II	CLASSIFICATION OF SENSORS	9			
Mechanical Sensors - Pressure, Force, and Strain sensors; Chemical Sensors - pH sensors, gas sensors, ion-selective electrodes; Thermal Sensors - Temperature sensors such as RTDs, Thermocouples; Optical Sensors - UV-VIS, fluorescence, IR, and color sensors. Biosensors - Electro-chemical, optical, and mass-based biosensors. Selection of appropriate sensors based on food type and application.					
UNIT III	SENSOR-BASED INSTRUMENTS IN FOOD TECHNOLOGY	9			
Food Quality Control Sensors: Temperature, humidity, and moisture sensors; Texture and color analysis sensors; Sensor-based instruments for detecting contaminants and adulterants - Instrumental Methods in Food Processing: Spectrometric instruments for food quality testing, Gas chromatography for food analysis, Mass spectrometry for trace analysis in food - Non-Destructive Testing Methods: Acoustic and ultrasonic sensors for food testing, Electrical and electromagnetic sensors in food quality assurance					
UNIT IV	BIOSENSORS - INTRODUCTION AND APPLICATION	9			
Definition - Components - Biological recognition elements: enzymes, antibodies, nucleic acids; Transducers: electrochemical, optical, and piezoelectric - Signal processing and data interpretation - Working Principle - Types based on the biological element - Specificity, sensitivity, and limits of detection in biosensors - Applications: monitoring food freshness and spoilage, Food Authentication and Traceability, Nutritional Content Monitoring and fortification					
UNIT V	ADVANCED APPLICATIONS AND FUTURE TRENDS	9			
Role of sensors - in the automation, Optimization in food processing - Smart packaging technologies, modified atmospheric storages - Environmental Monitoring in Food Processing Plants. Emerging applications in nano-biosensors for food safety and QC - Integration of AI with Food Sensors such as AI-based data analysis and Machine learning for real-time monitoring and QC in food industries - limitations of sensors in the food industry - Future advancements and interdisciplinary research in sensor technologies for food system					
		L:45	T: 0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	Food Quality Assurance: Principles and Practices, Singhal, R. S., & Raghavan, P. G., CRC Press, 2000.				
T2	Biosensors and Bioelectronics, Wang, J., Elsevier, 2006.				
REFERENCES					
R1	Food quality monitoring and control using sensors and biosensors, D'Onofrio, M., Food Research International, 54(1), 34-40, 2013.				
R2	Sensors for food quality and safety monitoring. Bourgeois, A. L., & Yadav, S. K. International Journal of Food Science & Technology, 47(1), 1-10, 2012.				
R3	Biosensors and food analysis. Morais, S., & Lima, J. L., Trends in Food Science & Technology, 21(8), 388-395, 2010.				
R4	Kumar, A., & Patruni, K. (2023). <i>Recent Advances in Food Biotechnology</i> . Springer.				
R5	Anandharamakrishnan, C., & Subramanian, P. (Eds.). (2023). <i>Industrial Application of Functional Foods, Ingredients and Nutraceuticals: Extraction, Processing and Formulation</i>				

of Bioactive Compounds. Academic Press.

COURSE OUTCOMES

At the end of the course students should be able to

CO 1	Understand the basic concepts of sensor, types, role in food processing applications
CO 2	Differentiate and select suitable sensor from various types that is appropriate for application in food industry
CO 3	Understand the working principles of various sensor-based measurement instruments and their applications
CO 4	Analyze the mechanism of sensing, types and applications of bio-sensors.
CO 5	Design and develop technologies using sensors for various types of applications in the development of food processing and packaging industries

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2										3	2	
CO2		3			3							3	1	1
CO3	3	2	3	2								3	3	2
CO4		3			3							3		
CO5			3	3	3							3	1	3

23FTE305	INSTRUMENTATION AND PROCESS CONTROL			L	T	P	C
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> To provide fundamental knowledge on instruments and their applications in food processing To understand the function of instruments in food product development 							
UNIT I	INTRODUCTION TO SENSORS AND TRANSDUCERS						9
Introduction to measurement system - Resistive Transducers: Strain gauges - Resistance thermometers - Thermistors - Hotwire anemometer - Piezoresistive sensors - Humidity sensors - Inductive. Transducers: LVDT - Induction potentiometer - Electromagnetic sensors - Capacitive Transducers: Variable air gap type - Variable permittivity type.							
UNIT II	LEVEL, FLOW AND TEMPERATURE MEASUREMENTS						9
Level measurement: Float gauges - level switches - bubbler tube - Capacitance type - Ultrasonic type - Flow Measurement: Fixed and variable type flow meter - turbine flow meter - Electromagnetic flow meter - Temperature Measurement: RTD - Thermistor - Thermocouple - Dry and wet bulb psychrometers - Viscosity measurements.							
UNIT III	PROCESS MODEL AND CONTROLLER						9
Introduction to open and closed loop system - Building blocks of mechanical and electrical systems - Single and Two tank system model - Controller Design: ON-OFF Control - P-Mode, I-Mode, D-Mode, P+I+D mode of controller - Digital Controller: Position and Velocity control.							
UNIT IV	TIME AND FREQUENCY RESPONSE ANALYSIS						9
Time response - time domain specifications - Standard test inputs - Frequency response Characteristics: Bode diagram - Nyquist plot and Stability analysis - Jury's stability test.							
UNIT V	INSTRUMENTATION AND SENSORS FOR THE FOOD INDUSTRY						9
Optical Inspection: Computer Vision system, Color sorter. NIR and FTNIR for Food compositional analysis. Principles of measurement - Calibrations application in food industry. Practical considerations for implementing online measurements. Radiation thermometers: Principles - Applications. Introduction to automation in food processing. Biosensors-e nose, NIR.							
			L:45	T:0	P: 0	Total: 45 Periods	
TEXT BOOKS							
T1	Erika Kress-Rogers and Christopher J. B. Brimelow, Instrumentation and sensors for the food industry, Wood head publishing, 2001.						
T2	Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30th reprint 2008.						
REFERENCES							
R1	E. O. Doebelin, Measurement Systems: Applications and Design, Tata McGraw-Hill Book Co., 2008.						
R2	Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006.						
R3	Kirk, F. W., Weedon, T. A., & Kirk, P. (2023). <i>Instrumentation and Process Control</i> (7th ed.). American Technical Publishers.						
R4	Dunn, W. C. (2023). <i>Fundamentals of Industrial Instrumentation and Process Control</i> (2nd ed.). McGraw-Hill Education.						
R5	Khaki-Sedigh, A. (2023). <i>An Introduction to Data-Driven Control Systems</i> . Wiley-IEEE Press.						
COURSE OUTCOMES							
At the end of the course students should be able to							
CO 1	Recall the parts of instrumentation and their working in food industry						
CO 2	Understand the working principles of various measurement instruments and their applications						
CO 3	Analyze the Modeling of physical process, controller characteristics, selection of controller						

	mode and control schemes
CO 4	Examine the concepts of system representation, time and frequency responses of systems
CO 5	Design and develop instruments for food product development

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3							3	2	
CO2	2	2			3							3	1	1
CO3	3	2	3	2								3	3	2
CO4	3			3	2							3		
CO5			3	3	2							3	1	3

OPEN ELECTIVE COURSES (Common to all Branches)

23FTO301	PRINCIPLES OF FOOD SAFETY	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To make students to understand the various requirements related to good manufacturing practices. • To provide the students about the in-depth knowledge related to Industrial legislation, disputes trade unions: Industrial legislation and laws, acts and disputes. 					
UNIT I	INTRODUCTION TO FOOD SAFETY	9			
Food safety - FSSAI act, 2006-What is Quality w.r.t Foods and Food Systems- Food Fraud-Prerequisites for a Hygienic design of Food Plants.					
UNIT II	FOOD SAFETY PROTOCOLS	9			
Indian Factories Act on safety- HACCP-Desirable safety features of some food processing equipment-Personal protective equipment- Safety from adulteration of food -Hygiene and sanitation requirement in food processing and fermentation industries- Cleaning-sanitizing & pest control in food processing-storage and service areas					
UNIT III	FOOD QUALITY CONTROL	9			
Introduction to Quality- Quality control and quality assurance- Introduction, Evaluation of food quality-concept of total quality control (TQM)- Objectives of production planning and procedure of production control-Requirement of good manufacturing process (GMP)-good hygienic process (GHP)- Codex Alimentarius commission.					
UNIT IV	FOOD SAFETY TRAININGS	9			
FSSAI, International Organization for standardization (ISO): Introduction- ISO standards-benefits, procedure-ISO 9000, PRP for Food Safety: GAP – objectives, principles, benefits - GMP – objectives, GMP in food industry HACCP: Introduction, History of HACCP-Benefits of HACCP -ISO 22000 -Agmark, FPO, PFA, BIS, consumer protection act, Vanaspati control order, MMPO, export quality control and inspection act					
UNIT V	FOOD LAWS	9			
Industrial Legislation, Disputes and trade Unions: Industrial legislation and laws, acts and disputes. Industrial disputes act –1947, WTO, GATT, Patent Laws and IPR.					
		L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	Quality Assurance for the Food Industry by J. Andres Vasconcellos.				
T2	Food Safety Handbook by Ronald H. Schmidt and Gary Rodrick.				
REFERENCES					
R1	Bioterrorism and Food Safety By Barbara A. Rasco , Bledsoe ISBN 9780367393366.				
R2	Food Safety Handbook Ronald H. Schmidt , Gary E. Rodrick ,ISBN: 978-0-471-21064-1.				
R3	Overbosch, P., & Blanchard, S. (2023). "Principles and Systems for Quality and Food Safety Management." In Food Safety Management (pp. 497-512).				
R4	Andersen, V. Y. (2023). Food Safety Management: A Practical Guide for the Food Industry (2nd ed.).				
R5	McSwane, D., Rue, N., & Linton, R. (2023). Essentials of Food Safety and Sanitation (6th ed.).				
COURSE OUTCOMES					
At the end of the course students should be able to					
CO 1	Ability to understand the food quality evaluation and the basic concept of total quality control.				
CO 2	To understand the various requirements related to good manufacturing practices, good hygienic process and codex Alimentarius commission.				
CO 3	To understand the basic concept of FSSAI, HACCP and its implications in food industries.				
CO 4	To provide the students about the in-depth knowledge related to Industrial legislation, disputes				

CO 5	To give the brief overview of industrial disputes act-1947, WTO, GATT, Patent Laws and IPR.
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COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2									3		2
CO2			3		2							3	1	1
CO3	3			2								3	3	2
CO4	3				3							3		
CO5	3			3								3	1	3

23FTO302	PROCESSING OF FRUITS AND VEGETABLES	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To recognize the physiology, pre- processing and storage techniques of fruits and vegetables. To identify specific processing technologies for vegetables, fruits and value added Products. 					
UNIT I	BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS	9			
Ability to identify - all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Production and processing - scenario of fruits and vegetable India and World. Scope of Fruit and Vegetable - Preservation Industry in India. Present status - constraints and prospectus. Problem solving- in post-harvest quality of fruits and vegetables.					
UNIT II	FRESH FRUITS AND VEGETABLES	9			
Physical - Textural characteristics - structure and composition. Maturity standards - Importance, methods of Maturity determinations maturity indices - for selected fruits and vegetables. Harvesting of important - fruits and vegetables. Fruit ripening- chemical changes,- regulations, methods. Calculation of respiration rates - Spoilage of fruits- vegetable and their processed products.					
UNIT III	PROCESSING TECHNOLOGY OF FRUITS AND FRUIT BEVERAGES	9			
Unit operations involved in Juice preparation - equipments - screw type juice extractor, pulper, pressing, Rack and cloth press, Hydraulic Press, Filters, clarification and concentration by membranes. Classification of fruit juices - Squash, cordial, nectar, RTS. IMF products Jam - Jelly, marmalade - candied preserves, crystallized fruit, glazed fruit, fruit toffee and fruit powders - fruit leather and tutti-frutti. Production of Fruit powders and Fruit bar. Osmotic dehydration - Tutti fruit. Edible coating of fruits – processing, quality parameters.					
UNIT IV	PROCESSING TECHNOLOGY OF VEGETABLE PRODUCTS, SPECIALITY PRODUCTS	9			
Preparation and processing parameters - of vegetable wafers, soup powders - pulp, puree, pastes, sauces, ketchups - chutneys. Preparation of various types of pickles and fermented products. Dehydrated vegetable - and leafy products. Processing parameters of mushroom and baby corn.					
UNIT V	HURDLE TECHNOLOGY, MINIMALLY PROCESSED FRUITS AND VEGETABLES, EDIBLE COATING	9			
Types of hurdle - aspects of hurdle technology, stress - effect on fresh produce, shelf stable products. Factors affecting the - shelf life and the quality of the minimally processed fruits and vegetables, physiology and biochemistry of the fresh cut fruits and vegetables. Processing, quality parameters and biochemical changes - in the final quality of the fresh produce. HACCP for Fruits and Vegetables					
		L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS					
T1	Sivasankar., B. (2002). Food Processing and Preservation. Prentice Hall of India.				
T2	Salunke,D . K and S. S Kadam “Hand Book of Fruit Science and Technology Production, Composition, Storage and Processing”. Marcel Dekker, 2005.				
REFERENCES					
R1	P. J. Fellows., (2000). Food Processing Technology – Principles and Practice (2nd Edition). Woodhead Publishing Limited				
R2	Srivastava., R and Sanjeev Kumar., (1998). Fruit and Vegetable Preservation, Principles and Practices International Book Distributing Co				
R3	Kumar, A., & Patruni, K. (2023). <i>Recent Advances in Food Biotechnology</i> . Springer.				
R4	Anandharamakrishnan, C., & Subramanian, P. (Eds.). (2023). <i>Industrial Application of Functional Foods, Ingredients and Nutraceuticals: Extraction, Processing and Formulation of Bioactive Compounds</i> . Academic Press.				
R5	Anandharamakrishnan, C., Sinija, V. R., & Mahendran, R. (Eds.). (2023). <i>Non-Thermal</i>				

	<i>Technologies for the Food Industry: Advances and Regulations</i> . CRC Press.
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1	Assess the basic agricultural aspects of fruits and vegetables
CO 2	Demonstrate the processing of fruits and vegetables
CO 3	Illustrate the processing techniques of fruits and fruit beverages.
CO 4	Identify the processing technology of vegetables and vegetable based speciality products.
CO 5	Apply the concepts of hurdle technology, minimal processing and edible coating in fruits and vegetables processing.

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2									3	2	
CO2	3				2							3	1	
CO3	3			2								3	3	
CO4	3	3										3		
CO5	3	3										3	1	

23FTO303	SENSORY EVALUATION OF FOOD PRODUCTS			L	T	P	C
				3	0	0	3

COURSE OBJECTIVES:

- To make students to understand the various requirements related to Sensory evaluation of various food Products.
- To provide the students about the in-depth knowledge related to Industrial Sensory panels.

UNIT I FUNDAMENTALS OF SENSORY EVALUATION 9

Definition of sensory evaluation; basic tastes; human senses and sensory perception; threshold; psychophysics.

UNIT II ARRANGEMENTS FOR SENSORY EVALUATION 9

Test controls: environment and test room design; product controls: sample preparation and presentation; panelist controls; factors influencing measurements: psychological and physiological errors

UNIT III STATISTICAL ANALYSIS 9

Mean; mode; median; range and dispersion, variance and standard deviation; normal distribution; z score, Student's t test; ANOVA; multiple comparisons test; testing hypothesis; level of significance; type I and II errors.

UNIT IV METHODS OF SENSORY EVALUATION 9

Classification of test methods; discrimination tests: paired-comparison, duo-trio and triangle tests; affective tests: qualitative (interview and focus group) and quantitative tests (paired preference and acceptance tests); descriptive analysis: Flavor Profile, Texture Profile, Quantitative Descriptive Analysis, Spectrum Descriptive Analysis

UNIT V APPLICATION OF SENSORY ANALYSIS IN FOOD INDUSTRY 9

Quality control; storage stability testing; product development and consumer acceptance, Overview on Mouthfeel. Sensory evaluation of Tea and Beverages,

L:45 T:0 P: 0 Total: 45 Periods

TEXT BOOKS

T1 Sensory Evaluation of Food: Principles and Practices

T2 Food Safety Handbook by Ronald H. Schmidt and Gary Rodrick.

REFERENCES

R1 Sensory Evaluation of Food: Principles and Practices, 2nd Edition. H.T. Lawless and H.

R2 Heymann. Springer, 2010. ISBN 978-1441964878.

R3 Costa, A. I. de A., Monteiro, M. J. P., & Lamy, E. (Eds.). (2023). *Sensory Evaluation and Consumer Acceptance of New Food Products: Principles and Applications*. Royal Society of Chemistry.

R4 Clark, S., Costello, M., Drake, M. A., & Bodyfelt, F. W. (2023). *The Sensory Evaluation of Dairy Products* (3rd ed.). Springer.

R5 ASTM International. (2023). *Sensory Evaluation Standards*. ASTM International.

COURSE OUTCOMES

At the end of the course students should be able to

CO 1 Understand the basics of taste and olfactory perception

CO 2 Comprehend the basic psychology of common sensory tests

CO 3 Able to choose the proper sensory test for a wide range of common objectives

CO 4 Knowledge to conduct discrimination tests, consumer acceptability and preference tests, and

CO 5 Learn the descriptive analysis conducted in the Industry.

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2					2			3	2	
CO2	3	3	2		2				2			3	1	1
CO3	3	3	2	2					2			3	3	2
CO4	3	2	2						2			3	2	
CO5	3	2		2					2			3	1	3

23FTO304	BAKING TECHNOLOGY			L	T	P	C
				3	0	0	3
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> Preamble The course enables the students to study the phenomena of modes of heat transfer, heat exchangers, and its application in food processing operations. This course provides an insight to the diffusion process and mechanisms of mass transfer. 							
UNIT I	SCIENCE BEHIND BAKING						9
Classification of bakery products. Bakery Ingredients-Testing of raw materials and functions - flour, yeast, sugar, fat, egg, water, salt, coloring agents, flavoring agents, milk, milk powder, emulsifiers, leaveners, antioxidants and improvers.							
UNIT II	EQUIPMENTS IN BAKERY INDUSTRY AND RHEOLOGY OF DOUGH						9
Handling of ingredients- dough mixers, dividers, rounder, sheeter, laminating equipments, fermentation enclosures and brew equipment, ovens and slicers. Farinograph, Amylograph, Alveograph, Extensograph.and Mixograph							
UNIT III	BREAD MAKING PROCESS AND CAKE MAKING						9
Chemistry of Dough Development. Bread making methods- Straight dough/bulk fermentation, Sponge and dough, Activated dough development, Chorleywood bread process, No time process. Characteristics of good bread- Internal and external characters. Bread defects/faults and remedies. Spoilage of bread. Cake making ingredients and their function. Methods for different types of cakes							
UNIT IV	BISCUIT MAKING AND CONFECTIONERY						9
Ingredients and their functions. Types of biscuit dough – Developed dough, short dough’s, semi-sweet, enzyme modified dough and batters. Biscuit manufacturing process, Wafers, puff pastry, chemically leavened bakery products. Classification of confectionery Products – Ingredients-Basic Technical considerations in sugar-based confectionery							
UNIT V	CONFECTIONERY PRODUCTS						9
Composition and manufacturing process- Sugar boiled products-Candy, Toffees, fudge, caramel, aerated confectionery. Bubble gums and chewing gums. Chocolate Processing –chocolate shells, candy bars. Fruit confections. Confectionery product quality parameters, faults and corrective measures. Spoilage of confectionery products.							
				L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS							
T1	Weibiao Zhou and Y. H. Hui, "Bakery Products Science and Technology", 2nd Edition, Wiley Blackwell, US, 2014.						
T2	Ferenc A. Mohos, "Confectionery and Chocolate Engineering: Principles and Applications", 1st Edition, Wiley BI						
REFERENCES							
R1	W. P. Edwards, “The Science of Bakery Products”, United Kingdom: Royal Society of Chemistry,2015						
R2	Samuel A. Matz, "Bakery Technology and Engineering", 3rd Edition, Springer, US, 2008.						
R3	Davidson, I. (2023). Biscuit Baking Technology: Processing and Engineering Manual (3rd ed.). Academic Press.						
R4	Cauvain, S. P., & Young, L. S. (2023). Technology of Bread making (3rd ed.). Springer.						
R5	Pyler, E. J., & Gorton, L. A. (2023). Baking Science & Technology (4th ed.). Sosland Publishing.						
COURSE OUTCOMES							
At the end of the course students should be able to							
CO 1	Outline the role of ingredients in bakery industry						
CO 2	Select appropriate equipment for baking process and relate the rheological properties of dough						
CO 3	Identify and apply processing techniques for bread and cake manufacturing process						

CO 4	Illustrate the processing techniques for preparation of miscellaneous bakery products and summarize the role of confectionery ingredients
CO 5	Apply the processing techniques to formulate different confectionery products

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1		2				1	1	2	1	
CO2	3	2	1	1		1				1	2	3	2	
CO3	3	3	1	1		2				1	2	3	2	
CO4	3	3	3	3		2				1	2	3	2	
CO5	3	3	3	3		2				1	2	3	2	

23FTO305	SAFETY AND HAZARD MANAGEMENT IN FOOD INDUSTRIES			L	T	P	C
				3	0	0	3
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> Understand food safety and the importance of food regulations. Learn the concepts of hazard management in food industries 							
UNIT I	FOOD SAFETY						9
Food safety - definition, food safety issues, factors affecting food safety. Foodborne diseases and outbreaks. Food Contamination - Types of food contamination, harmful effects, and control. Food adulteration - common adulterants in foods: milk and milk products, edible oils, cereals and pulses, spices, and beverages. Simple screening and control of food adulteration.							
UNIT II	FOOD SAFETY REGULATIONS AND STANDARDS						9
Food Safety Management System (HACCP LEVEL 4, ISO 22000/FSSC 22000), International standards - and regulations for - food safety, Codex Alimentarius and its role in food safety - Understanding the basic concepts of microbiology in food safety, Emerging trends - in food safety (like HARPC, etc), Food Quality Regulations and guidelines in India.							
UNIT III	FOOD HAZARDS AND TYPES						9
Physical hazards - Foreign objects, equipment malfunctions .Chemical hazards - Pesticides, additives, heavy metals, food contaminants.Biological hazards - Bacteria, viruses, fungi, parasites. Identification - and assessment of hazards in food production. Hazard analysis critical control point - Definition, principles, development, and application of HACCP plan. Control - measures for each type of hazard.							
UNIT IV	RISK ASSESSMENT, MANAGEMENT AND HYGENIC PRACTICES						9
Risk analysis in food safety - Risk assessment methodologies Qualitative vs. quantitative risk assessment. Risk management strategies - Mitigating and controlling food safety risks - Emerging risks in food safety. Importance of sanitation and hygiene in food production - Cleaning and sanitizing methods.Pest control in food facilities - Employee hygiene and training Environmental monitoring (e.g., ATP testing, microbial sampling)							
UNIT V	CRISIS MANAGEMENT IN FOOD INDUSTRIES						9
Crisis management and food safety emergencies - Handling food recalls and withdrawals Communication during a food safety crisis.Over view of food supply chain, Risks and Controls in Food Chain, Potential Hazards, Good Hygiene practices in food chain - Examples of Food safety Incidents - One Point Lessons in online Production, Risk and Control - Backward and forward flow of process line, Instrumental analysis of Food.							
				L:45	T:0	P: 0	Total: 45 Periods
TEXT BOOKS							
T1	Kiron Prabhakar, (2017). "A Practical Guide to Food Laws and Regulations", Bloomsbury India, ISBN: 9789386141705.						
T2	Gould, W.A and Gould, R.W, (2006). "Total Quality Assurance for the Food Industries", CTI Publications Inc. Baltimore, ISBN: 9781845696153,						
REFERENCES							
R1	Patricia A. Curtis, (2005.) "Guide to Food Laws and Regulations", Wiley-Blackwell; 1st Edition, ISBN: 0813819466,						
R2	Mehta R. and George J., (2005). "Food Safety Regulation Concerns and Trade - The Developing Country Perspective", Published by Macmillan India Ltd., New Delhi. ISBN: 9781403925046						
R3	Andersen, V. Y. (2023). <i>Food Safety Management: A Practical Guide for the Food Industry</i> (2nd ed.).						
R4	ISO 22000:2018 - Food Safety Management Systems – Requirements for Any Organization in the Food Chain.						
R5	U.S. Food and Drug Administration (FDA). (2023). <i>Draft Guidance for Industry: Hazard</i>						

<i>Analysis and Risk-Based Preventive Controls for Human Food</i>	
COURSE OUTCOMES	
At the end of the course students should be able to	
CO 1	Evaluate the structure and processes of safety management systems
CO 2	Learn the history, importance, and concepts of food regulations.
CO 3	Gain the knowledge about food hazards and types
CO 4	Familiar with risk assessment and hygienic practices
CO 5	Apply the crisis management in food industries

COs	Mapping of Programme Outcomes / Programme Specific Outcomes													
	(1/2/3 indicates Correlation Levels) 1- Slight(Low) 2- Moderate (Medium) 3-Substantial (High)													
	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3	1	
CO2					3							2		
CO3			3									3	3	
CO4		2										2		
CO5				2					3			2	2	