Department: Food Technology
Curriculum Structure
(Effective from 2021-22 admission batch)

First Year First Semester

Sl.N	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	**2**	2
	B. PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering ScienceCourses	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I:Soft Skill	0	0	1	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	0	0	0
	TOTAL CREDIT							13.0

First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
5	Basic Science course	CH291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics & Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation and Yoga / Photography	0	0	2	2	0
	TOTAL CREDIT							21

2nd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	CH(FT)301	Chemistry-II	3	0	0	3	3
2	Engineering ScienceCourses	CH(FT)302	Environmental Engineering	3	1	0	4	4
3	Engineering ScienceCourses	FT301	Thermodynamics and Kinetics	3	1	0	4	4
4	Program Core Course	FT302	Food Microbiology	3	0	0	3	3
5	Program Core Course	FT303	Chemistry of Food	3	0	0	3	3
6	Humanities and SocialSciences including Management courses	HSMC303	Universal Human Values 2:Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Basic Science course	CH(FT)391	Chemistry-II Lab	0	0	3	3	1.5
8	Engineering ScienceCourses	CH (FT)392	Environmental EngineeringLab	0	0	3	3	1.5
9	Program Core Course	FT391	Chemistry of Food Lab–I	0	0	3	3	1.5
10	Program Core Course	FT392	Food Microbiology Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme Based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC381	Learning an Art Form [vocalor instrumental, dance, painting, clay modeling, etc.]OR Environmental Protection Initiatives	0	0	2	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							27
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS Course-I	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**31**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

2nd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	M(FT)401	Applied Statistics and Numerical Methods	2	1	0	3	3
2	PC	FT401	Biochemistry and Nutrition	4	0	0	4	4
3	PC	FT402	Principles of Food Preservation	3	0	0	3	3
4	PC	FT403	Microbial Technology and Food Biotechnology	4	0	0	4	4
5	PC	FT404	Food Process Technology–I (Cereals, Fruits, Vegetables, Beverages)	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	Engineering Science course	M(FT)491	Applied Statistics and Numerical Methods Lab	0	0	3	3	1.5
8	PC	FT491	Biochemistry Lab	0	0	3	3	1.5
9	PC	FT492	Chemistry of Food Lab-II	0	0	3	3	1.5
10	PC	FT493	Microbial Technology Lab	0	0	3	3	1.5
11	PROJECT	PR491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV: Soft Skill and Aptitude-I	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC401	Environmental Science	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							26
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**30**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

3rd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC505	Principles of Management	2	0	0	2	2
2	PC	FT501	Food Process Technology–II (Fish,Meat, Poultry)	3	0	0	3	3
3	PC	FT502	Food Process Technology–III (Milkand Milk Products)	3	0	0	3	3
4	PE	FT503A/B/C (Professional Elective I)	A. Principles of Biochemical Engineering	2	1	0	3	3
			B. Enzyme Technology	2	1	0	3	3
			C. Modeling and Simulation of Food Processing	2	1	0	3	3
5	PE	FT504A/B/C (Professional Elective II)	A. Fluid Mechanics and Heat Transfer	2	1	0	3	3
			B. Mass Transfer I	2	1	0	3	3
			C. Mechanical Operation andSeparation Process I	2	1	0	3	3
B. PRACTICAL								
6	PC	FT591	Food Processing Lab–I	0	0	3	3	1.5
7	PC	FT592	Food Analysis and Quality ControlLab-I	0	0	3	3	1.5
8	PE	FT593A/B/C (Professional Elective II Lab)	A. Fluid Mechanics and Heat Transfer Lab	0	0	3	3	1.5
			B. Mass Transfer I Lab	0	0	3	3	1.5
			C. Mechanical Operation andSeparation Process I Lab	0	0	3	3	1.5
9	PROJECT	PR591	Minor Project I	0	0	2	2	1
10	PROJECT	PR592	Skill Development V: Soft Skill and Aptitude-II	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
11	MC	MC501	Constitution of India	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D. MOOCS COURSES**								
12	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**24**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to betaken from MOOCS BASKET**

3rd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciencesincluding Management courses	HSMC604	Economics for Engineers	2	0	0	2	2
2	PC	FT601	Bakery, Confectionary and Extruded Foods	3	0	0	3	3
3	PC	FT602	Food Process Technology–IV (Edible Fats and Oils)	3	0	0	3	3
4	PE	FT603A/B/C (Professional Elective III)	A. Mass Transfer II	2	1	0	3	3
			B. Separation Process II	2	1	0	3	3
			C. Transport Phenomena	2	1	0	3	3
5	PE	FT604A/B/C (Professional Elective IV)	A. Food Additives	3	0	0	3	3
			B. Supply Chain Management and Food Marketing	3	0	0	3	3
			C. Food Security and Sustainability	3	0	0	3	3
6	OE	FT605A/B/C (Open Elective I)	A. Data Structure and Algorithms	2	1	0	3	3
			B. Data Base Management System	2	1	0	3	3
			C. Software Engineering	2	1	0	3	3
B. PRACTICAL								
7	PC	FT691	Food Processing Lab–II	0	0	3	3	1.5
8	PC	FT692	Food Analysis and Quality Control Lab-II	0	0	3	3	1.5
9	PE	FT693A/B/C (Professional Elective III Lab)	A. Mass Transfer Lab II lab	0	0	3	3	1.5
			B. Separation Process II Lab	0	0	3	3	1.5
			C. Transport Phenomena Lab	0	0	3	3	1.5
10	OE	FT694A/B/C (Open Elective I Lab)	A. Data Structure and Algorithms Lab	0	0	2	2	1
			B. Data Base Management System Lab	0	0	2	2	1
			C. Software Engineering Lab	0	0	2	2	1
11	PROJECT	PR691	Minor Project II	0	0	3	2	1
12	PROJECT	PR692	Skill Development VI: Soft Skill and Aptitude-III	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC601	Intellectual Property Right	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.0
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**28.0**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PC	FT701	Food Process Engineering	3	1	0	4	4
2	PE	FT702A/B/C (Professional Elective V)	A. Food Packaging Technology	3	0	0	3	3
			B. Functional Foods and Nutraceuticals	3	0	0	3	3
			C. Protein Technology	3	0	0	3	3
3	OE	FT703A/B/C (Open Elective II)	A. Process Instrumentation and Control	3	0	0	3	3
			B. Renewable Energy Technology	3	0	0	3	3
			C. Nanotechnology	3	0	0	3	3
4	OE	FT704A/B/C (Open Elective III)	A. Artificial Intelligence	3	0	0	3	3
			B. Machine Learning	3	0	0	3	3
			C. Introduction to Internet of Things	3	0	0	3	3
B. PRACTICAL								
5	PC	FT791	Food Engineering Lab	0	0	3	3	1.5
6	PROJECT	PR791	Major Project-I	0	0	4	4	2
7	PROJECT	PR792*	Industrial Training / Internship	0	0	0	0	1
8	PROJECT	PR793	Skill Development VII: Seminar and Group Discussion	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
9	MC	MC701	Entrepreneurship and Innovation Skill	2	0	0	2	0
TOTAL CREDIT WITHOUT MOOCS COURSES								18
D.MOOCS COURSES**								
10	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22**

*Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break &Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken fromMOOCS BASKET

4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	FT801A/B/C (Professional Elective VI)	A. Waste Management of Food Industries	3	1	0	4	4
			B. Project Engineering and Food Plant Layout	3	1	0	4	4
			C. Plant Maintenance, Safety and Hygiene	3	1	0	4	4
2	OE	FT802A/B/C (Open Elective IV)	A. Entrepreneurship Development and Start-Up Management	3	0	0	3	3
			B. Quality Management System	3	0	0	3	3
			C. Smart Technologies	3	0	0	3	3
B. PRACTICAL								
3	PROJECT	PR891	Major Project-II	0	0	12	12	6
4	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
5	MC	MC801	Essence of Indian Knowledge Tradition	2	0	0	2	0
TOTAL CREDIT								14

Total:

Total for FT	
Without MOOCS	**With MOOCS**
34	**34**
27	**31**
26	**30**
20	**24**
24	**28**
18	**22**
14	**14**
163	183 (for Honors/minor)

Credit Distribution

Subject Category	Subjects	Credit Distribution as per AICTE (%)	Suggested Breakup of Credits (Total 160) as per AICTE	
Humanities and Social Sciences including Management courses (HSMC)	**Humanities & Social Science:** (i)English (ii)Language / English Lab **Management courses** (i)Principle of Management, (ii)Economics for Engineers (iii)Values & Ethics in Profession	5 to 10%	**12**	**9+3** **5.63%**
Basic Sciences (BS)	**Physics** (i)Introduction to Electromagnetic Theory (ii)Introduction to Mechanics (iii)Quantum Mechanics for Engineers (iv)Oscillation, Waves and Optics (v)Semiconductor Optoelectronics (vi)Semiconductor Physics	**15 to 20%**	**25**	**24.5** **15.3%**
	Chemistry & Biology (i)Chemistry – I (Concepts in chemistry for engineering) (ii)Chemistry Laboratory **Elective Courses** (i)Chemistry-II (Chemical Applications) (ii)Polymer Chemistry (iii)Experiments in Polymer Chemistry **Biology**			
	Mathematics **(i)Mathematics (Option 1)**			

	Mathematics 1 Mathematics 2 Mathematics 3 **(ii)Mathematics (Option 2)** (for CSE students)			
Engineering Sciences and Skills (ES)	(i)Workshop / Manufacturing Practice (ii)Drawing / Engineering Graphics & Design, (iii)Basics of Electrical (iv)Computer / Programming for Problem Solving (v) Numerical Methods (vi) Circuit theory	15 to 20%	**24**	**23** **14.38%**
Professional core courses (PC)	Courses relevant to chosen branch	30 to 40%	**48**	**51** **31.88%**
Professional Elective	Elective courses relevant to chosen specialization/branch	10 to 15%	**18**	**23.5** **13.75%**
Open Elective	Elective Courses from other technical programs and /or **emerging subjects**: 1.Artificial Intelligence (AI) 2. Internet of Things (IoT) 3. Block Chain 4. Robotics 5. Quantum Computing 6. Data Sciences 7. Cyber Security 8. 3D Printing and Design 9. Virtual Reality (VR)	5 to 10%	**18**	**13** **8.13%**
Project work, seminar and internship in industry or elsewhere	(i) PROJECT (PR....91): Project work (ii) PROJECT (PR....92): (iii) PROJECT (PR ...93): (iv)Grand Viva - 1	10 to 15%	**15**	**17.5** **10.94%**
Mandatory Courses [Environment	**MC Courses:** (i)Environmental Science, (ii)Foreign language,	**No Credit Course**	Minimum 2 units per semester min.	

al Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	(iii)Constitution of India (iv)Behavioral & Interpersonal skills (v)Essence of Indian Knowledge Tradition **&others as mentioned in AICTE guidelines** **MC Activities:** (i)Induction Programming (ii)NSS/NCC/Yoga (iii)Technical Lecture Presentation **&others as mentioned in AICTE guidelines**		Max: 28 Units/Program	

Summary

Sub	Credit	%	AICTE %
HSMC	9	5.63	5to10
BSHU	24.5	15.3	15to20
ES	23	14.38	15to20
PC	51	31.88	30to40
PE	22	13.75	10to15
OE	13	8.13	5to10
Project	17.5	10.94	10to15
	160	100.00	

Professional Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)				
	Option 1	**Option 2**	**Option 3**	**Option 4**
Professional Elective I	A. Principles of Biochemical Engineering	B. Enzyme Technology	C. Modeling & Simulation of Food Processing	
Professional Elective II	A. Fluid Mechanics & Heat Transfer	B. Mass Transfer I	C. Mechanical Operation and Separation Process I	
Professional Elective III	A. Mass Transfer II	B. Separation Process II	C. Transport Phenomena	
Professional Elective IV	A. Food Laws and Standards	B. Food Supply Chain Management	C. Food and Consumer Studies	
Professional Elective V	A. Food Packaging Technology	B. Functional Foods & Nutraceuticals	C. Protein Technology	
Professional Elective VI	A. Waste Management of Food Industries	B. Project Engineering and Food Plant layout	C. Plant Maintenance, Safety and Hygiene	

Open Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)				
	Option 1	**Option 2**	**Option 3**	**Option 4**
Open Elective I	A. Data Structure and Algorithms	B. Data Base Management System	C. Software Engineering	
Open Elective II	A. Process Instrumentation and Control	B. Renewable Energy Technology	C. Nanotechnology	
Open Elective III	A. Artificial Intelligence	B. Machine Learning	C. Introduction to Internet of Things	
Open Elective IV	A. Entrepreneurship Development and Start-Up Management	B. Quality Management System	C. Smart Technologies	

Major/Honors programme for Dept. of Food Technology in R21 regulations

Program Name: Major/Honors in BIOPROCESSES

CURRICULUM

Sl.	Course Code	Course Name	Typ	Credi
1	HMFT001(BP)	Aspects of Biochemical Engineering	CC	3
2	HMFT002(BP)	Downstream Processing	CC	3
3	HMFT003(BP)	Material and Energy Balances	CC	3
4	HMFT004(BP)	Transport Phenomena in Biological Systems	CC	3
5	HMFT005(BP)	Thermodynamics for Biological Systems : Classical and Statistical Aspect	OC	3
6	HMFT006(BP)	Experimental Biotechnology	OC	3
7	HMFT007(BP)	Fundamental of Fluid Mechanics for Chemical and Biomedical Engineers	OC	3
8	HMFT008(BP)	Environmental Biotechnology	OC	3
9	HMFT009(BP)	Genetic Engineering: Theory and Application	OC	3

CC=> COMPULSORY COURSE

OC=> OPTIONAL COURSE

1. Students from B.Tech. in FT can follow this curriculum for a **Major/Honors** degree.
2. Students from any program not offering a major can follow this curriculum for a **Minor** degree.
3. Students can take the courses in order of their preference.
4. If any course(s) is(are) already taken by the student in their program curriculum, then the Computer Science department will suggest a different course in lieu of that, which has to be accepted by the students.
5. Students must take the courses from the **SWAYAM platform** and transfer the credit.
6. Courses in **Sl. No 1 to 4** are **compulsory courses,** which are to be taken on a **mandatory** basis.
7. Courses in **Sl. No. 5 to 9** are **optional courses,** and students must select the required number of courses to make the total credit a **minimum of 18** (including the credits of compulsory courses).
8. **A minimum of 18 credits are required for the Major/Minor Degree**.
9. Any syllabus proposed by the SWAYAM platform for any course is accepted.
10. Students must complete the courses taken from the SWAYAM platform and submit the completion certificate to the Department for the requisite Degree.
11. **Students are advised to check the credit of the course before enrolling the course.**

Program Name: Major/Honors in ENERGY AND ENVIRONMENT

CURRICULUM

Sl.	Course Code	Course Name	Typ	Credi
1	HMFT001(EE)	Environmental Quality Monitoring & Analysis	CC	3
2	HMFT002(EE)	Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems	CC	3
3	HMFT003(EE)	Basic Environmental Engineering and Pollution Abatement	CC	3
4	HMFT004(EE)	Energy conservation and waste heat recovery	OC	3
5	HMFT005(EE)	Biomass Conversion and Biorefinery	OC	3
6	HMFT006(EE)	Physico-chemical processes for wastewater treatment	OC	3
7	HMFT007(EE)	Hydrogen Energy: Production, Storage, Transportation and Safety	OC	3
8	HMFT008(EE)	Ecology and Environment	OC	2
9	HMFT009(EE)	Technologies for clean and renewable energy production	OC	2

CC=> COMPULSORY COURSE

OC=> OPTIONAL COURSE

1. Students from B.Tech. in FT can follow this curriculum for a **Major/Honors** degree.
2. Students from any program not offering a major can follow this curriculum for a **Minor** degree.
3. Students can take the courses in order of their preference.
4. If any course(s) is(are) already taken by the student in their program curriculum, then the Computer Science department will suggest a different course in lieu of that, which has to be accepted by the students.
5. Students must take the courses from the **SWAYAM platform** and transfer the credit.
6. Courses in **Sl. No 1 to 3** are **compulsory courses,** which are to be taken on a **mandatory** basis.
7. Courses in **Sl. No. 4 to 9** are **optional courses,** and students must select the required number of courses to make the total credit a **minimum of 18** (including the credits of compulsory courses).
8. **A minimum of 18 credits are required for the Major/Minor Degree**.
9. Any syllabus proposed by the SWAYAM platform for any course is accepted.
10. Students must complete the courses taken from the SWAYAM platform and submit the completion certificate to the Department for the requisite Degree.
11. **Students are advised to check the credit of the course before enrolling the course.**

Program Name: Major/Honors in BIOSCIENCES

CURRICULUM

Sl. No.	Course Code	Course Name	Type	Credits
1	HMFT001(BS)	Biochemistry	CC	3
2	HMFT002(BS)	Structural Biology	CC	3
3	HMFT003(BS)	Basics of Biology	CC	3
4	HMFT004(BS)	Introduction to Cell Biology	CC	2
5	HMFT005(BS)	Experimental Biochemistry	OC	3
6	HMFT006(BS)	Genetic Engineering: Theory and Application	OC	3
7	HMFT007(BS)	Introduction to proteomics	OC	2
8	HMFT008(BS)	Environmental Biotechnology	OC	3
9	HMFT009(BS)	Introduction to Developmental Biology	OC	3

CC=> COMPULSORY COURSE
OC=> OPTIONAL COURSE

1. Students from B.Tech. in FT can follow this curriculum for a **Major/Honors** degree.
2. Students from any program not offering a major can follow this curriculum for a **Minor** degree.
3. Students can take the courses in order of their preference.
4. If any course(s) is(are) already taken by the student in their program curriculum, then the Computer Science department will suggest a different course in lieu of that, which has to be accepted by the students.
5. Students must take the courses from the **SWAYAM platform** and transfer the credit.
6. Courses in **Sl. No 1 to 4** are **compulsory courses,** which are to be taken on a **mandatory** basis.
7. Courses in **Sl. No. 5 to 9** are **optional courses,** and students must select the required number of courses to make the total credit a **minimum of 18** (including the credits of compulsory courses).
8. **A minimum of 18 credits are required for the Major/Minor Degree**.
9. Any syllabus proposed by the SWAYAM platform for any course is accepted.
10. Students must complete the courses taken from the SWAYAM platform and submit the completion certificate to the Department for the requisite Degree.
11. **Students are advised to check the credit of the course before enrolling the course.**

Department: Food Technology
Curriculum Structure & Syllabus
(Effective from 2021-22 admission batch)

1st Year 1st Semester

Sl.N	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	**2**	2
	B. PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering ScienceCourses	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	0	0	
	TOTAL CREDIT							13.0

PAPER NAME: PHYSICS –I
PAPER CODE: PH101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students' should be able to

CO1: describe various types of mechanical resonance and its electrical equivalence

CO2: explain basic principles of Laser, Optical fibers and Polarization of light

CO3: apply superposition principle to explain interference and diffraction

CO4: analyze different crystallographic structures according to their co-ordination number and packing factors

CO5: justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:

Module 1 (5L):-
Waves &Oscillations:-
Simple Harmonic Motion (Recap), superposition of waves, damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 5L

Module 2 (12L):-
Classical Optics:
2.01- Interference of light: Huygens's principle, conditions of sustained interference, classification of interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, related numerical problems. 4L

2.02-Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, double slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems. 4L

2.03-Polarization: Definition, Plane of polarization, Plane of vibration, Malus Law, Fundamental concepts of plane, circular & elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: Ordinary & Extra ordinary rays, positive and negative crystal, Nicol's prism, Numerical problems
4L

Module 3 (8L):-
Quantum Mechanics-I
Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. Introduction of Schrödinger wave equation (only statement).

4L

Module 4 (3L):-
Solid State Physics-I:
4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L

Module 5 (8L):
Modern Optics-I:
5.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 5L

5.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L

Recommended Text Books for Physics I (PH101):

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder &B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder &B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal&Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book& Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. PhysicalOptics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuila(S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

**Total marks of the questions set from each module should be in proportion to the number of lectures allotted.

Project Domains

1. Study of Superposition of waves: Lissajous figures.

2. Electrical analogue of mechanical vibrations: application to electrical circuit (LC and LCR circuits), Electrical and mechanical impedance, quality factor, complex representation and phasor diagram.

3. Study of N-slit diffractions

4. Optical Fiber & its applications: Study of losses, estimation of numerical aperture in practical problems.

5. Photonic nature of electromagnetic waves

6. Optical Rotation

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	3	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	1		-
CO4	2	3	-	-	-	-	-	-	-	-	-	2	2	3	-
CO5	2	3	-	-	-	-	-	-	-	-	-	2			-
Overall Mapping	2.6	2.66										2	**2.25**	**2.67**	-

COURSE NAME: MATHEMATICS-I
COURSE CODE: M101
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDITS: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, calculus, and vector algebra.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO2: Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO3: Apply the appropriate mathematical tools of matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra, differential calculus, multivariable calculus, vector calculus.

Course Content:

Module I: Matrix Algebra
11L

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series **10L**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Leibnitz's Test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) **13L**

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian. Maxima and minima of functions of two variables, Method of Lagrange multipliers.

Module IV: Multivariable Calculus (Integration)
6L

Line Integral, Double Integral, Triple Integral, Change of order in multiple integrals, Change of variables in multiple integrals.

Module V: Vector Calculus
8L

Gradient, Directional derivatives, Divergence, Curl, vector line integrals, vector surface integrals, vector volume integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Project Domain:

1. Study on eigen values and eigenvectors.
2. Study on convergence of infinite series.
3. Application of partial derivatives.
4. Application of vector calculus
5. Application of integral calculus.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO-PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3	-	-
CO4	2	3	2	2	-	-	-	-	-	-	-	2	1	-	2
Overall Mapping	2.75	2.25	2	2								2	2		2

COURSE NAME: PROFESSIONAL COMMUNICATION
COURSE CODE: HSMC101
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDITS: 2

Pre-requisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Outcomes (COs):

After attending the course students' should be able to

CO1: apply the modalities and nuances of communication in a workplace context.

CO2: analyze communication across cultures and societies.

CO3: apply the basic formats, templates of business and official communication.

CO4: employ formal communication modes in meetings and reports.

CO5: justifyimportance of culturally neutral language in interpersonal and business communication.

Course Content:

Module- 1:Verbal and Non-verbal communication **4L**

: Definition, Relevance and Effective Usage

: Components of Verbal Communication: Written and Oral Communication

: Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage

: Barriers to Effective Communication

Module- 2: Social Communication Essentials and Cross-Cultural Communication **6L**

: Communication in Society and the Workplace

: Greetings, Courtesies and Socially Useful Language

: Cultural Contexts: High Context and Low Context Cultures

2.4: Understanding Cultural Nuances and Stereotyping

2.5: Achieving Culturally Neutral Communication in Speech and Writing

Module- 3: Meetings **4L**

: Meetings: Nature and Types

: Conducting Meetings: Organization and Procedures

: Meeting Coordination: Roles of Chairpersons and Members

3.4: Notice and Agenda for a Meeting

3.5: Preparing the Minutes of a Meeting (MOM)

Module- 4: Report Writing **4L**

4.1: Nature and Function of Reports

4.2: Types of Reports

4.3: Researching for a Business Report

4.4: Format, Language and Style

4.5: Report Documentation

Module 5: Employment Communication **6L**

: Writing Business Letters- (Enquiry, Order, Sales, Complaint, Adjustment, Job Application,Offer)

: Preparing a CV or Rẽsumé

: Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)5.4: Writing E-mails: types, convention, and etiquette

: Memo, Notices and Circulars

: Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Text Books & Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. *Technical Communication*. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. *Cambridge English for Engineering*. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. *Professional English in Use: Engineering*. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. *Business Communication: Connecting in a Digital World*. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. *Writing Reports*. Oxford: Oxford University Press, 2002.
6. Judith Leigh. *CVs and JobApplications*. Oxford: Oxford University Press, 2002.
7. Judith Leigh. *Organizing and Participating in Meetings*. Oxford: Oxford University Press, 2002.
8. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking.* 8th ed. London: Longman, 2001.
10. Diana Booher. *E-writing: 21st Century Tools for Effective Communication*.

Links:

1. Purdue University's Online Writing Lab (OWL)-https://owl.purdue.edu/
2. Business English Pod-https://www.businessenglishpod.com/

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	2	-	-	3	-	2	1	2	1
CO2	2	3	2	-	-	2	2	2	-	3	-	3	2	2	1
CO3	2	3	-	-	-	3	3	3	-	3	-	3	2	1	2
CO4	-	-	-	-	-	3	3	3	-	3	-	3	2	1	2
CO5	-	-	-	-	-	-	3	3	-	3	-	3	1	2	2
Overall mapping	2	3	2			2.67	2.6	2.75		3		3	1.6	1.6	1.6

PAPER NAME: PHYSICS I LAB
PAPER CODE: PH191
CONTACT HOURS: 0:0:3
CREDIT: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students' will be able to

CO1 : demonstrate experiments allied to their theoretical concepts

CO2 : conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer

CO3 :participateas an individual, and as a member or leader in groups in laboratory sessions actively

CO4 :analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Any 6 to be performed from the following experiments

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)
3. Determination of Q factor using LCR Circuit.
4. Calibration of an oscillator using Lissajous Figure.

Experiments on Classical Optics:
5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. To determine the angle of optical rotation of a polar solution using polarimeter

Experiments on Quantum Physics-I:
8. Determination of Planck's constant using photoelectric cell.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Stefan's Constant

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment

Probable experiments beyond the syllabus:
1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.

5. Measurement of nodal and antipodal points along transmission wire and measurement of wavelength.
6. Any other experiment related to the theory**.**

Recommended Text Books for Physics I Lab (PH291):

Waves & Oscillations:
1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder &B.Ghoshs (Book & Allied Publisher)

Quantum Mechanics-I
1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics-I:
1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:
1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	1	1	2
CO2	2	2	-	3	-	-	-	-	-	-	-	2	1	1	1
CO3	2	2	-	-	-	-	-	-	3	-	-	2	2	1	1
CO4	2	2	-	-	-	-	-	-	-	3	-	2	1	2	3
Overall Mapping	2.25	2		3					3	3		2	1.25	1.25	1.75

COURSE NAME: WORKSHOP AND MANUFACTURING PRACTICESCOURSE CODE: ME191
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify and operate various hand tools related to variety of manufacturing operations

CO2: Safely fabricate simple components with their own hands.

CO3: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO4: Produce small devices of their interest in project or research purpose.

Course Content:

(i) Theoretical discussion & videos: 3P

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting

(ii) Workshop Practice:

Module 1 - Machine shop 6P

Typical jobs that may be made in this practice module:

i. To make a pin from a mild steel rod in a lathe.

ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop 6P

Typical jobs that may be made in this practice module:

i. To make a Gauge from MS plate.

Module 3 - Carpentry 6P

Typical jobs that may be made in this practice module:

i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) 3P

Typical jobs that may be made in this practice module:

i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metalarcwelding.

ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics 3P

House wiring, soft Soldering

Module 6 – Smithy **3P**

Typical jobs that may be made in this practice module:

i. A simple job of making a square rod from a round bar or similar.

For further study (Optional)

Module 7 - Casting **3P**

Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding& Glass Cutting **3P**

Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	3	2	-	2	2	2	3	2	1	1
CO2	2	2	3	2	2	2	2	-	3	2	2	3	3	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2	3	3	3	3
CO4	2	2	3	2	3	3	2	-	3	3	3	3	3	3	3
Overall Mapping	2.25	2	2.5	2	2.25	2.5	2	2	2.5	2.25	2.25	3	2.75	2.25	2.25

1st Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
5	Basic Science course	CH291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics and Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation and Yoga / Photography	0	0	2	2	
	TOTAL CREDIT							21

COURSE NAME: CHEMISTRY
COURSE CODE: CH201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Pre requisites: A basic knowledge in 10+2 science with chemistry

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table

CO2: Apply fundamental concepts of thermodynamics in different engineering applications.

CO3: Apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4: Determine the structure of organic molecules using different spectroscopic techniques.

CO5: Evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

Course Content

Module- I: Inorganic Chemistry
9L

(i) Atomic structure 5L

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties
4L

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry
8L

(i) Use of free energy in chemical equilibria 6L

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Real Gases
2L

Reason for deviation of real gases from ideal behavior, Equations of state of real gases,Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry **8L**

(i) Stereochemistry **4L**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L& cis trans), racemisation.

(ii) Organic reactions **4L**

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction).

Module IV: Industrial Chemistry
8L

(i) Water **2L**

Hardness, alkalinity, numerical

(ii) Corrosion. **2L**

Types of corrosion: wet & dry, preventive measures

(iii) Polymers **3L**

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Synthesis of a commonly used drug molecule. **1L**

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3L**

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
4. Physical Chemistry, by P. W.Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Editionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

Project Domain

1. Application of Thermodynamics
2. Application of polymers in daily life
3. Nanomaterials and its applications
4. Determination of water quality parameters
5. Electronic storage devices

6. Managing E –wastes
7. Application of chemistry in core engineering
8. Application of spectroscopy in medical field
9. Applications of green chemistry
10. Merits of commercial organic products
11. Bioplastics
12. Any other related topics

CO-PO-PSO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	-	-	-	-	2	2	2	2	2	-	-
CO2	3	3	3	3	-	-	-	-	2	2	2	3	1	1	-
CO3	3	3	2	2	-	2	2	-	2	-	3	3	1	1	-
CO4	3	2	3	2	-	-	2	-	2	2	3	3	-	-	-
CO5	3	3	3	3	2	2	2	-	2	-	2	3	1	-	-
Overall Mapping	3	2.6	2.6	2.4	2	2	2		2	2	2.4	2.8	1.25	**1**	

COURSE NAME: MATHEMATICS-II
COURSE CODE: M201
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) calculus.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.

CO2: Determine the solutions of the problems related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.

CO3: Apply appropriate mathematical tools of ordinary differential equations, improper integral, Laplace transform and numerical techniques for the solutions of the problems.

CO4: Analyze engineering problems by using differential equation, Laplace Transform and Numerical Methods.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE): 10L

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE): 10L

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear ODEs.

Module III: Laplace Transform (LT): 14L

Improper integrals; Beta and Gamma functions and their properties.
Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods 14L

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Project Domains:

1. Mathematical modeling using ODE.
2. Application of ODE.
3. Application of Laplace Transform in different engineering branches.
4. Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-II, New age International Publishers
7. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.
6. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education(India) Private Limited.
7. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International Publishers

CO-PO-PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3	-	-
CO4	2	3	2	2	-	-	-	-	-	-	-	2	1	-	2
Overall Mapping	2.75	2.25	2	2								2	2		2

COURSE NAME: BASIC ELECTRICAL ENGINEERING
COURSE CODE: EE201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcomes (COs):

After attending the course students would be able to

CO1: understand and analyze basic electric circuits

CO2: study the working principles of electrical machines.

CO3: introduce the components of low voltage electrical installations

CO4: study the fundamentals of electrical Power systems and Control Systems

Course Content

Module- I: DC Circuits
8L

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff ‘s laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin‘s Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module- II: AC Fundamentals
8L

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module- III: Electrical Machines
10L

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Auto-transformer and three-phase transformer connections.

Rotating Machines - DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation. Three-Phase Induction Motor: Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module- IV: Electrical Installations **3L**

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module- V: Fundamentals of Power Systems **5L**

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems). Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service mains.

Module- VI: Introduction to Control Systems **2L**

Concept control systems, Objectives of control system, Types of control systems, Real examples of control systems.

Text books:

A. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
1. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
3. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

CO-PO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	-	-	-	-	-	-	-	-	1	3	3	2
CO2	1	2	2	-	-	-	-	-	-	-	-	1	3	-	1
CO3	-	2	2	-	-	-	-	-	-	-	-	2	3	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-	1	3	2	2
Overall Mapping	1	2	2									1.25	3	2.5	1.75

COURSE NAME: PROGRAMMING FOR PROBLEM SOLVING
COURSE CODE: CS201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs): After completion of the course students would be able to

CO1: Understand the fundamental concept of Computer and mathematical knowledge and apply them in designing solution to engineering problem.

CO2: Understand the basic concept of C programming and use of data types/operators/input/output function for developing and implementing complete program leading to solution of mathematical and engineering problem.

CO3: Use conditional branching, iteration, recursion and formulate algorithms and programs in solving mathematical/ scientific/ engineering problem leading to lifelong learning.

CO4: Understand the concept of arrays, pointers, fileand dynamic memory allocation and apply it for problem solving and also create new data types using structure, union and enum.

CO5: Understand how to decompose a problem into functions and assemble into a complete program by means of modular programming possibly as a team.

Course Content:

Module-1: Fundamentals of Computer
9L

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.
Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using1'scomplementand2'scomplement).
Representation of Characters-ASCII Code
Basics of Compiler, Interpreter and Assembler
Problem solving – Basic concept of Algorithm. Representation of algorithm using flow chart and pseudo code. Some basic examples.

Module-2: Introduction to C Programming **5L**

Overview of Procedural vs Structural language; History of C Programming Language.
Variable and Data Types: The C characterse identifiers
And keywords, data type & sizes, variable names, declaration, statements.
Operators & Expressions: Arithmetic operators,relational operators, logical operators, increment anddecrementoperators,bitwiseoperators,assignmentoperators,conditionaloperators,specialoperators-typeconversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output–print f,formatted input scan f.

Module-3: Branch and Loop 5L

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder.
Switch Case: break andcontinue; switch-case, concept of goto and labels
Loops - while, for, do while

Module-4: Program Structures
4L

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.
Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables
C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer 7L

Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function
Pointers: Pointers, Pointer andArray, Pointer and functions.
Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String.
Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum
3L

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C
3L

Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15thEdition

ReferenceBooks:

1. **Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India**
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO-PSO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	1	-	2
CO5	2	2	2	2	-	-	-	-	3	2	-	-	-	-	-
Overall Mapping	2.4	2.4	2.4	2.2	2.5				3	2		3	2		2

COURSE NAME: CHEMISTRY LAB
COURSE CODE: CH291

CONTACT: 0:0:3
CREDITs: 1.5

Pre-requisite: A basic knowledge in 10+2 science with chemistry.

Course Outcomes (COs):

After attending this course, students would be

CO1: able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CO2: able to analyze and determine the composition of liquid and solid samples working as an individualand also as a team member.

CO3: able to analyze different parameters of water considering environmental issues.

CO4: able to synthesize drug and polymer materials.

CO5: Capable to design innovative experiments applying the fundamentals of chemistry.

Course Content:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Determination of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductometric tritration
7. pH metric titrations
8. Synthesis of a polymer/drug
9. Saponification/acid value of an oil
10. Chemical analysis of a salt
    Chemical oscillations- Iodine clock reaction
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Estimation of iron in Mohr's salt solution by permanganometry (Redox Titration)
14. Innovative experiments (any one)
    - Synthesis of silver nano-particles
    - Green synthesis

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	2	3	-	-	-	-	2	2	1	-
CO2	2	2	2	2	-	2	-	-	-	2	-	2	1	-	-
CO3	-	-	-	-	-	-	-	-	3	3	2	2	-	1	-
CO4	2	2	2	2	-	-	2	-	-	-	-	2	1	-	-
CO5	3	3	3	3	2	2	2	2	-	-	2	2	2	1	-
Overall Mapping	2.25	2.25	2.5	2.25	2	2	2.33	2	3	2.5	2	2	1.5	1	

COURSE NAME: PROFESSIONAL COMMUNICATION LAB
COURSE CODE: HSMC291
Contact: 0:0:2
CREDIT: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Outcomes (COs):

After attending the course students' would be

CO1: Able to explain advanced skills of Technical Communication in English through Language Laboratory.

CO2: Able to apply listening, speaking, reading and writing skills in societal and professional life.

CO3: Able to demonstrate the skills necessary to be a competent Interpersonal communicator.

CO4: Able to analyze communication behaviours.

CO5: Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module- 1: Introduction to the Language Lab

a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module- 2: Active Listening

a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module- 3: Speaking

a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Business Meetings and Sales Talks

Module- 4: Lab Project Work

a. Making a brief Advertisement video (1-2 minutes)
b. Making a brief Business Documentary film (5-7 minutes)
c. Client interaction video (5-7 minutes)
d. Making a short video CV (1-2 minutes)

References:

1. IIT Mumbai, Preparatory Course in English syllabus
2. IIT Mumbai, Introduction to Linguistics syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	2	-	-	3	-	2	1	-	1
CO2	2	3	2	-	-	2	2	2	-	3	-	3	2	1	-
CO3	2	3	-	-	-	3	3	3	-	3	-	3	-	-	1
CO4	-	-	-	-	-	3	3	3	-	3	-	3	2	-	2
CO5	-	-	-	-	-	-	3	3	-	3	-	3	1	2	-
Overall Mapping	2	3	2			2.66	2.6	2.75		3		2.8	1.5	1.5	1.33

COURSE NAME: BASIC ELECTRICAL ENGINEERING LABORATORY
COURSE CODE: EE291
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify and use common electrical components.

CO2: To develop electrical networks by physical connection of various components and analyze the circuit behavior.

CO3: Apply and analyze the basic characteristics of transformers and electrical machines.

List of Experiments

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	-	-	1	-	-	1	2	-	1
CO2	-	2	2	2	-	-	-	-	2	-	-	1	-	2	-
CO3	-	2	-	2	-	-	-	-	2	-	-	1	1	-	1
Overall Mapping		2	2	2					1.66			1	1.5	2	1

COURSE NAME: ENGINEERING GRAPHICS AND DESIGNLAB

COURSE CODE: ME292
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes (COs):

After attending the course students would

CO1: get introduced with Engineering Graphics and visual aspects of design.

CO2: know and use common drafting tools with the knowledge of drafting standards.

CO3: be able to apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

CO4: be able to produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,
CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House

2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House

2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	-	2	2	2	2	2	1	1
CO2	2	2	3	2	2	2	2	2	2	2	2	2	3	2	2
CO3	2	2	3	2	3	2	2	-	2	2	2	3	3	3	3
CO4	2	2	3	3	3	3	2	2	3	3	2	2	3	3	3
Overall Mapping	2	2	3	2.25	2.5	2.25	2	2	2.25	2.25	2	2.25	2.75	2.25	2.25

COURSENAME: PROGRAMMING FOR PROBLEM SOLVING LAB
COURSE CODE: CS291
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs):

After completion of the course students would be able to

CO1: Understand and propose appropriate command or function in running system or developing program for engineering and mathematical problems depending on the platform used even in changed environment leading to their lifelong learning.

CO2: Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.

CO3: Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.

CO4: Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem.

CO5: Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using **switch-case** statement
b) How to write a function and passing values to a function
c) How to write a **recursive function.**

Module-6: Problem based on

a) How to use **array (both I-Dand2-D).**
b) How to pass an **array** to a **function.**

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variables in C
b) How to handle file in C
c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15thEdition

ReferenceBooks:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO-PSO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	3	3	-	-	-	3	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	1	-	2
CO5	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-
Overall Mapping	3	3	3	2.75	3			3	3	3		3	2		2

2nd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	CH(FT)301	Chemistry-II	3	0	0	3	3
2	Engineering ScienceCourses	CH(FT)302	Environmental Engineering	3	1	0	4	4
3	Engineering ScienceCourses	FT301	Engineering Thermodynamics and Kinetics	3	1	0	4	4
4	Program Core Course	FT302	Food Microbiology	3	0	0	3	3
5	Program Core Course	FT303	Chemistry of Food	3	0	0	3	3
6	Humanities and SocialSciences including Management courses	HSMC303	Universal Human Values 2:Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Basic Science course	CH(FT)391	Chemistry-II Lab	0	0	3	3	1.5
8	Engineering ScienceCourses	CH (FT)392	Environmental Engineering Lab	0	0	3	3	1.5
9	Program Core Course	FT391	Chemistry of Food Lab–I	0	0	3	3	1.5
10	Program Core Course	FT392	Food Microbiology Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme Based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC381	Learning an Art Form [vocalor instrumental, dance, painting, clay modeling, etc.]OR Environmental Protection Initiatives	0	0	2	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							27
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS Course-I	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**31**

THEORY

Paper Name: Chemistry-II

Paper Code: CH(FT)301

Contact: L-T-P=3-0-0

Total Contact Hours: 36

Credit: 3

Pre requisites: 10+2 science with chemistry

Course Objective:

Understanding of the fundamental theories and applications of the concepts of Dilute solutions , Colligative properties and Ionic Equilibrium and to get an insight into Instrumental Methods of Spectral Analysis. Learning about the Structure reactivity of the Organic molecules, Co-ordination chemistry and Colloid Chemistry.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand fundamental concepts of Dilute solutions, Colligative properties and Ionic Equilibrium in different engineering applications.
CO2: Analyze the Structures of the molecules by the different spectral techniques.
CO3: Synthesize Colloid Systems and emulsions.
CO4: Apply the basic concept of Organic Chemistry and knowledge of chemical kinetics to industrial and technical fields.
CO5: Analyze different types of co-ordination compounds and their structures with the help of Crystal Field Theory**.**

Course Contents:

Module I (8L): Dilute solutions – Colligative properties

Raoult's law, Lowering of vapor pressure of solution, elevation of boiling point, freezing point depression, definition, principles, and laws of osmotic pressure.

Ionic equilibrium: Solubility and solubility product, common ion effect, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer.

Module II (6L): Spectroscopy and Photochemistry

UV, IR and NMR spectroscopy: Basic concepts and applications

Lambert's law and Beer's Law, Laws of photochemistry, Photochemical processes, Phosphorescence, Chemi luminescence.

Module III (8L):

Coordination Chemistry

Double salt, Complex salt, Werner's Theory, Structures of coordination compounds corresponding to coordination number 6; types of ligands; Elementary idea about Crystal Field Theory (CFT), isomerism (geometrical, optical, ionization, linkage and coordination).

Colloid Chemistry

Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of colloid and emulsion.

Module IV (10L):

Basic concept of organic molecules, tetra covalency of carbon, hybridization, electronic effects.

General treatment of reaction mechanisms: Ionic and radical reactions; heterolytic and, homolytic bond cleavage.

Reactive intermediates: carbocations (cabenium and carbonium ions), carbanions, carbon radicals, carbenes: structure using orbital picture, electrophilic/nucleophilic behaviour, stability, generation and fate.

Nucleophilic substitution reactions: S_N1, S_N2, S_Ni mechanisms.

Addition reaction.

Elimination Reactions: E1, E2, and E1cB mechanisms. Saytzeff and Hofmann rules.Elimination vs substitution reaction.Electrophilic and Activated Nucleophilic substitution reactions of Benzene (Nitration, sulphonation, Halogenation and Friedel Craft reactions).

Chemistry and mechanism of some selective organic name reactions: Aldol condensation, Cannizaro reaction, Reimer-Teiman reaction, Pinacol-pinacolone rearrangement, Keto-enol tautomerism, Benzoin condensation, oxidation and reduction reactions.

Sterio chemistry : enantiomers, diastereomers, epimers

Revison: 4L

Text Books:

1. Physical Chemistry, P.C. Rakshit

2. Inorganic Chemistry, R.L. Dutta

3. Concept of Inorganic Chemistry, J.D.Lee

Reference Books:

1. Organic Spectroscopy, W. Kemp

2. A Guide book to Mechanism in Organic Chemistry, P. Sykes

CO-PO-PSO Mapping:

CO(S)	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO1 1**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	-	-	-	-	-	-	-	-	-	-	**3**	**2**	**1**
CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	2
CO3	-	-	2	-	2	-	-	-	-	-	-	1	3	2	2
CO4	2	-	1	-	2	-	-	-	-	-	-	-	3	3	3
CO5	2	-	-	-	-	-	2	-	-	-	-	1	3	2	3
Overall Mapping	2.5	1.5	2		**2**		2					1	3	2.2	2.2

Paper Name: Environmental Engineering

Paper Code: CH(FT)302

Contact: L-T-P=3-1-0

Total Contact Hours: 48

Credit: 4

Pre requisites: 10+2 science with chemistry

Course Objective:

Understanding of the fundamentals of environment and its relation with human activities. Learning the environmental laws and regulations to develop guidelines for health and safety issues. Acquiring skills to solve problems related to air, water noise and land pollutions.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the natural environment and its relationships with human activities and environmental management and protection.
CO2: Apply the fundamental knowledge of science and engineering to assess environment and health risk.
CO3: Understand environmental laws and regulations to develop guidelines and procedures for health and safety issues for sustainable development.
CO4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents:

Module I (12L): Importance of population study in environmental engineering, Mathematics of population growth: Exponential and Logistic growth methods and associated problems; Demography; Definition and type of resource; Sustainable Development.

Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function.

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function, Forest, Grassland, Aquatic, Mangrove ecosystem (special reference to Sundarbans); Food chain [definition and one example of each food chain], Food web, Importance of food chain: Bio magnification; Biogeochemical cycles: C, N, O, S, P cycles; Biodiversity: types,

importance, Endemic species, Biodiversity hotspots, threats and conservation of biodiversity.

Environmental management: EIA, Environmental audit, environmental laws and protection act of India, Different International environmental treaty/ agreement/ protocol.

Module II (12L): Air Pollution and Control

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant.

Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN.

Smog, Photochemical smog and London smog.

Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification.

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.

Anthropogenic degradation like Acid rain: cause, effects and control.

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation Inversion).

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smoke stack plumes and Gaussian plume model.

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

Module III (10L): Water Pollution and control

Hydrosphere, Hydrological cycle and Natural water.

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds.

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only), Darcy's law

Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition.

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic.

Module IV (6L): Land Pollution

Lithosphere; Internal structure of earth, rock and soil.

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, Recovery and disposal method: Open dumping, Land filling, incineration, composting, recycling.

Solid waste management and control (hazardous, biomedical waste and E-waste).

Module V (2L): Noise Pollution

Definition of Noise, effect of noise pollution, noise classification.

Definition of Noise frequency, noise intensity, noise threshold limit value, equivalent noise level, noise measuring index and related numerical.

Control measure of Noise pollution.

Revision:4L

Text Books:

1. Basic Environmental Engg. and Elementary Biology, Gourkrishna Das Mahapatra
2. Basic Environmental Engg. and Elementary Biology, Patra and Singha

Reference Books:

1. Basic Course in Environmental Studies, Deswal and Deswal

CO-PO-PSO Mapping:

CO(S)	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO1 1**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	3	-	-	-	3	-	-	-	2	2	**3**	**2**	**1**
CO2	-	-	1	-	**1**	-	-	-	-	-	-	-	3	2	2
CO3	2	-	2	-	2	-	**2**	-	-	-	-	-	3	2	2
CO4	-	-	2	-	-	**2**	**2**	-	-	-	-	-	3	3	3
Overall Mapping	2.5	2	2		1.5	**2**	**2.33**				**2**	2	3	2.25	2

Course Name: Engineering Thermodynamics and Kinetics

Course Code: FT301
Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Physics, Chemistry and Mathematics

Course Objective:

To introduce the principles of chemical engineering thermodynamics and illustrate their applications in the design of chemical process plants and to learn about reaction kinetics for single, multiple, isothermal, non-isothermal reactions

Course Outcome(s):

After completion of the course students will be able to:

CO1: Understand the basic concept to engineering thermodynamics and their applications in engineering field

CO2: Identify the phase equilibria in two-component and multi-component systems

CO3: Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture

CO4: Discover the concepts of order and molecularity of chemical reactions.

Course Contents:

Module I (11L): Review of 1^{st}, 2^{nd} and 3^{rd} law of thermodynamics; PVT behaviour of Pure Substances; Virial Equation of State, Generalized Correlations for Gases and Liquids; Application of the Virial Equations; Cubic Equations of State; The Nature of Equilibrium; The Phase Rule; Duhem's Theorem.

Module II (11L): Simple model's for vapour/liquid Equilibrium, Rault's Law, Henry's law, Modified Raoult's Law, Vapour Liquid Equilibrium, K-value correlations; VLE from Cubic Equations of State; Equilibrium and Stability; Liquid/liquid equilibrium; Solid/liquid equilibrium; Solid/vapour equilibrium.

Module III (11 L): Thermodynamics and its Applications: The Chemical Potential and Phase Equilibria Fugacity and Fugacity, Coefficient: for pure species and solution; Generalized correlations for Fugacity, the Ideal Solution, Property Changes and Heat Effects of Mixing Processes. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

Module IV (11 L): Kinetics: Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First and Second order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method.

Revision:4L

Text Book:

1. Smith &Vanness, Thermodynamics for Chemical Engineers, MGH

2. Richardson, J.F., Peacock, D.G.Coulson& Richardson's Chemical Engineering-Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd.1998

Reference Books:

1. Levenspiel.O., Chemical Reaction Engineering, Wiley EasternLtd.

2. Bailey & Olis, Biochemical Engg. Fudamentals, MGH,1990

3. Physical Chemistry: Castellan, NarosaPublishing.

4. Physical Chemistry ; Moore,PHI

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	2	-	-	-	-	2	2	1	3	3	3	3
CO2	3	3	2	2	1	1	2	-	2	2	2	3	3	2	2
CO3	3	3	2	2	2	2	1	2	2	2	2	3	3	2	2
CO4	3	3	1	2	-	-	-	-	2	2	1	3	3	2	3
Overall Mapping	3	3	1.75	2	1.5	1.5	1.5	2	2	2	1.5	3	3	2.25	2.5

Course Name: Food Microbiology

Course Code: FT302
Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Biology, Chemistry

Course Objective:

To familiarize students with procedures and techniques used to detect and enumerate microorganisms in foods and develop an understanding of spoilage microorganisms and their effects on food and integrate their basic knowledge of microbiology, chemistry, biochemistry, food processing.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Classify different types of microorganism which are present in the environment with special reference to food.
CO2: Describe the internal and external factors and predict growth of microorganisms, which can cause food spoilage.
CO3: Interpret the microbiology of various food materials and causes of food borne diseases and their etiology.
CO4: Evaluate the measures required to control undesired microorganisms in food based on the knowledge about disinfection and disinfectants.

Course Contents:

Module I (8L): Introduction – definition, significance of food microbiology; Microscope; Classification & morphology of microbes including pathogens and non pathogens; Techniques of pure culture; Bacterial growth kinetics; Bacteriology of water; Antimicrobial agents – physical & chemical – mechanism &action

Module II (8L): Disinfection & disinfectants; Thermal inactivation of microbes; Concept, determination & importance of TDT, F, Z & D values; Factors affecting heat resistance; Pasteurization and sterilization.

Module III (8L): Microbiology of milk & milk products like cheese, butter, Basic microbiology of meat, fish, poultry, prebiotics and probiotics

Module IV (8L): Microbiology of fruits & vegetable and products like jam, jelly, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary

Revision:4L

Text Book:

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers,Delhi
2. Food Microbiology; WC Frazier; Tata McGraw Hill,Delhi

Reference books:

1. Modern Food Microbiology; James M Jay; CBS Publishers,Delhi
2. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill,Delhi
3. Basic Food Microbiology; Bannett, Chapman andHall
4. Food Microbiology; M. R.Adams
5. Hand Book of Microbiology;Bisen

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	3	-	-	1	1	3	-	-	-	-	3	3	3	3
CO2	-	3	1	2	1	2	3	-	-	-	-	3	3	3	2
CO3	-	2	2	-	2	3	3	-	2	2	2	3	2	3	3
CO4	2	3	2	-	-	2	3	2	2	2	-	3	3	3	2
Overall Mapping	2	2.75	1.66	2	1.33	2	3	2	2	2	2	3	2.75	3	2.5

Course Name: Chemistry of Food

Course Code: FT303
Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Biochemistry

Course Objective

The main objectives of this course is for students to differentiate chemical interactions and reactions of food components and their effect on sensory, nutritional, and functional properties of foods, and how processing influences these properties.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Understand the structure and composition of different nutrients.
CO2: Interpret the chemistry underlying the properties and reactions of various food components and along with the function of the nutrients in different food materials.
CO3: Analyze how processing conditions are likely to change the reactivity of food components.
CO4: Apply fundamental concepts to know the principles behind analytical techniques associated with food.

Course Contents:

Module I (8L): Importance of food chemistry; Food Groups; Water in foods and its properties: different types of moisture in food; Water activity, Determination of moisture content, water absorption isotherm.

Carbohydrate: Sources of food carbohydrates; Classifications; Structure, Physico-chemical and functional properties: Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides, homosachharides and heterosachharides; Starch: Structure, sources, properties (hydrolysis, gelatinization, retrodradation, dextrinisation, crystallization); Glycogen: definition, properties, Cellulose, pectin, gums: Occurrences, properties, uses.

Module II (8L): Proteins: Sources, Basic structure and physico-chemical and functional properties: Amphoterism, hydration, binding of ions, precipitation with antibiotics, gel formation, Different types of food proteins. Purification of proteins (basic concepts): Electrophoresis, Gel filtration Spectrophotometric analysis, Chromatographic analysis.

Amino acids: Essential and non essential amino acids, their structures, deficiency diseases; Acidic and basic amino acids.

Module III (8L): Fats: Sources; Classifications; Fatty acids: Classifications with examples and structure (SAFA, MUFA, PUFA); Omega 3 and Omega 6 fatty acids.

Physico-chemical and functional properties; Rancidity: Definition, types of rancidity of fats and oils; Reversion of fats; Antioxidants: Definition, examples, roles; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Lipids of biological importance like cholesterol and phospholipids.

Module IV (8L): Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Provitamins A&D;Vitamins as antioxidants. Food Pigments & Flavouring Agent: Importance, types and sources of pigments (Chlorophyll,
carotenoids,anthocyanin,andflavonoids)−theirchangesduringprocessingandstorages.

Revision:4L

Text Book:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2
2. Food Chemistry by L. H.Meyer

Reference books:

1. Hand Book of Analysis of fruits & vegetables by S.Ranganna
2. Chemical changes in food during processing byRichardson
3. Food Science by Norman N. Potter & JosephH.Hotchkiss
4. Food Chemistry by H. K. Chopra & P. S.Panesar

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	2	1	-	-	-	-	3	3	2	2
CO2	3	3	3	2	1	2	1	1	2	1	2	3	3	2	2
CO3	3	3	3	3	2	2	2	1	2	2	1	3	3	2	2
CO4	3	3	2	2	2	2	2	2	2	2	1	3	3	3	2
Overall Mapping	3	2.75	2.66	2.33	1.66	2	1.5	1.33	2	1.66	1.33	3	3	2.25	2

Course Name: UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Course Code: HSMC303

Contacts: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre-requisite: None

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Develop holistic perspective based on self exploration about themselves (human being), family, society and nature/existence.

CO2: Cultivate the harmony in the human being, family, society and nature/existenc.

CO3: Strengthen self-reflection.

CO4: Build commitment and courage to act.

Course Content:

Module1: Course Introduction Need, Basic Guidelines, Content and Process for Value Education 8L

Self-Exploration–what is it? - Its content and process;'Natural Acceptance'and Experiential Validation-as the process for self-exploration. Continuous Happiness and Prosperity- Alookat basic Human Aspirations. Right understanding, Relationship and PhysicalFacility-
thebasicrequirementsforfulfilmentofaspirationsofeveryhumanbeingwiththeir correct priority. Understanding Happiness and Prosperity correctly-Acritical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility(livinginrelationship,harmonyandco-existence)ratherthanasarbitrarinessinchoicebasedonliking-disliking.

Module 2:Understanding Harmony in the Human Being-Harmonyi n Myself! 6L

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).Understanding the characteristics and activities of 'I' and harmony in 'I'.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Ensuring health vs dealing with disease discussion.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship 7L

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding them eaning of Trust; Difference between intention and competence. Understanding them eaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society(societybeinganextensionoffamily):Resolution,Prosperity,fearlessness(trust)andco-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society-Undivided Society,Universal Order-from family to world family. Practicesessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Elicit examples from students'lives.

Module 4: Understanding Harmony in the Nature and Existence-Whole existence asCoexistence 8L

Understanding the harmony in the Nature.Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.Practicesessions to discuss human being as cause of imbalance in nature (film "Home"canbe used),pollution, depletion of resources and role of echnology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics 7L

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for HumanisticEducation, Humanistic Constitution and Humanistic Universal Order.

Competence in professiona lethics:

a.Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b. At the level of society: as mutually enriching institutions and organizations.

Practice Exercises and Case Studies in Practice (tutorial) Sessions to discuss the conduct as an engineer or scientist etc.

Text Books:

1. HumanValuesandProfessionalEthicsbyRRGaur,RSangal,GPBagaria,ExcelBooks,NewDelhi,2010

Reference Books:

1. JeevanVidya:EkParichaya, ANagaraj,JeevanVidyaPrakashan, Amarkantak,1999.
2. HumanValues,A.N.Tripathi, NewAgeIntl.Publishers,NewDelhi,2004.
3. TheStoryofStuff(Book).
4. TheStoryofMyExperimentswithTruth-byMohandasKaramchandGandhi
5. SmallisBeautiful-E.FSchumacher.
6. SlowisBeautiful- CecileAndrews
7. EconomyofPermanence-JCKumarappa
8. BharatMeinAngrejiRaj-PanditSunderlal
9. Rediscovering India-byDharampal
10. HindSwarajorIndianHomeRule-byMohandasK.Gandhi
11. IndiaWinsFreedom-MaulanaAbdulKalamAzad
12. Vivekananda-RomainRolland(English)
13. Gandhi-RomainRolland(English)

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	1	-	-	-	2	3	3	1	-	2
CO2	3	2	-	1	3	2	-	1	2	-	3	3	2	-	1
CO3	3	2	2	-	2	3	2	-	2	1	3	3	3	1	-
CO4	3	1	-	2	-	-	-	2	-	3	3	3	2	-	2
Overall Mapping	3	1.75	**1.5**	1.5	**2.33**	**2**	**2**	1.5	**2**	2	3	3	2	**1**	1.66

PRACTICAL

Paper Name: Chemistry-2 Lab

Paper Code: CH(FT)391

Contact: L-T-P=0-0-3

Credit: 1.5

Pre requisites: 10+2 science with chemistry

Course Objective:

Understanding of the fundamental theories and applications of the concepts of Dilute solutions , Colligative properties and Ionic Equilibrium and to get an insight into Instrumental Methods of Spectral Analysis. Learning about the Structure reactivity of the Organic molecules, Co-ordination chemistry and Colloid Chemistry.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Understand fundamental concepts of Dilute solutions, Colligative properties and Ionic Equilibrium in different engineering applications.
CO2: Analyze the Structures of the molecules by the different spectral techniques.
CO3: Synthesize Colloid Systems and emulsions.
CO4: Apply the basic concept of Organic Chemistry and knowledge of chemical kinetics to industrial and technical fields.
CO5: Analyze different types of co-ordination compounds and their structures with the help of Crystal Field Theory**.**

Course Contents:

Exp 1: Study on kinetics of iodine / ester hydrolysis

Exp 2: Detection of aldehyde / aliphatic or aromatic alcohol / carboxylic / ester / amino group(s)

Exp. 3: To identify the following Basic Radicals by dry and wet tests – Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+}, Ca^{2+}, Mg^{2+} , Na^{+} , K^{+} , $NH4^{+}$

Exp. 4: To identify the following Acid Radicals by dry and wet tests – Cl^- , CO_3^{2-}, SO_4^{2-}, S^{2-} , NO_3^-

Exp. 5: To identify an unknown water soluble salt containing one basic and one acid radical as mentioned above.

Exp. 6: Preparation of Potash Alum.

Exp. 7: Preparation of nano particles (innovative experiment)

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	3	2	1	2	1	1	-	-	2	-	-	-	3	1	2
CO2	-	-	-	-	-	-	-	-	3	-	-	-	3	3	2
CO3	-	-	-	-	-	2	3	-	-	-	-	2	3	2	2
CO4	-	-	-	-	2	1	-	-	-	-	-	-	3	1	2
CO5	2	-	2	-	1	-	-	-	-	-	-	1	3	2	2
Overall Mapping	2.5	2	1.5	**2**	1.33	**1.33**	3		**2.5**			1.5	3	1.8	2

Paper Name: Environmental Engineering Lab

Paper Code: CH(FT)392

Contact: L-T-P: 0-0-3

Credit: 1.5

Pre requisites: 10+2 science with chemistry

Course Objective:

Acquiring knowledge on Standard solutions and the various reactions in homogeneous medium. Understanding the basic principles of pH meter for different applications and analyzing water and soil with respect to their various parameters.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Apply different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2: Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
CO3: Analyze different parameters of water considering environmental issues.
CO4: Analyze the different parameters of soil considering environmental issues.

Course Contents:

Exp 1.

Determination of Water Quality Index

a. Total Solid, Total Dissolved Solid, Total Suspended Solid

b. Total Hardness of water

c. Estimation of Chloride by Mohr's method

d. Estimation of Iron

e. Determination of Dissolved oxygen (DO)

Exp 2.

Chemical estimation of Sewage/Water and soil

a. pH, colour, odour.

b. Estimation of Chemical Oxygen Demand

Exp. 3.

Microbial examination of Sewage/Water:

a. Biological Oxygen Demand (BOD)

Exp. 4.

Determination of Soil nitrate and soil phosphate.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	2	1	-	-	2	-	-	-	3	3	3
CO2	-	-	-	-	-	-	-	-	3	-	-	-	3	3	3
CO3	-	-	-	-	-	2	3	-	-	-	-	2	3	3	3
CO4	2	-	2	-	1	-	-	-	-	-	-	1	3	2	2
Overall Mapping	2.5	2	1.5	**1**	1.5	**1.5**	3		**2.5**			1.5	3	2.25	2.25

Course Name: Chemistry of Food Lab I

Course Code: FT391
Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry

Course Objective:

To provide an opportunity to the students to define chemistry as the study of the composition, structure, properties of food materials and identify methods and instruments that can be used to study of food chemistry and To focus on the development of skills to control the quality of food by providing an opportunity to the students prioritize different controlling parameters to improve shelf-life of food and to prevent adulteration.

Course outcome:

After the completion of the Chemistry of Food Lab-I the students will be able to:

CO1: Define chemistry as the study of the composition, structure, properties of food materials and including methods and instruments that can be used to study of food chemistry.

CO2: Recognize the importance of proximate analysis.

CO3: Choose different controlling parameters to improve shelf-life of food.

CO4: Evaluate data generated by experimental methods for chemical characterization of food materials.

List of Experiment:

1. Determination of Moisture in food sample
2. Determination of Protein in food sample
3. Determination of Ash in food sample
4. Determination of Crude Fat in food sample by Soxhlet apparatus.
5. Determination of fat present in liquid milk by Gerber centrifuge.
6. Determination of Acidity and pH in food sample/beverages
7. Determination of total, non-reducing and reducing sugars in food sample

8. Determination of Vitamin C in food sample
9. Innovative experiment

Text books:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2
2. Food Chemistry by L. H.Meyer

Reference books:

1. Hand Book of Analysis of fruits & vegetables by S.Ranganna
2. Chemical changes in food during processing by Richardson
3. Food Science by Norman N. Potter & Joseph H.Hotchkiss
4. Food Chemistry by H. K. Chopra & P. S.Panesar

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	2	2	1	3	2	2	3	3	3	3
CO2	2	2	1	-	3	2	1	2	3	2	2	3	3	2	2
CO3	2	2	2	2	2	2	2	2	3	1	2	3	2	2	2
CO4	3	2	2	1	-	-	-	-	2	2	2	3	3	2	2
Overall Mapping	2.5	1.75	1.25	1.5	2.33	2	1.66	1.66	2.25	1.75	2	3	2.75	2.25	2.25

Course Name: Food Microbiology Lab

Course Code: FT392
Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Microbiology

Course Objective:

To help the students understand various methods of isolation, characterization and screening of bacteria, fungi and other related microorganisms and apply different preservation techniques relative to food safety and spoilage.

Course outcome:

After the completion of the Food Microbiology Lab the students will be able to:

CO1. Explain various methods of isolation, characterization and screening of bacteria, fungi and other related organisms
CO2. Develop skills to monitor various microbial food processing operations in food industries.
CO3. Apply different preservation techniques relative to food safety and spoilage.
CO4. Illustrate the growth requirements of common food borne pathogens and spoilage microorganisms.

List of Experiments:

1. Study of a compound microscope.
2. Simple staining, Gram Staining and the study of cellular morphology of bacteria.
3. Study of autoclave, preparation and sterilization of nutrient broth.
4. Sub-culturing of a bacterial strain in liquid and solid medium.
5. Study of the growth of *E. coli* by spectrophotometer.
6. Study of microbiological quality of milk by MBRT test.
7. Preparation of synthetic medium for the growth of yeast and mold and inoculation with standard strains of yeasts and molds.
8. Isolation of starch-hydrolyzing organism from soil. Dilution and Plating by spread –plate and pour –plate techniques.
9. Dilution and Plating by spread –plate and pour –plate techniques.
10. Isolation of pure culture.
11. Morphological study of bacteria, yeast & mold and taking of photograph using Binocular Microscope.
12. Preparation and characterization of fermented food products

13. Innovative Experiments

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	1	3	-	2	-	2	-	-	2	3	3	2
CO2	2	2	1	2	3	1	2	-	1	1	2	2	3	3	2
CO3	2	2	-	-	2	-	3	2	2	2	2	3	3	2	3
CO4	2	-	-	-	3	2	2	2	1	1	-	2	3	3	3
Overall Mapping	2	1.66	1.5	1.5	2.75	1.5	2.25	2	1.5	1.33	2	2.25	3	2.75	2.5

2nd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	M(FT)401	Applied Statistics and Numerical Methods	2	1	0	3	3
2	PC	FT401	Biochemistry and Nutrition	4	0	0	4	4
3	PC	FT402	Principles of Food Preservation	3	0	0	3	3
4	PC	FT403	Microbial Technology and Food Biotechnology	4	0	0	4	4
5	PC	FT404	Food Process Technology–I (Cereals, Fruits, Vegetables, Beverages)	3	0	0	3	3
6	Humanities and Social Sciences including Managemen tcourses	HSMC402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	EngineeringScience course	M(FT)491	Applied Statistics and Numerical Methods Lab	0	0	3	3	1.5
8	PC	FT491	Biochemistry Lab	0	0	3	3	1.5
9	PC	FT492	Chemistry of Food Lab-II	0	0	3	3	1.5
10	PC	FT493	Microbial Technology Lab	0	0	3	3	1.5
11	PROJECT	PR491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV: Soft Skill and Aptitude-I	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC401	Environmental Science	2	0	0	2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							26
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**30**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

THEORY

Course Name: Applied Statistics and Numerical Methods
Course Code: M(FT)401
Total Contact Hours: 36
Credit: 3

Pre requisite:

The students to whom this course will be offered must have the concept of (10+2) standard number system, algebra and calculus.

Course Objectives:

The purpose of this course is to provide basic understanding of the derivation and the use of the numerical methods and applied statistics.

Course Outcomes (COs):
On successful completion of the learning sessions of the course, the learner will be able to:

CODES	BLOOM'ST AXONOMY	DESCRIPTIONS
CO1	Remember	Recall the distinctive principles of numerical methods and statistics.
CO2	Understand	Determine the theoretical workings of numerical Methods and applied statistics.
CO3	Apply	Apply numerical methods to obtain approximate solutions to intractable mathematical problems such as system of linear and non-linear equations
CO4	Analyze	Analyze and interpret the results of numerical techniques, and complex statistical findings

Course Content

MODULE I:*(8 Lectures)*

Numerical solution of system of linear equations

Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.

Numerical solution of algebraic and transcendental equations

Bisection method, Regula-Falsi, Newton-Raphson method, Secant Method

MODULE II: *(16 Lectures)*

Descriptive Statistics:

Measures of central Tendency, Measures of Dispersion, Skewness and Kurtosis.

Correlation and Regression:

Types of Correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation and Spearmen's Rank Correlations, Method of Least Squares, Regression (The two regression lines).

Curve Fitting

Curve fitting by the method of least squares- fitting of straight lines, second degree parabola.

Test of significance

Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Testing of fitness

Test for single mean, difference of means and correlation coefficients, Chi-square test for goodness of fit and independence of attributes

MODULE III:*(12 Lectures)*

Designing Engineering Experiment:

Concept of Randomization, Completely Randomized Design, Randomized Block Design, Latin square Design.

Analysis of Variance:

Concept, Assumptions, One way classification and two-way classifications.

Statistical Quality Control: Importance of SQC in food industry, Construction of control charts for variables (mean, range and standard deviation)

Project Domains:

1. Study on numerical solution of system of linear equations in Engineering Field.
2. Application of numerical methods for the relevant field.
3. Mathematical modeling.
4. Statistical analysis of data related to different Engineering fields.

Text and Reference Books:

1. Shishir Gupta &S.Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
2. C.Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta& Jana: Introductory Numerical Analysis. PHI Learning
4. J.B.Scarborough: Numerical Mathematical Analysis.Oxford and IBH Publishing
5. Jain, M. K., Iyengar, S. R. K. and Jain, R. K.*Numerical Methods (Problems and Solution)*. New age International Publisher.
6. PrasunNayek: Numerical Analysis, Asian Books
7. N. G. Das: Statistical Methods, TMH.

8. *Sancheti , D. S. &Kapoor ,V.K. : Statistics Theory , Method & Application,* Sultan chand& sons ,
New Delhi

9. N.K.Dutta (2004). Fundamentals of Biostatistics, Kanishka Publishers.
10. Gurumani N. (2005) . An Introduction to Biostatistics, MJP Publishers

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	2	1	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	3	-	-	-	-	-	-	-	1	3	3	3
Overall Mapping	3	2	1.5	3								1.5	3	2.25	2.5

Course Name: Biochemistry and Nutrition

Course Code: FT401
Contact: 4:0:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Chemistry, Biology

Course Objective

To introduce the students to the biological basis of nutrition and the mechanisms by which diet can influence health and help them develop laboratory skills required for modern biochemical and molecular studies of nutrition.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Describe the major metabolic pathways involved in the metabolism of nutrients in the human body.
CO2: Understand the principles of biochemical processes and methods and be able to use them with appropriate application.
CO3: Interpret the basis of reactivity of biologically relevant molecules and their interactions.
CO4: Evaluate the data for different biochemical experimental procedures.

Course Contents:

Module I (10L): Introduction to Biochemistry: Proteins and protein structures; Trans amination; Metabolism of proteins (digestion and absorption); Nitrogen balance and nitrogen pool; Evaluation of quality of proteins: BV, PER, NPU, Chemical Score.

Module II (11L): Enzymes; Definition, function, classification, nomenclature & structure; Co- enzymes and its function; Mechanism of enzyme action: Single, bi and multi substrate reactions;

Lock and Key model, Induced fit model;

Enzyme kinetics: MME, Significance of MM Constant, MME and Allosteric enzyme kintics; Enzyme inhibition: Reversible and Irreversible; LB Plot, Feedback inhibition, Substrate acts as inhibitor, Turn over number.

Module III (13L): Carbohydrates; Metabolic pathways for breakdown of carbohydrates: glycolytic pathway and its importance, energy yield; pentose phosphate pathway and its importance, energy yield; citric acid cycle and its importance, energy yield; Gluconeogenesis; Pathway, importance, energy yield, Cori cycle; Electron transport chain: Pathway, importance, Energy yield, Oxidative phosphorylation, ATP balance.

Essential fatty acids, Metabolism of ketone bodies, alpha, beta and omega oxidation of fatty acids; Digestion & absorption of lipids.

Module IV (10L): Vitamins & minerals: Physiological function of vitamins and minerals. Introduction to human nutrition; Nutritive values of foods; Basal metabolic rate; Techniques for assessment of human nutrition, Dietary requirements and deficiency diseases of different nutrients, micronutrients, importance of nutraceuticals with some case studies.

Revision:4L

Text Book:

1. Lehninger, Nelson & Cox, Principle of Biochemistry, CBSPublication
2. Modern Experimental Biochemistry, Boyer, PearsonEducation
3. Lubert stryer, Biochemistry, Freeman & Co,N.Y.

Reference books:

1. Voet & Voet, Fundamentals of Biochemistry, Jonh Willey &Sons
2. Instant Notes in Biochemistry by D. Hames & N.Hooper
3. Biochemistry by DebojyotiDas
4. Textbook of Biochemistry by E. S. West & W. R.Tod

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	-	-	2	-	-	-	-	3	3	2	3
CO2	3	3	2	2	2	1	-	2	-	-	2	3	3	2	2
CO3	3	3	3	3	2	2	2	-	-	2	-	3	2	3	1
CO4	3	3	3	3	-	-	-	-	2	2	-	3	2	3	3
Overall Mapping	3	3	2.5	2.5	2	1.5	2	2	2	2	2	3	2.5	2.5	2.5

Paper Name: Principles of Food Preservation

Paper Code: FT402

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Food Microbiology, Food Chemistry

Course Objective:

To describe students, different principles involved in food preservation and processing and to make them aware about different concepts involved in food spoilage and its prevention by using different food preservation principles and technologies.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Describe actions that need to be taken to maintain foods with the desired properties or nature for as long as needed.

CO2: Identify quality-loss mechanisms by means of biological, chemical, and Physical.

CO3: Develop food handling practices that reduce the potential for food-borne illness.

CO4: Apply traditional and advanced preservation methods relevant to contemporary industrial and society needs

Course Contents:

Module I (11L): Introduction to food preservation – Objectives and techniques of food preservation, Canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods

Module II (6L): Dehydration and drying of food items; cold chain, freezing (including cryogenic freezing)

Module III (7L): Preservation by fermentation and chemical preservatives, curing, pickling, Bio-preservatives, Antibiotics.

Module IV (3L): Ionization Radiation including UV Radiation.

Module V (5L): Other non-conventional preservation methods, Hurdle technology Non-thermal preservation processes (High pressure processing, Osmo dehydration, Use of ultrasonic sound), minimal processing.

Revision:4L

Text Book:

1. Technology of Food Preservation by Desrosier

2. Food Science by Potter

3. Fruits and vegetable processing by Cruess

4. Preservation of Fruits & Vegetables by IRRI

Reference books:

1. Principles of Food Preservation- Fennema

2. Handbook of Food Presrevation-M. Shafiur Rahman

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	3	2.75	2.75	2.5	3	2.5	2.25	2.66	2	2.25	2	3	3	2.75	2

Paper Name: Microbial Technology and Food Biotechnology

Paper Code: FT403

Contact: 4:0:0

Total Contact Hours: 48

Credit: 4

Prerequisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:

To provide an opportunity for students to know about the pathogenic & nonpathogenic beneficial organisms and the use of beneficial organisms in food industry along with genetic engineering.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Use of the idea of biotechnology and microbiological quality of water and food.

CO2: Understand the production method of organic acids, alcoholic beverages and glycerol.

CO3: Apply fermentation method to produce different foods and medicines.

CO4: Understand the basic knowledge on genetic engineering and genetically modified crop.

Course Contents:

Module I (11L): Methods for the microbiological examination of water and foods, Coliform bacteria, Coliform test; Food borne illnesses and diseases.

Module II (11L): Production of organic acids (vinegar, lacticacid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka).

Module III (11L): Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); SCP and mushrooms

Module IV (11L): Basics of microbial genetics – Gene, DNA, RNA; Replication, transcription, transformation, transduction, conjugation, translation; Regulation of gene expression; Application in GM foods with case studies.

Revision:4L

Text Book:

1. Industrial Microbiology Prescott & Dunn, CBS Publishers
2. Food Microbiology; Frazier WC; 4th ed, Tata-McGrawhill Pub.
3. Modern Food Microbiology by Jay JM, CBS Publishers
4. Microbiology by Pelczar, Chan, and Krieg, TMH

Reference books:

1. Comprehensive Biotechnology by Murray &Mooyoung, Academic press

2. Industrial Microbiology by Casida L.R., New Age International Pvt. Ltd.

3. Fermentation Biotechnology, Principles, Processed Products by Ward OP, Open University Press.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	-	2	2	-	-	2	-	3	3	2	1
CO2	3	3	-	-	2	2	2	-	2	2	-	3	3	2	2
CO3	3	3	-	-	-	1	-	-	2	-	-	3	2	3	3
CO4	3	3	1	-	3	2	3	2	-	-	2	3	3	3	1
Overall Mapping	3	3	1.5	2	2.5	1.75	2.33	2	2	2	2	3	2.75	2.5	1.75

Course Name: FOOD PROCESS TECHNOLOGY – I (Cereals, Fruits, Vegetables, Beverages)

Course Code: FT404

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Food Chemistry, Food Preservation, Food Microbiology

Course Objective:

To provide the students an opportunity to gain knowledge about the storage procedure of different cereals, fruits and vegetables and to help students to understand the different procedure of production of various cereal based, fruit based and vegetable based products.

Course outcome(s):

After completion of the course students will be able to:

CO1: Understand the sustainable Processing and effective storage of cereals, fruits and vegetables.
CO2: Identify suitable equipments for cereals, fruits and vegetables processing for effective use in society
CO3: Summarize the knowledge of processing methods in food and allied industries for cereals, fruits, vegetables, carbonated and non-carbonated nonalcoholic beverages
CO4: **Develop** ideas about innovative technologies for sustainable product development for daily life uses.

Course Contents:

Module I: 8L

Basic composition and utilization of cereals; Drying of grains; Milling of rice and processes for rice- based products; Milling of wheat and processes of wheat based products; Milling and utilization of corn, barley, oat and millets; Common infestation in grains; Principle and practice of storage of cereals; Storage structures. Quality characteristics influencing final milled product, Parboiling

Module II: 6L

Feed for livestock from wheat bran and germ; Production of starch, modified starch; Extraction of proteins from cereals; Potato processing (potato chips, flakes, powder).

Module III: 10L

Handling and quality assessment of fruits & vegetables; Storage of fruits & vegetables; Production of fruits and vegetable juices/puree/nectar, Intermediate moisture foods from

fruits (jam, jelly, marmalade, leathers, candy); Sauce and ketchup from tomato., Dehydrated fruits & vegetables; Utilization of by- products from fruit-based industries – extraction of pectin, fat/oil from peel and seeds, aroma from peel and pomace candied peel. Equipments, cleaning methods, sorting, grading, peeling and blanching of fruits and vegetables before processing, methods of precooling, minimal processing of fruits and vegetables.

Module IV: 8L

Non-alcoholic beverages; Processing of tea, coffee and cocoa, Instant coffee; Production of chocolate and cocoa butter; Extraction of caffeine from tea leaves; Food additives -coloring agents, humectants, anti-caking agents, natural and artificial low calorie sweeteners, pH control agents, thickeners.

Revision:4L

Text Books:

1. Food Science by Potter
2. Food Science by Mudambi
3. Food Science by B. Srilakhsmi
4. Food Additives by Udipi

Reference Books:

1. Postharvest Technology of Fruits & Vegetables (vol 1 & 2): Handling, Processing, Fermentation and Waste Management – L. R. Verma& V. K. Joshi, Indus Pub, New Delhi, 2000.
2. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices – A. Chakraverty, Arun S. Mujumdar, G. S. V. Raghavan& H. S. Ramaswamy - Marcel Dekker, 2003
3. Postharvest Technology and Food Process Engineering – A Chakraverty& R. Paul Singh, CRC Press, 2014
4. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
5. Principles of Food Science, Vol-I by FennmaKarrel
6. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	1	2	2	-	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	3	3	3	2.75	2.5	2.75	2.75	2.75	2.66	2.25	2.66	3	3	2.25	2.75

Course Name: GENDER, CULTURE AND DEVELOPMENT

Course Code: HSMC402

Contacts: 2:0:0

Total Contact Hours: 24

Credit: 2

Prerequisite: None

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Provide an analysis of the location of women in the processes of economic development; to understand what economic development is, the scales or levels at which it occurs, and the centrality of gender at every level.

CO2: Examine theoretical and conceptual frameworks for that analysis.

CO3: Reflect upon linkages between the global economy and the gendered macro and micro process of development and transitions from 'government' to 'governance.'

CO4: Explain the usefulness of a rights based approach to gender justice.

CO5: Provide basis for research, practical action and policy formulation and or evaluating for evaluating directions and strategies for social change from a gender perspective.

Course Content:

Module1:

Introduction to Gender, Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender 4L

Module 2:

Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labour 6L

Module 3:

Gender Development Issues , Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender

and Mainstreaming. 5L

Module 4:

Gender-based Violence, The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective. 5L

Module5:

Gender and Culture Gender and Film, Gender and Electronic Media, Gender and Advertisement, Gender and Popular Literature. 4L

Text Books:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press. (GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR or WGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff. (2011). The Women, Gender and Development Reader. 2nd Edition. Zed Press (WGD)

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	1	-	-	-	2	3	3	1	-	2
CO2	3	2	-	1	3	2	-	1	2	-	3	3	2	-	1
CO3	3	2	2	-	2	3	1	-	2	1	3	3	3	2	-
CO4	3	1	-	2	-	-	-	2	-	3	3	3	2	-	2
CO5	3	2	-	1	-	1	2	-	2	-	3	3	3	1	-
Overall Mapping	3	1.8	1.5	1.33	2.33	1.75	1.5	1.5	2	2	3	3	2.2	1.5	1.66

PRACTICALS:

Course Name: Applied Statistics and Numerical Methods Lab

Course Code: M(FT)491
Total Contact Hours: 36
Credit: 1.5

Prerequisite:

The students to whom this course will be offered must have the concept of any introductory course on programming language (C/ Matlab).

Course Objectives:

The purpose of this course is to provide basic programming skills for solving the problems in numerical methods and applied statistics.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Apply the programming skills to solve the problems using numerical and statistical approaches.

CO2: Analyze and interpret the results of numerical and statistical approaches using command.

CO3: Judge the multiple numerical approaches in terms of their accuracy level.

CO4: Design and develop effective programs for numerical and statistical approaches to solve the engineering problems.

Course Content

List of Experiments:

1. Assignments on Newton forward /backward, Lagrange‘s interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson‘s 1/3 rule, Weddle’s Rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method.
5. Assignments on ordinary differential equation: Euler‘s method, Euler‘s Modified Method, Runge-Kutta Method (4^{th} Order).
6. Assignments on Measures of Central Tendency- Mean, Median, Mode,
7. Assignments on Measures of Dispersion - Variance, Standard Deviation, Mean Deviation.

8. Assignments on Skewness and Kurtosis.
9. Assignments on Correlation Coefficient and Regression lines.
10. Assignments on curve fitting

Implementation of numerical methods and statistics through Software: C/ Matlab /Python/ Scilab.

Text Books:

1. Scarborough, J. B., *Numerical Mathematical Analysis*, Oxford University Press.
2. Kanetkar, Y., *Let us C,* BPB Publication,15th Edition
3. Das, N. G.,*Statistical Methods*, TMH.
4. Gupta, S.and Dey, S., *Numerical Methods*, Mc. Grawhill Education Pvt. Ltd.
5. Balagurusamy, E.,*Numerical Methods*, Scitech. TMH.

Reference Books:

1. Xavier, C.,*C Language and Numerical Methods*, New age International Publisher.
2. Venugopal, K. R.andPrasad, S.R.,*Mastering-C,*TMH,2nd Edition.
3. Sancheti, D. S. and Kapoor,V.K.,*Statistics Theory , Method & Application*, Sultan chand&sons , New Delhi.
4. Guha, S. and Srivastava, R. *Numerical Methods*, Oxford Universities Press

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PS O3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	3
Overall Mapping	3	2.75	2.25	2.5	-	-	-	-	-	-	-	1.75	3	2.25	2.5

Course Name: Biochemistry Lab

Course Code: FT491
Contact: 0:0:3

Credit: 1.5

Pre requisites: Biochemistry

Course Objective:

To assist the students develop skills to monitor various enzymatic reactions and to learn about association of food protein structure to help the students point out the threat of possible danger to health from contamination in water from effluent.

Course outcome(s):

After the completion of Biochemistry Lab students will be able to:

CO1: Understand the separation of immiscible liquids and solids from liquids including various methods of sugars and amino acids separation.

CO2: Develop skills to monitor various enzymatic reactions.

CO3: Learn association of food protein structure with solubility, viscosity, gelation, texturization, emulsification and foaming.

CO4: Identify the threat of possible danger to health, or the very existence of certain species, for determination of the quality of a water source before water is drawn off for consumption.

List of Experiment:

1. Separation of amino acids/sugars by Ascending Paper Chromatography.
2. Separation of sugars/amino acids by Thin Layer Chromatography.
3. Separation of sugars /amino acids by Radial Chromatography
4. Separation and isolation of proteins/amino acids by PaperElectrophoresis.
5. Preparation of cell-free extract: Bacterial cell by sonication, Chicken liver by homogenization.
6. Assay of enzyme activity (a) Phosphatase assay [Chicken liver] (b) Proteaseassay
7. Study of an enzymatic reaction.
8. Studyonthepresenceofalkalinephosphataseenzymeinrawandpasteurizedmilk.

9. Determination of BOD_5 of a sample of waste water.
10. Innovative Experiments

Text books:

1. Modern Experimental Biochemistry, Boyer, Pearson Education

Reference books:

1. An Introduction to Practical Biochemistry, David TPlummer

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	1	2	1	-	-	2	3	3	2
CO2	3	2	2	2	3	-	1	2	1	2	2	2	2	2	2
CO3	3	2	2	2	3	-	1	-	1	1	-	2	3	1	3
CO4	2	2	1	1	-	2	2	-	2	-	2	2	3	3	3
Overall Mapping	2.75	2	1.75	1.75	3	2	1.25	2	1.25	1.5	2	2	2.75	2.25	2.5

Course Name: Chemistry of Food Lab II

Course Code: FT492
Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry

Course Objective:

To help students in developing the concept and to learn various methods of estimation of minerals, pigments, crude fibre, antioxidants, pigments etc. by spectrophotometric and chemical analysis.

Course outcome:

After the completion of the Chemistry of Food Lab II the students will be able to:

CO1: Learn various methods to determination different minerals, antioxidant, crude fibre, amino acid content of food materials.

CO2: Measure different food compositions by spectrophotometric analysis.

CO3: Evaluate data generated by experimental methods for chemical characterization of food materials.

CO4: Analyze how the pigments of the food materials change in different conditions.

List of Experiments:

1. Determination of pigments in food sample.
2. Estimation of calcium in food sample.
3. Estimation of iron in food products.
4. Estimation of zinc in food sample.
5. Estimation of crude fiber in food sample.
6. Estimation of antioxidant(s) / polyphenol(s) in food sample.
7. Analysis of lysine content in animal /vegetable sources.
8. Estimation of alcoholic acidity present in wheat flour.
9. Innovative Experiments

Text books:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2
2. Food Chemistry by L. H.Meyer

Reference books:

1. Hand Book of Analysis of fruits & vegetables by S.Ranganna
2. Chemical changes in food during processing byRichardson
3. Food Science by Norman N. Potter & Joseph H.Hotchkiss
4. Food Chemistry by H. K. Chopra & P. S.Panesar

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	2	1	-	3	2	2	1	2	2	2	3	3	3	2
CO2	2	2	1	-	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	-	-	-	2	2	1	3	3	2	3
CO4	3	2	2	1	1	-	-	-	2	2	-	3	3	2	3
Overall Mapping	2.75	2	1.5	1.5	2.25	2	2	1.5	2	2	1.66	3	3	2.5	2.5

Course Name: Microbial Technology Lab

Course Code: FT493
Contact: 0:0:3

Credit: 1.5

Pre requisites: Principles of Food Preservation, Unit Operation, Food Microbiology

Course Objective:

To help the students understand various methods of isolation, characterization and screening of bacteria, fungi and other related organisms and apply different preservation and fermented food productions techniques relative to food safety and spoilage.

Course outcome:

After the completion of this course students will be able to:

CO1: Understand biotechnological processing/engineering principles to variety of fermented products.

CO2: Develop new fermented products.

CO3: Interpret the data in scientific format.

CO4: Identify new development in this field with analytical thinking of the various aspects ofthe new technology.

List of Experiments:

1. Study of the microbial alcohol fermentation process
2. Study of the organic acid fermentation – Vinegar / citric / lactic acid production
3. Observation of the propagation of the baker's yeast
4. Preparation of fermented dairy products
5. Detection of *E.coli* in food/water sample
6. Production of microbial enzyme
7. Production of amino acid
8. Detection of various types of microorganism in different food items
9. Innovative experiment.

Text book:

1. Fundamental Principles of Bacteriology – A. J. Salle

Reference book:

1. Food Microbiology – M. R. Adams, M. O. Moss.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	-	-	-	-	2	2	-	2	-	-	3	3	2	2
CO2	3	2	2	-	-	-	1	-	2	2	2	3	3	2	3
CO3	3	3	2	2	-	-	-	2	1	2	-	3	3	2	3
CO4	3	2	-	-	2	2	-	1	1	-	1	3	2	3	1
Overall Mapping	3	2.33	2	2	2	2	1.5	1.5	1.5	2	1.5	3	2.75	2.25	2.25

MANDATORY COURSE

Course Name: Environment Science

Course Code: MC401

Contact: 2:0:0

Total Contact Hours: 24

Credit: 0

Course Objective:

- Be able to understand the natural environment and its relationships with human activities.
- Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Be able to solve scientific problem-solving related to air, water, noise & land pollution.

Course outcome(s):

After completion of the course students will be able to:

CO 1: Understand the natural environment and its relationships with human activities.
CO 2: Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
CO 3: Develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
CO 4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents:

1. General 11 L

Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy
Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography
Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control) Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web,

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems
Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.

2. Air pollution and control 10L

Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant
Types of air pollutants: primary & secondary pollutant; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),
Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion
Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury).

3. Water Pollution 9L

Classification of water (Ground & surface water)

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.
Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD
Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)
Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride

3.7 Layout of waste water treatment plant (scheme only).

4. Land Pollution 3L

Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste
Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).
Waste management: waste classification, waste segregation, treatment & disposal

5. Noise Pollution 3L

Definition of noise, effect of noise pollution on human health, Average Noise level of some common noise sources
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18 hr Index) .
Noise pollution control.

Text Books

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited

References Books:

1. Environmental Studies, Dr. J P Sharma, University Science Press
2. Environmental Engineering, J K Das Mohapatra, Vikas Publication

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	2	3	-	-	-	3	-	-	-	2	2	3	2	1
CO2	-	-	1	-	-	-	-	-	-	-	-	-	3	2	2
CO3	2	-	2	-	1	-	2	-	-	-	-	-	3	2	2
CO4	-	-	2	-	-	2	2	-	-	-	-	-	3	3	3
Overall Mapping	2.5	2	2		1	2	2.33				2	2	3	2.25	2

3rd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC505	Principles of Management	2	0	0	2	2
2	PC	FT501	Food Process Technology–II (Fish,Meat, Poultry)	3	0	0	3	3
3	PC	FT502	Food Process Technology–III (Milkand Milk Products)	3	0	0	3	3
4	PE	FT503A/B/C (Professional Elective I)	A. Principles of Biochemical Engineering	2	1	0	3	3
			B. Enzyme Technology	2	1	0	3	3
			C. Modeling and Simulation of Food Processing	2	1	0	3	3
5	PE	FT504A/B/C (Professional Elective II)	A. Fluid Mechanics and Heat Transfer	2	1	0	3	3
			B. Mass Transfer I	2	1	0	3	3
			C. Mechanical Operation andSeparation Process I	2	1	0	3	3
B. PRACTICAL								
6	PC	FT591	Food Processing Lab–I	0	0	3	3	1.5
7	PC	FT592	Food Analysis and Quality ControlLab-I	0	0	3	3	1.5
8	PE	FT593A/B/C (Professional Elective II Lab)	A. Fluid Mechanics and Heat Transfer Lab	0	0	3	3	1.5
			B. Mass Transfer I Lab	0	0	3	3	1.5
			C. Mechanical Operation andSeparation Process I Lab	0	0	3	3	1.5
9	PROJECT	PR591	Minor Project I	0	0	2	2	1
10	PROJECT	PR592	Skill Development V: Soft Skill and Aptitude-II	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
11	MC	MC501	Constitution of India	2	0	0	2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D. MOOCS COURSES**								
12	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**24**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific andto be taken from MOOCS BASKET**

THEORY

Course name: Principles of Management

Course Code: HSMC505

Contact: 2:0:0
Total Contact Hours: 24

Credit: 3

PREQUISTES: NIL

Course Objective:

1. To understand and apply management principles in to manufacturing organization.

2. To understand concepts of work study, method study, and Quality control method to improve performance of any organization.

Course outcome:

On completion of the course students will be able to:

CO1: To recall and identify the relevance of management concepts.

CO2: To apply management techniques for meeting current and future management challenges faced by the organization

CO3: To compare the management theories and models critically to solve real life problems in an organization.

CO4: To apply principles of management in order to execute the role as a manager in an organization.

Course Content:

Module-1: Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow **(4L)**

Module - 2: Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO,SWOT analysis,McKinsey's7S Approach.
Organising for decision making: Nature of organizing, span of control ,Organisational structure –line and staff authority. Basic control process -control as a feedback system – Feed Forward Control – Requirements for effective control – control **(4L)**

Module - 3: Group dynamics: Types of groups, characteristics, objectives of Group Dynamics. Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership **(4L)**

Module – 4: Work Study and work measurement: Definition of work study**,** Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives,, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types.Calculation of Standard Time. Work sampling**(4L)**

Module-5: Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy **(2L)**

Module - 6: Quality management: Quality definition, Statistical quality control, acceptance sampling

,Control Charts –Mean chart, range chart,c chart,p chart,np chart, Zero Defects,Quality circles, , Kaizen & Six Sigma ,ISO -9000 Implementation steps,Totalqualitymanagement **(6L)**

Text Books:

1. Essentials of Management, by Harold Kooritz & Heinz Weihrich TataMcGraw
2. Production and Operations Management-K.Aswathapa,K .Shridhara Bhat,Himalayan Publishing House

References Books:

1. Organizational Behavior, by Stephen Robbins Pearson Education, NewDelhi
2. New era Management, Daft, 11th Edition, CengageLearning
3. Principles of Marketing, Kotlar Philip and Armstrong Gary,Pearsonpublication

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PS03
CO1	-	-	-	-	-	-	-	-	3	-	3	-	1	2	3
CO2	-	-	-	-	2	2	-	3	3	-	3	3	1	2	3
CO3	-	-	2	-	-	-	-	-	2	-	3	3	2	2	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-	1	2	3
Overall Mapping			2		2	2		3	2.75		3	3	1.25	2	3

Course name: FOOD PROCESS TECHNOLOGY – II (fish, meat, poultry)

Course Code: FT501

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Food Chemistry, Food Preservation, Food Microbiology

Course Objective:

To provide an opportunity for students to classify different processing techniques required for preservation of fish, meat, poultry and classify the different by products related to these industries.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Identify the significance different processing techniques required for preservation of fish.
CO2: Classify the different by products related to fish processing industries and describe their use.
CO3: Compare the various components of the meat muscle with special focus on slaughtering and post mortem changes in meat, preservation and to recognize the different processing techniques related to meat processing industry and use of meat byproducts
CO4: Develop a general understanding on the structure, composition, nutritional values and effective preservation methods of eggs.

Course Contents:

Module I (10L):

Classification of fresh water fish and marine fish; Commercial handling, storage and transport of fish; proximate composition and nutritive value of fish; Indices of freshness and its quality assessment, contaminants and toxicants in fish- both endogenous and exogenous,; Spoilage of fish; Methods of Preservation of fish and fish products: Canning, Freezing, Drying, Curing, Smoking, Fermentation (fish sauce) marinating and pickling, irradiation; effect of processing and storage on nutritive value; packaging.

Module II (6L):
Fish byproducts - production of fish meal, fish protein concentrate, and fish protein hydrolysate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish; Processing of fish wastes.

Module III (12L):

Slaughtering of animals; Classification, composition and nutritive value of poultry meat; Post mortem changes of meat; Curing and smoking of meat; Fermented meat products (sausages and sauces); Frozen meat & meat storage; By-products from slaughter houses and meat processing industries and their utilization.

Module IV (4L):

Structure, composition and nutritive values of eggs; Quality assessment (defects) of eggs; Processing of eggs; Byproduct Utilization, Utilization of egg- derived products as food ingredients.

Revision: 4L

Text Books:

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBSPublishers.
2. Food Science by B.Srilakhsmi

Reference Books:

1. Meat Science and Applications - Y H. Hu., Wai-Kit Nip, Robert W. Rogers& Owen A. Young, Marcel Dekker,2001.
2. Advanced Technologies for Meat Processing - Leo M. L. Nollet& Fidel Toldrá, CRC Press, 2006.
3. Meat; Cole DJA &Lawrie RA; 1975, AVIPub.
4. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA &Pasch S; 1988, Elliswood Ltd.
5. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub.Ltd.
6. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan PubCorp
7. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
8. Fish Processing Technology ,Rogestein & Rogestein
9. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRCPress.
10. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVIPub.

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	2	3	3	3	-	3	3	3	3	3	-	3	2	3	3
CO2	2	3	3	3	2	3	3	3	3	3	-	3	2	3	3
CO3	3	3	3	3	2	3	3	3	3	3	2	3	2	2	3
CO4	2	3	3	3	2	3	3	3	3	3	2	3	2	3	3
Overall Mapping	2.25	3	3	3	2	3	3	3	3	3	2	3	2	2.25	3

Course Name: FOOD PROCESS TECHNOLOGY – III (Milk and Milk products)

Course Code: FT502

Contact: 3:0:0

Total Contact Hours: 36
Credit: 3

Pre requisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:
To provide an opportunity for students to classify different processing techniques required for preservation of milk and classify the different by products related to this industry.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Define milk, its composition, variety and different testing methods to detect adulterant in milk
CO2: Develop understanding about thermal processing of milk and milk products and discuss cleaning and sanitization of different milk industry
CO3: Solve simple problems based on milk drying and to categorize different dried milk products
CO4: Formulate different milk based products and to prepare different traditional Indian dairy products.

Course Content:

Module I (10 L):
Definition of milk, Composition of milk, Varieties of milk, Nutritional values, Checks for purity of milk and adulteration in milk, Cleaning and sanitization, HACCP of processing unit.

Module II (10 L):
Thermal processing of fluid milk – Pasteurization (LTLT,HTST & UHT), Packaging of fluid milk, Fermentation of milk and fermented milk products – Cheese, Yogurt, Curd, Kefir, Kumis, Flavored yogurt, Therapeutic value of Fermented Products, concept of Probiotics, prebiotics and probiotics dairy products

Module III (8 L):
Processing of evaporated and dried milk products – Milk powder, Malted milk and Infant formulae. Manufacturing and standardization of Cream, butter/butter oil, ghee, Ice-cream, Cheese, Simple problem based on milk drying, standardization, etc.

Module IV (4 L):
Traditional Indian sweets- Kheer, Paneer, Channa, Srikhand, Dairy processing by-products: and Production of lactose and protein from whey. Application of technologies in dairy industry

Revision: 4L

Text Books:

1. Outlines of Dairy Technology, De S; Oxford.
2. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.

Reference Books:

1. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
2. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
3. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	3
CO2	3	2	2	1	-	1	2	1	-	-	-	3	3	2	3
CO3	3	3	2	2	-	-	2	-	-	-	-	3	3	3	2
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2
Overall Mapping	3	2.5	2	1.5		2	2.5	1.5				3	3	2.33	2.5

Course Name: PRINCIPLES OF BIOCHEMICAL ENGINEERING

Course Code: FT503A

Contact: 2:1:0

Total Contact Hours: 36
Credit: 3

Pre requisites: Food Engineering, Food Processing, Unit Operations

Course Objective: To help the students understand the basic principles of various biochemical processes and realize the importance of different design parameters in bioreactor operation

Course outcome(s):

After completion of the course, the students will be able to

CO1: Recognize the industrial implication of biochemical engineering.
CO2: Interpret the kinetics of microbial reactions.
CO3: Develop the design parameters for a bioreactor.
CO4: Illustrate the importance of downstream processing in bioprocess industries and to evaluate the importance of design considerations in a fermentation plant design project and examine scale up operations.

Course Contents:

Module I (8L):

Introduction to biochemical process industries; Industrial alcohols, antibiotics, acids, alcoholic beverages, vitamins, enzymes, single cell protein, dairy products

Module II (10L):

Bioreactor design: Mechanisms and kinetics (Monod model), Fermentation - types of fermenters, chemostat, chemostat with recycle, turbidostat, PFR, fluidized bed reactor, air lift fermenter, Fed Batch reactions; Mass transfer in microbialreactors

Module III (10L):

Bioproduct recovery: Downstream processing - separation process for cell mass and product, filtration, centrifuging, membrane processes (reverse osmosis, ultrafiltration, and chromatographic separation). Ion exchange process

Module IV (4L):

Scale-up of bioprocess; Bioprocess economics and cost analysis, Fermentation plant design project, Bio-product regulation

Revision: 4L

Text Books:

1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli,MGH
2. Biochemical Engineering: Aiba S; Academia press,NY
3. Michael L. Shuler and Fikret Kargi: Bioprocess Engineering: Basic Concepts, 2nd Edition

Reference Books:

1. Bioprocess Engineering Principles, Pauline M.Doran
2. Principles of Bioseparation Engineering, Raja Ghosh

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	2	3
CO2	3	3	3	2	2	1	2	1	2	2	2	3	2	1	2
CO3	3	3	3	2	1	2	2	2	2	2	2	3	1	2	3
CO4	3	3	3	1	3	1	1	-	-	-	3	3	3	2	3
Overall Mapping	3	2.75	2.75	1.75	2	1.33	1.66	1.5	2	2	2.33	3	2.25	1.75	2.75

Course Name: Enzyme Technology

Course Code: FT503B

Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of food, food microbiology, food biotechnology

Course Objective:

To help student to gain knowledge about different enzyme production, purification and isolation process as well as the use of enzymes in food technology.

Course outcome(s):

After completion of the course students will be able to:

CO1: Explain the enzyme kinetics and the effects of different parameters on enzymes.
CO2: Understand the production and purification processes of enzyme.
CO3: Analyze the applications of enzyme in biochemical and food processing industries.
CO4: **Identify** the concepts of recombinant DNA Technology and immobilized enzymes in biochemical engineering.

Course Contents:

Module I: 8L

Introduction to enzyme technology; Industrial enzymes – present status and opportunities with special reference to food industries; Catalytic properties of enzymes; Intracellular and extra-cellular enzymes.

Module II: 10L

Enzyme production technology: Introduction of enzyme reactors and process design. Basic concept of scale-up. Application of recombinant DNA technique in enzyme technology.

Module III: 7L

Cell disintegration by physical, chemical and biological methods; Enzyme purification methods: Salting out, organic solvent precipitation, dialysis, reverse osmosis etc.

Module IV: 7L

Application of enzymes in food processing industries; Application of immobilized enzymes and cells. Production of Commercial Enzymes.

Revision:4L

Text Book:

1. Biochemical Engg. Fundamentals-Baily, Ollis.MGH
2. Bioprocess Engineering by Michael L. Shuler and FikretKargi

Reference Books:

1. Prescott & Dunn's Industrial MicrobiologyMacmiller
2. Principles of Fermentation Technology-Wittaker and Stanby
3. Methods in Enzymology, Edited by Dan S. Tawfik,Science Direct

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	1	2	1	2	2	2	3	3	3	2
CO 3	3	3	3	2	1	2	2	2	2	2	2	3	3	3	3
CO 4	3	3	3	1	3	1	1	-	-	-	3	3	3	2	3
Overall Mapping	3	2.75	2.75	1.75	2	1.33	1.66	1.5	2	2	2.33	3	3	2.75	2.5

Course Name: Modeling and Simulation of Food Processing

Course Code: FT 503C
Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Food Process Engineering, Unit Operations of Chemical Engineering I & II

Course Objective:
To help the students understand the basic principles of food processing operations and represent the processes in terms f mathematical models and performing simulations for validation of the mathematical models.

Course outcome(s):
After completion of the course students will be able to:

CO 1: Understand the importance of mathematical modeling of food processing operations.
CO 2: Utilize theoretical concepts for development of mathematical models for designing error free traditional food process operations.
CO 3: Apply the basic concepts of advanced food processes.
CO 4: Choose the dependent and independent variables of mathematical processes for process optimization regarding performance enhancement.

Course Contents:
Module 1: 10L

Introduction to mathematical modeling of food processes; Food process analysis and simulation; Model building; Classification and uses of mathematical models in food processes; Fundamental laws and formulation of mathematical models.

Module 2: 7L

Batch processes in food industry; Equilibriation in batch processes; Steady state flow processes of non reacting systems; Mixing in food processes involving flow.

Module 3: 7L

Advanced food processing operations; Simultaneous heat and mass transfer in packed tower systems of food processing; Immobilized enzyme systems of food processing.

Module 4: 8L

Modelling and simulation of food fermentation processes; Significance of process optimization; Parameter selection and optimization of food processes.

Revision:4L

Text Book:

1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli,MGH
2. Michael L. Shuler and Fikret Kargi: Bioprocess Engineering: Basic Concepts, 2nd Edition

Reference books:

1. Biochemical Engineering: Aiba S; Academia press,NY

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	1	2	1	2	2	2	3	3	3	2
CO 3	3	3	3	2	1	2	2	2	2	2	2	3	3	3	3
CO 4	3	3	3	1	3	1	1	-	-	-	3	3	3	2	3
Overall Mapping	3	2.75	2.75	1.75	2	1.33	1.66	1.5	2	2	2.33	3	3	2.75	2.5

Course Name: Fluid Mechanics and Heat Transfer

Course Code: FT504A
Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To introduce history, importance and components of fluid mechanics& heat transfer, concepts of unit operations and unit processes, and current scenario of chemical & allied process industries.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the basic principles of fluid mechanics

CO2: Analyze pipe flows as well as fluid machinery

CO3: Solve conduction, convection and radiation problems

CO4: Design the performance of heat exchangers.

Course Contents:

Module I (12L): Introduction Basic Concepts of Fluid Mechanics : Conversion of equations. Basic equations of Fluid Flow, Hagen Poiseille equation, Bernoulli Equation, Fluid Friction. Friction in flow through packed beds, fundamentals of fluidization

Module II (10L): Flow measurements and machineries : Flow through pipes and open channels, Orifice and Venturimeters, Pitot Tube, Rotameters. Transportation of fluids, Pipe Fittings and valves, Pumps – classification.

Module III (10L): Heat transfer: Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Countercurrent and parallel flow.Enthalpy balance in heat exchange equipment.Different types of heat exchangers used in food processing, Individual heat transfer coefficients, overall coefficient,Radiation.

Revision:4L

Text Book:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5thedition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rdedition
3. Introduction to Chemical Engineering: Walter L. Badger,Julius T. Banchero, Julius T. Bancheo

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, ButterworthHeinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition,JWS Perry, Chilton & Green, Chemical Engineers' Handbook,MGH

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO 3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO 4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

Course Name: Mass Transfer I

Course Code: FT504B
Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

- To impart knowledge on fundamentals of mass transfer phenomenon.
- To explain the principles of mass transfer and their application to separation and purification processes.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the principles of molecular diffusion and basic laws of mass transfer.
CO2: Utilize mass transfer concepts to design gas absorption systems.
CO3: Explain the basics of humidification process and its application
CO4: Analyze the concept of crystallization process and identification of suitable crystallizer

Course Contents:

Module I (10L): Diffusion

Molecular and turbulent diffusion, diffusion coefficient, Fick's Law of diffusion, Dependence of diffusion coefficient on temperature, pressure and composition; measurement and estimation of diffusivity. Diffusionin multi -component gas mixtures. Diffusion in Solids: Molecular, Knudsen &surfacediffusion;Inter-phasemasstransfer:Masstransfercoefficients, Diffusionbetweenphases,Equilibriumsolubilityofgasesinliquids,Mass transfer theories, Mass transfer in fluidized beds, Flow past solids and boundary layers, Simultaneous heat and mass transfer.

Module II (8L): Absorption and Stripping:

Equipments, Gas-liquid equilibrium, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns, simultaneous heat and mass transfer studies in packed columns, HTU, NTU &HETP concepts, Design equations for packed column, Absorption with chemical reaction and mass transfer.

Module III (8L): Humidification and Dehumidification:
Vapour liquid equilibrium and enthalpy for a pure substance, vapour pressure temperature curve, Vapour gas mixtures, Definition and derivationsofrelationshipsrelatedwithhumidityFundamentalconceptof humidification, Dehumidification and water cooling, Wet bulb temperature,Adiabaticandnon-adiabaticoperations,Evaporativecooling, Classification and design of cooling towers.

Module IV (6L): Crystallization
Equilibrium yield of crystallization, Heat and mass transfer rates in crystallization, Theories of crystallization, Factors governing nucleation and crystal growth rates, controlled growth of crystal, Classification and design of crystallizers.

Revision:4L

Text Book:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5thedition

2. Transport Processes & Unit operations: Geankopolis, PHI, 3rdedition

3. Robert. E. Treybal. ―Mass Transfer Operation‖, 3e, Mc Graw Hill, NY

4. Geankoplis, C.J. ―Transport Processes and Unit Operations‖, 3e, Prentice Hall (I)

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, ButterworthHeinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition,JWS
4. Perry, Chilton & Green, Chemical Engineers' Handbook,MGH

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO 3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO 4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

Course Name: Mechanical Operations and Separation Process I

Course Code: FT504C
Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To understand different type of Mechanical operations like crushing and Grinding and Sieve separation technique and to apply their knowledge in different types of separation processes like centrifugation, filtration, extraction, drying and crystallization

Course Outcome(s):

After Completion of the course students will be able to:

CO1:Understand different disintegration processes

CO2: Explain different types of separation processes

CO3: Solve the problems of filtration, extraction, drying and crystallization

CO4: Explain the modern separation and purification processes

Course Contents:

Module I (8L): Mechanical Operations: Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Mechanical separation, Screening, Types of screen, Filtration, Principle of Constant pressure and constant rate filtration.

Module II (8L): Centrifugation: Principle of settling, sedimentation, flocculation, devices and types of each operation (free and hindered settling, hydraulic separation and heavy media separation), Crystallization: material and energy balance calculations and introduction to crystallizer design.

Module III (10L): Extraction and Drying: selectivity and choice of solvent; material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages; Fundamental principles of leaching operation and material balance

calculations. batch drying and mechanism of batch drying.

Module IV: 6L

Advanced separation processes: Dialysis, ultrafiltration, reverse osmosis, pervaporation, electro dialysis and membrane separation.

Revision:4L

Text Book:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5thedition

2. Transport Processes & Unit operations: Geankopolis, PHI, 3rdedition

3. Introduction to Chemical Engineering: Walter L. Badger,Julius T. Banchero, Julius T. Bancheo

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, ButterworthHeinemann

2. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition,JWS

3. Perry, Chilton & Green, Chemical Engineers' Handbook,MGH

4. Fundamentals of Food Process Engineering R.T. Toledo CBS publication

5. Food Processing Technology P.J. Fellows CRC press

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO 3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO 4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

PRACTICAL

Course Name: Food Processing Lab I

Course Code: FT591

Contact: 0:0:3

Credit: 1.5

Pre requisites: Principles of Food Preservation, Unit Operation

Course Objectives:

To assist the students in using laboratory techniques common to basic Food Processing and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Apply the principles that make a food product safe for consumption.

CO2: Use laboratory techniques common to basic Food Processing.

CO3: Interpret government regulations pertaining to food manufacturing.

CO4: Evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

List of Experiments:

1. Preparation of citrus fruit squash/nectar/concentrated juice.
2. Preparations of fruit jam/mixed jam/marmalade.
3. Preparation of jelly/synthetic jelly.
4. Preparation of tomato ketchup/puree/sauce.
5. Preparation of fruit/vegetable pickles.
6. Preparation of dried vegetable.
7. Design and layout of various food processing systems
8. Preparation of value added different soups
9. Preparation of fermented cereal/vegetable (Sauerkraut) food products

10. Innovative experiment.

Text Books:

1. Food Science by B. Srilakhsmi
2. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2

Reference Books:

1. Hand Book of Analysis of fruits & vegetables by S. Ranganna

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	-	-	2	3	2	-	2	2	3	1	1	3
CO2	2	2	1	1	3	2	2	-	-	1	2	2	1	2	2
CO 3	2	1	1	-	-	2	3	-	-	-	-	3	1	1	3
CO 4	3	2	2	2	2	-	-	-	3	-	-	3	2	2	2
Overall Mapping	2.25	1.75	1.5	1.5	2.5	2	2.66	2	3	1.5	2	2.75	1.25	1.5	2.5

Course Name: Food Analysis and Quality Control Lab-I

Course Code: FT592

Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry, Biochemistry

Course Objectives:

To help the students develop practical skill in analyzing various components e.g. carbohydrate, fat, protein, vitamin etc. available in various food materials and to measure the acidity, ash, sugar content, moisture, total solid content, viscosity, unsaturation, volatile fatty acid, hydrolytic rancidity, oxidative rancidity of these food samples.

Course outcome(s):

After the completion of the Food Analysis and Quality Control Lab I the students will be able to:

CO1: Determine the methods of selecting appropriate techniques for analysis of food products.
CO2: Analyze different components present in various food materials.
CO3: Gain the **knowledge** of food standards, regulations and quality control
CO4: Identify the tests methods to detect adulterant in various food samples.

List of Experiments:

1. Analysis of portable water.
2. Analysis of jam, jelly, marmalade.
3. Analysis of spices.
4. Analysis of tea including polyphenols/ antioxidant content
5. Analysis of coffee including chicory, polyphenols/ antioxidant content
6. Analysis of non alcoholic beverages
7. Analysis (lactic acid content) of Sauerkraut.
8. Innovative Experiments

Text Books:

1. FSSAI Manuals
2. Raghuramulu, N. et al., “A Manual of Laboratory Techniques”. 2nd Edition. NIN, 2003.
3. Nielson, S. Suzanne. “Food Analysis” 3rd Edition. Springer, 2003.

Reference Books:

1. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis : Theory and Practice". 3rd Edition. Springer, 2000.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2	PS03
CO1	3	2	1	-	2	-	1	1	2	2	-	2	3	3	2
CO2	2	2	2	2	3	2	2	2	2	2	2	2	3	3	2
CO3	3	2	2	-	-	2	2	2	-	-	-	2	3	2	3
CO4	3	2	2	1	2	2	2	3	2	2	2	2	3	2	2
Overall Mapping	2.75	2	1.75	1.5	2.33	2	1.75	2	2	2	2	2	3	2.5	2.25

Course Name: Fluid Mechanics and Heat Transfer Lab
Course Code: FT593A
Contact: 0:0:3
Credit: 1.5

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course outcome(s):

After the completion of the laboratory course students will be able to:

CO1: Define process equipment via hands-on learning.
CO 2: Analyze the experiments on flow regime and different flow meter
CO 3: Measure the Overall heat transfer coefficient of heat exchangers
CO 4: Determine the pressure drop for flow through packed bed.

Course Contents:

1. Experiments on Reynolds's Apparatus –Determination of flow regime and construction of friction factor against NRE
2. Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orifice meter, (c) Rotameter
3. To determine pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation
4. To determine the rate of heat transfer through double pipe heat exchanger with parallel and countercurrent flow
5. To determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside and outside diameter of the tube
6. To study the viscosity of processed food (Jam, Jelly, Ketchap, Edible oils) with varying shear stress
7. To study the flow characteristics of processed food (Jam, Jelly, Ketchap, Edible oils) by Rheometer and verification of power law with graphical interpretation
8. Innovative Experiments

Text books:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Heat Transfer: D.Q. Kern, MGH

CO-PO-PSO Mapping:

COs	**Program Outcomes**												**Program Specific Outcomes**		
	PO1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

Course Name: Mass Transfer Lab I
Course Code: FT593B
Contact: 0:0:3
Credit: 1.5

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

- To impart knowledge about the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course outcome(s):

After the completion of the laboratory course students will be able to:
CO1: Analyze the data on diffusion coefficient and mass transfer coefficient.
CO 2: Study the characteristic of packed bed absorption column
CO 3: Discuss the working of a cooling tower and temperature drop in a fluid inside it.
CO 4: Understand the working mechanism of crystallizer and dryer

Course Contents:

1. To determine Mass transfer coefficient / kLa
2. To determine the Gas-phase mass-transfer coefficient in wetted wall column
3. To determine the diffusion co-efficient of an organic vapor (naphthalene) in air.
4. To estimate the Solid liquid mass-transfer coefficient for dissolution of benzoic acid in water.
5. To study the absorption of a gas in a packed column and calculation of NTU and HTU
6. To study flooding and loading characteristic of Packed bed absorption column
7. To find out crystal yield in batch crystallizer
8. To study working and operation of the cooling tower
9. Innovative Experiments

Text books:

1. Robert. E. Treybal. ―Mass Transfer Operation‖, 3e, Mc Graw Hill, NY,
2. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
3. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. J.D. Seader & Henley E. J., "Separation Process Principles‖ 2e, Wiley India Pvt. Ltd,

CO-PO-PSO Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

Course Name: Mechanical Operations and Separation Process I Lab
Course Code: FT593C
Contact: 0:0:3
Credit: 1.5

Course Objective:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course Outcome:

After the completion of the course students will be able to:
CO1: Plan experiments and present the experimental data meaningfully
CO2: Apply theoretical concepts for data analysis and interpretation
CO3: Understand chemical engineering unit operations related to comminution
CO4: Apply different separation processes like centrifugation, filtration, extraction, drying, crystallization.

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Contents:

1. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements
2. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed
3. To determine filter medium resistance & cake resistance in cake filtration.
4. To determine separation coefficient in centrifugation.
5. To determine separation coefficient by vacuum evaporation using Rotary Vacuum Evaporator
6. To determine drying rates of food using different types of driers (Tray Drier, Fluidized bed Drier, Freeze Drier, Spray Drier
7. Innovative Experiment

Text books:

1. Robert. E. Treybal. ―Mass Transfer Operation‖, 3e, Mc Graw Hill, NY,
2. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
3. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference books

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. J.D. Seader & Henley E. J., "Separation Process Principles‖ 2e, Wiley India Pvt. Ltd,

CO-PO-PSO Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	1.25

MANDATORY COURSE

Course Name: Constitution of India
Course Code: MC501
Contact: 2:0:0
Total Contact Hours: 24

Credit: 0

Pre requisites: NA

Course Outcome(s):

After completion of the course students will be able to:

CO1: Identify and explore the basic features and modalities of Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.

CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

Course content:

Module 1: Introduction: 4L

"Constitution"- Historical Background of the Constituent Assembly, Indian Constitution and its Salient Features, the Preamble of the Constitution.

Module 2: Fundamental Rights, Fundamental Duties,

Directive Principles of State Policy: 8L

The Right to Equality

The Right to Freedom: I (Article 19)

The Right to Freedom: II (Articles 20, 21 and 22)

The Right against Exploitation

The Right to freedom of Religion

Cultural and Educational rights

The Right to Property

The Right to Constitutional Remedies

The Directive Principles

Fundamental Duties

Module 3: Union Government and its Administration 6L

Structure of the Indian Union, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module 4: The Machinery of Government in the State 6L

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges

State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Text/ Reference Books:

1) Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2) Constitution of India by Subhas C Kasyap, Vitasta Publishing
3) The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003.
4) Indian Constitution Text Book - Avasthi, Avasthi,Publisher: LAKSHMI NARAIN AGARWAL

CO-PO-PSO Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	3	-	2	2	-	2	-	3	-	1	3	3	1	2	3
CO2	3	2	-	1	-	1	-	2	2	3	3	3	1	2	3
CO3	3	-	1	-	-	3	-	2	-	1	3	3	2	3	3
Overall Mapping	3	2	1.5	1.5		2		2.33	2	1.66	3	3	1.33	2.33	3

3rd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC604	Economics for Engineers	2	0	0	2	2
2	PC	FT601	Bakery, Confectionary and Extruded Foods	3	0	0	3	3
3	PC	FT602	Food Process Technology–IV (Edible Fats and Oils)	3	0	0	3	3
4	PE	FT603A/B/C (Professional Elective III)	A. Mass Transfer II	2	1	0	3	3
			B. Separation Process II	2	1	0	3	3
			C. Transport Phenomena	2	1	0	3	3
5	PE	FT604A/B/C (Professional Elective IV)	A. Food Additives	3	0	0	3	3
			B. Supply Chain Management and Food Marketing	3	0	0	3	3
			C. Food Security and Sustainability	3	0	0	3	3
6	OE	FT605A/B/C (Open Elective I)	A. Data Structure and Algorithms	2	1	0	3	3
			B. Data Base Management System	2	1	0	3	3
			C. Software Engineering	2	1	0	3	3
B. PRACTICAL								
7	PC	FT691	Food Processing Lab–II	0	0	3	3	1.5
8	PC	FT692	Food Analysis and Quality Control Lab-II	0	0	3	3	1.5
9	PE	FT693A/B/C (Professional Elective III Lab)	A. Mass Transfer Lab II lab	0	0	3	3	1.5
			B. Separation Process II Lab	0	0	3	3	1.5
			C. Transport Phenomena Lab	0	0	3	3	1.5
10	OE	FT694A/B/C (Open Elective I Lab)	A. Data Structure and Algorithms Lab	0	0	2	2	1
			B. Data Base Management System Lab	0	0	2	2	1
			C. Software Engineering Lab	0	0	2	2	1
11	PROJECT	PR691	Minor Project II	0	0	3	2	1
12	PROJECT	PR692	Skill Development VI: Soft Skill and Aptitude-III	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC601	Intellectual Property Right	2	0	0	2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.0
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**28.0**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to betaken from MOOCS BASKET**

Course Name: ECONOMICS FOR ENGINEERS

Course Code: HSMC604

Contact: 2:0:0

Total contact hour: 24

Credits: 2

Prerequisites: NIL

Course Objective:

- To develop decision making skills using basic economic Principles
- To educate the students in evaluating various Business Projects

Course outcome:

On completion of the course students will be able to

CO1: Identify various uses for scarce resources

CO2: Understand key economic concepts and implement in real world problems

CO3: Apply critical thinking skills to analyze financial data and their impacts

CO4: Evaluate business performance through the knowledge of cost accounting principles

Course Content:

Module - 1: **Introduction to Economics:** Meaning, Nature and Scope of Economics **[2L]**

Module - 2: Theory of Demand and Supply: Concept of demand, Determinants of demand, Individual and Market Demand, Exception to the law of demand. Concept of Supply, Shift in Demand and Supply Curve, Movement along the demand and supply curve, Determinants of equilibrium price and quantity, Elasticity of Demand and Supply. **[4L]**

Module - 3: Theory of Production and Cost : concept of Production function, types pf Production function, Laws of return to scale and variable Proportion, Cost Function, Types of Cost Function, Different Cost curves, Relation between Average and marginal cost, Relationship between Short Run costs and Long Run costs, Profit maximisation **[6L]**

Module - 4: Macroeconomic Aggregates and Concepts: GDP, GNP. Concepts of National Income . Concept of Business Cycle **[3L]**

Module - 5: Inflation: Concept , Causes and Remedies of Inflation. **[2L]**

Module - 6: Accounting: Basic concept of Journal, Preparation of Income Statement and Balance Sheet **[4L]**

Module - 7: Cost Volume Profit Analysis: Contribution, P/V Ratio, Break-Even Point, Margin of Safety, Short term decision making: Make or Buy, Shut-down point, Export Pricing,
Opportunity and Sunk cost. **[3L]**

Text Books:

1. Economics,by Lipsey and Chrystal, Oxford university Press
2. Modern Accountancy,vol.-I-, by Hanif &Mukherjee,TataMgrowHill

References:

1. Modern Economic Theory ,by K.K. Dewett, S.Chand
2. Principles of Economics,by H.L. Ahuja, S. Chand
3. Engineering Economics,by R.Paneer Seelvan, PHI
4. Economics for Engineers, by Dr. Shantanu Chakraborty &Dr. Nilanjana singharoy, Law Point Publication

CO-PO- PSO Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	2	-	1	2	3
CO2	-		-	-	-	3	-	-	-	-	2	-	1	2	3
CO3	-	-	2	2	3	-	-	-	-	-	2	2	2	2	3
CO4	-	-	3		-	-	-	-	-	-	3	2	1	2	3
Overall Mapping	3		2.5	2	3	3					2.25	2	1.25	2	3

Course Name: BAKERY, CONFECTIONARY AND EXTRUDED FOODS

Course Code: FT601

Contact: 3:0:0

Total Contact Hours: 36
Credit: 3

Pre requisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:

To provide an optimum environment for students to gain knowledge on the different functional properties of the ingredients, processes and machinery involved in production of different bakery and confectionery products. Students can also get idea about the safety, hygiene and maintenance of different bakery industries.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Gain knowledge on the ingredients, process and machinery involved in bakery and confectionery technology and extruded products.
CO2:Evaluate the function, properties and interaction of raw materials by manufacturing a range of products and to use a selected range of testing procedures to assess the performance of raw materials in the product.
CO3: Demonstrate a detailed knowledge of the law relating to the composition, labeling and advertising of food and food products within this area sold for human consumption and to analyze production faults and suggest corrective actions and to assess product quality for industry and consumer requirements.
CO4: Remember the technical knowledge for the development of Bakery and Confectionary industry and Extruded products

Course Contents:

Module I (8L): Introduction to baking; Bakery ingredients and their functions; Machines and equipment for batch and continuous processing of bakery products.

Module II (8L): Testing of flour; Preparation techniques of different baked products: bread, cake and biscuits; Cake icing techniques, wafer manufacture, cookies, crackers, dusting or breading; Analysis of bakery products;

Module III (8L): Preparation techniques of confectionary: pies and pastries, doughnuts, chocolates and candies; Chocolates: Introduction. Different ingredients require for chocolate preparation and their functions and value added product; Maintenance, safety and hygiene of bakery plants.

Module IV (8L): Importance and applications of extrusion in food processing; Pre and post extrusion treatments; Manufacturing process of extruded products: Texturized vegetable protein; Change of functional properties of food components during extrusion.

Revision:4L

Text books:

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.

Reference Books:

1. Up to-date Bread Making; Fance WJ &Wrogg BH; 1968, Maclasen& Sons Ltd.
2. Modern Cereal Chemistry; Kent-Jones DW & Amos AJ; 1967, Food Trade PressLtd.

CO – PO-PSO Mapping:

COs	**Program Outcome**												**Program Specific Outcomes**		
	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO1**	**PSO 2**	**PSO3**
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	2
CO2	3	2	2	1	-	1	2	1	-	-	-	3	3	2	2
CO3	3	3	2	2	-	-	2	-	-	-	-	3	3	3	3
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2
Overall Mapping	3	2.5	2	1.5		2	2.5	1.5				3	3	2.33	2.25

Course Name: Food Process Technology–IV (Edible Fats and Oils)

Course Code: FT602

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of Food, Principles of Food Preservation

Course Objective:

To study in depth the chemical, physical and nutritional properties of fats and oils and the technologies involved in the production of vegetable oils/fats and theirby-products.

Course outcome(s):

After completion of the course students will be able to:

CO1: Analyze the various properties of fats and oils in processing, non-processing and storage condition.
CO2: Explain the different production and refining processes of vegetable oil.
CO3: Identify different technology for manufacture of designer fats.
CO4: Formulate newer methods for analysis of non-oil constituents of oil bearing materials.

Course Contents:

Module I (8L):

Importance of fats and oils in foods; Extraction of fats and oils from plant sources by Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil extraction.

Module II (8L):

Processing of oils – Degumming, refining, dewaxing, bleaching, deodorization, fractionation; Pyrolysis of fats, toxicity of frying oil.

Module III (8L):

Plastic fat –hydrogenation, esterification, inter-esterification and emulsification; Application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortenings, margarine processing.

Module IV (8L):

By-products of fat/oil processing industries; Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its mechanism of application.

Revision:4L

Text Book:

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley &Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961,Pergamon Press.

Reference books:

1. Food Oils and their Uses; Weiss TJ; 1983, AVI.

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	1	-	2	1	-	-	-	3	3	2	2
CO2	3	2	2	1	2	2	2	2	2	2	2	3	3	3	2
CO3	3	3	2	2	2	1	2	2	2	2	2	3	3	3	2
CO4	3	3	2	2	2	2	2	1	2	2	2	3	3	3	2
Overall Mapping	3	2.5	2	1.66	1.75	1.66	2	1.5	2	2	2	3	3	2.75	2

Course Name: Mass Transfer II

Course Code: FT603A

Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Engineering Thermodynamics, Mass Transfer I

Course Objective:

- To impart knowledge on fundamentals of mass transfer phenomena and to apply those concepts to real engineering problems.
- Toexplaintheprinciplesofmasstransferandtheirapplicationtoseparationandpurificatio nprocesses

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the basics of distillation process for separation.
CO2: Analyze the distillation process for binary and multi component mixtures
CO3: Determine the number of stages required for separation of liquid-liquid and solid-liquid extraction process.
CO4: Explain the concept and mechanism of drying operations.

Course Contents:

Module I (6L): Distillation

Pressure-composition, Temperature-concentration, Enthalpy-concentration diagrams for ideal and non-ideal solutions, Raoults law and its application, 8 Maximum and minimum boiling mixtures, concept of relative volatility, Single Stage Distillation, Differential distillation, Flash vaporization, Vacuum, molecular and steam distillation.

Module II (8L): Continuous Distillation of Binary Mixtures

Multistage contact operations, Characteristics of multistage tower, McCabe Thiele method, Reflux, maximum, min. and optimum reflux, Use of open steam, Tray efficiency, Determination of height and column diameter, Multistage batch distillation; Principles of azeotropic and extractive distillation

Module III (10L): Extraction

Liquid-Liquid Extraction: Ternary liquid equilibrium, Triangular graphical representation concept of theoretical or ideal stage, Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation Super critical fluid extraction.
Solid /Liquid Extraction: Leaching, Solid liquid equilibrium, Equipment used in solid-liquid extraction, Single and multistage cross current contact and counter current operations.

Module IV (6L):Drying

Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers.

Revision:4L

Text books:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5thedition

2. Transport Processes & Unit operations: Geankopolis, PHI, 3rdedition

3. Robert. E. Treybal. ―Mass Transfer Operation‖, 3e, Mc Graw Hill, NY

4. Geankoplis, C.J. ―Transport Processes and Unit Operations‖, 3e, Prentice Hall (I)

Referencebooks:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, ButterworthHeinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition,JWS
4. Perry, Chilton & Green, Chemical Engineers' Handbook,MGH

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	3
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1	2		1.5	3	3	2.25	1.75

Course Name: Separation Process II

Course Code: FT603B

Contact: 2:1:0

Total Contact Hours: 36

Credit:3

Pre requisites: Thermodynamics, Separation Process I

Course Objective:

To learn conceptual design of separation processes and design of equipment involved.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: **Understand** the principles of molecular diffusion and basic laws of mass transfer.
CO 2: **Study** the characteristic of packed bed absorption column
CO3: Understand the basics of distillation process for separation
CO4: Solve the problems of separation by diffusion, absorption and distillation

Course Contents:

Module I: 10L

Principles of molecular diffusion and diffusion between phases, Fick's Law, Diffusivity, Equation of continuity, Diffusion in solids. definition of Mass transfer coefficient, Correlation of mass transfer coefficients, Theories of Mass Transfer, mass transfer across interfaces.

Module II: 10L

Introduction, Mechanism of absorption, Absorption equipments, Diameter and height calculations for packed columns, Kremser equation, H. E. T. P. , H. T. U. , and N. T. U. concepts, Packed tower design, height of column based on conditions in the gas, liquid film, and overall coefficients, plate type towers, number of plates by use of absorption factor.

Module III: 12L

Introduction, Vapor-liquid equilibria, Relative volatility, Ideal and non -ideal solutions, Batch, differential and equilibrium distillation, Enthalpy concentration diagram, Rectification of binary systems, Design of rectification column, calculation of number of ideal plates in a

distillation column by McCabe-Thiele method, importance of reflux ratio, Azeotropic mixture & Extractive Distillations, Introduction to multi-component distillation.

Revision: 4L

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.

2. Transport process and Unit Operations: Geankoplis. 3rd Edn., PHI.

3. Unit Operations in Chemical Engineering : McCabe, Smith, and Harriot. MGH, Sth Edn.

Reference books:

1. Multicomponent Distillation: Holland, C. D., PHI.

2. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.

3. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.

4. Separation Processes: King, C. J. MGH.

5. Design of Equilibrium Stage Processes: Smith, B. D. MGH.

6. Distillation: van Winkle, M., MGH.

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	3
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1	2		1.5	3	3	2.25	1.75

Course Name: Transport Phenomena

Course Code: FT603C

Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objective:

To be able to analyze various transport processes with understanding of solution approximation methods and their limitations.

Course Outcome(s):

After Completion of the course students will be able to:
CO1: Understand the chemical and physical transport processes and their mechanism
CO2: Apply heat, mass and momentum transfer analysis
CO3: Analyze industrial problems along with appropriate approximations and boundary conditions
CO4: Develop steady and time dependent solutions along with their limitations

Course Contents:

Module I: 8L

Introduction: Concept of unified approach to Momentum, Heat and Mass Transport through Transport Phenomena - Assumptions of Transport phenomena; Similarity of Mass, Momentum and Energy transfer, Diffusivities, Transport Theorem

Module II: 8L

Momentum Transport: Viscosity, Newton's law of viscosity, calculation of momentum flux, Non-Newtonian fluids – Bingham model, – Flow of a falling film with constant/variable viscosity, Flow through a circular tube, Laminar flow between two flat stationary/moving plates, Shape of the surface of a rotating fluid. Concept of Boundary layer and Boundary layer theory. Concept of turbulence.

Module III: 8L

Energy Transport:

Modes of heat transfer; concepts of (a) thermal conductivity – constant and temperature dependent, (b) thermal diffusivity and (c) heat transfer coefficient. Fourier's law of heat

conduction. Shell energy balance and boundary conditions – Heat conduction with electrical, nuclear, viscous and chemical heat source, Heat conduction through composite walls

Module IV: 8L

Mass Transport: Concentrations, Velocities and Mass and Molar fluxes. Concept of Mass diffusivity and Mass transfer coefficient.Fick's law of diffusion.
Shell mass balance and boundary conditions – Diffusion through stagnant gas film

Revision: 4L

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International studentEdition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.
3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.
4. Multicomponent Distillation: Holland, C. D.,PHI.

Reference books:

The Elements of Fractional Distillation: Robinson, C. S. and

Gilliland, E. R. MGH. 2. Mass Transfer: Sherwood, Pigford,

and Wilke, MGH.

3. Separation Processes: King, C. J.MGH.
4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

CO – PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	3
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		1.5	2		1.5	3	3	2.25	2.33

Course Name: Food Additives

Course Code: FT604A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Food Chemistry, Food Preservation

Course Objective:

To provide the students an opportunity to gain knowledge of the class, function, and uses of additives, relate the various role of additives, select suitable additives in food composition and categorize uses of additives with regulations and food laws

Course outcome(s):

After completion of the course students will be able to:
CO1: Understand the various roles of additives
CO2: Apply their knowledge in formulation with the uses of different additives.
CO3: Identify suitable additives in food composition
CO4: Categorize uses of additives with regulations and food laws

Course Contents:

Module I: 10L

Definitions of Food Additives, Basic criterion of additives, Classification and Functions, Legitimate uses of Additives in foods, Intentional & Non Intentional additives, Indirect food additives; Food uses and functions in formulations; Toxicological evaluation of food additives (intake assessments), generally recognized as safe (GRAS), Regulations and food laws on food additives, Joint FAO/WHO Expert Committee (JECFA)/CODEX recommendation for harmonization and control of food additives, GFSA

Module II: 10L

Uses & functions of Acid, Base, Buffer systems, Salts, acidulants and Chelating/Sequestering agents, Artificial sweeteners and health implications; Low calorie and non-nutritive sweeteners, Polyols. Antioxidants and chelating agents, Emulsifying and stabilizing agents, Anticaking agents, and Humectants, Thickeners, Firming agents. Flour bleaching agents and Bread improvers. Fat mimetics and replacers

Module III: 6L

Antimicrobial agents / Class I, Class II, and Class III preservatives as per PFA Act. Acceptable Daily Intake (ADI) recommendation by JECFA, Carry-Over of Food Additives from ingredients and raw materials into foods, Clarifying agents. Tracers and other additives

Module IV: 6L

Colours and Flavours (synthetic and natural) Types of flavors, flavor emulsions; essential oils and oleoresins, Flavor enhancer, Method of analysis. Risks and benefits of food additives, Food additives and hypersensitivity, Nutritional additives

Revision: 4L

Text Books:

1. Gerorge AB. 1996. Encyclopedia of Food and Color Additives.Vol. III.CRC Press.
2. Branen AL, Davidson PM & Salminen S. 2001. Food Additives.2nd Ed.Marcel Dekker.
3. Fenaroli's Handbook of Flavor Ingredients. 5th Ed.CRC Press.

Reference Books:

1. Fennema OR.1996. Food Chemistry. Marcel Dekker
2. Stephen AM. (Ed.). 2006. Food Polysaccharides and Their Applications.Marcel Dekker.

CO-PO-PSO Mapping

CO(S)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	3	2	2	1	1	2	2	-	1	-	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3
CO 4	3	3	3	3	2	3	2	3	3	3	2	3	3	3	3
Overall Mapping	3	3	2.5	2.75	2.25	2.25	2.5	2.75	2.66	2.25	2.33	3	3	2.25	2.75

Course Name: Supply Chain Management and Food Marketing

Course Code: FT604B

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Basic understanding of management principles and tools, Food Preservation

Course Objective:

- To impart knowledge and understanding on supply chain management and its relevance to today's business decision making
- To enable students to be aware of marketing techniques, schemes, and practices related to food products in place- and nationally and globally.

Course outcome(s):

After completion of the course students will be able to:

CO1: Remember principles of supply chain management principles to find the scope of food businesses

CO2: Interpret the tools and solutions that are being developed to solve arising in a supply chain during food processing problems

CO3: Apply sequential strategic planning involved in managing effective production, operation and distribution, and limitation of different processed foods keeping concerned existing advertising laws, regulations, and policies concerning the supply of safe food to consumers.

CO4: Develop system tools to meet the specific need of Food Product Development and Commercialization with effective supply chain mapping and traceability systems.

Course Contents:

Module I: 9L

Supply Chain definition, Objectives and Types, Various definitions, Drivers and Need for SCM, SCM decisions and skills, Strategy formulation in SCM, Value in Supply Chain and Tradeoffs, CRM Strategy relationship matrix, Strategic Sourcing, Source evaluation – collaborative perspective, Buyer-Supplier Relationship, Partner Selection, develop of Partnership, the importance of inventory, imbalances and uncertainties, inventory costs

Module II: 12 L

Transportation Selection, Trade off, modes of transportation, models for transportation and distribution, factors affecting network effectiveness, 3 PL advantages, Indian transport infrastructure, IT solutions, EDI, e-Commerce, e-Procurement, Bar Coding and RFID

technology, Critical business processes and information systems, DBMS, benefits of ERP, information system and bull whip effect, SCM software packages, modeling concepts, Vendor analysis model, Coordinated SCM, Simulation modeling reverse Vs forward supply chain, types of reverse flows, collaborative SCM's and CPFR, agile systems, sources of variability, characteristics

Module III:5L

Supply Chain Mapping (based on quantification of customer sensitivity and risk), Supply Chain Management and profitability, quality management, mass customization and globalization, Ethical Supply Chains, e-business and SCM, Balanced Score Card, Benchmarking

Module IV: 6L

Food marketers act (Advertising law and regulation), Policymakers, food marketing practices, Product Development and Commercialization, Manufacturing Flow Management, Supplier Relationship Management regulation of food markets (e.g. food safety, false advertising, etc.)

Revision: 4L

Text Books:

1. Mohanty R.P, S.G Deshmuki "Supply Chain Management" Biztantra, New Delhi 936 PAPER IV S

Reference Books:

1. Jacobs F.R, Berry W.L, Whybark D.C, Vollmann T.E,. Manufacturing Planning and Control for Supply Chain Management: The CPIM Reference, Second Edition
2. Chopra S., Supply Chain Management: Strategy, Planning, and Operation (7th Edition) (What's New in Operations Management)

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO2**	**PSO 3**
CO 1	3	3	2	2	1	1	2	2	2	1	3	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	2	3	2	3	3	3	3	3	3	3	3
Overall Mapping	3	3	2.5	2.75	2.25	2.25	2.5	2.75	2.5	2.25	2.5	3	3	2.5	2.75

Course Name: Food Security and Sustainability

Course Code: FT604C

Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Environmental science, basic biology, agriculture, geography, microbiology, food processing, quality control, and food regulations

Course Objective:

To enable the students to learn about the severity of depletion of natural resources and its effect on food security and also enlighten about the different practices, policies, and initiatives to ensure food security and sustainability

Course outcome(s):

After completion of the course students will be able to:

CO1: Identify the importance of utilization and preservation of land, water, and other natural resources for Food Security and Sustainability.
CO2: Analyze the different existing and proposed technologies to set up sustainable food eco-systems with compliance to principles to aid in Food Security and Sustainability
CO3: Evaluate food production trends to monitor and explore various avenues to cater to the development of sustainable practices in society
CO4: Develop mass awareness and contribute at various levels as individuals or as active members of organizations to uphold the magnitude of Food Security and Sustainability

Course Contents:

Module I: 9L

Food Security and Sustainability - Definition, Elements, Prospects and Challenges, Food production and nutritional aspects, Food –ecosystems, Factors affecting agriculture and crop yield, Indicators of Sustainable food availability, Population pressure and agricultural productivity, GMO, organic farming, vertical farming – principles and practices, Subsistence Food Production Practices, Security of foods of animal origin and its implications,

Module II: 8L

Performance of major categories of food over the past decades, trends in food production, Decline in total factor productivity growth, Demand and supply projections, Impact of market forces, Sustainable food security indicators and index, Indicator of sustainability of food Security, Path to sustainable development.

Module III: 9L

Impact of depletion of water resources, Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation, Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Groundwater & Surface water)

Module IV: 6L

International and National policies for Food Security and Sustainability, Schemes, initiatives, and mass awareness programs by Government, PSUs, Case studies on CSR activities of different organizations related to Food Security and sustainability

Revision: 4L

Text Books:

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture: A vision for future, New India Publishing
Agency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013

Reference Books:

1. Swarna S.Vepa etal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2.Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable
agriculture, Scitech Publications, Chennai, 1999.
3. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
4. M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	**PO 2**	**P O3**	**PO 4**	**P O5**	**P O6**	**P O7**	**P O8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO2**	**PSO 3**
CO 1	3	3	2	2	1	2	2	2	2	1	2	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
Overall Mapping	3	3	2.5	2.75	2.25	2.5	2.75	2.75	2.5	2.25	2.5	3	3	2.5	2.75

Course Name: DATA STRUCTURE AND ALGORITHM
Course Code: FT605A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory.

Course Outcomes:

After completion of the course students will be able to
CO1:Differentiate how the choices of data structure & algorithm methods impact the performance of program.
CO2:Solve problems based upon different data structure & also write programs.
CO3:Identify appropriate data structure & algorithmic methods in solving problem.
CO4:Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing
CO5:Compare the benefits of dynamic and static data structures implementations.

Course Contents:

Module I: Linear Data Structure [10L]

Introduction (2L):

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.

Algorithms and programs, basic idea of pseudo-code (1L)

Algorithm efficiency and analysis, time and space analysis of algorithms – order notations (1L)

Array (2L):

Different representations – row major, column major (1L)

Sparse matrix - its implementation and usage, Array representation of polynomials (1L)

Linked List (6L):

Singly linked list – operations, Doubly linked list – operations (4L)

Circular linked list – operations, Linked list representation of polynomial and applications (2L)

Module II: Linear Data Structure [6L]

Stack and Queue (4L):

Stack and its implementations (using array and linked list) (1L)

Applications (infix to Postfix, Postfix Evaluation) (1L)

Queue, circular queue, de-queue (1L)

Implementation of queue- linear and circular (using array and linked list) (1L)

Recursion (2L):

Principles of recursion - use of stack, tail recursion. (1L)

Applications - The Tower of Hanoi(1L)

Module III: Nonlinear Data structures [12L]

Trees (8L):

Basic terminologies, forest, tree representation (using array and linked list) (1L)

Binary trees - binary tree traversal (pre-, in-, post- order) (1L)

Threaded binary tree (1L)

Binary search tree- operations (creation, insertion, deletion, searching) (1L)

Concept of Max-Heap and Min-Heap (creation, deletion) (1L)

Height balanced binary tree – AVL tree (insertion with examples only) (1L)

Height balanced binary tree – AVL tree (deletion with examples only) (1L)

m –Way Search Tree, B Tree – operations (insertion, deletion with examples only) (1L)

Graphs (4L):

Graph theory review (1L)

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge) (2L)

Minimal spanning tree – Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods) (1L)

Module IV: Searching, Sorting [8L]

Sorting Algorithms (4L):

Bubble sort, Insertion sort, Selection sort – with notion of complexity (1L)

Quick sort, Merge sort – with complexity (2L)

Radix sort – with complexity (1L)

Searching (2L):

Sequential search – with complexity (1L)

Binary search, Interpolation Search– with complexity (1L)

Hashing (2L):

Introduction to Hashing and Hashing functions (1L)

Collision resolution techniques (1L)

Text Books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, SartajSahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson

CO- PO-PSO mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	-	3	2	2
CO2	-	-	-	-	-	2	3	2	2	-	-	-	3	2	3
CO3	-	-	1	-	-	-	-	-	2	3	-	-	3	3	3
CO4	-	1	-	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	-	-	-	-	3	-	-	-	-	-	-	3	3	3
Overall Mapping	3	2	1.5	2	3	2.5	3	2	2	3			3	2.6	2.8

Course Name: DATABASE MANAGEMENT SYSTEM
Course Code: FT605B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives:

1. To learn the data models, conceptualize and depict a database system
2. To design system using E-R diagram.
3. To learn SQL & relational database design.
4. To understand the internal storage structures using different file and indexing techniques.
5. To know the concepts of transaction processing, concurrency control techniques and recovery procedure.

Course Outcomes (COs):

On completion of the course students will be able to
CO1: Apply the knowledge of Entity Relationship (E-R) diagram for an application.
CO2: Create a normalized relational database model
CO3: Analyze real world queries to generate reports from it.
CO4: Determine whether the transaction satisfies the ACID properties.
CO5: Create the database of an organization.

Course Contents:

Module 1:
Introduction [3L]
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module 2:
Entity-Relationship and Relational Database Model [9L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

Module 3:

SQL and Integrity Constraints [6L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module 4:

Relational Database Design [6L]

Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study

Module 5:

Internals of RDBMS [6L]

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling

Module 6:

File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. ElmasriRamez and NovatheShamkant, “Fundamentals of Database Systems”, Benjamin Cummings
Publishing.Company.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.
5. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
3. “Fundamentals of Database Systems”, RamezElmasri, ShamkantB.Navathe, Addison Wesley Publishing Edition
4. “Database Management Systems”, Arun K.Majumdar, PritimayBhattacharya, Tata McGraw Hill

CO-PO-PSO MAPPING:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CO2	2	3	3	3	3	1	1	1	2	2	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3
Overall Mapping	2.6	2.8	2.4	2.6	2.8	1.6	1.4	1.4	2.2	2.2	2.8	3	3	2.6	2.8

Course Name: SOFTWARE ENGINEERING
Course Code: FT605C
Contact Hours: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. An understanding of basic computer software
2. Object Oriented programming skills.

Course Objectives:

1. To develop basic Knowledge in Software Engineering including software Engineering layered architecture, software process models for software development.
2. To design software requirements and specifications of documents.
3. To understand project planning, scheduling, cost estimation, risk management.
4. To describe data models, object models, context models, behavioral models and coding style and testing issues.
5. To know about the quality checking mechanism for software process and product.

Course Outcomes:

On completion of the course students will be able to:

CO1:Analyze software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

CO2: Specify software requirements through a productive working relationship with various stakeholders of the project

CO3: Design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.

CO4: Develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice.

CO5: Identify modern engineering tools necessary for software project management, time management and software reuse, and an ability to engage in life-long learning.

Course Contents:

Module I [**10L]** SoftwareEngineering–
Characteristics,Components,Application,Definitions,Software Processmodels- Waterfall Model, Prototype model, Spiral., Software Project Planning-FeasibilityAnalysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation : COCOMO(Basic, intermediate, Complete) model

Module II [8L]
System Analysis: Principle of Structure Analysis, Requirement Analysis, DFD, Entity Relationship Diagram, Data Dictionary, Data Modeling, Software Requirements Specification
Software Design Aspects: Objectives, Principles, Concepts, HLD and LLD, Top-Down and Bottom-Updesign; Decision tree, decision table and structured English, Structure chart, Transform analysis Functional Vs. Object-Oriented approach.

Module III[10L]
Coding & Documentation–Structured Programming, Modular Programming, Module Relationship- Coupling, Cohesion, Object Oriented Programming, Information Hiding, Reuse, System Documentation.
Testing–Levels of Testing, Integration Testing, System Testing**.**
Test Cases-White Box and Black Box testing Software Quality, Quality Assurance, Software Maintenance, Software Configuration Management.

Module IV [8L]
Software Project Management – Project Scheduling, Staffing, Quality Assurance, Risk Management: Reactive vs. Proactive Risk strategies, Software risks, Risk identification, Risk projection, Risk refinement Project Monitoring.

Text Books:

1. Software Engineering: A practitioner's approach–Pressman(TMH)

Reference Books:

1. Software Engineering-Pankaj Jalote (Wiley-India)
2. Software Engineering-Rajib Mall(PHI)
3. Software Engineering–Agarwal and Agarwal(PHI)

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	-	-	-	-	-	2	-	3	2	2
CO2	2	2	1	-	-	-	-	-	-	1	-	-	3	2	3
CO3	-	-	3	-	-	2	-	2	-	2	-	-	3	3	3
CO4	-	-	-	-	2	-	-	1	3	-	1	2	3	3	3
CO5	-	-	-	-	-	-	-		2	1	2	2	3	3	3
Overall Mapping	1.5	1.5	2.33	2	2	2		1.5	2.5	1.33	1.5	2	3	2.6	2.8

PRACTICALS

Course Name: FOOD PROCESSING LAB II
Course Code: FT691
Contact: 0:0:3
Credit: 1.5

Prerequisites: Principles of Food Preservation, Unit Operations, Chemistry of Food

Course Objective:

To assist the students to use laboratory techniques common to basic Food Processing and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

Course outcome(s):

After completion of this course students will be able to:

CO1: Use of laboratory techniques common to basic Food Processing.
CO2: Apply the principles that make a food product safe for consumption.
CO3: Interpret Statutory & Regulatory body pertaining regulations to food manufacturing.
CO4: Evaluate the effective test methods used in sensory evaluation and the resulting information.

List of Experiment:

1. Preparation of dry onion/ chilli/ garlic.
2. Preparation of bread
3. Manufacture of macaroni by extruder.
4. Manufacture of potato powder.
5. Manufacture of ice cream.
6. Manufacture of Rosogolla and Sandesh.
7. Manufacture of candied fruits.
8. Production of milk powder by spray drying
9. Preparation of sponge cake.
10. Preparation of fruit leathers
11. Study and characteristics different herbs and spices
12. Comparison of shelf life (nutritional Value and sensory test) of slow frozen and quick frozen food.
13. Innovative experiment.

Text Books:

1. Food Science by B. Srilakhsmi

2. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2

Reference Book:

1. Hand Book of Analysis of fruits & vegetables by S. Ranganna

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**P O3**	**PO 4**	**P O5**	**P O6**	**P O7**	**P O8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO2**	**PSO 3**
CO 1	3	1	3	3	2	3	-	2	2	1	2	2	3	1	1
CO 2	3	3	2	1	-	2	2	3	3	3	3	3	3	2	1
CO 3	3	3	2	2	3	2	3	1	2	2	3	3	3	3	3
CO 4	3	2	2	2	3	-	-	2	1	3	1	3	3	3	3
Overall Mapping	3	2.25	2.25	2	2.66	2.33	2.5	2	2	2.25	2.25	2.75	3	2.25	2

Course Name: Food Analysis and Quality Control Lab-II

Course Code: FT692
Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry, Biochemistry

Course Objectives:

To help the students develop practical skill in analyzing various components e.g. carbohydrate, fat, protein, vitamin etc. available in various food materials and to measure the acidity, ash, sugar content, moisture, total solid content, viscosity, unsaturation, volatile fatty acid, hydrolytic rancidity, oxidative rancidity of these food samples.

Course outcome(s):

After the completion of the Food Analysis and Quality Control Lab II the students will be able to:

CO1: Determine the methods of selecting appropriate techniques for analysis of food products.
CO2: Analyze different components present in various food materials.
CO3: Execute the knowledge of food standards, regulations and quality control.
CO4: Identify the tests methods to detect adulterant in various food samples.

List of Experiments:

1. To analyze wheat flour
2. To analyze bread, biscuit and extruded products.
3. To analyze milk, milk powder and sweetened condensed milk
4. Determination of adulteration in milk and dairy products.
5. Estimation of (a) Iodine value, (b) Saponification value (c) acid value (d) peroxide value, (e) RM value (f) P value, (g) K value of fats and oils, (h) Para anisidine value.
6. Determination of adulterants in milk.
7. InnovativeExperiments

Text Books:

1. FSSAI Manuals

2. Raghuramulu, N. et al., “A Manual of Laboratory Techniques”. 2nd Edition.NIN, 2003.

3. Nielson, S. Suzanne. “Food Analysis” 3rd Edition.Springer, 2003.

Reference Books:

1. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis : Theory and Practice". 3rd Edition.Springer, 2000.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	1	1	2	2	-	2	3	3	2
CO2	2	2	2	2	3	2	2	2	2	2	2	2	3	3	2
CO3	3	2	2	-	-	2	2	2	-	-	-	2	3	2	3
CO4	3	2	2	1	2	2	2	3	2	2	2	2	3	2	2
Overall Mapping	2.75	2	1.75	1.5	1.75	2	1.75	2	2	2	2	2	3	2.5	2.25

Course Name: Mass Transfer II Lab
Course Code: FT693A

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

- To impart knowledge of the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course Outcome:

After the completion of the course students will be able to:

CO1: Analyze the data on vapor-liquid equilibrium and Boiling point diagram
CO2: Discuss the performance of distillation column
CO3: Understand the separation process by Liquid- Liquid Extraction and solid liquid extraction.
CO4: Understand the working mechanism of different type of dryers

Course Contents:

1. To study vapor-liquid equilibrium and prepare Boiling point diagram for a binary liquid mixture.
2. To determine relative volatility of solvent mixtures by distillation.
3. To determine the ternary curve for the system acetic acid-water-carbon tetrachloride
4. To study the solid –liquid extraction system- Soxhlet's experiment
5. To study the operation on extraction of oil from seed.
6. To determine drying rates of food using different types of driers
   (i) Tray Drier,
   (ii) Fluidized bed Drier,
   (iii) Freeze Drier,
   (iv) Spray Drier
7. Innovative Experiment

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International studentEdition.

2. Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.

3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.

4. Multicomponent Distillation: Holland, C. D.,PHI.

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH. 2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.

2. Separation Processes: King, C. J.MGH.

3. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PS03
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	3	3	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		2.5	2.5		1.5	3	3	2.25	1.25

Course Name: Separation Process II Lab

Course Code: FT693B

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

- To impart knowledge of the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course Outcome:

After the completion of the course students will be able to:

CO1: Define process equipment via hands-on learning.

CO2: Determine the filter medium resistance & cake resistance

CO3: Estimate separation coefficient in centrifugation and vacuum evaporation

CO4: Compare drying rates of food using different types of driers

Course Contents:

1. To determine filter medium resistance & cake resistance in cake filtration.
2. To determine separation coefficient in centrifugation.
3. To determine separation coefficient by vacuum evaporation using Rotary Vacuum Evaporator
4. To determine absorption coefficient in a packed tower.
5. To determine drying characteristics of a material under constant drying air condition
6. To compare of drying rates of food using different types of driers

Innovative Experiments

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International studentEdition.

2.Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.

3.Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.

4.Multicomponent Distillation: Holland, C. D.,PHI

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.
2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.
3. Separation Processes: King, C. J.MGH.
4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	3	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		2	2		1.5	3	3	2.25	1.25

Course Name: Transport Phenomena Lab

Course Code: FT693C

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course Outcome:

After the completion of the course students will be able to:

CO1: Plan experiments and present the experimental data meaningfully
CO2: Apply theoretical concepts for data analysis and interpretation
CO3: Understand chemical engineering unit operations related to fluid and particle mechanics, and mass transfer
CO4: Understand the experimental techniques related to chemical reaction engineering

Course Contents:

1. To determine Drag Coefficient
2. Experiments on Tubing, interconnects flow measurement
3. To determine flow measurement
4. Experiments on Industrial-scale equipment, valving
5. Experiments on Temp and flow control, calibration
6. Experiments on Psychrometric chart, vapor pressure, flow control, humidity sensors
7. Experiments on Dissolved oxygen sensors, spargers
8. Innovative Experiment

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International studentEdition.

2. Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.

3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.

4. Multi component Distillation: Holland, C. D.,PHI.

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.

2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.

3. Separation Processes: King, C. J.MGH.

4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PS03
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	3	2	-	2	3	3	3	2
Overall Mapping	3	3	2.25	2	2.33	1.5		2	2		1.5	3	3	2.25	1.25

Course Code: DATA STRUCTURES AND ALGORITHM LAB
Course Code: FT694A
Contact: 0:0:2
Credits:1

Pre requisites:

1. Computer Fundamentals and principal of computer programming Lab

Course Outcomes:

After the completion of the course students will be able to:

CO1: Select appropriate data structure as applied to specified problem definition.

CO2: Handle operations like searching, insertion, deletion, traversing mechanism on various data structures.

CO3: Use practical knowledge on the applications of data structures.

CO4: Able to store, manipulate and arrange data in an efficient manner.

CO5: Implement queue and stack using arrays and linked list. Implementation of queue, binary tree and binary search tree.

List of Experiment:

1. Write a C program to implement Single Link List
2. Write a C program to implement Double Link List
3. Write a C program to implement Single Circular Link List
4. Write a C program to implement Double Circular Link List
5. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.
6. Write a C program to convert a given infix expression into its postfix Equivalent.
7. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
8. Write a C program to implement Binary Search Tree (BST).
9. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
   a. Insertion sort
   b. Merge sort

10. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
   a. Quick sort
   b. Selection sort

11. Write C programs for implementing the following searching methods:
   a. Linear Search
   b. Binary Search

Write a C program to implement all the functions of a dictionary (ADT) using hashing.

12. Write C programs for implementing the following graph traversal algorithms:
   a. Depth first search
   b. Breadth first search

13. Innovative experiments

Text Books:

1. Data Structures using C, R. Thareja, 2nd Edition, Oxford University Press.
2. Data Structures Using C E. Balagurusamy, Mcgraw Hill

Reference Books:

1. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson
2. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
3. Data structures using C, A.K.Sharma, 2nd Edition, Pearson
4. Fundamentals of Data Structures of C by Ellis Horowitz, SartajSahni, Susan Anderson-freed 2nd Edition, Universities Press

CO-PO-PSO– PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	3	-	-	3	2	2
CO2	-	2	2	-	2	-	-	-	-	2	-	2	3	2	3
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	2	-	2	-	-	-	-	-	-	3	-	3	3	3
CO5	-	-	2	1	2	-	-	-	-	-	2	2	3	3	3
Overall Mapping	2.66	3	1.75	1.66	2					2.5	2.5	2	3	2.6	2.8

Course Name: DATABASE MANAGEMENT SYSTEM LAB
Course Code: FT694B
Contacts: 0:0:2
Credits: 1

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives:

1. To learn the data models, conceptualize and depicts data base system
2. To learn the fundamental concepts of SQL queries.
3. To understand the concept of designing a data base with the necessary attributes.
4. To know the methodology of Accessing, Modifying and Updating data& information from the relational databases
5. To learn database design as well as to design user interface and how to connect with database.

Course Outcome(s):

On completion of the course students will be able to

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.

CO2: Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.

CO3: Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.

CO4: Analyze database system concepts and apply normalization to the database.

CO5: Apply different transaction processing and concurrency control applications.

Course Contents:

- Structured Query Language

Module1: [6L]

Creating Database
Creating a Database
Creating a Table Specifying Relational Data Types
Specifying Constraints Creating Indexes

Module2: [3L]
Table and Record Handling
INSERT statement
Using SELECT and INSERT together
DELETE, UPDATE, TRUNCATE statements
DROP, ALTER statements
Module3: [6L]
Retrieving Data from a Database
The SELECT statement
Using the WHERE clause
Using Logical Operators in the WHERE clause
Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause Using Aggregate Functions
Combining Tables Using JOINS
Sub-queries
Module 4: [3L]
Database Management
Creating Views
Creating Column Aliases
Creating Database Users
Using GRANT and REVOKE
Module 5:[6L]
PL/SQL
Module 6:[6L]
Database design using E-R model and Normalization
Module 7:[6L]
Design and implementation of some on line system [Library Management System]

Text Books:

1) SQL, PL/SQL by Ivan Bayross, BPB Publications
2) Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CO2	2	3	3	3	3	1	1	1	2	2	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3
Overall Mapping	2.6	2.8	2.4	2.6	2.8	1.6	1.4	1.4	2.2	2.2	2.8	3	3	2.6	2.8

Course Name: SOFTWARE ENGINEERING LAB
Course Code: FT694C
Contact Hours: 0:0:2
Credits: 1

Prerequisites:
For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

Course Objectives:
- To learn software development skill through various stages of software life cycle. .
- To ensure the quality of software through software development with various protocol based environment.

Course Outcomes:

On completion of the course students will be able to:
CO1: Handle software development models through rational method.
CO2: Prepare SRS document, design document, test cases and software configuration management and risk management related document.
CO3: Develop function oriented and object oriented software design using tools like rational rose.
CO4: Perform unit testing and integration testing
CO5: Apply various white box and black box testing techniques

Assignments to be given from the following
1. Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.
2. Project Schedule preparation. Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables.
3. Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.(For standard application problems)
4. Software Development and Debugging. Estimation of project size using Function Point(FP) for calculation.
5. Design Test Script/Test Plan(both Black box and White Box approach)
6. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Cost Estimation models. COCOMO

Text Book:

1. Software Engineering: A practitioner's approach–Pressman(TMH)

Reference Book:

1. Software Engineering-Pankaj Jalote (Wiley-India)

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	3	3	2	2
CO2	3	2	3	-		-	-	-	-	-	-	2	3	2	3
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
Overall Mapping	3	2.4	3	2	2.5							2.33	3	2.6	2.8

MANDATORY COURSE

Course Name: Intellectual Property Right

Course Code: MC601

Contacts: 2:0:0

Total Contact Hours: 24

Credit: 0

Prerequisite: None

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Explain fundamental aspects of Intellectual property Rights to students
CO2: Disseminate knowledge on patents, patent regime in India and abroad and registration aspects
CO3: Disseminate knowledge on copyrights and its related rights and registration aspects
CO4: Disseminate knowledge on trademarks and registration aspects
CO5: Disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
CO6: Aware about current trends in IPR and Govt. steps in fostering IPR

Course Content

Module 1: 4 hrs

Overview of the IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - International organizations. agencies and treaties,

Module 2: 4 hrs

Patents-Trips Definition, kind of inventions protected by patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Le8al requirements for patents — Granting of patent - Rights of a patent-exclusive

right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document: specification and Claims.Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents,Surrender and Revocation of Patents, Infringement, Remedies & Penalties

Module 3: 4 hrs

Trademarks-Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties –trade mark registration processes.

Module 4:

Copyrights- 4 hrs

Right and protection covered by copyright- Law of copy rights: Fundamental of copy right law. Originality **of material,** rights of reproduction ,rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration, notice of copy right.Internationalcopyrightlaw.InfringementofCopyrightunderCopyrightAct

The Role arid Liabilities of lPRs in India – Cyber law issues: Criminal law. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security.

Module 5: **4 hrs**

Geographical Indication of Goods: Types, why and how GI need protection and GI laws. Indian GI act.

Industrial Designs: protection. Kind of protection provided by industrial designs. Integrated Circuits

Module 6: 4 hrs

India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR – Career Opportunities in IP - IPR in current scenario with case studies

Text book:

1. Fundamentals oflP for Engineers: K.Bansl&P.Bansal

2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

3. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**-**	**1**	**2**	**3**	**-**	**-**	**2**	**-**	**2**	**3**	**3**	**1**	**2**	**3**
CO2	**3**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**3**	**-**	**1**	**-**
CO3	**3**	**-**	**1**	**2**	**3**	**-**	**-**	**2**	**-**	**2**	**3**	**3**	**2**	**2**	**3**
CO4	**3**	**1**	**-**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**3**	**3**	**-**	**1**	**-**
CO5	**3**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**3**	**2**	**-**	**2**
CO6	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**3**	**3**	**-**	**3**	**-**
Overall Mapping	**3**	**1.33**	**1.33**	**1.4**	**2.66**	**3**	**1.5**	**2**	**1.33**	**2**	**3**	**3**	**1.66**	**1.8**	**2.66**

4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PC	FT701	Food Process Engineering	3	1	0	4	4
2	PE	FT702A/B/C (Professional Elective V)	A. Food Packaging Technology	3	0	0	3	3
			B. Functional Foods and Nutraceuticals	3	0	0	3	3
			C. Protein Technology	3	0	0	3	3
3	OE	FT703A/B/C (Open Elective II)	A. Process Instrumentation and Control	3	0	0	3	3
			B. Renewable Energy Technology	3	0	0	3	3
			C. Nanotechnology	3	0	0	3	3
4	OE	FT704A/B/C (Open Elective III)	A. Artificial Intelligence	3	0	0	3	3
			B. Machine Learning	3	0	0	3	3
			C. Introduction to Internet of Things	3	0	0	3	3
B. PRACTICAL								
5	PC	FT791	Food Engineering Lab	0	0	3	3	1.5
6	PROJECT	PR791	Major Project-I	0	0	4	4	2
7	PROJECT	PR792*	Industrial Training / Internship	0	0	0	0	1
8	PROJECT	PR793	Skill Development VII: Seminar and Group Discussion	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
9	MC	MC701	Entrepreneurship and Innovation Skill	2	0	0	2	
TOTAL CREDIT WITHOUT MOOCS COURSES								18
D.MOOCS COURSES**								
10	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22**

***Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

THEORY

Course Name: FOOD PROCESS ENGINEERING

Course Code: FT701

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Mass balance, Unit Operation

Course Objective:

To help the students design the process parameters for thermal processing, freezing, evaporation, dehydration, separation, extraction and to develop skills in formulating solutions to solve problems in food industry.

Course outcome(s):

After the completion of the course students will be able to:

CO1: Explain the food processing techniques of thermal processing, eg, sterilization, evaporation, dehydration, separation, extraction.

CO2: Build the knowledge of different freezers.

CO3: Know the theory of different dryers.

CO4: Understand basic principles of different types of heat exchangers and extruders.

Course Contents:

Module I (11L): Batch and continuous sterilization processes (including steps and various machineries involved) used in canning of foods; Commercial sterilization, Constructional and operational features of pasteurizer; homogenizer; Constructional features and principles of single effect evaporators (including mass and energy balances) used for concentration of liquid foods.

Module II (11L): Constructional features of cold storage and basic design approach; Different types of freezers including plate contact freezer, air blast freezer; Cryogenic freezing; Refrigerated mobile vans.

Module III (11L): Theory of drying and mechanism of moisture transfer in drying; Drying kinetics and constant & falling rate periods in drying; Constructional & operational features of various types of cross-flow, through flow and recirculatory dryers – Tray dryer, roller dryer, drum dryer, spray dryer, fluidized bed dryer, freeze dryer and solar dryer, rotary dryer, tunnel dryer, other grain dryers (LSU-type).

Module IV (11L): Heat exchangers (Co-current and counter-current heat exchanger); Constructional features of various types of heat exchangers – DPHE, Shell& tube heat exchanger, Plate heat exchanger, extended surface heat exchangers; Theory and operation of extrusion systems used in food industry; Cold extrusion and Extrusion cooking systems; Single and twin-screw extruders – constructional and operational features including advantages/disadvantages with case studies..

Revision: 4L

Text Books:

1. Fundamentals of Food Process Engineering (3rd Ed.) – R. T. Toledo, Springer, 2007.
2. Unit Operations of Chemical Engineering – W.L. McCabe, J. C. Smith & P. Harriott, McGraw Hill International, 1993.
3. Introduction to Chemical Engineering – S. K. Ghosal, S. K. Sanyal, S.Datta.

Reference Books:

1. Introduction to Food Engineering (5th Ed.) – R. P. Sing & D. R. Heldman, Academic Press, 2014
2. Food Process Engineering & Technology (2nd Ed.) – Z. Berk, Academic Press, 2014
3. Food Process Engineering Operations – G. D. Saravacos& Z. B. Maroulis, CRC Press, 2011.
4. Transport Processes & Separation Process Principles – C. J. Geankoplis, PHI, 2003
5. Introduction to Food Process Engineering – A. Ibraz& G. V. Barbosa-Canovas – CRC Press, 2014.
6. Introduction to Food Process Engineering (2nd Ed.) – P. G. Smith, Springer, 2011.
7. Postharvest Technology and Food Process Engineering- AmalenduChakraverty& R. Paul Singh, CRC Press, 2014.
8. Fundamentals of Food Engineering – D. G. Rao, PHILearning, 2014.
9. Food Process Engineering & Technology – Md. Iffan A. Ansari – Jain Brothers
10. Processing & Food Engineering – M. K. Garg& P. Chandra, Jain Brothers
11. Solved Problems in Food Engineering -StavrosYanniotis, Springer

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**	**PS03**
CO1	3	2	2	1	3	3	2	-	2	-	-	3	3	1	2
CO2	3	1	3	2	3	-	2	2	-	2	-	3	3	3	2
CO3	3	3	3	3	3	-	-	-	-	1	2	3	3	2	2
CO4	3	1	2	2	3	-	1	-	1	-	2	3	3	3	1
Overall Mapping	3	1.75	2.5	2.25	3	3	1.25	2	1.5	1.5	2	3	3	2.25	1.75

Course Name: Food Packaging Technology
Course Code: FT702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Chemistry of Food, Food Process Engineering, Principles of Food Preservation

Course Objective:

To help the students identify the importance of packaging in the food industry and understand the recent developments in food packaging.

Course outcome(s):

After completion of the course students will be able to:

CO1: Define food packaging and explain its function for different food packaging materials.
CO2: Identify potential use of different packaging materials in context to industry and environment.
CO3: Perceive knowledge of bio composite and biodegradable materials for safe food packaging including active and intelligent packaging.
CO4: Adapt rules of different statutory and regulatory bodies in food packaging and disposal protocols for food packaging in industries.

Course Contents:

Module I: 8L

Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging film; Methods of packaging and packaging equipment

Module II: 8L

Mechanical strength of different packaging materials; Printing of packages; Barcodes & other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.

Module III: 7L

Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.

Module IV: 9L

Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing

equipment; Labelling; Aseptic and shrink packaging; Secondary and transport packaging. Advances in Packaging Technologies; MAP, CAP, Active packaging, Intelligent Packaging, Nano-Packaging, Irradiated food Packaging.

Revision: 4L

Text Books:

1. Food Packaging: Principles and Practice by G. L. Robertson. Taylor & FrancisInc.
2. Food Packaging Technology by Richard Coles, Derek MC Dowell and Mark J. Kirwan.Blackwell Publishing, CRCpress.

3. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC,1988.)

Reference Books:

1. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC,1988.)
2. Packaging foods with plastics by winter A. Jenkins & James P Harrington – Technomic publishing co. Inc, Lancaster.Basel.
3. Flexible food packaging (Question & Answers) by Arthur Hirsch VNB – Van Nostrand Reinhold, New York (An AVI Book), ISBN0-442-00609-8.
4. Food Packaging and Preservation (theory & practice) by M.Mathlouthi-Elsevier Applied science publisher, London and NewYork.
5. Food Packaging Materials (Aspect of Analysis & Migration of contaminants) by N.T.crosby applied science publishers LTD.London.
6. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.
7. Packaging (specifications, purchasing & Quality Control) 3rd edition by Edmond A Leonard- Marcel Dekker, INC- Newyork &Basel.
8. Plastics in packaging by forwarded by H.B Ajmera & M.R Subramanium – Indian institute of packaging. Published by A.P.Vaidya, Secretary II, E2, MIDC, Industrial Area (Andheri (East),Bombay-400093.
9. Food Packaging- Stanley Sacharois & Roger C. Griffin- The AVI Publishing company Inc. 1970.
10. Principles of packaging development- Griffin & Sacharow. (The AVI Publishing company, Inc. 1972).

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	2	2	2	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO3	3	1	2	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	3	2.5	2.5	3	2.5	2.25	2.75	2.75	2.5	2.25	2.66	3	3	2.25	2.75

Course Name: Functional Foods and Nutraceuticals
Course Code: FT702B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites:

Basic biology, food chemistry, biochemistry, nutrition, food processing, quality control and food regulations

Course Objective:

1. To develop the understanding of the concept of Nutraceuticals & Functional Foods
2. To enable the students to learn about the health beneficial properties of Nutraceuticals & Functional Foods
3. To enable the students to learn about the manufacturing processes, regulatory challenges and market trends of Nutraceuticals & Functional Foods.

Course outcome(s):

After Completion of the course students will be able to:
CO1: Understand the fundamental concept of Nutraceuticals and Functional Foods on their origin, presence and functionality.
CO2: Identify the disease preventing and health enhancing properties of Nutraceuticals and Functional Foods.
CO3: Apply the basic knowledge to comprehend the manufacturing of various fortified, value-added functional foods and nutraceuticals in different forms for consumption
CO4: Analyze the toxicological aspect, related risks in formulating dosage and defining consumption patterns of Nutraceuticals and Functional Foods.

Course Contents:

Module I: 7L

Definitions of Functional Foods and Nutraceuticals, Types of functional foods and Nutraceutcals, Components like nutrients such as lipids, fibers, amino acids, spices, herbs, polyphenols and bioactive properties, Vitamins and Health, Minerals and Health, Concepts and of Probiotic, prebiotics, synbotics, Supplements like antioxidants and their biochemical functions

Module II: 7L

Nutritional significance: Role of nutraceutical / functional foods in cardiovascular health, diabetes, obesity, immunity, neurodegenerative and age related muscular degeneration, stress management; Nutrition and nutraceuticals for targeted population such as children, woman, adults and elderly.

Module III: 7L

Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods (MSG; Bakery and confectionary products e.g. bread, biscuit and cookies; Breakfast and ready to eat cereals; Infant formulas; Protein mixes; Vegetable Mixes; Dairy product e.g. ice cream; Beverages including diet beverages, Sports drink, Value addition in processed food products

Module IV: 11L

Functional ingredients: Extraction / purification of lycopene, essential oils, isoflavonoids, prebiotics and probiotics glucosamine, phytosterols, and their stability in processing conditions, Manufacturing of dietary supplements in the form of liquid, rehydration powder, tablet, pill, capsule or mix. Principles of toxicology and risk assessment of Nutraceuticals, Dosage levels; adverse effects and toxicity of nutraceuticals Principles of toxicology and risk assessment of Nutraceuticals, Dosage levels; Adverse effects and toxicity of nutraceuticals, Regulatory and labeling issues, CODEX, FDA, FSSAI, Global nutraceuticals/Functional food market. Recent research and patents on nutra-ingredients.

Revision: 4L

Text Books:

1. Handbook of Nutraceuticals and Functional Foods, Robert E.C. Wildman, CRCPres
2. Nutraceutical and Functional Food Components, Charis Galanakis, AcademicPress

Reference Books:

1. Functional Foods and Nutraceuticals (Food Science Text Series), Rotimi E. Aluko, Springer; 2012edition

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	2	2	2	1	-	3	3	2	2
CO2	3	3	2	3	3	2	3	3	2	2	2	2	2	2	3
CO3	3	2	3	2	3	3	2	3	3	3	3	1	3	2	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
Overall Mapping	3	2.75	2.75	2.75	2.5	2.25	2.5	2.5	2.5	2.25	2.66	2.25	2.75	2.25	2.75

Course Name: Protein Technology
Course Code: FT702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Engineering Chemistry, Chemistry of Food

Course Objective:

To help the students develop an advanced idea about protein utilization in food and its importance in our daily diet.

Course outcome(s):

After Completion of the course students will be able to:
CO1: Define protein structure and properties and to analyze different sources of protein.
CO2: Describe protein concentrate and isolate and their functions.
CO3: Interpret manufacturing of protein hydrolysates and to develop textured protein.
CO4: Apply different technique to detect and estimate protein.

Course Contents:

Module I: 8L

Determination of protein structure; Nutritional and commercial importance of proteins; Physical, chemical and functional properties of proteins; Folding of proteins; Commercial sources of proteins; Creation of new proteins by bio-composite synthesis technique, Introduction to protein engineering; salient features of amino acids and their –R groups; conformation of proteins, the Ramachandran plot, tertiary structure and structural domains and motifs of proteins

Module II: 8L

Process of making protein isolates and concentrates; Factors affecting quality of isolates and concentrates; Treatment to isolate and concentrate; Packaging of protein isolates and concentrates; Food and non food uses of isolates and concentrates.

Module III: 8L

Methods of manufacturing protein hydrolysates; Factors affecting quality of hydrolysates; Food uses of hydrolysates; Fibre spinning process of proteins; Textured protein gels and expanded products; Simulated milk products; Restructured protein; Nonconventional sources of protein.

Module IV: 8L

Centrifugation; Cell disruption; Protein precipitation and its recovery; Aqueous two-phase separation; Ion exchange chromatography; Gel filtration; Affinity chromatography; Electrophoresis; Cross filtration; Ultra filtration.

Revision: 4L

Text Books:

1. Altschul, A.M and Wilcke, , H.L Ed 1978. new protein Foods. Vol III. Academic Press, NewYork
2. Bodwell, C.E.Ed. 1977. evaluation of proteins for Humans. AVI,Westport
3. Milner,M., Scrimshaw, N.S and Wang, D.I.C.Ed. 1978. Protein Resources and Technology. AVI,Westport
4. Salunkhe, O.K and Kadam, S.S Eds. 1999. Handbook of world legumes; Nutritional Chemistry, Processing Technology and Utilization. Volume I to III, CRC Press,Florida
5. Salunkhe, D.K. Chavan, J.K.,Adsule, R.N Kadam, S.S 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, NewYork

Reference Books:

1. Bioseparation Engineering: Principles, Practise and Economics, M.Ladish; Wiley Inter science
2. Proteolytic enzymes: a practical approach, Beynon, R.J and Bond, J.S; IRL Press, Oxford

Protein Biotechnology, Franks, F.; Humana Press

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	3	2	2	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
Overall Mapping	2.75	3	2.75	2.75	2.5	2.5	3	2.5	2.5	2.25	2.66	3	2.75	2.5	2.75

Course Name: PROCESS INSTRUMENTATION &CONTROL
Course Code: FT703A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Basic Physics

Course Objective:

This course helps the student

1. To have a knowledge on sensors & transducers

2. To understand the procedures of different process variable measurement

3. To have a knowledge of control system blocks

4. To have a knowledge of process control loops & controllers

Course Outcome(s):

After Completion of the course students will be able to:
CO1: Demonstrate the fundamentals of control systems

CO2: Differentiate the operation of sensors & transducers

CO3: Describe operation of different process parameter measurement

CO4:Apply the knowledge of controller in process control loop design

Module 1: 6L

Operational aspect of instrument system, Control and requisites; Sensors &Transducers, Difference between Sensors & Transducers, Types & classification and selection criteria, Basic principles, Construction and applications of transducer elements, Strain gauge with bridge circuits and calibration procedure

Module 2: 12L

Temperature Measurement: Temperature measurement by bi-metal thermometers – resistance thermometers, thermistors and thermocouples. Radiation and optical pyrometers

Flow measurement: Variable area type flowmeter, variable head type flow meter, magnetic flow meters

Pressure Measurement: Low pressure measurement by McLeod Gage and Pirani Gage

Moisture measurement cells for granular material, infrared, transmission measurement of moisture

Module 3: 6L

Control system, Open and closed loop system, transfer function of open loop and closed loop control systems; Concept of Block diagram; Mathematical modelling

Module 4: 12L

Basic Process Control Loop, Process characteristics, Controller, Controller modes,Pneumatic Controllers, Final control Element, Control valve, Control valve accessories, Actuators, Application of control in heat-exchangers, distillation column

Text and reference books:

1. Instrumentation, Measurement and Analysis; Nakra BC & Chaudhury KK; TMH

2. Process System Analysis & Control; Coughanowr DR; MGH

3. D. P. Eckman, Automatic Process control, John Wiley, New York

4. Surekha Bhanot, Process Control Principal & Application , Oxford

5. G. Stephanopoulos, Chemical process Control, PHI

6. C. D. Johnson, Process Control Instrumentation Technology, PHI

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	2	1	1	1	1	1	3	2	2
CO2	3	2	1	1	2	2	2	2	1	3	2	1	2	3	3
CO3	2	1	3	1	2	1	1	1	2	2	1	3	3	2	3
CO4	3	2	2	3	2	3	2	3	3	1	1	2	3	3	3
Overall Mapping	2.5	1.5	1.75	1.5	1.75	1.75	1.75	1.75	1.75	1.75	1.25	1.75	2.75	2.5	2.75

Course Name: Renewable Energy Technology

Course Code: FT703B
Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Basic Environmental Engineering, Food Process Engineering, Unit Operation.

Course Objective:
To help the students develop an overview on the application of non conventional energy and realize its role in sustainable development.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Define the different biological fuels and biomass as a source of renewable energy

CO2: Explain the phenomenon of thermal combustion of biomass and biogas generation.

CO3: Describe the process of hydrogen production by photosynthetic bacteria.

CO4: Classify the different technologies behind the conversion of biomass to clean fuels and petrochemical substitutes.

Course Contents:

Module I: 8L

Biological fuel generation; Biomass as a renewable energy source; Types of biomass: forest, agricultural and animal residues; Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.

Module II: 8L

Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol from biomass.

Module III: 8L

Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

Module IV: 8L

Solar energy; Solar collectors, solar pond, photovoltaic cells, chemical storage; Geothermal energy and wind energy; Use of geothermal energy; Operating principles of different types of wind energy mills; Nuclear energy; Nuclear reactions and power generation; Tidal wave energy.

Revision: 4L

Text Books:

1. J. E. Smith – Biotechnology, 3rd edn. Cambridge UnivPress.
2. S. Sarkar – fuels and combustion, 2nd edn., UniversityPress.

Reference books:

1. Biochemical Engg. Fundamentals-Baily, Ollis.MGH
2. Bioprocess Engineering by Michael L. Shuler and FikretKargi

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	2
CO2	3	2	2	1	-	2	2	2	-	-	-	2	3	2	2
CO3	3	3	2	2	-	-	2	-	-	-	-	3	2	3	2
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2
Overall Mapping	3	2.5	2	1.5		2.5	2.5	2				2.75	2.75	2.33	2

Course Name: Nanotechnology

Course Code: FT703C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Basic knowledge of physics, mathematics, mechanics, electronics and chemistry

Course Objective:

- To learn about basis of nano material science, preparation method and different types of nano materials
- To enable the students to learn about potential applications of nano materials in food Research

Course outcome(s):

After the completion of the course students will be able to:

CO1: Familiarize about the science and importance of nano materials and nano particals
CO2: Apply the knowledge acquired for characterization of different nano materials/nanoparticals
CO3: Analyze the risk assessment and safety issues of nanoparticals in food and packaging applications
CO4: Evaluate further area of research in food nanotechnology/nano encapsulation/ nano packaging

Course Contents:

Module I (6L):

Back ground of Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles-quantum dots, nanowires, ultra-thin-films-multilayered materials.

Module II (6L):

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal system,,self assembly, High energy milling and grain size analysis.

Module III (8L):

Chemical methods of sol-gel techniques, Gel filtration techniques, Protein gel and nanostructures, Nano porous materials, nano membranes, and carbon nanotubes, Carbohydrates and starch multilayers synthesis ,Structure-property relationships applications, Oil water emulsions and liposome structure analysis.

Module IV (6L):

Chromatographic techniques--- Gel Filtration, Ion exchange, Affinity chromatography, TLC , Polyacrylamide and agarose gel electrophoresis , Microscopy – Fluorescence Microscope , Surface Analysis techniques and Nanoindentation.

Module V (8L):

Applications of Nano composite materials in active/smart packaging, Nano encapsulation: techniques and targeted controlled release of nutrient/ bioactives delivery systems, Nutraceuticals and nano materials stability and applications in food industries. Safety issues and Legal/legislative/regulatory guidelines for use of nanomaterials in food products; concerns.

Revision: 2L

Text Books:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”,
Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”,
2nd edition,WeinheimCambridge, Wiley-VCH, 2000.

Reference Books:

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

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	2	3	2	2	1	-	-	3	2	2
CO2	3	3	3	3	-	2	3	3	2	2	2	-	1	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	-	2	2	3
CO4	3	3	2	3	3	3	3	2	3	3	3	3	2	3	3
Overall Mapping	3	3	2.75	2.75	2.33	2.5	3	2.5	2.5	2.25	2.66	3	2	2.5	2.75

Course Name: Artificial Intelligence
Course Code: FT704A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

- The objective of the course is to enable students to
- Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
- Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
- Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
- Design AI-Frameworks for Inferencing based on knowledge base.
- Analyzethe effectiveness of an AI-Inferencing Modeling offering solutions to the respectiveproblem.

Course Outcomes(s):

After completion of this course students will be able to:

CO1: Understand and explain the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CO2: Identify and formulate an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Agent Design Frame work within the scope of Artificial Intelligence paradigm.

CO3: Explore relevant literature and apply the concept of Heuristic Techniques or Inferencing Models of Artificial Intelligence to solve problems.

CO4: Develop Inferencing Models for proposing solutions to the problems of Artificial Intelligence.

CO5: Implement Inferencing Models of Artificial Intelligence through developing feasible algorithms and investigate their effectiveness by analyzing their performances in solving the relevant problems.

Course Content:

MODULE-1: Introduction to Artificial Intelligence [1L]
Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

MODULE-2: Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [5L]
Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching.
Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.

MODULE-3: Heuristic Techniques for Goal Searching [8L]
Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search.Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search.
Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.

MODULE-4: Adversarial Search for Game Playing [2L]

Basic Concepts, Minimax Search, Alpha-Beta Pruning.

MODULE-5: Knowledge Representation and Inference using Propositional Logic and Predicate Logic [5L]
Propositional Logic: Knowledge Representation and Inference using Propositional Logic
Predicate Logic:Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

MODULE-6: Slot-and-Filler Structure for Knowledge Representation [2L]
Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames.
Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.

MODULE-7: Reasoning under Uncertainty [5L]
Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model.

Planning [5L]

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm.

Introduction to Natural Language Processing [1L]

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.

MODULE-8: Introduction to Machine Learning [2L]

Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

CO–PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	-	-	2	3	3	2	2
CO2	2	3	-	-	-	2	1	-	-	-	-	-	1	3	3
CO3	3	2	3	2	-	-	-	2	3	2	1	-	2	2	3
CO4	2	2	2	3	-	-	3	-	1	-	-	2	2	3	3
CO5	2	2	3	3	2	-	2	-	-	-	3	2	2	2	1
Overall Mapping	2.4	2.2	2.66	2.66	2	2	2	1.5	2	2	2	2.33	2	2.4	2.4

Course Name: Machine Learning
Course Code: FT704B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization ; Statistics; Calculus.

Course Objective(s)

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcome(s):

After completion of this course students will be able to:

CO1: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
CO3: Understand how to evaluate models generated from data.
CO4: Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Course Contents:

Module 1: [8L]

Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module2: [5L]

Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)

Module3: [4L]

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module 4: [7L]

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module 5: [7L]

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module6: [4L]

Recent trends in various learning techniques of machine learning and classification methods.

Text Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

References Books:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

CO-PO-PSO–PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	1	-	-	2	3	3	2	3
CO2	-	3	3	2	-	2	1	-	2	-	-	-	3	1	3
CO3	2	3	3	3	1	-	-	2	3	2	1	-	3	2	3
CO4	2	2	3	3	-	-	3	-	1	-	-	2	2	2	2
CO5	3	3	3	3	2	-	2	-	-	-	3	2	3	2	3
Overall Mapping	2.5	2.6	3	2.6	2.5	2	2	1.5	2	2	2	2.33	2.8	1.8	2.8

Course Name: Introduction to Internet of Things
Course Code: FT704C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcome(s):

On completion of the course students will be able:

CO1: Understand and differentiate the concepts of Internet of Things and Internet
CO2: Identify appropriate MAC protocols and routing protocols while solving a problem
CO3: Analyze and compare the basic protocols in wireless sensor network and IoT
CO4: Solve different real life problems in different domains based upon the concept of IoT and sensor network
CO5: Implement basic IoT applications on embedded platform

Course Content:

Module 1: [7L]
Fundamental of IoT
The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module 2: [6L]
Wireless Sensor Network
Network & Communication aspects, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment & Node discovery, Data aggregation &

dissemination.

Module 3: [7L]
IoT and M2M
A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4: [7L]
IoT Architecture
Introduction, ArchitectureReference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5: [5L]
IoT Applications for Value Creations
Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities,Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6: [4L]
Internet of Things Privacy, Security and Governance
Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference books:

1. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Waltenegus Dargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO-PSO–PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	2	-	-	-	3	2	3
CO2	3	3	3	3	2	-	-	2	3	-	-	3	3	1	3
CO3	3	3	3	2	2	-	1	-	-	-	3	2	3	2	3
CO4	3	3	3	3	3	2	2	3	-	-	-	-	2	2	2
CO5	3	3	3	3	3	2	2	-	2	2	1	1	1	2	2
Overall Mapping	3	3	3	2.8	2.4	2	1.75	2	2.33	2	2	2	2.4	1.8	2.6

PRACTICALS

Course Name: FOOD ENGINEERING LAB

Course Code: FT791

Contact: 0:0:3

Credit: 1.5

Prerequisites: Food Process Engineering, Unit Operations, Principles of Food Preservation

Course Objective:

To help the students develop a practical idea about different operations related to food engineering.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Define the practical implication of the theoretical ideas regarding basic food engineering phenomenon.

CO2: Interpret practical application of the extraction phenomenon related to food processing and to explain the different separation techniques that are used in food industries.

CO3: Analyze the driving principles of different types of driers like spray dryer, tray dryer, drum dryer, microwave heating etc. and determine the working parameters required for a desired thermal processes.

CO4: Explain the practical use of rheological study in a food based industry

List of Experiment:

1. Optimization of oil extraction by using Soxhlet apparatus
2. Study of Drying efficiency – spray dryer, tray dryer, drum dryer, fluid bed dryer, freezedryer
3. Process optimization of preparing fruitjuice concentrate using Rotary Vacuum Evaporator.
4. Characterization of fruit juice concentrates based on refractive index
5. Rheological Study for food materials with different consistency
6. Study of separation percentage using process of Centrifugation
7. Study of separation percentage by filtration
8. Effect of microwave heating on functional properties of food material
9. Innovative Experiments

Text Books:

1. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi

Reference Book:

1. Separation Processes: King, C. J. MGH

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	3	-	3	2	-	-	2	3	3
CO2	3	3	2	3	2	2	-	2	3	2	-	-	3	3	3
CO3	3	3	2	3	2	3	-	2	3	3	-	3	3	3	3
CO4	3	3	2	3	2	3	3	2	3	2	2	3	3	3	3
Overall Mapping	3	3	2	3	2	2.66	3	2	3	2.25	2	3	2.75	3	3

MANDATORY COURSE

Course Name: Entrepreneurship and Innovation

skillCourse Code: MC701

Contacts: 2:0:0

Total Contact Hours: 24

Credit: 0

Pre-requisite: None

Course Outcomes:

After the completion of the course, the students will be able to:

CO1: Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.

CO2: Demonstrate an ability to design a business model canvas.

CO3: Evaluate the various sources of raising finance for startup ventures.

CO4: Explain the fundamentals of developing and presenting business pitching to potential investors.

Course Content

Module 1: **4 hrs**

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges. Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Module 2: **4 hrs**

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation; Advantage and Limitations of Entrepreneurship; Process of Entrepreneurship.

Module 3: **4 hrs**

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Module 4: **4 hrs**

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Module 5: **4 hrs**

Entrepreneurs as problem solvers: Innovations and Entrepreneurial Ventures – Global and Indian; Role of Technology – E-commerce and social media; Social Entrepreneurship – Concept; Entrepreneurship – The Indian Scenario

Module 6: **4 hrs**

Project/Case Study: (Any One)

1. Visit of the District Industries Centre and prepare a report of activities and programs undertaken by them

2. Conduct a case study of any entrepreneurial venture in your nearby area.

3. Field Visit: Visit any business firm near your locality; interact with the owner of the business firm and prepare a field report on parameters like: type of business, scale of business, product/service dealing in, target customer, problems faced and measures to solve the faced challenges. 4. Know your State Handicraft and Handlooms as a means of economic activity

Text Books:

1. Bessant, J. (2003) High Involvement Innovation: Building and Sustaining Competitive Advantage Through Continuous Change. Chicester: John Wiley & Sons.
2. Bygrave, W and Zackarakis, A (2013) Entrepreneurship, 3rd Edition, John Wiley and Co.
   Drucker, P. (1999) Innovation and Entrepreneurship, Butterworth Heinemann, Oxford.
3. Fagerberg, J, Mowery, DC and Nelson, RR (2005) The Oxford Handbook of

Innovation, Oxford University Press, NY.
4. Hisrich, R.D., Peters, M.P., and Shepherd, D. (2013) Entrepreneurship, McGraw-Hill Irwin, Boston.
5. Kuratko, D. (2013) Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wiley online library.
6. Moore, Geoffrey, (1999) Crossing the Chasm, Harper & Collins.
7. Porter, ME, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, New York, NY, 1985

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	2	3	-	-	2	-	2	3	3	1	2	3
CO2	3	1	-	1	-	-	2	-	3	-	3	3	1	1	2
CO3	3	-	2	-	2	3	-	-	-	2	3	3	2	3	3
CO4	3	2	-	1	-	-	3	2	2	-	3	3	3	1	2
Overall Mapping	3	1.5	1.5	1.33	2.5	3	2.5	2	2.5	2	3	3	1.75	1.75	2.5

4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	FT801A/B/C (Professional Elective VI)	A. Waste Management of Food Industries	3	1	0	4	4
			B. Project Engineering and Food Plant Layout	3	1	0	4	4
			C. Plant Maintenance, Safety and Hygiene	3	1	0	4	4
2	OE	FT802A/B/C (Open Elective IV)	A. Entrepreneurship Development and Start-Up Management	3	0	0	3	3
			B. Quality Management System	3	0	0	3	3
			C. Smart Technologies	3	0	0	3	3
B. PRACTICAL								
3	PROJECT	PR891	Major Project-II	0	0	12	12	6
4	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
5	MC	MC801	Essence of Indian Knowledge Tradition	2	0	0	2	
TOTAL CREDIT								14

THEORY

Course Name: Waste Management of Food Industries

Course Code: FT801A

Contact hour: 3:1:0

Total contact hour: 48

Credits: 4

Pre requisites: Basic Environmental Engineering, Unit Operations, Thermodynamics and Kinetics.

Course Objective:
To help the student develop a detailed understanding on waste generated from food industry and its reusability.

Course outcome(s):

After completion of the course students will be able to:
CO1: Classify different industrial waste, nature of the waste and its characteristics.
CO2: Identify different treatment methods for liquid/solid waste and the recovery of useful material from waste as byproducts
CO3: Interpret data regarding different waste treatment method.
CO4: Apply different methods in industry and domestic purpose.

Course Contents:

Module I: 10L

Introduction: Types of Pollution, Waste disposal methods – physical, chemical and biological. Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological

Module II: 12L
Treatment methods for liquid wastes from food process industries; Design of activated sludge process, Rotating biological contactors, Trickling filters, UASB, Numerical Problem.

Module III: 10L
Biofilters/ bioclarifiers, Biogas plant, Ion exchange treatment of waste water, Bioremediation,

Adsorption process in waste treatment, Recovery of useful materials from effluents by different methods.

Module IV:12L

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermicomposting pit, Biomanure, Numerical Problem.

Revision: 4L

Text Books:

1. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.

Reference Book:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.

2. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.

3. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.

4. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.

5. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	2	1	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	2.75	2.5	2.25	2.5	3	2.5	2.25	2.66	2	2.25	2	3	3	2.75	2

Course Name: Project Engineering and Food Plant Layout

Course Code: FT801B

Contact: 3:1:0

Total Contact Hours: 48
Credit: 4

Prerequisites: Basic mathematics, food processing, quality control, and food regulations

Course Objective:

1. To develop the knowledge of plant design and layout of specific foodindustries
2. To enable the students to learn about the regulations governing food plantdesign
3. To enable the students to learn how to scale up plant designs

Course outcome(s):

After completion of the course students will be able to:

CO1: Demonstrate the concept and different aspect required for food plant design and
CO2: Select appropriate requirement of design and layout for the specific food industry with compliance with FSSAI
CO3: Understand the function of PERT, CPM, ISO and HACCP in food plant design
CO4: Develop a food plant layout with taken into account different legal, economic, social aspects

Course Contents:

Module 1: 11L

Basic concepts of plant layout and design including a basic understanding of equipment layout, ventilation; Design consideration for the location of food plants. The material of Construction for food processing equipment; Specifications of processing equipments and accessories; provision for waste disposal, and safety arrangements aspects of plant layout and designSymbols used for food plant design and layout

Module 2: 11L

Introduction to feasibility study and analysis Layout and design aspects of pilot and semi-commercial food processing plants; Reference to the design of bakery and biscuit, fruits, vegetable, and beverage processing, and dairy industries; Hygienic Design of Food Plants; specific FSSAI requirements in food plant layout and design

Module 3: 11L

Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoring; application of ISO, HACCP in food plant, Experimentation in Pilot Plant

Module 4: 11L

Introduction to project engineering; Process design development: Optimum economic design, Feasibility Survey; Preparation of flow sheets for material movement and utility consumption in food plants; Cost estimation for a Food Plant; Scale-up, Food processing enterprise, Plant operation

Revision: 4L

Text Books:

1. Manufacturing Facilities Design and Material Handling by Fred E. Meyers, and Matthew P. Stephens, 3rd Edition, Pearson Prentice Hall,2000

2. James M Moore, "Plant Layout and Design", Mcmillan& Co.,(1959)

Reference books:

1. Bolz, Harold A George E., "Material HandlingHandbook.
2. J M Apple, "Plant layout and Material Handling", John Willey & Sons,(1977)

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	2	2	1	2	1	1	1	1	1	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Overall Mapping	3	2.5	2.75	2.75	2.5	2.25	2.25	2.25	2	2.25	1.75	3	3	2.75	2

Course Name: Plant Maintenance, Safety and Hygiene

Course Code: FT801C

Contact: 3:1:0

Total Contact Hours: 48

Credits: 4

Pre requisites: Principles of Food Preservation, Food Process Engineering

Course Objective:

To help the students understand the importance of maintaining safety and hygiene in different food industry.

Course outcome(s):

After completion of the course students will be able to:

CO1: Describe safety levels in different food industries.
CO2: Understand different industrial parameters that affect the environment in food processing units.
CO3: Apply the HACCP protocols in food industries.
CO4: Create an overall safe environment for food processing industries and safety from adulterated food.

Course Contents:

Module I: 11L

Plant maintenance program; Role of maintenance staff and plant operators; Preventive maintenance; Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through '5S'.

Module II: 11L

The objective of safety, health & environment; Cost of safety; Accident investigation report; Safety promotional activity; Environmental pollution and its control.Safety promotional activity; ISO 45001-Occupational health and safety;

Module III: 11L

Indian Factories Act on safety; HACCP; Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food,Food fraud and Food defense

Module IV: 11L

Hygiene and sanitation requirement in food processing and fermentation industries;

Cleaning, CIP Systems, sanitizing & pest control in food processing; storage and service areas, Safety during receiving- unloading- shifting and storage of food materials and packaging materials

Revision: 4L

Text Books:

1. Basic Concepts of Industrial Hygiene, Ronald M Scott, CRCPress.
2. Safety design criteria for industrial plants. Maurizio Cumo & Antonio Naviglia.CRC Press.

Reference books:

1. Industrial Hygiene & Toxicology by JosefBrozek-1948.
2. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes.Springer.

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	2	2	1	2	1	1	1	1	1	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	2.75	2.75	2.75	2.75	2.5	2.5	2.25	2.25	2	2.25	1.75	3	3	2.75	2

Course Name: Entrepreneurship Development and Start-Up Management

Course Code: FT802A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Food Process Engineering, Unit Operations in Food Technology, Food Processing Technology.

Course Objective:

1. Acquire knowledge in Entrepreneurship Development
2. Able to study and prepare the business plan for any organization
3. Classify and study the organizational structure between small, medium, and large scale manufacturing industries

Course outcome(s):

After completion of the course, students will be able to

CO1: Understand opportunities to set-up Food processing industries

CO2: Identify the market competitors and conduct and prepare survey reports accordingly.

CO3:Design thefinance,humanresource,andoperationstrategyforeffectivemarketgrowth

CO4: Develop the effective business ecosystem

Course Contents:

Module I 10L

Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality Characteristics- Knowledge- Skills- Attitude Requirement; Business Environment- Role of Family and Society- Entrepreneurship Development Training and Other Support Organizational Services- Central and State Government Industrial Policies and Regulations, MoFPI scheme and support to budding food entrepreneurs, Skill Development by Central Government, International Business.

Module II 9L

Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product- Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the Project- Feasibility Report Preparation and Evaluation Criteria; legal aspect; Selection of land and factory sheds

Module III 5L

Finance and Human Resource Mobilization- Operations Planning- Market and Channel election- Growth Strategies- Product Launching

Module IV 8L

Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business, Overview of Startup food business and challenges.

Revision: 4L

Text Books:

1) Hisrich, "Entrepreneurship", Tata McGraw Hill, New Delhi,2005.
2) Saravanavel, P., 'Entrepreneurial Development', Ess Pee key publishing House, Chennai,2005.

References Books:

1. Khanka, S S., "Entrepreneurial Development", S.Chand and Co Limited, New Delhi,2001.

2. Jain, P C., "Handbook for New Entrepreneurs", Second Edition, Oxford University Press, New Delhi,2002.

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**	**PSO 3**
CO 1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	3	2.75	2.75	2.5	3	2.5	2.25	2.66	2	2.25	2	3	3	2.75	2.25

Course Name: Quality Management System

Course Code: FT802B

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Basic mathematics, basic biology, food preservation, quality control and assurance,

Course Objective:

1. To develop the knowledge of students regarding quality control and management principles, tools and their application

2. To enable the students to be aware of the voluntary and mandatory food standards and certifications in place- globally and nationally

Course outcome(s):

After completion of the course, students will be able to:

CO1: **Interpret** principles of natural, biological science, and engineering fundamentals with basics food safety and quality management.

CO2: Apply food safety management principles with an understanding of the limitations in application of the same in food quality and safety maintenance in a food industry.

CO3: Analyze existing food laws and quality management techniques in relation to follow legal limits and supply safe food to consumers.

CO4: **Develop** system tools to meet specific needs of food safety and maintain the effective quality of food during processing taking into consideration public health and safety, cultural, societal and environmental issues.

Course Contents:

Module I: 8L

Definition of quality, Quality specifications and quality attributes of different foods, Statistical quality control, Quality control programs: History and development, Total quality

management (TQM), Quality assurance, Management Principles, ISO 9000 Family (QMS), principles and requirements

Module II: 8L

Food Safety Management System ISO-22000 – Family, Key role, Principles of FSMS and requirements, HACCP- Prerequisites; GMP/C-GMP, GHP, GLP, Cleaning and Sanitation, Safety practices in the production areas, Pest Control, Withdrawal and Recall Procedures, traceability system, Principles and steps of HACCP Plan, Hazard Identification, Risk assessment, CCP Decision Tree, CAPA Plan, document and records,

Module III: 8L

Mandatory and voluntary regulations world-wide, CODEX, FDA, WHO, EFSA, WTO, (TBT, SPSs), GATT. Role of regulatory authorities in India - functioning, legal acts and their enforcements- FSSAI (in detail), BIS, AGMARK, Legal Metrology Act, Industry Specific Regulations, ASCI, EPA, Export Quality Control and Inspection Act

Module IV:8L

Certification, Certification procedures, Certifying bodies, Accrediting bodies, International bodies. GFSI benchmarking, FSSC 22000, BRC, SQF, IFS, FSMA, OSHA, Auditing procedures- types of audit, Surveillance; Mock audit, third party quality certifying audit, Auditors and Lead auditors.

Revision: 4L

Text Books:

1. Total Quality Management, M.P. Poonia & S.C. Sharma, Khanna Publishing House (AICTE Recommended Textbook - 2018)

2. Total Quality Management, Poornima M. Charantimath, Pearson Education India

3. Total Quality Management for the Food Industries. WA Gould, Woodhead Publishing

4. Management and control of quality. James R Evans, William M Lindsey. Thomson Southwestern

5. Bioethics and Biosafety, M. K. Sateesh, I. K. International Pvt Ltd.

Reference Books:

1. The Essentials of Quality Control Management, Peter N T Pang, Trafford publishing

2. Guide to Quality Management system for the food industry. Ralph Early

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	3	3	-	2	1	-	2	2	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	2
CO 3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Mapping	2.75	2.75	3	3	3	2.5	2.25	2.66	2.25	2.5	2	3	3	2.75	2.25

Course Name: Smart Technologies

Course Code: FT802C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Sensors, System Integration, Cloud and Network Security, Basic Engineering Mathematics, Automation and Control

Course Objective:

To impart necessary and practical knowledge of components of the Internet of Things and develop skills required to build real-life IoT based projects

Course outcome(s):

After completion of the course, students will be able to

CO1: **Understand** the Internet of Things and its hardware and software components

CO2: **Develop** real-life IoT based projects

CO3: **Integrate** mechanical and electrical hardware for a real prototype of the robotic device.

CO4:Select a robotic system for a given application

Course Contents:

Module I: 9L

Introduction to IoT, Architectural Overview, Design principles and needed capabilities, IoT applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

Module II: 8L

Introduction to Robotics Types and components of a robot, Robot Actuation Systems, Classification of robots, closed-loop and open-loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Module III: 8L

IoT Application Development and case studies, Solution framework for IoT applications-Implementation of Device Integration, Data acquisition and integration, Device data storage-Unstructured data storage on cloud/local server, Authentication, authorization of devices.

Module IV: 7L

Sensors and Vision System Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics

Revision: 4L

Text Books:

1. Vijay Madisetti, ArshdeepBahga, İnternet of Things, "A Hands on Approach", University Press

2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

4. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

5. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media

6. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference Books:

1. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.

2. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.

3. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi.2018

4. **Jeeva Jose, Internet of Things, Khanna Publishing House, 2018.**

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	2	2	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	2	3	2	2	2	3	3	3	3
Overall Mapping	2.75	2.75	2.75	2.75	3	2.5	2	2.66	1.75	2	2	3	3	2.75	2

MANDATORY ACTIVITIES / COURSES

Course Name: Essence of Indian Knowledge Tradition

Course Code: MC801

Total Contact Hours: 2h /Week
Non-Credit Mandatory Course

Course Objectives:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Outcomes:

CO 1: Identify the concept of Traditional knowledge and its importance.

CO 2: Explain the connection between Modern Science and Indian Knowledge System.

CO 3: Understand the importance of Yoga for health care.

CO 4: Interpret the effect of traditional knowledge on environment.

Module 1:Basic structure of Indian Knowledge System

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module 2: Modern Science and Indian Knowledge System

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module 3: Yoga and Holistic Health care

Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

Module 4: Traditional Knowledge and Environment

Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity

Text books/References:

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
4. Fritzof Capra, The Wave of life
5. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International ChinmayFoundation, Velliarnad, Arnakulam
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
7. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi Prakashan, Delhi 2016

CO-PO-PSO Mapping:

COs	Program outcomes												Program Specific Outcomes		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	2	-	-	2	1	2	1	1	1	3
CO 2	-	-	-	-	-	-	-	3	2	1	2	2	1	2	3
CO 3	-	-	-	-	2	-	-	-	2	2	-	1	1	2	3
CO 4	-	-	-	-	-	-	-	-	1	2	-	1	1	2	3
Overall Mapping					2	2		3	1.75	1.5	2	1.25	1	1.75	3