Semester-II

TRADITIONALFOODPROCESSENGINEERING			
CourseCode	MFDT201	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandthepropertiesoffoodsandtraditionalfoodprocessingmethods.
- Toapplyandanalyzefoodprocessingtechniquesatambienttemperature.
- Toevaluatetheimpactofheatremovalmethodsinfoodprocessing.
- Toapplytraditionalheatapplicationmethodsforfoodpreservationandprocessing.

Module-1

PROPERTIESOFFOODS&TRADITIONALPROCESSINGMETHODSATAMBIENTTEMPERATURE:

Properties of Foods: Composition, physical, rheological, and biochemical properties. Sensory characteristics, nutritional quality.

Traditional Food Processing Methods:Raw food processing: Cooling crops and carcasses. Cleaning: Wet and dry cleaning techniques. Sorting and grading: Shape and size sorting, weight sorting, colour and machine vision sorting andgrading.Peelingandsizereduction:Theories,equipment,developmentsintechnology,effectsonfoodsand microbes.

Module-2

TRADITIONALFOODPROCESSINGATAMBIENTTEMPERATURE

MixingandForming: Theoriesofsolidsandliquidsmixing,equipment,effectsonfoodsandmicroorganisms. Forming: Bread moulders, pie, tart, biscuit formers, confectionery moulders, and depositors.

SeparationandConcentrationTechniques: Centrifugation,filtration,andexpression:Theoryandequipment. Solvent extraction: Supercritical CO_2, types of solvents, equipment, effects on foods and microorganisms.

Module-3

TRADITIONALHEATREMOVALMETHODSINFOODPROCESSING

Chilling and Modified Atmospheres: Refrigeration theory, modified atmospheres, mechanical refrigerators, cryogenic chilling. Cold storage, temperature monitoring, modified and controlled atmospheric storage. Effects on sensory and nutritional qualities of foods, impact on microbes.

FreezingandFreeze-Drying:

Icecrystalformation,soluteconcentration,freezingtimecalculation.Mechanicalfreezers,cryogenicfreezers, frozen storage, thawing. Freeze-drying and freeze concentration: Theories, equipment, effects on foods and microbes.

Module-4

TraditionalHeatApplicationMethodsinFoodProcessing

Heat Processing: Thermal properties of foods, heat transfer, direct and indirect heating methods. Energy use and methodstoreduceenergyconsumption,typesofheatexchangers.Effectofheatonmicrobes,enzymes,nutritional andsensorycharacteristicsoffood.

Module-5

TRADITIONALFOODPROCESSINGBYHEATAPPLICATION

BlanchingandPasteurization: Theory,equipment:Steamblanchers,hotwaterblanchers,newblanching methods. Pasteurization of packaged and unpackaged foods, effects on foods and microbes.

SterilizationandEvaporation: In-containersterilization,retorting,Ultra-hightemperature(UHT)processing. Evaporation: Improvement of evaporation economics, equipment, effects on foods and microbes.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Foodprocessingtechnology-principlesandpractice.P.J.Fellows,CRCpress,3rdedition,2009
2. IntroductiontoFoodEngineering.R Paul Singh & Dennis R Heldman,AmsterdamElsevier/Academic Press, 4th Edition, 2009
3. Fundamentalsoffoodengineering.D.G.Rao,PHILeraningPrivateLimited,NewDelhi,2010
4. Foodprocessengineeringandtechnology.ZekiBerk,1stedition,2009,CRCPress,NewYork
5. TrendsinFoodEngineering.JorgeE.Lozano,CristinaAnon,GustavoV.Barbosa-Canovas,EfrenParada- Arias, CRC Press; 1st Edition, 2000
6. Novel Food Processing Technologies (Food Science and Technology Series). Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Publisher: CRC Press, 1st Edition, 2004
7. MinimalProcessingTechnologiesintheFoodIndustry.ThomasOhlssonandNilsWoodheadPublishing Limited, 1st Edition, 2002

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105011/
2. https://archive.nptel.ac.in/courses/126/105/126105015/
3. https://onlinecourses.nptel.ac.in/noc22_ag03/preview
4. https://onlinecourses.nptel.ac.in/noc19_ag02/preview
5. https://onlinecourses.nptel.ac.in/noc22_ch53/preview
6. https://nptel.ac.in/courses/126105011
7. https://www.youtube.com/watch?v=_U1PBYkuSVk
8. https://onlinecourses.nptel.ac.in/noc22_me135/preview

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecific topics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Identify the key properties of foods and the basic principles of traditional processing methods at ambient temperature.	L1
CO2	Explain the theories and mechanisms behind traditional food processing techniques, such as mixing, forming, and chilling.	L2
CO3	Demonstratetheapplication oftraditional heat removal methods like freezing and chilling, and evaluate their effects on food quality.	L3
CO4	Analyzetheeffectsofheatapplicationmethods,includingblanchingand sterilization, on food safety, quality, and microbial activity.	L4
CO5	Evaluatetheefficiencyandsustainabilityoftraditionalfoodprocessingmethods, considering energy use and environmental impact.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodernengin eering and ITtools includingpredictionandmodelingtocomplexengineering activitieswithanunderstandingofthelimitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice.	PO6
7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	PO8

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2										
CO2	3					2						
CO3			3		2							
CO4		3		2								
CO5							3	2				

Semester-II

MODERNFOODPROCESSENGINEERING+LAB(IPCC)			
CourseCode	**MFDT202**	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:2:0	SEEMarks	50
TotalHoursofPedagogy	40hoursTheory+10-12Labslots	TotalMarks	100
Credits	4	ExamHours	3

Courseobjectives:

- TraditionalHeatApplicationMethodsinFoodProcessing
- HeatProcessing:
- Thermalpropertiesoffoods,heattransfer,directandindirectheatingmethods.
- Energyuseandmethodstoreduceenergyconsumption,typesofheatexchangers.
- Effectofheatonmicrobes,enzymes,nutritionalandsensorycharacteristicsoffood.

Module-1

MODERNFOODPROCESSINGATAMBIENTTEMPERATURE

Irradiation: Theory, dose distribution, radiation dose measurement. Applications: Radappertisation, radicidation, radurisation, ripening control, disinfection, sprouting inhibition. Effects on foods: Induced radioactivity, radiolytic products, nutritional and sensory qualities, impact on microbes, effect on packaging.

High Pressure Processing: Theory: Effects on food components, microbial cell inactivation mechanisms. Equipment:Batchandsemi-continuousoperations,processdevelopments.Combinationswithotherminimal processingtechniques,impactonmicrobes,enzymes,andfoodquality.

Module-2

MINIMALFOODPROCESSINGMETHODS

PulsedElectricField(PEF)Processing: Theory,equipment,effectsonmicrobes,enzymes,andfoodcomponents. Combinations of PEF with other treatments.

Electric Arc Discharges, Oscillating Magnetic Fields, and Pulsed Light: Theories, equipment, effects on microbes, enzymes, and food components. Use of UV light and pulsed X-rays, applications, and impact on food quality.

UltrasoundandMicrowaveProcessing:

Theory,equipment,effectsonmicroorganismsandfoodquality.

Module-3

MODERNHEATAPPLICATIONMETHODS

Dehydration (Drying) with Heated Air and Surfaces: Theory: Drying with heated air and heated surfaces, intermediate moisture foods. Equipment: Hot air driers, heated surface driers, control of dryers, rehydration. Effects on sensory and nutritional properties of food and microbes.

Smoking,Baking,andRoasting:

Theories and equipment: Batch and semi-continuous ovens, continuous ovens, smoking equipment. Effects on sensory and nutritional qualities of foods, impact on microorganisms.

Module-4

ADVANCEDHEATAPPLICATIONMETHODS

DielectricHeating: Theory,equipment,applications,effectsonfoodsandmicrobes.

OhmicHeating: Theory,equipment,applications,effectsonfoodsandmicrobes.

InfraredHeating: Theory,equipment,applications,effectsonfoodsandmicrobes.

Module-5

ADVANCEDEXTRACTION&HURDLETECHNOLOGY

Solid-Liquid Extraction (Leaching): Types of extraction processes, counter-current extraction, batch and continuous extractors. Applications in food processing: Extraction of oils & fats, oleoresins, food colors, coffee, flavors, and pigments.

Hurdle Technology: Basics of hurdle technology, mechanisms, applications to foods. Newer chemical and biochemical hurdles: Organic acids, plant-derived antimicrobials, antimicrobial enzymes, bacteriocins, chitin/chitosan.

PRACTICALCOMPONENTOFIPCC

Sl.NO	Experiments
1	**PreservationofFruitsandVegetablesbyOsmoticDehydration,Salting,and Canning:** Performosmoticdehydration,salting,andcanningonselectedfruitsandvegetables;evaluatetheeffects on taste, texture, and microbial stability.
2	**YieldandPerformanceEvaluationofJuiceExtractionandProcessing:** Extractjuicefromfruitsusingmechanicalmethods;measureyield,performance,andenergyconsumption.
3	**DeterminationofPhysicalPropertiesofGrains,Cereals,andSpiceSeeds:** Measuresize,shape,density,andmoisturecontentofvariousgrains,cereals,andspices.
4	**EnergyConsumption,Yield,andPerformanceDuringSizeReductionofCereals**: Perform size reduction on cereals using hammer mills; measure energy consumption, yield, and particlesize distribution.
5	**BlanchingOperations:** Blanchvegetablesusinghotwaterandsteam;measureenzymeactivitybeforeandafterblanching.
6	**DryingExperimentUsingHotAirOven:** Dryvegetablesinahotairoven;recordmoisturecontentatregularintervalstocreateadryingcurve.
7	**EstimationofFreezingTimeinaFreezer:** Freeze various food samples and measure the time taken to reach the desired temperature; evaluate theeffects on texture and flavor.
8	**Comparative Study of the Total Bacterial Count of Food Processed in Microwave and Food Kept at Ambient Temperature:** Processfoodinamicrowave,thencomparebacterialcountswithfoodstoredatambienttemperature.
9	**FreezeDryingOperations**: Freezedryselectedfoodsamples;measuremoisturecontent,texture,andnutrientretention.
10	**RotaryVacuumEvaporation:** Usearotaryvacuumevaporatortoconcentratefoodextracts;measureyieldandqualityofthe concentrate.
11	**SolventExtraction:** Extractoilsorothercompoundsfromfoodusingsolvents;analyzetheyieldandpurityoftheextract.
12	**ComparativeStudyoftheOrganolepticCharacteristicsofFoodProcessedbyHighTemperatureand Kept at Ambient Temperature:** Processfoodathightemperatures;comparetaste,texture,andappearancewithfoodstoredatambient temperature.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in thetotalof the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIEforthetheorycomponentofIPCC

1. TwoTestseachof**25Marks**
2. Twoassignmentseachof**25Marks/OneSkillDevelopmentActivityof50marks**
3. TotalMarksoftwotestsandtwoassignments/oneSkillDevelopmentActivityaddedwillbeCIEfor 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIEforthepracticalcomponentofIPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for **10 marks**. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test at the end /after completion of all the experiments shall be conducted for **50 marks** and scaled down to **05 marks.**

Scaled-downmarksofwrite-upevaluationsandtestsaddedwillbeCIEmarksforthelaboratory component of IPCC for **20 marks**.

SEEforIPCC

TheorySEEwillbeconductedbytheUniversityasperthescheduledtimetable,withcommonquestion papers for the course (duration 03 hours)

1. Thequestionpaperwillbesetfor100marksandmarksscoredwillbescaleddownproportionately to 50 marks.
2. Thequestionpaperwillhavetenquestions.Eachquestionissetfor20marks.
3. Therewillbe2questionsfromeachmodule.Eachofthetwoquestionsunderamodule(witha maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. Thestudentshavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.

ThetheoryportionoftheIPCCshallbeforbothCIEandSEE,whereas thepracticalportionwillhave aCIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratorycomponentshall beincluded**.**The maximum of04/05questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.(Student has to secure an aggregate of50%ofmaximummarksofthecourse(CIE+SEE)

SuggestedLearningResources:

Books

1. Foodprocessingtechnology-principlesandpractice.P.J.Fellows,CRCpress,3rdedition,2009
2. IntroductiontoFoodEngineering.RPaulSingh&DennisRHeldman,AmsterdamElsevier/AcademicPress, 4th Edition, 2009
3. Fundamentalsoffoodengineering.D.G.Rao,PHILeraningPrivateLimited,NewDelhi,2010
4. Foodprocessengineeringandtechnology.ZekiBerk,1stedition,2009,CRCPress,NewYork
5. TrendsinFoodEngineering.JorgeE.Lozano,CristinaAnon,GustavoV.Barbosa-Canovas,EfrenParada- Arias, CRC Press; 1st Edition, 2000
6. Novel Food Processing Technologies (Food Science and Technology Series). Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Publisher: CRC Press, 1st Edition, 2004
7. MinimalProcessingTechnologiesintheFoodIndustry.ThomasOhlssonandNilsWoodheadPublishing Limited,1stEdition,2002

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/104/126104004/
2. https://archive.nptel.ac.in/courses/126/104/126104004/
3. https://www.youtube.com/watch?v=iuW3nk5EADg
4. https://www.digimat.in/nptel/courses/video/126105015/L29.html
5. https://www.youtube.com/watch?v=Ut9uSlK-f-8

ActivityBasedLearning(SuggestedActivitiesinClass)/PracticalBasedlearning Skill Development Activities Suggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Recallandsummarizethefundamentalprinciplesofmodernfoodprocessing methods,includingirradiation,high-pressureprocessing,andminimalprocessing techniques, along with the theories, mechanisms, and equipment used in advanced processing methods like dielectric heating and ohmic heating.	BTL1
CO2	Explain the impact of modern food processing methods on the sensory, nutritional, andmicrobialqualityoffoodproducts,andtheimportanceofenvironmentaland ethicalconsiderationsintheuseofadvancedfoodprocessingtechnologies.	BTL2
CO3	Applyknowledgeofmodernfoodprocessingmethodstoreal-worldsituations, analyzing and evaluating the effectiveness of various technologies in improving food safety,quality,andsustainability.	BTL3
CO4	Analyze the effectiveness, limitations, and sustainability of modern food processing technologies,includingtheeconomicandoperationalfeasibilityoftheirimplementationintheind ustry,andproposeimprovementsforbetterefficiency andfoodsafety.	BTL4
CO5	Evaluatetheresultsofpracticalexperimentsinvolvingmodernfoodprocessing methods,comparingtheperformanceofvarioustechniques,anddeveloping recommendationsforindustrialapplications,whileeffectivelycommunicatingfindings through reports and presentations..	BTL5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesofmathematics, natural sciences, and engineering sciences.	PO2
2	**Design/development of solutions**: Design solutions for complex engineering problemsand designsystem components or processes that meet thespecified needs with appropriate considerationforthepublichealthandsafety,andthecultural,societal,andenvironmental considerations	PO3
3	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisofthe informationtoprovidevalidconclusions.	PO4
4	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineeringandITtoolsincludingpredictionandmodelingtocomplexengineeringactivities withanunderstandingofthelimitations	PO5
5	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgetoassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
6	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
7	**Ethics:**Applyethicalprinciplesandcommittoprofessionalethicsandresponsibilitiesandnorms oftheengineeringpractice	PO8
8	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththeengineeringcom munityandwithsocietyatlarge,suchas,beingabletocomprehendandwrite effective reports and design documentation, make effective presentations, and give and receive clearinstructions	PO10
9	**Projectmanagementandfinance:**Demonstrateknowledgeandunderstandingofthe engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments	PO11
10	**Life-longlearning:**Recognizetheneedfor, and havethepreparationandabilityto engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1		1	1		1		1					
CO2		2		1			2	2				2
CO3			2	2			2					1
CO4			2	2							2	2
CO5		3	3			2			2	2		

Semester-II

FOOD PACKAGING AND STORAGE ENGINEERING			
CourseCode	MFDT203	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Understand the Principles of Packaging and Storage: Provide students with a comprehensive understandingoftheessentialfunctions,properties,andtypesofpackagingandstoragesystems in the food industry.
- AnalyzePackagingMaterialsandEquipment:Equipstudentswiththeskillstoselectappropriate packaging materials and use modern packaging machinery for various food products.
- ApplyScientificKnowledgeinFoodStorage:Enablestudentstoapplyscientificprinciplestothe storage of food products, focusing on minimizing product damage and maximizing shelf life.
- ExploreBiodegradablePackagingSolutions:Introducestudentstobiodegradablepackaging materials, their properties, manufacturing processes, and environmental impacts.
- InvestigateandEvaluatePackagingandStorageSolutions:Developtheabilitytocritically evaluate different packaging and storage solutions, considering sustainability, cost, and technologicaladvancements.

Module-1

INTRODUCTIONTOFOODPACKAGING

Overview: Functionofpackaging,marketingconsiderations,andtypesofpackaging.
PropertiesofPackagingMaterials: Barrierproperties,gaspermeationrates(OTR,WVTR),burstingstrength, tensile strength, tearing strength.
TestingMethods: Droptest,puncturetest,andotherrelevantmechanicaltests.

Module-2

PACKAGINGMATERIALSANDMACHINERY

SelectionCriteria: Packagingmaterialsforrawandprocessedfoodproducts.
PackagingMachinery: Formfillandsealmachines,vacuumpackaging,shrinkwrappackaging,multilayerpackaging systems.

Module-3

FOODSTORAGEENGINEERINGI

Scientific Storage Systems: Importance and postharvest physiology of semi-perishables and perishables. ClimactericandNon-ClimactericFruits:Respiration,ripening,changesduringripening,ethylenebiosynthesis. **Storage Structures:** Traditional, improved, and modern storage structures; farm silos.
Stored Grain Management and Aeration: Moisture and temperature changes, conditioning, aeration theory, and systemoperation.

Module-4

FOODSTORAGEENGINEERINGII

StorageSystems: ContinuationofModule3topicswithdeeperfocusonthescientificprinciplesofstorageand managementtechniques.
DamagePrevention: Productdamagesduringstorageandmethodstomitigatethem.
AdvancedStorageStructures: Innovativeandmodernstoragetechniques,impactofdifferentstorage environments on food quality.

Module-5

BIODEGRADABLEPACKAGING

TypesofPackaging: Classification,advantages,andlimitations.
EconomicsofPackagingMaterials: Cost-benefitanalysis,testingstandards,andbiodegradability.
Natural and Synthetic Polymers: Properties, chemical modifications, and applications in food packaging.
ManufacturingandTesting: Methodsforproducingbiodegradablepackagingmaterialsandevaluationoftheir properties.

AssessmentDetails(bothCIEandSEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.The minimumpassing mark forthe CIE is 50%of themaximum marks. Minimumpassingmarks in SEE is 40% of the maximummarksofSEE.Astudentshallbedeemedtohavesatisfiedtheacademicrequirementsandearnedthe

credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. FoodPackaging:PrinciplesandPractice.GordonL.Robertson,CRCPress,2012
2. HandbookofPostharvestTechnology:Cereals,CRCPress,2003

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Recall the fundamental concepts of food packaging, including barrier properties and packaging functions.	L1
CO2	Explain the selection criteria for packaging materials and the operation of packaging machinery.	L2
CO3	Applyprinciplesofscientificstoragetoassesstheimpactofstorageconditionson food quality.	L3
CO4	Analyze the effects of different storage methods on postharvest physiology and food quality	L4
CO5	Evaluatetheeffectivenessandenvironmentalimpactofbiodegradablepackaging materials.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineeringknowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/developmentofsolutions**:Designsolutionsforcomplexengineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and needforsustainabledevelopment	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	PO8
9	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1	1										
CO2	1				2		2					
CO3		2			1		2					
CO4			2	2			2					1
CO5							3	2				2

Semester-I

FRUIT,VEGETABLE,PLANTATIONPRODUCTS,ANDSPICESTECHNOLOGY			
CourseCode	MFDT214A	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- To equip students with comprehensive knowledge of post-harvest handling techniques for fruits, vegetables,andplantationproducts,focusingonfactorsthataffectpost-harvestlossesandstorage practices.
- Toprovidein-depthunderstandingandskillsrelatedtotheprocessingoffruits,vegetables,spices,dry fruits, and plantation products, including canning, extraction, concentration, and powder preparation methods.
- Tointroducestudentstonovelandadvancedprocessingtechnologiessuchashigh-pressureprocessing, ultrasound, and membrane processing, along with their applications in food preservation and quality enhancement.
- Todeveloptheabilitytoevaluateandimplementqualityandsafetystandardsinfoodprocessing,including the functional roles and quality specifications of spices, and the safety considerations in novel processing methods.
- To foster an understanding of the environmental impact and sustainability issues related to food processingandpost-harvesthandling,encouragingtheapplicationofsustainablepracticesintheindustry

Module-1

POST-HARVESTHANDLINGOFFRUITS,VEGETABLES,ANDPLANTATIONPRODUCTS

ProductionandCompositionofMajorFruitsandVegetables,Post-HarvestHandling:TransportandStorage Practices,FactorsAffectingPost-HarvestLosses,ProductionandCompositionofPlantationProducts(e.g.,tea, coffee, cocoa), Post-Harvest Handling and Storage Practices for Plantation Products

Module-2

PROCESSINGOFFRUITSANDVEGETABLES

Canning: Preparation and Machinery, Juice and Pulp Extraction: Methods and Equipment, Fruit Juice Concentrates: Concentration Methods and Evaporators, Fruit Powders: Preparation and Process Operations

Module-3

PROCESSINGOFSPICESANDDRYFRUITS

Classification, Composition, and Structure of Spices, Processing Techniques for Major and Minor Spices, Spice Oils, Oleoresins, and Spice Mixtures, Processing of Cashew Nuts and Other Dry Fruits, Functional Role and Quality Specification of Spices

Module-4

TEA,COFFEE,ANDCOCOAPROCESSING

TeaProcessing:CTC,Black,Green,andOolongTea,CoffeeProcessing:WetandDryMethods,InstantCoffee, Specialty Coffee, Cocoa Processing: From Bean to Cocoa Products and Chocolate Manufacturing

Module-5

NOVELPROCESSINGMETHODS

UV,High Pressure,Ultrasound,Membrane Processing, High-Intensity PulsedElectricField,Ozone,Irradiation MinimalProcessing,StorageinModifiedAtmosphere,ActivePackaging,FreezeConcentration,VacuumFrying

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Handbookoffruitsandfruitprocessing.N.K.Sinha,J.S.Sidhu,J.Barta,J.S.B.Wu,M.P.Cano,Wiley- Blackwell, 2nd edition, 2012
2. Hand book of vegetables and vegetable processing. N.K.Sinha, Y. H. Hui,E. O.Evranuz, M. Siddiq, J. Ahmed,Wiley-Blackwell, 1st edition, 2011
3. Hand Book of Vegetable Preservation and Processing. Y. H. Hui, E. ÖzgülEvranuz, CRC Press, 2nd Edition,2015
4. FruitandVegetablePreservation;PrinciplesandPractices.R.P.SrivastavaandSanjeevKumar,CBS;3rd Edition, 2014
5. TechnologicalInterventionsInTheProcessingOfFruitsAndVegetables.RachnaSehrawat,KhursheedA. Khan, Megh R. Goyal, Apple Academic Press Inc. 2018
6. Thecompletebookoncultivationandmanufactureoftea.PandaH,2ndrevisededition,AsiaPacific Business Press Inc., NIIR
7. Coffee-growing,processing,sustainableproduction.WintgensJ.N.,Wiley-VCH,2004.
8. Cocoaproductionandprocessingtechnology.AfoakwaEO.TaylorandFrancisgroup,2014
9. HandbookonSpicesandCondiments(Cultivation,ProcessingandExtraction).PandaH.AsiaPacificBusiness Press Inc., NIIR, 2010
10. Small-scalecashewnutprocessing.Azam-AliS.H.andJudgeE.C.FAO,2001
11. Vanilla-post harvest operations. InPho-Post harvest compendium. Javier De La Cruz Medina , Guadalupe C. Rodriguez Jiménes, and Hugo S. García. FAO, 2009

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. http://ecoursesonline.iasri.res.in/course/view.php?id=156
3. https://onlinecourses.nptel.ac.in/noc22_ag13/preview
4. https://www.youtube.com/watch?v=x-m3SnyURa8
5. https://www.youtube.com/watch?v=0eBEmkB3tyE

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	Recall the production and composition of major fruits, vegetables, and plantation products, including basic post-harvest handling practices.	L1
CO2	Explain the factors affecting post-harvest losses and the techniques used to minimize these losses during transport and storage.	L2
CO3	Applyknowledgeofmachineryandequipmentusedinthecanning,extraction, concentration, and preparation of fruit juices and powders.	L3
CO4	Analyzethecomposition,structure,andprocessingtechniquesofspicesanddryfruits, including the functional roles and quality specifications.	L4
CO5	Evaluate different processing methods for tea, coffee, and cocoa, from basic processing to advanced manufacturing techniques like instant coffee and chocolate production.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineeringknowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs withappropriateconsiderationforthepublichealthandsafety,and thecultural,societal,and environmentalconsiderations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand research methods including design of experiments, analysisand interpretation of data,and synthesis of the information to providevalid conclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,and modernengineeringandITtoolsincludingpredictionandmodelingtocomplex engineeringactivitieswithanunderstandingofthelimitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevanttotheprofessionalengineeringpractice	PO6
7	**Environment and sustainability:** Understand the impact of the professional engineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and needforsustainabledevelopment	PO7
8	**Individualandteamwork:**Functioneffectivelyasanindividual,andasamemberor leader in diverse teams, and in multidisciplinary settings	PO9

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3					1	2					
CO2	3	2					2					
CO3	3				3		2					
CO4		2	2	2								
CO5	3			3					2			

Semester-II

GRAINPROCESSINGANDBAKINGTECHNOLOGY			
CourseCode	MFDT214B	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- To provide students with a thorough understanding of the classification, composition, storage, and processing techniques of major cereal grains like wheat, rice, corn, and barley.
- To equip students with practical knowledge of both dry and wet milling processes for cereals and oil extraction from oilseeds, including recent advancements in milling technology.
- To enable students to master the techniques involved in bread, cookie, biscuit, and cake making, focusingon the ingredients, equipment, and processes used in both yeast-leavened and chemically leavened products.
- To introduce students to the principles and techniques of pastry and confectionery production, including the preparation of various traditional confectionery products.
- To foster the ability to apply engineering principles to solve complex problems in grain processing, baking technology, and confectionery production, with an emphasis on sustainability and innovation

Module-1

GRAINPROCESSINGI

ClassificationandCompositionofCerealGrains(Wheat,Rice,Corn,Barley),StorageandDryingofCereals,Dry Milling of Wheat: Storage, Cleaning, Conditioning, and Milling, Recent Developments in Flour Milling

Module-2

GRAINPROCESSINGII

Dry Milling of Corn and Maize, Decortication and Attrition Milling: Barley, Sorghum, Millet, Wet Milling of Rice: Process and Types, Rice Quality Indicators and By-products of Milling, Oil Extraction from Oilseeds and Processing of Vegetable Oil

Module-3

BAKINGTECHNOLOGYI

Overview of Leavening Agents, Bread Making: Ingredients, Equipment, and Processes, Detailed Process of Straight Dough Bread Making, Bread Staling and Other Yeast-Leavened Products

Module-4

BAKINGTECHNOLOGYII

Chemical Leavening Agents and ChemicallyLeavened Products, Cookie and BiscuitMaking: Types and Processes, Cake Making: Ingredients and Mixing Processes, Phenomena During Cookie and Cracker Making

Module-5

PASTRYANDCONFECTIONERY

Types of Pastries: Short Crust, Flaky, Puff, Choux, Confectionery Production: Ingredients and Principles, Traditional Confectionery Products: Candies and Toffees, Technical Considerations in Confectionery Production

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.

2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Principlesofcerealscienceandtechnology.J.A.Delcour,R.C.Hoseney,AACCInternational,3rdedition, 2010
2. FoodTechnology-II.A.Patel,H.C.Devraja,P.Sharma,R.R.B.Singh,www.agrimoon.com,ICAR
3. FoodTechnology-I.A.K.Singh,P.N.Raju,A.Jana,www.agrimoon.com,ICAR
4. BakeryProducts:scienceandtechnology.Y.H.Hui,H.Corke,I.D.Leyn,WKNip,N.Cross,Blackwell Publishing, 2006
5. Cerealgrainsforthefoodandbeverageindustries.E.K.Arendt,E.Zannini,WoodheadPublishing,2013.
6. CerealsProcessingTechnology.G.Owens,CRCPress,WoodheadPublishing,2001.

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/104/126104004/
2. https://www.youtube.com/watch?v=iuW3nk5EADg
3. https://www.digimat.in/nptel/courses/video/126105015/L29.html
4. https://www.youtube.com/watch?v=Ut9uSlK-f-8

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Identifytheclassificationandcompositionofmajorcerealgrainsandthebasicsoftheir storage and drying processes.	L1
CO2	Describethedryandwetmillingprocessesofvariouscereals,includingtherecentdevelopments in flour milling and oil extraction from oilseeds.	L2
CO3	Applytheknowledgeofbakingingredientsandequipmenttotheproductionofbread, cookies, biscuits, and cakes, considering the chemical and physical changes during baking.	L3
CO4	Analyzetheprocessesinvolvedinpastryandconfectioneryproduction,includingthe functional roles of ingredients and technical considerations in production.	L4
CO5	Evaluate the sustainability and environmental impact of various grain processing, baking, and confectionery methods, proposing improvements or alternative solutions.	L5

ProgramOutcomeofthiscourse

Sl. No	Description	PO
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics, natural sciences, and engineering sciences.	PO2
3	**Design/developmentofsolutions**:Designsolutionsforcomplexengineeringproblemsanddesign system components or processes that meet thespecified needs with appropriate considerationforthepublichealthandsafety,andthecultural,societal,andenvironmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysisandinterpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
7	**Communication:** Communicate effectively on complex engineering activities with the engineeringcommunityand withsocietyat large,suchas,beingable to comprehendand write effectivereportsanddesigndocumentation,makeeffectivepresentations,andgiveandreceive clearinstructions	PO10
8	**Projectmanagementandfinance:**Demonstrateknowledgeandunderstandingofthe engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamemberand leader in a team, to manage projects and in multidisciplinary environments	PO11
9	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengage in independentandlife-longlearninginthebroadestcontextoftechnologicalchange	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3						1					2
CO2	3				2		2					
CO3	3		3							2		
CO4		3	2	2								
CO5	3						3				3	

Semester-II

DAIRY AND MILK BASED PRODUCT PROCESSING			
CourseCode	MFDT214C	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandthecompositionandproductionofmilkanditsimpactonpost-harvesthandlingandstorage practices.
- Togainknowledgeofbasicandadvancedmilkprocessingtechniquesandtheirapplicationsindairy product manufacturing.
- Toexploreasepticandmodernprocessingmethodsforextendingtheshelflifeofmilkanddairyproducts while maintaining quality.
- Todevelopskillsintheapplicationofinnovativetechnologiesinmilkprocessingandpackagingforproduct development.
- Toapplyengineeringprinciplesandmoderntoolsinsolvingcomplexproblemsrelatedtomilkprocessing and dairy product innovation.

Module-1

POST-HARVESTHANDLINGOFMILK

ProductionandCompositionofMilkinIndia,Post-HarvestHandling:TransportandStoragePractices,Factors Affecting Post-Harvest Losses in Milk.

Module-2

BASICMILKPROCESSINGTECHNIQUES

Filtration,BulkCooling,Stirring,Mixing, Standardization,Pasteurization,Sterilization,Centrifugation, Homogenization.

Module-3

ADVANCEDMILKPROCESSINGTECHNIQUES

EvaporationandCondensation,ManufacturingofMilkProducts:Cheese,IceCream,Butter,PrinciplesofProcessing: Milk Powder, Casein, Whey, Curd, Buttermilk, Dairy-Based Chocolates: Ingredients, Processing Techniques, and Quality Control.

Module-4

ASEPTICANDOTHERPROCESSINGMETHODS

Aseptic Processing: Equipment and Techniques, Hurdle Technology in Milk Processing, Other Methods: UV, High Pressure, Minimal Processing, Chocolate-Based Dairy Products: Innovations in Aseptic Processing, Packaging, and Shelf-Life Extension.

Module-5

NOVELPROCESSINGMETHODSFORMILKPRODUCTS

AdvancedTechniques:Ultrasound,High-IntensityPulsedElectricField,OhmicHeating,ActivePackagingand StorageinModifiedAtmosphere,FreezeConcentrationandEdibleCoatings,NovelDairyandChocolate Combinations: Application of Modern Techniques in Product Development and Packaging.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.

2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. OutlinesofDairyTechnology.SukumarDe,OxfordUniversityPress,5thEdition,2005
2. DairyPlantSystemandLayout.TufailAhmed,KitabMahal,NewDelhi,1996
3. Milkprocessingandqualitymanagement.A.Y.Tamime,Wiley-Blackwell,WestSussex,UK,2009
4. DairyTechnology:PrinciplesofMilkPropertiesandProcesses.P.Walstra,T.J.Geurts,A.Noomen,A. Jellema, M.A.J.S. van Boekel, 1st Edition, Marcel Dekker, New York ,1999
5. Dairyscienceandtechnologyhandbook-Principlesandproperties.Y.H.Hui,Wiley-VCH,NewYork,1993

WeblinksandVideoLectures(e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	Identifytheproduction andcomposition ofmilk andthe factors influencingpost-harvest losses in milk	L1
CO2	Explaintheprinciplesandapplicationsofbasicmilkprocessingtechniquessuchas filtration, pasteurization, and homogenization.	L2
CO3	Applyadvancedmilkprocessingtechniquesinthemanufacturingofdairyproducts, ensuring quality control and safety.	L3
CO4	Analyze the effectiveness of aseptic and modern processing methods in extending the shelf life of milk products.	L4
CO5	Innovatenewdairyproductsusingnovelprocessingmethodsandadvancedpackaging techniques, considering the impact on sustainability and product development.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and needforsustainabledevelopment.	PO7
7	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3											
CO2		2	2									
CO3			3		2							
CO4				3			2					
CO5							3					2

Semester-II

LIVE STOCK AND AQUATIC PRODUCTS PROCESSING			
CourseCode	MFDT214D	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Toprovideacomprehensive overviewoftheproduction,economics,andprocessingscenariosofmeat,fish, and poultry industries.
- Toimpartknowledgeaboutvariouspreservationtechniquesformeat,fish,andpoultry,including traditional and modern methods.
- Toexplorethefactorsaffectingthequalityofmeatproducts,focusingonaspectssuchastexture,tenderness, and water-holding capacity.
- Toequipstudentswithknowledgeaboutabattoirdesign,meatplantsanitation,by-productsutilization, and the processing of eggs and poultry.
- To introduce students toadvanced processingmethods, includingbulk handling, chilling,quick freezing, and modified-atmosphere packaging, for enhancing the shelf life of meat and seafood products.

Module-1

INTRODUCTION

OverviewofProductionandEconomics: Detailedexaminationoftheproductionandeconomicsignificanceof meat, fish, and poultry industries at the global and regional levels.
ProcessingScenarios: In-depthstudyofthecurrentprocessingtechnologiesandpracticesformeat,fish,and poultry.
Preservation Techniques: Comprehensive exploration of traditional and modern preservation methods including dehydration, freezing, pickling, curing, cooking, and smoking.
AdvancedPreservationMethods: Applicationofionizingradiation,antibiotics,andchemicalpreservativesin meat preservation; discussion of safety and regulatory aspects.

Module-2

QUALITYOFTHEPRODUCT

EatingQualityandDiscoloration: Analysisoffactorsaffectingtheeatingqualityofmeat,withafocuson discoloration, flavor, and aroma.
Water-HoldingCapacityandJuiciness: Investigationofthemechanismsaffectingwater-holdingcapacityand juiciness in both cooked and uncooked meat products.
TextureandTenderness: Definition,measurement,andassessmentofmeattextureandtenderness;exploration

Module-3

PROCESSING

AbattoirDesignandLayout: Principlesofdesigningabattoirsandmeatplants;focusonoptimizingworkflow, hygiene, and safety.
MeatPlantSanitationandSafety: Bestpracticesformaintainingsanitationandensuringsafetyinmeat processing plants.
By-ProductsUtilization: Techniquesforeffectiveutilizationofmeatprocessingby-productstominimizewaste and maximize value.
Egg Processing and Preservation: Methods for processing and preserving eggs; production of egg yolk and eggwhite powders.
PoultryProcessing: Overviewoftheprocessingtechniquesspecifictopoultry,includingslaughtering,dressing, and packaging

Module-4

UNITOPERATIONS

PoultryProductProcessing: Detailedstudyofunitoperationsinvolvedintheproductionofvariouspoultry products such as cuts, processed meats, and ready-to-eat items.
FishProcessingUnitOperations:Examinationoftheunitoperationsinvolvedinfishprocessing,including filleting, deboning, and canning.
TechnologicalAdvances: Reviewofrecentadvancementsinunitoperationsforpoultryandfishprocessingto improve efficiency and product quality.

Module-5

ADVANCEDPROCESSING

Post-Harvest Quality Changes in Seafood: Understanding the physiological and biochemical changes in seafood post-harvest and their impact on quality.

Bulk HandlingandChilling: Techniques forbulk handling and chillingofseafood tomaintainfreshness during transport and storage.

Quick Freezing: Methods and equipment used inthe quick freezing of seafood to preserve quality and extend shelf life.

Cook-ChillProcessing: Processesinvolvedincook-chillmethodsforseafood;discussionofsafety,quality,and shelflife.

PackagingInnovations: Explorationofmodified-atmospherepackaging(MAP)andretortpouchpackagingtechniques, with a focus on extending the shelf life of seafood products.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
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3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Lawrie'sMeatScience.FidelToldra,WoodheadPublishing,8thEdition,2007
2. EggScienceandTechnology.W.J.StadelmenandO.J.Cotterill,CRCPress,4thEdition,1995
3. HandbookofMeatProcessing.Ed.FidelToldrá,BlackwellPublishing,1stEdition,2010
4. Marine and Freshwater Products Handbook, Roy E. Martin, Emily Paine Carter, George J. Flick, Jr., Lynn M. Davis, CRC Press, 1st Edition, 2000
5. MeatHandbook.A.Lavie,AVI,Westport,4thEdition,1980
6. FoodScience.NormanN.PotterandJosephH.Hotchkiss,S.ChandPublication,5thEdition,2007
7. MeatProductsHandbook.GFeiner,WoodheadPublishing,1stEdition,2006
8. MuscleasFood.P.J.Bechtel,AcademicPress,1stEdition,1986

WeblinksandVideoLectures(e-Resources):

1. https://www.youtube.com/watch?v=9h7Q62thXGg
2. https://www.youtube.com/watch?v=At8iNR38rfo
3. https://www.youtube.com/watch?v=irnVa3Bn7_w
4. https://www.youtube.com/watch?v=l8AT48eIFQw

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Recallthebasicsofproductionandprocessingscenariosofmeat,fish,andpoultry.	L1
CO2	Explaintheprinciplesbehindvariouspreservationtechniquesformeat,fish,and poultry.	L2
CO3	Analyzethefactorsaffectingthequalityofmeatproductsandsuggestimprovements.	L3
CO4	Designandevaluateprocessinglayoutsformeatplants,includingsanitationand safety protocols.	L4
CO5	Innovate and implement advanced processing and packaging methods for meat and seafood products.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevanttotheprofessionalengineeringpractice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and needforsustainabledevelopment.	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics andresponsibilities and norms of the engineering practice	PO8
9	**Individualandteamwork:** Functioneffectivelyasanindividual,andasamemberorleader in diverse teams, and in multidisciplinary settings	PO9
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and writeeffectivereportsanddesigndocumentation,makeeffectivepresentations,andgive andreceiveclearinstructions	P10
11	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	1										2
CO2	3		2				1					
CO3		3		2					2			
CO4			3		2					2		
CO5				3			2				2	

Semester-II

SUGAR,PROTEIN AND OIL TECHNOLOGY			
CourseCode	MFDT214E	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- To provide students with a deep understanding of the molecular structure, properties, and functionalitiesof sugars, proteins, and lipids, enabling them to analyze and apply this knowledge in food science and technology.
- To equip students with the knowledge and skills required to understand, operate, and optimize various processing techniques for sugars, proteins, and oils, ensuring the production of high-quality food products.
- To introduce students to advanced lipid applications in food systems, including emulsions, non-aqueous foods, and specialized products, with a focus on innovation and technology integration.
- To educate students on the utilization of by-products from sugar and oil processing, promoting sustainability and the development of value-added products from waste materials.
- To foster critical thinking and problem-solving abilities in students, enabling them to design, analyze, and optimize processes in sugar, protein, and oil.

Module-1

INTRODUCTIONTOSUGARS,PROTEINS,ANDLIPIDS

StructureandPropertiesofSugars: Detailedexaminationofthe molecularstructure,physicochemicalproperties, and functional roles of various sugars in food systems.

StructureandPropertiesofProteins: Analysisoftheaminoacidcomposition,proteinfolding,andfunctional properties such as solubility, emulsification, and gelation in different food applications.

StructureandPropertiesofLipids:Studyofthestructuraldiversityoflipids,theirphysicalandchemical properties, and their functionality in food systems, including emulsification and fat crystallization.

Module-2

SUGARTECHNOLOGY,PRODUCTS,ANDBY-PRODUCTS

SugarRawMaterials: Explorationofsugarcaneandsugarbeetasprimaryrawmaterialsforsugarproduction, including their cultivation and harvesting practices.

ManufacturingProcesses: Detailedflowchartsanddescriptionsofthemanufacturingprocessesforgranulated and liquid sugars, including extraction, purification, decolorization, evaporation, crystallization, and centrifugation. **Sugar Properties and Handling:** Understanding the physical and chemical properties of granulated sucrose and liquid sugars, invert sugar characteristics, and the handling and storage of sugar products post-centrifugation.

By-Products of Sugar Production: Study of the by-products generated during sugar processing, such as bagasse, molasses, pressed and dried pulp, and their potential uses in other industries.

Module-3

PROTEINPROCESSINGTECHNOLOGIES

ProteinExtraction: Examinationofvariousmethodsforproteinextractionfromplantandanimalsources, including mechanical, enzymatic, and chemical techniques.

Protein Separation and Purification: Techniques for separating and purifying proteins, including centrifugation, membrane filtration, and chromatography.

ProteinConcentration: Methodsforconcentratingproteins,suchasultrafiltration,precipitation,andspraydrying, with a focus on maintaining functional properties.

Module-4

OILPROCESSINGANDMODIFICATION

Oil Pressing andExtraction: Study ofmechanical andchemical methods for oil extraction from seeds andnuts, including cold pressing and solvent extraction.

OilRefiningProcesses: Examinationofthechemicalandphysicalrefiningprocesses,includingdegumming, neutralization, bleaching, and deodorization.

OilModificationTechniques: In-depthstudyofoilmodificationmethods,suchasinter-esterificationand hydrogenation, and their effects on fat crystallization and stability.

Module-5

ADVANCEDAPPLICATIONSOFLIPIDS

Food Emulsions and Non-Aqueous Systems: Study of the role of lipids in the formation and stabilization of food emulsions, as well as their applications in non-aqueous food products.

SpecialApplicationsofLipids: Explorationofadvancedapplicationssuchasediblecoatings,filmbarriers,andthe

sprayprocessingoffat-containingfoodstuffs,includingspraydryingandcoolingtechniques.
Functional Lipid Products: Understanding the formulation and uses of low-calorie fats, food emulsifiers, and lipid emulsions in food, nutrition, and pharmaceutical applications.
Lipid-BasedFormulations: Studyoftheproductionandapplicationofshortenings,margarine,andotherlipid- based food products, with a focus on texture, stability, and sensory attributes.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**
CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. LipidTechnologiesandApplications.FrankD.GunstoneandFredB.Padley,CRCPress,1stEdition,1997
2. PracticalGuidetoVegetableOilProcessing.MonojK.Gupta,AOCSPress,1stEdition,2004
3. BleachingandPurifyingFatsandOils,GaryR.List,AOCSPressandAcademicPress,2ndEdition,2009
4. SugarTechnology-BeetandCaneSugarManufacture.P.W.vanderPoel,H.Schiweck,T.K.Schwartz, Publisher: Verlag Dr Albert Bartens KG, 1998
5. PrinciplesofSugarTechnology.P.Honig,Elsevier,1stEdition,1953
6. EncyclopediaofProteinTechnology.JosieMehta,DominantPublishersAndDistributors,1993

WeblinksandVideoLectures(e-Resources):

1. https://nptel.ac.in/courses/103107081
2. https://ch402npc.wordpress.com/2020/03/17/sugar-and-fermentation-industry-nptel/
3. https://onlinecourses.nptel.ac.in/noc21_bt48/preview

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Recallanddescribethefundamentalstructuralandfunctionalpropertiesofsugars, proteins, andlipids.	L1
CO2	Explainandillustratethevariousprocessingtechniquesusedinsugar,protein,andoil industries,includingextraction,refining,andconcentrationmethods.	L2
CO3	Applytheirknowledgeofsugar,protein,andoiltechnologiestooptimizeprocessingconditions for enhanced product quality and efficiency.	L3
CO4	Analyze the by-products generated during processing and propose sustainable practices for theirutilization.	L4
CO5	Evaluateadvancedlipidapplicationsandinnovatenewformulationsandprocessing techniques for specialized food products.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevanttotheprofessionalengineeringpractice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and need for sustainable development.	PO7
8	**Communication**:Communicateeffectivelyoncomplexengineeringactivitieswiththeengineering communityandwithsocietyatlarge,suchas,beingabletocomprehendand writeeffectivereportsanddesigndocumentation,makeeffectivepresentations,andgive and receive clear instructions	PO10
9	**Projectmanagementandfinance:**Demonstrateknowledgeandunderstandingofthe engineering and management principles and apply these to one's own work, as a memberand leader in a team, to manage projects and in multidisciplinary environments	PO11
11	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2										
CO2	3		2				1					
CO3				3	1						2	
CO4						2	3					1
CO5			3							2		1

Semester-II

WATERANDBEVERAGETECHNOLOGY			
CourseCode	MFDT214F	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Toprovidestudentswithanin-depthunderstandingofvariousbeveragetypes,includingalcoholic,non-alcoholic, functional, and specialty beverages, and their nutritional, economic, and cultural significance.
- To impart knowledge on the technological processes involved in the manufacturing of juice-based, synthetic,non-alcoholic,andalcoholicbeverages,includingqualitycontrolmeasuresandpreservation techniques.
- Tofamiliarizestudentswiththecurrentstatus,markettrends,keyplayers,andregulatorychallengesofthe beverage industry in India.
- Toeducatestudentsontheprinciplesofwaterchemistry,wateractivity,purificationmethods,and treatment processes crucial for beverage production and packaging.
- Toprovidestudentswithasolidunderstandingofwaterpackagingtechnologies,qualityevaluation techniques, and the standards set by the Bureau of Indian Standards (BIS) for bottled water.

Module-1

INTRODUCTIONTOBEVERAGES

OverviewofBeverageTypesandImportance: Classificationofbeverages:alcoholic,non-alcoholic,functional, and specialty beverages. Nutritional and economic significance of beverages in the global and Indian markets.

CurrentStatus of theBeverageIndustry inIndia: Markettrends,growthprospects,andkeyplayersintheIndian beverage industry. Regulatory landscape and challenges in the Indian beverage sector.

ManufacturingTechnologyforJuice-BasedBeverages: Processflowtoproducefruitjuices,nectars,andconcentrates. Quality control parameters and preservation techniques in juice-based beverages.

IntroductiontoSyntheticBeverages: Typesofsyntheticbeveragesandtheirmarketdemand.Ingredients, formulation, and manufacturing processes for synthetic drinks.

Module-2

Module2:NON-ALCOHOLICBEVERAGES

IngredientsUsedinBeveragePreparationsandTheirRoles: Sweeteners,acids,flavors,preservatives,and stabilizers in beverage formulation. Functional ingredients: vitamins, minerals, probiotics, and plant extracts.

RoleandTechnologyofCarbonationinSoftDrinks: Principlesofcarbonationanditsimpactontasteand texture. Equipment and processes used for carbonation in soft drinks.

Detailed Study of Non-Alcoholic Beverages: Still Beverages: Juice drinks, herbal infusions, and flavored waters. Carbonated Beverages: Colas, sodas, and sparklingwaters.Low-Calorie Beverages: Sugar substitutes, diet drinks, and their market trends. Dry Beverages: Powdered drinks and instant beverage mixes.

IsotonicandSportsDrinks: Composition,formulation,andbenefitsofsportsdrinks.Marketdynamicsand technology for isotonic beverages.

Specialty Beverages: Production, processing, and market for tea, coffee, cocoa, and herbal beverages.The role of spices, plant extracts, herbs, and nuts in specialty beverages. Challenges and Limitations of Dairy-Based Beverages: **Formulation challenges:**Stability, shelf life, and sensory attributes.Market potential and consumer preferences for dairy-based beverages.

Module-3

ALCOHOLICBEVERAGES

Brewing Technology: Overview of the brewing process: Malting, mashing, fermentation, and packaging. Key ingredients: Water, barley, hops, yeast, and their roles in brewing.

Types of Alcoholic Beverages: Fermented Beverages: Production techniques and quality parameters for beer, wine, and cider. Distilled Beverages: Distillation principles, equipment, and processes for spirits like whiskey,vodka, rum, and gin. Use of various raw materials: Cane sugar, sugar beet, honey, fruits, grains, herbs, seeds, and vegetables.

Manufacturing Processes and Quality Evaluation of Alcoholic Beverages: Role of fermentation in alcohol production, with a focus on yeast types and their impact on flavor. Quality control, sensory evaluation, and aging techniques for different alcoholic beverages.

TypesofBeer: CharacteristicsanddifferencesbetweenAleandLager.Moderninnovationsandcraftbeertrends.

Equipment Used in Brewing and Distillation Processes: Overview of brewing equipment: Mash tuns,fermenters, and bottling lines. Distillation equipment: Pot stills, column stills, and hybrid stills.

Module-4

WATERCHEMISTRYANDTREATMENT

UnderstandingWaterChemistryandWaterActivity: Compositionofwater:pH,hardness,alkalinity,and mineral content. The importance of water activity in beverage preservation and stability.

WaterPurificationMethodsandTreatmentProcesses: Filtration,reverseosmosis,UVtreatment,and chlorination. Advanced water treatment techniques: Deionization, distillation, and ozonation.

CommonImpuritiesinWaterandTheirAnalysis: Identificationandremovalofphysical,chemical,and biological contaminants. Analytical techniques for water quality testing: TDS, microbial load, and heavy metals.

Module-5

WATERPACKAGINGANDQUALITYSTANDARDS

DefinitionandTypesofPackagedDrinkingWater: Categoriesofbottledwater:Springwater,mineralwater, purified water, and flavored water. Emerging trends in flavored and functional bottled water.

ManufacturingProcessesforPackagedDrinkingWater: Processflow:Watersourcing,purification,bottling,and packaging. Quality control measures at different stages of water bottling.

QualityEvaluationofRawandProcessedWater: Parametersforassessingthequalityofrawwater:Source, contaminants, and taste. Standards for processed water: Microbial load, chemical composition, and shelf life.

MethodsofWaterTreatmentandPurification: Treatmentprocessesspecifictodifferenttypesofbottledwater. Role of filtration, UV treatment, and ozone in ensuring water safety and quality.

BIS Quality Standards for Bottled Water: Overview of BIS (Bureau of Indian Standards) regulations for bottled water. Labeling requirements and compliance with national and international standards.

Types of Bottled Water: Mineral Water: Natural sources, mineral content, and health benefits. Natural Spring Water: Sourcing, processing, and packaging considerations. Flavored Water: Formulation, market trends, and consumer preferences. Carbonated Water: Carbonation levels, packaging, and market applications.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Food Product Development: Maximizing Success. R. Earle and A. Anderson, Woodhead Publishing Series in Food Science, Technology and Nutrition, CRC Press; 1st Edition, 2001
2. New Food Product Development: From Concept to Marketplace, Gordon W. Fuller, CRC Press, 3rd Edition, 2011
3. FoodProductDevelopment: FromConcepttotheMarketplace.E.GrafandI.Saguy,SpringerUS,1stEdition, 1991
4. Nutraceuticals Food Processing Technology: Innovative Scientific Research. Ed. R.P. Shukla, R.S. Mishra, Abhishek Dutt Tripathi, Ashok Kumar Yadav, Manju Tiwari, Raghvendra Raman Mishra, BhartiPublications; 1st Edition, 2017
5. FoodScience.B.Shrilakshmi,NewAgeInternational(P)LimitedPublication,3rdEdition,2003
6. Foodprocessingtechnology-principlesandpractice.P.J.Fellows,CRCpress,3rdedition,2009
7. IndustrialEconomics:AnIntroductoryTextbook.R.R.Barthwal,NewAgePublication,1stEdition,2010

WeblinksandVideoLectures(e-Resources):

1. https://www.youtube.com/watch?v=O-MRC0dskHg
2. https://www.youtube.com/watch?v=rKn0NuUpRf0
3. https://www.youtube.com/watch?v=UhwjbPprwX0
4. https://www.youtube.com/watch?v=Q_MZkOCdUzc

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	Students will be able to recall and classify various types of beverages, including alcoholic, non-alcoholic, functional, and specialty beverages.	L1
CO2	Students will understand and describe the manufacturing technologies for juice-based and synthetic beverages, along with the ingredients used in non-alcoholic beverages.	L2
CO3	Students will apply knowledge of carbonation techniques and water treatmentprocesses to real-world beverage production scenarios	L3
CO4	Studentswillanalyzethemarkettrends,qualitycontrolparameters,andregulatory challenges in the beverage industry, especially in the context of the Indian market.	L4
CO5	Studentswillevaluatethequalitystandardsofpackageddrinkingwater,andassessthe effectiveness of different water purification methods and packaging technologies.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineering and ITtools includingpredictionandmodelingtocomplexengineering activitieswithanunderstandingofthelimitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and need for sustainable development.	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	PO8

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2				1						
CO2	3		2				1					
CO3				3	2							
CO4		3					2					
CO5			3					2				

Semester-II

FOOD PRODUCT DEVELOPMENT			
CourseCode	MFDT215A	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- To provide students with a comprehensive understanding of the need, importance, and objectives of formulating new food products, including the business strategies and philosophies behind product development.
- To equip students with the skills to formulate new products based on available resources and cost-effectiveness, and to standardize these formulations for consistent quality and performance.
- To develop students' ability to apply adaptable and sustainable technologies in the process development and scale-up of new food products from lab to pilot scale.
- To train students in assessing the nutritional, sensory, shelf-life, and safety qualities of newly developed food products, as well as to develop effective market testing and marketing plans.
- To provide students with knowledge and tools to perform economic evaluations, including cost estimation, break-even analysis, and optimization, leading to the successful commercialization and product launch.

Module-1

INTRODUCTIONTOFOODPRODUCTDEVELOPMENT

NeedandImportance: Understandthenecessityofdevelopingnewfoodproductsinthecontextofchanging consumer preferences, health trends, and market demands.

ObjectivesofNewProductDevelopment: Explorethekeyobjectives,includinginnovation,differentiation, market expansion, and addressing specific consumer needs.

Ideasand Concept Generation: Study various sourcesof ideas for new product development, includingmarket research, consumer insights, and technological innovations.

BusinessPhilosophyandStrategy: Analyzethebusinessstrategiesinvolvedinnewproductdevelopment, including aligning with company goals, brand positioning, and competitive advantage.

Module-2

FORMULATIONANDSTANDARDIZATIONOFNEWPRODUCTS

Formulation Principles: Learn the principles of formulating new food products based on ingredient availability, nutritional value, sensory attributes, and cost competitiveness.

SourceAvailabilityandCostConsiderations: Studyhowtooptimizeformulationbyconsideringingredient sourcing, seasonal variations, and cost factors.

StandardizationTechniques: Understandthemethodsforstandardizingformulationstoensureconsistencyin product quality, taste, texture, and appearance.

ProductDesignandOptimization: Exploretheprinciplesofproductdesign,includingselectingappropriate processing methods, packaging materials, and shelf-life optimization.

Module-3

TECHNOLOGYANDPROCESSDEVELOPMENT

AdaptableandSustainableTechnology: Exploretheapplicationofadaptabletechnologiesthatsupport sustainable development in food processing, including energy-efficient processes and waste minimization.

Process Control and Scale-Up: Learn about process control parameters and the scale-up of production processes from lab to pilot scale, including challenges and solutions.

ProductionTrialsandValidation: Studytheimportanceofconductingproductiontrialstovalidateprocess parameters and ensure product quality during scale-up.

Pilot-ScaleDevelopment: Understandthe roleofpilot-scaletrialsinrefiningprocessesandpreparingforfull-scale production, including equipment selection and process optimization.

Module-4

QUALITYASSESSMENTANDMARKETTESTING

Quality Assessment Techniques: Learn about the various methods for assessing the quality of newly developed food products, including nutritional analysis, sensory evaluation, and shelf-life testing.

Safety Evaluation: Study the guidelines and regulations for ensuring food safety, including compliance with FSSAI standards and other relevant regulations.

MarketTestingStrategies: Exploredifferentapproachestomarkettesting,includingconsumertrials,focus groups, and test marketing in different geographical areas.

MarketingPlanDevelopment: Understandthekeyelementsofasuccessfulmarketingplan,includingtarget market identification, pricing strategies, distribution channels, and promotional

Module-5

ECONOMICEVALUATIONANDCOMMERCIALIZATION

CostingandEconomicAnalysis: Learnhowtoconductcostanalysisfornewproductdevelopment,including ingredient costs, processing costs, and overheads.

EconomicsofFoodPlantConstruction: Studytheeconomicconsiderationsinconstructingfoodprocessing plants, including cost estimation, plant size optimization, and breakeven analysis.

Volume of Production Estimation: Understand the methods for estimating production volumes required to meet market demand and achieve profitability.

Commercialization and Product Launch: Explore the steps involved in launching a new food product, including regulatory approvals, scaling up production, and market entry strategies.

AssessmentDetails(bothCIEandSEE)

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5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. Food Product Development: Maximizing Success. R. Earle and A. Anderson, Woodhead Publishing Series in Food Science, Technology and Nutrition, CRC Press; 1st Edition, 2001
2. New Food Product Development: From Concept to Marketplace, Gordon W. Fuller, CRC Press, 3rd Edition, 2011
3. FoodProductDevelopment: FromConcepttotheMarketplace.E.GrafandI.Saguy,SpringerUS,1stEdition, 1991
4. Nutraceuticals Food Processing Technology: Innovative Scientific Research. Ed. R.P. Shukla, R.S. Mishra, Abhishek Dutt Tripathi, Ashok Kumar Yadav, Manju Tiwari, Raghvendra Raman Mishra, BhartiPublications; 1st Edition, 2017
5. FoodScience.B.Shrilakshmi,NewAgeInternational(P)LimitedPublication,3rdEdition,2003
6. Foodprocessingtechnology-principlesandpractice.P.J.Fellows,CRCpress,3rdedition,2009
7. IndustrialEconomics:AnIntroductoryTextbook.R.R.Barthwal,NewAgePublication,1stEdition,2010

WeblinksandVideoLectures(e-Resources):

1. https://www.youtube.com/watch?v=oHM1Sr9p60Y
2. https://www.youtube.com/watch?v=DKTLASC2M
3. https://youtu.be/oHM1Sr9p60Y
4. https://archive.nptel.ac.in/courses/112/107/112107217/

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Recognize and explain the importance and objectives of new product development.	
CO3	L1CO2 Formulateandstandardizenewfoodproductsconsideringresourceavailabilityand costcompetitiveness. Applyadaptableandsustainabletechnologiesintheprocessdevelopmentoffood products from lab to pilot scale.	L2 L3
CO4	Assess the quality and market potential of newly developed food products based on nutritional, sensory, and safety standards.	L4
CO5	Performeconomicevaluationsanddevelopcommercializationstrategiesfornew food products.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevanttotheprofessionalengineeringpractice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and need for sustainable development.	PO7
8	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththeengineering communityandwithsocietyatlarge,suchas,beingabletocomprehendand writeeffectivereportsanddesigndocumentation,makeeffectivepresentations,andgive and receive clear instructions	PO10
9	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	PO11
10	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3											2
CO2		2	3									2
CO3				2	3		2					
CO4				3		2				2		
CO5			2						1		3	

Semester-II

FOOD INDUSTRY BY PRODUCT AND WASTE MANAGEMENT			
CourseCode	MFDT215B	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tocomprehendthegeneration,classification,andpotentialusesofbyproductsfromvariousfood processing industries.
- Toexploreandevaluatevariouswastetreatmenttechniquesapplicabletodifferentfood processing sectors.
- Tounderstandandapplythelaws,regulations,andguidelinesgoverningwastemanagementin the food processing industry.
- Topromotesustainablepracticesbylearningaboutzero-dischargeandzero-emissionsystemsin food processing plants.
- Togainskillsinassessingtheeconomicaspectsofwastemanagement,includingcost-benefit analysisandoptimizationofresource use.

Module-1

BYPRODUCTSFROMFOODPROCESSINGINDUSTRY

Byproducts of Cereal and Legume Processing: Explore the various byproducts generated from the processing of cereals and legumes, including bran, husks, and protein isolates, and their applications in food and non-foodsectors.
Byproducts of Oil Seeds Processing: Study the byproducts such as oil cakes, meal, and gums produced during the extraction of oil from seeds and their uses in animal feed, biofuels, and other industries.
Dairy Industry Byproducts: Understand the byproducts of dairy processing, including whey, lactose, and milk permeate, and their utilization in nutraceuticals, food additives, and environmental applications.
Fruit and Vegetable Processing Byproducts: Examine the byproducts such as peels, seeds, and pulp from fruit andvegetableprocessing,andtheirpotentialusesinfoodfortification,cosmeticindustry,andbiodegradable packaging.

Module-2

BYPRODUCTSFROMANIMALANDAGRO-BASEDINDUSTRIES

MeatProcessingByproducts: Learnaboutthebyproductsgeneratedfrommeatprocessing,includingbones, blood, and offal, and their utilization in pet food, pharmaceuticals, and fertilizers.
Fish Processing Byproducts: Study the byproducts such as fish meal, oil, and collagen from fish processing, andtheir applications in aquaculture, health supplements, and bioactive compounds.
Agro-BasedIndustryByproducts: Exploretheusesofbyproductsfromagro-basedindustries,includingcrop

Module-3

LAWSANDREGULATIONSFORWASTEMANAGEMENT

Waste Management Regulations: Study the key national and international laws governing waste management in the food processing industry, including hazardous waste regulations and environmental impact assessments.
FSSAIGuidelines:UnderstandthespecificregulationssetbytheFoodSafetyandStandardsAuthorityofIndia (FSSAI) regarding the disposal and recycling of food industry waste.
SustainabilityandCompliance: Exploretheimportanceofcompliancewithenvironmentalregulationsforsustainable food production, including penalties for non-compliance and incentives for waste reduction initiatives. **CaseStudies:** Analyze real-worldexamples ofwaste managementpractices inthe foodindustryandhowtheyalign withlegalrequirements.

Module-4

WASTETREATMENTMETHODSINTHEFOODINDUSTRY

CerealandFruitProcessingWasteTreatment: Learnaboutthemethodsfortreatingwastegeneratedfrom cereal and fruit processing, including composting, anaerobic digestion, and energy recovery.
VegetableandMeatProcessingWasteTreatment: Studythetreatmenttechniquesforvegetableandmeat processing waste, such as rendering, enzymatic hydrolysis, and bioconversion.
Fish and DairyProcessing WasteTreatment: Understandthe specific challenges andsolutions fortreating waste from fish and dairy processing, including effluent treatment, solid waste management, and valorization.
BreweryandAlcoholIndustryWasteTreatment: Explorethetreatmentmethodsforbreweryandalcohol industry waste, including yeast recovery, spent grain utilization, and effluent treatment systems.

Module-5

WASTEWATERTREATMENTANDZERO-DISCHARGESYSTEMS

PreliminaryandPrimaryTreatment: Learnabouttheinitialstagesofwastewatertreatment,includingscreening, sedimentation, and chemical coagulation, and their importance in reducing pollutant loads.

Secondary and Advanced Treatment: Study biological treatment methods, such as activated sludge, trickling filters, and membrane bioreactors, as well as advanced oxidation processes for treating wastewater in the food industry.

Final Treatment and Discharge: Understand the processes involved in the final treatment and safe discharge of treated wastewater, including disinfection, sludge management, and compliance with discharge standards.

Zero-Discharge and Zero-Emission Systems: Explore the design and implementation of zero-discharge and zero-emission systems in food processing plants, promoting sustainable water use and minimizing environmentalimpact.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. HandbookofWasteManagementandCo-ProductRecoveryinFoodProcessing.K.Waldron,Woodhead Publishing Limited, 1st Edition, 2007
2. WasteManagementfortheFoodIndustries.I.S.Arvanitoyannis,AcademicPress,2008
3. Utilization of By-Products and Treatment of Waste in the Food Industry. Vasso Oreopoulou and WinfriedRuss, Springer US, 1st Edition, 2007
4. FoodScience.NormanN.PotterandJosephH.Hotchkiss,S.ChandPublication,5thEdition,2007
5. FoodProcessingBy-ProductsandtheirUtilization,Ed.AnilKAnal,WilleyPublication,1stEdition,2017

WeblinksandVideoLectures(e-Resources):

1. https://www.coursera.org/lecture/meat-we-eat/by-products-P51Cd
2. https://www.youtube.com/watch?v=bf-XC8Ko42I
3. https://www.youtube.com/watch?v=ikKFMgmqjOo

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Identifythebyproductsgeneratedfromfoodprocessingindustriesanddescribetheirpotential uses.	L1
CO2	Explainthevariouswastetreatmentmethodsfordifferenttypesoffoodindustrywaste.	L2
CO3	Applytheknowledgeoflawsandregulationstoevaluatewastemanagementpracticesin food processing industries	L3
CO4	Analyzetheenvironmentalimpactofwastemanagementtechniquesandproposesustainable solutions, including zero-discharge systems	L4
CO5	Evaluate the economic feasibility of waste management strategies and design cost-effective waste management systems for food processing plants	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodernengin eering and ITtools includingpredictionandmodelingtocomplexengineering activitieswithanunderstandingofthelimitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevanttotheprofessionalengineeringpractice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and need for sustainable development.	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	PO8
9	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1						2					
CO2		2			2		3					
CO3						2		3				
CO4			2	3			3					
CO5			2									3

Semester-II

HUMANNUTRITION, FUNCTIONAL FOODS, AND NUTRACEUTICALS			
CourseCode	MFDT215C	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandthebiochemicalprinciplesunderlyinghumannutritionandtheroleoffunctionalfoodsand nutraceuticals.
- Toevaluatethenutritionalrequirementsandidentifyfunctionalfoodcomponentsthatcontributeto disease prevention and health promotion.
- Toanalyzethefunctionalclaimsandregulationsrelatedtonutraceuticalsandfunctionalfoods.
- Tocomprehendenzymekineticsandmetabolicpathwaysofmacronutrients,andtheirimplicationsin health and disease.
- Toassessandapplytheregulatoryframeworkandmarketdynamicsforfunctionalfoodsand nutraceuticals globally..

Module-1

INTRODUCTIONTONUTRITIONANDFUNCTIONALFOODS

Overview of Nutrition: Nutrition, malnutrition, functions of food, basic food groups, nutritional needs, requirements, and recommended dietary allowances.

Introduction to Functional Foods and Nutraceuticals: Concepts, definitions, and the link between nutrition and medicine. Functional foods' components, such as probiotics, prebiotics, dietary fibers, and their functional properties.

SourcesandBioavailability: Sourcesofnutraceuticalsandthebioavailabilityofkeyfunctionalingredients.

Module-2

ENZYMOLOGYANDMETABOLISM

EnzymeKinetics: Mechanismofenzymeaction,coenzymes,enzymekinetics,derivationofMichaelis-Menten equation.

MetabolismofMacronutrients: Sources,functions,digestion,absorption,andmetabolismofcarbohydrates, proteins, and lipids. Metabolic pathways: Glycolysis, TCA cycle, beta-oxidation, and protein catabolism.

Role of Enzymes in Nutraceuticals: Enzymatic processes involved in the synthesis and modification of functional food components.

Module-3

FUNCTIONALFOODCOMPONENTSANDDISEASEPREVENTION

MicronutrientsandPhytochemicals: Vitamins,isoflavones,flavonoids,carotenoids,andlycopene.Theroleof antioxidants, Omega-3 fatty acids, and other key nutraceuticals in disease prevention.

Disease-SpecificFunctionalFoods: Functionalfoodsandnutraceuticalsforgastrointestinalhealth,coronaryheart disease, cancer prevention, and other chronic conditions.

Marine-DerivedNutraceuticals: Functional food components from marine sources like macroalgae, microalgae, and their therapeutic applications.

Module-4

MINERALS,VITAMINS,ANDNUTRITIONALDEFICIENCY

Essential Mineralsand Vitamins: Functions,sources,factors affectingabsorption, andconsequences ofdeficiency for minerals like calcium, iron, zinc, and vitamins.

HormonalInteractions: Theroleofvitaminsandhormonesinmetabolismandoverallhealth.

Restoration and Fortification: Nutrient restoration, enrichment, fortification, and supplementation strategies in food processing.

Module-5

FUNCTIONALFOODCLAIMS,MARKETING,ANDREGULATION

Health Claims and Labeling: Functional claims, packaging and labeling requirements, nutrient modification, and disease-specific claims.

RegulationsandLaws: OverviewofDietarySupplementHealthandEducationAct(DSHEA),regulationsinthe USA, EU, and India for functional foods and nutraceuticals.

Market Dynamics: The market for functional foods, consumer preferences, and the role of health in food choices. Commercialization strategies and economic aspects of functional food products.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

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CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

1. FunctionalFoods:PrinciplesandTechnology.M.Guo,WoodheadPublishing,1stEdition
2. Functionalfoods-ConcepttoproductGibsonG.R.,WilliamsG.M.WoodheadPublishingLtd,2000
3. HandbookofNutraceuticalsandFunctionalFoods.WildmanR.E.C.,SecondEdition,CRCPress,2007
4. Handbookoffermentedfunctionalfoods.FarnworthE.R.,CRCPress,2003
5. PhytochemicalfunctionalfoodsJohnsonI.,WilliamsonG.WoodheadPublishingLtd,2000
6. PhytosterolasfunctionalfoodcomponentsandnutraceuticalsDuttaP.C.,MarcelDekker,2004
7. FunctionalfoodingredientsandnutraceuticalsShiJ.,TaylorandFrancis,2007
8. BiotechnologyinfunctionalfoodsandnutraceuticalsBagchiD.,LauF.C.,Ghsh,D.K.,TaylorandFrancis, 2010
9. DietarysupplementsandfunctionalfoodsWebb,G.P.,BlackwellPublishing,2006
10. Textbook of Nutrition and Dietetics. Kumud Khanna, Sharda Gupta, Santosh Jain Passi, Rama Seth, Ranjana Mahna and Seema Puri, Elite Publishing House Pvt. Ltd., 2nd Edition, 2016
11. PrinciplesofBiochemistry,A.L.Lehninger,D.L.NelsonandM.M.Cox,W.H.Freeman,4thEdition,1993
12. TextbookofBiochemistry.E. S.West,W.R.Todd,H. S.Mason,and J. T.VanBruggen, MacMillan,4thEdition, 1966
13. NutritionandDietetics.ShubhanginiA.Joshi,TataMcGrow-HillpublishingCompanyLtd,1992
14. BiochemistryofFoods.N.A.MEskin,AcademicPress,1stEdition,1971
15. FoodChemistry.O.R.Fennema,MarcelDekkarInc,3rdEdition,1996
16. EssentialsofFoodandNutrition.M.S.Swaminathan,GaneshandCo,1stEdition, 1974
17. OutlinesofBiochemistry.EricE.ConnandP.K.Stumpf,JohnWileyandSons,3rdEdition,1972

WeblinksandVideoLectures(e-Resources):

1. https://www.classcentral.com/course/swayam
2. https://www.functionalfoodscenter.net/OnlineCourses.html
3. https://academy.nutrifytoday.com/
4. https://www.youtube.com/watch?v=gCeSLR5PFIc
5. https://www.youtube.com/watch?v=HLzB3miHWM8
6. https://www.youtube.com/watch?v=CU3J9UGzRL0
7. https://www.youtube.com/watch?v=zLZwbOZMesY
8. https://www.youtube.com/watch?v=XzCGonFs0k0
9. https://www.digimat.in/nptel/courses/video/102105034/L01.html
10. https://www.youtube.com/watch?v=BbKi6ExQdxo

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Recallandexplainthebasicprinciplesofhumannutritionandthekeycomponentsof functional foods and nutraceuticals.	L1
CO2	Understandanddiscussthemechanismsofenzymeaction,coenzymefunctions,andthe metabolism of macronutrients	L2
CO3	Apply knowledge of functional foods to assess and evaluate nutritional claims, including the health benefits and risks associated with various nutraceuticals.	L3
CO4	Analyzedifferentnutritionalproducts,theirfunctionalproperties,andtheirimpacton specific health conditions such as cardiovascular disease, cancer, and metabolic disorders.	L4
CO5	Evaluateregulatoryguidelinesanddesignfunctionalfoodproductsthatmeetnutritional requirements and comply with labeling and health claims standards.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineering and ITtools includingpredictionandmodelingtocomplexengineering activitieswithanunderstandingofthelimitations	PO5
6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevant to the professional engineering practice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstrate theknowledgeof,and need for sustainable development.	PO7

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2	1									
CO2	3	3	2									
CO3		3	3		2							
CO4		3		3		2						
CO5			3	3	3		2					

Semester-II

FOOD ALLERGIES AND ALLERGENS			
CourseCode	MFDT215D	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandthebasicconceptsoffoodallergiesandallergens,includingtheirprevalenceandimpacton public health.
- Toexplorethefactorsinfluencingfoodallergenicity,includinggeneticandenvironmentalaspects.
- Tostudythechemicalandbiological characteristicsoffoodallergensandthemethodsfortheirdetection and diagnosis.
- Tolearnaboutthemanagementandriskassessmentstrategiesforfoodallergens,includinggenetic modificationtechniques.
- Toexaminepreventivemeasures,regulatoryframeworks,andlabelingguidelinesforfoodallergens.

Module-1

INTRODUCTION

Overviewoffoodallergiesandallergens,Theimmunesystemandantigen-antibodyinteractions,Signs&symptoms offoodallergies,Globalprevalenceoffoodallergies,Classificationofhypersensitivityreactions,Useof bioinformatics in identifying potential cross-allergens

Module-2

FACTORSINFLUENCINGFOODALLERGENICITY

Factorsaffectingfoodallergenicity,Issuesrelatedtofoodadditivesandingredients,Geneticinheritanceoffood allergies, Immunological responses, Oral allergy syndrome, GM foods and the risk of allergy

Module-3

CHARACTERISTICSANDDETECTIONOFFOODALLERGENS

Natural sources and chemistry of food allergens, Handling food allergies, Detection & diagnostic techniques for allergies, Limitations of current diagnostic techniques, Characterization of allergens, Food sensitivities:Anaphylactic reactions, metabolic food disorders, and idiosyncratic reactions

Module-4

MANAGEMENTANDRISKASSESSMENTOFFOODALLERGENICITY

Principles of managing food allergens, Detailed knowledge of avoidance measures, Genetic modification to reduce allergenicity, Safety evaluation and risk assessment methods.

Module-5

PREVENTIVEMEASURESANDREGULATORYFRAMEWORK

Preventionofallergicdiseases:Primary,secondary,andtertiarymethods,Epidemiology,hygiene,andallergic march hypotheses, Case studies of food allergies and related recalls, Hypoallergenic foods and dietary management Effectsofprocessingtreatmentsonfoodallergenicity,Regulatoryproceduresatnationalandinternationallevels Labeling guidelines.

AssessmentDetails(bothCIEandSEE)

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ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
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Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

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2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.

3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.

Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. JudyOwen,JenniPunt,SharonStranford.(2013).ImmunologybyKuby.7thedition
2. SFlanagan.(2014).HandbookofFoodAllergenDetectionandControl,SimonFlanagan.1stedition Woodhead publishing .
3. ScottH.Sicherer.(2013).FoodAllergy:PracticalDiagnosisandManagement.1steditionCRCPress.
4. EbisawaM.Sagamihara,Ballmer-WeberB.K.Zurich,ViethsS.LangenandWood.
5. R.A.Baltimore,Md.(2015).FoodAllergy:MolecularBasisandClinicalPractice.KargerPublishing.

WeblinksandVideoLectures(e-Resources):

1. https://nptel.ac.in/courses/111107113
2. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
3. https://archive.nptel.ac.in/courses/126/105/126105015/
4. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Identifyanddescribebasicconceptsrelatedtofoodallergiesandallergens.	L1
CO2	Explainthefactorsaffectingfoodallergenicityandtheimmunologicalresponsesinvolved.	L2
CO3	Applydiagnostictechniquestodetectandcharacterizefoodallergens.	L3
CO4	Analyzeandevaluatemanagementstrategiesforfoodallergenicity,includinggenetic modification and risk assessment.	L4
CO5	Assessandproposepreventivemeasuresandregulatoryframeworksforfoodallergens, including labeling guidelines.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblems anddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems:**Useresearch-basedknowledgeand researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions.	PO4
5	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assesssocietal,health,safety,legalandculturalissuesandtheconsequentresponsibilities relevant to the professional engineering practice.	PO6
6	**Ethics:**Applyethicalprinciplesandcommittoprofessionalethicsandresponsibilitiesand norms of the engineering practice	PO8
7	**Project management and finance:** Demonstrate knowledge and understanding of the engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamember and leader in a team, to manage projects and in multidisciplinary environments	P11
8	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengage in independent and life-long learning in the broadest context of technological change	P12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1											
CO2	2	1										
CO3	2	2	1									
CO4	3	2	2	1								
CO5	3	3	2	2	1	2		2			2	1

Semester-II

BIOSENSORS AND FOOD ASSESSMENT			
CourseCode	MFDT215E	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- To provide an understanding of the fundamental principles and components of biosensors, with a focus on their application in food assessment.
- To explore various types of transducers and their role in the development and functionality of biosensors for food quality and safety.
- Tostudythebiochemicalrecognitionelementsusedinbiosensorsandtheirspecificityindetecting foodborne pathogens, contaminants, and allergens.
- Toanalyzemodernintegratedbiosensors,includingtheirdesign,fabrication,andapplicationinfood monitoring and assessment.
- Toexaminereal-worldapplicationsofbiosensorsinthefoodindustry,emphasizingtheiruseinquality control, safety assurance, and regulatory compliance.

Module-1

BIOSENSORCHARACTERISTICS

Overview and Definition: Definition and components of a biosensor with a focus on food assessment.
MeasurementSystems: Basic measurement system,measurement, measureand, errors inmeasurements, signal and noise.
SurfaceChemistryandMassTransport:Surfacechemistry,masstransportinfoodmatrices.
StaticandDynamicCharacteristics: Staticcharacteristics(accuracy,precision,linearity,hysteresis,threshold, dynamic range) and dynamic characteristics (response time, damping, calibration, standards, AC/DC bridges).
Biocompatibility and Integration: Biocompatibility, surface fouling, sensor integration, and systems fabrication specific to food applications.

Module-2

TRANSDUCERSFORFOODASSESSMENT

Types of Transducers: Principles and applications of various transducers used in food biosensors, including calorimetric, optical, potentiometric/amperometric, conductometric/resistometric, piezoelectric, and semiconductor transducers.
Advanced Techniques: Use of quantum dots, fluorescence, Raman spectroscopy, fluorescence enhancement, and DNA microarrays in detecting food quality and safety parameters.

Module-3

BIOCHEMICALRECOGNITIONINFOODBIOSENSORS

ChemicalReactions:Chemicalreactionsrelevanttofoodbiosensors,includinggravimetricandcolorimetric reactions, enzyme kinetics, and chemical equilibrium.
BiologicalRecognitionElements: Useofenzymes,antibodies,andnucleicacids(RNA,DNA)asrecognition elements in food biosensors.
AssayingFormats: CommonassayingformatsincludingELISAs,nucleotidecapture assays,andlabelingtechniques (radioisotopes, fluorophores, dyes, enzymes/substrates).

Module-4

MODERNINTEGRATEDBIOSENSORSFORFOODMONITORING

BioelectronicandBiophotonicSensors: FundamentalsandapplicationsofmicroelectronicsandCMOS-based sensors, photonic sensors, and plasmonic sensors in food assessment.
BiomechanicalSensorsandMicrofluidics:PrinciplesofMEMS(Micro-electromechanicalsystems)resonators, microfluidic devices for lab-on-a-chip applications in food safety.
NanotechnologyinFoodBiosensors: Applicationofnanotechnologyinbio-sensing,includingtheuseof nanoparticles, nanochannels, nanoelectronic, nanophotonic, and nanomechanical sensors.
Biosensor Arrays and Chemometrics: Development of biosensor arrays, electronic noses, and electronic tongues for food quality assessment.

Module-5

APPLICATIONSINFOODASSESSMENT

FoodQualityandSafety:Applicationofbiosensorsinmonitoringfoodquality,detectingcontaminants,andensuring safety in the food industry.

Biosensors for Industry: Use of low-cost biosensors for industrial food processes, including online monitoring and point-of-care testing.

Environmental Monitoring: Biosensors for detecting environmental contaminants that affect food safety.

RegulatoryCompliance:Theroleofbiosensorsinensuringcompliancewithfoodsafetyregulationsandstandards.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. F.G.Bănică,ChemicalSensorsandBiosensors:FundamentalsandApplications,Wiley,2012
2. B.D.Malhotra,A.P.F.Turner,AdvancesinBiosensors,Elsevier,2003
3. I.Willner,E.Katz,Bioelectronics:FromTheorytoApplications,Wiley-VCHVerlagGmbH,2006
4. Bilitewski,U.Turner,Biosensorsforenvironmentalmonitoring,A.P.F.Harwood,Amsterdam,2000

WeblinksandVideoLectures(e-Resources):

1. https://nptel.ac.in/courses/111107113
2. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
3. https://archive.nptel.ac.in/courses/126/105/126105015/
4. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Describe the fundamental principles and components of biosensors, including their static and dynamic characteristics.	L1
CO2	Applytheirknowledgeoftransducerstoanalyzetheirsuitabilityforvariousfood assessmentapplications.	L2
CO3	Evaluatedifferentbiochemicalrecognitionelements,suchasenzymesandantibodies, for their specificity and effectiveness in food biosensors.	L3
CO4	Designandinnovateintegratedbiosensorsforspecificfoodassessmenttasks,incorporating modern technologies such as microfluidics and nanotechnology.	L4
CO5	Apply their knowledge of biosensors in real-world food industry scenarios, focusing on quality control, safety assurance, and regulatory compliance.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Design/development of solutions**: Design solutions for complex engineeringproblemsanddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
3	**Conductinvestigationsofcomplexproblems:**Useresearch-basedknowledgeand researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions	PO4
4	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
5	**The engineer and society:** Apply reasoning informed by the contextual knowledge toassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice	PO6
6	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and needforsustainabledevelopment	PO7
7	**Ethics:**Applyethicalprinciplesandcommittoprofessionalethicsandresponsibilitiesand norms of the engineering practice	PO8
8	**Individualandteamwork:** Functioneffectivelyasanindividual,andasamemberorleader in diverse teams, and in multidisciplinary settings	PO9
9	**Project management and finance:** Demonstrate knowledge and understanding of the engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamember and leader in a team, to manage projects and in multidisciplinary environments	PO11
10	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengage in independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2										1
CO2		2	3									1
CO3	2			3	2							
CO4			3		3				2			
CO5						3		3				2

Semester-II

FOOD INDUSTRY BIOETHICS AND BIO SAFETY PRACTICES			
CourseCode	MFBDT215F	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandtheprinciplesofbioethicsandbiosafetyastheyapplytothefoodindustry.
- Toexplorethelegal,ethical,andsocietalimplicationsofbiotechnologyinthefoodsector.
- TointroducetheconceptsofHazardAnalysisandCriticalControl Points(HACCP)andHazardand Operability Study (HAZOP) in ensuring food safety.
- Toanalyzebiosafetyregulationsandguidelinesrelatedtofoodproduction,processing,anddistribution.
- Toevaluatecasestudiesofbioethicsandbiosafetychallengesinthefoodindustry.

Module-1

INTRODUCTIONTOBIOETHICSANDBIOSAFETYINTHEFOODINDUSTRY

Overview of Bioethics: Definition and importance of bioethics in the food industry, ethical principles (autonomy, beneficence, non-maleficence, justice).
Biosafety Concepts: Introduction to biosafety, importance in food safety, ethical conflicts, and public perception.
Historical ContextandCase Studies:Key eventsin the developmentofbioethics andbiosafety in foodscience, examples from both developed and developing countries.

Module-2

LEGALANDETHICALISSUESINTHEFOODINDUSTRY

Legal Frameworks: Overview ofnational and international regulationsgoverningbiosafety andbioethics inthe food industry, including the Cartagena Protocol on Biosafety.
IntellectualPropertyRights(IPR): EthicaldimensionsofIPRinfoodbiotechnology,technologytransfer,and global biotech issues.
Social Responsibility: Biotechnology and social responsibility in food production, public education, and informed decision-making processes.

Module-3

HACCPANDHAZOPINFOODSAFETYMANAGEMENT

HACCPOverview: IntroductiontoHazardAnalysisandCriticalControlPoints(HACCP),itsprinciples,andits application in the food industry.
HAZOPOverview: IntroductiontoHazardandOperabilityStudy(HAZOP),itsapplicationinidentifyingrisksin food processing.
Implementation: Practical steps for implementingHACCP and HAZOP infoodsafety management systems, case studies of successful implementations.

Module-4

BIOSAFETYREGULATIONSANDGOODPRACTICESINTHEFOODINDUSTRY

Regulatory Guidelines: Detailed analysis of biosafety assessment procedures, national and international biosafety regulations related to food products.
GoodManufacturingPractice(GMP) &GoodLaboratoryPractice(GLP):Guidelinesforensuring productsafety, quality, and compliance with regulatory standards.
BiosafetyManagement: Managingbiosafetyrisksinfoodproduction,includinglaboratorysafety,containment, and bioterrorism threats.

Module-5

ENVIRONMENTALANDETHICALIMPACTOFBIOTECHNOLOGYINTHEFOODINDUSTRY

EnvironmentalConcerns: Impactofgeneticallymodifiedorganisms(GMOs)ontheenvironment,biosafety assessment of transgenic foods.
Ethical Issues: Debate on GM foods, ethical considerations in the release of GMOs, environmental sustainability in food biotechnology.
Case Studies: Analysis of specific cases such as GM food controversies, biosafety breaches, and ethical dilemmas in food biotechnology.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximummarksofSEE.Astudentshallbedeemedtohavesatisfiedtheacademicrequirementsandearnedthe creditsallottedtoeachsubject/courseifthestudentsecuresnotlessthan50%(50marksoutof100)inthesum

totaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.**

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. BiotechnologyandSafetyAssessment.JohnA.ThomasandRoyL.Fuchs,AcademicPress,3rdEdition,2002
2. BiologicalsafetyPrinciplesandpractices.D.O.FlemingandD.L.Hunt,ASMPress,3rdEdition,2000
3. Biotechnology: A Multi-Volume Comprehensive Treatise Legal Economic and Ethical Dimensions. H.J.Rehm and G. Reed, Vch Verlagsgesellschaft Mbh, 1995
4. Bioethics:AnIntroductionfortheBiosciences.BenMepham,OxfordUniversityPress,2ndEdition,2008
5. Bioethics&Biosafety.R.Rallapalli&GeethaBali,APHPublication,2007
6. Bioethics&Biosafety.M.K.Sateesh,I.K.International,2008
7. BiotechnologiesandDevelopment.AlbertSasson,UNESCOPublications,1988
8. Biotechnologies in Developing Countries: Present and Future Regional and Sub-regional Co-operation and Joint Ventures. Albert Sasson, UNESCO Publishing, 1993

WeblinksandVideoLectures(e-Resources):

1. https://www.youtube.com/watch?v=gxm5ZLRGsoE
2. https://www.youtube.com/watch?v=R0s-Y8ugXSk
3. https://archive.nptel.ac.in/courses/109/106/109106092/
4. https://www.youtube.com/watch?v=APq3g7WYs6k
5. https://www.youtube.com/watch?v=4GviNafYdS4

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Describethefundamentalconceptsofbioethicsandbiosafetyinthefoodindustry.	L1
CO2	Analyzethelegalandethicalframeworksgoverningbiosafetyinfoodbiotechnology.	L2
CO3	ApplyHACCPandHAZOPprinciplestofoodsafetymanagementsystems.	L3
CO4	Evaluateandimplementbiosafetyregulationsandgoodpracticesinthefoodindustry.	L4
CO5	Assesstheenvironmentalandethicalimpactsofbiotechnologyinthefoodindustry.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblemsanddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modernengineeringandITtoolsincludingpredictionandmodelingtocomplexengineering activities with an understanding of the limitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgeto assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice.	PO6
7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	PO8

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3							3				
CO2						2		3				
CO3		2	3									
CO4				2	3							
CO5							3	3				

Semester-II

REGULATORYFRAMEWORKSANDSTANDARDSINFOODSAFETY			
CourseCode	MFDT206	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	3	TotalMarks	100
Credits	3	ExamHours	3

CourseLearningobjectives:

- Tounderstandtheconceptoffoodadulterationandtheimplementationoffoodsafety management systems.
- Togaincomprehensiveknowledgeofvariousnationalfoodlawsandtheirapplicationsinfood processing.
- ToexploretherolesandfunctionsoftheFoodSafetyandStandardsAuthorityofIndia(FSSAI) and related food safety legislation.
- Toexaminetheresponsibilitiesofotherrelevantnationalbodiesinvolvedinfoodsafetyand quality assurance.
- Toanalyzeinternationalfoodlawsandpractices,includingglobalstandardsandcertifications applicabletothefoodindustry

Module-1

FOODADULTERATIONANDFOODSAFETYMANAGEMENT
FoodAdulteration: Definition,types,andexamplesoffoodadulteration.
FoodSafetyManagementSystem: PrinciplesandcomponentsofaFoodSafetyManagementSystem(FSMS).
Mandatory vs. Voluntary Food Laws: Overview of mandatory food laws and voluntary guidelines for food safety and quality.

Module-2

DIFFERENTFOODLAWS
EssentialCommoditiesAct:Objectivesandapplicationsinfoodregulation.
PreventionofFoodAdulterationAct(PFA): Keyprovisionsandenforcement.
FruitProductsOrder(FPO)andMeatFoodProductsOrder(MFPO): Regulationsconcerningfruitandmeat

Module-3

FSSAI
StructureandFunction:OrganizationalstructureandrolesofFSSAI.
FoodSafetyandStandardsAct: Keyprovisions,amendments,andimpactonthefoodindustry.

Module-4

OTHERRELEVANTNATIONALBODIES
BureauofIndianStandards(BIS): Roleinfoodsafetyandstandardization.
Agricultural and Processed Food Products Export Development Authority (APEDA): Functions and relevance to food export.
MarineProductsExportDevelopmentAuthority(MPEDA): Regulationsandstandardsformarineproducts.
SpiceBoardIndia:Standardsandregulationsforspiceindustry.
AgriculturalMarketingandGradingStandards(AGMARK): Overviewandimportanceinfoodqualityassurance.

Module-5

INTERNATIONALFOODLAWSANDPRACTICES
FoodCodexLaws: InternationalCodexAlimentariusstandardsandtheirimpact.
Food and Drug Administration (FDA): Role and regulations in the U.S. food industry.
InternationalOrganizationforStandardization(ISO): KeyISOstandardsrelevanttofoodsafety. **Good Manufacturing Practices (GMP):** Principles and implementation in food production.
GoodAgriculturalPractices(GAP): Guidelinesandbenefitsforfoodsafetyandquality.
HazardAnalysisandCriticalControlPoint(HACCP): Principles,implementation,andcasestudies.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

ContinuousInternalEvaluation:

1. TwoUnitTestseachof**25 Marks**
2. Twoassignmentseachof**25Marks**or**oneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumoftwotests,twoassignments/skillDevelopmentActivities,willbe **scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyasperthe outcomedefinedforthecourse.

Semester-End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

Books

1. APracticalGuidetoFoodLawsandRegulations.KironPrabhakar,BloomsburyProfessionalIndia,1st Edition, 2016
2. International Food Law and Policy. Gabriela Steier and Kiran Patel, Springer International Publishing, 1st Edition, 2016
3. FoodRegulation:Law,Science,PolicyandPractice,N.D.Fortin,WileyPublication,2ndEdition,2016
4. Food Safety and Standards Act and Regulations, Food Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India, 2006
5. InternationalFoodLawandPolicy.GabrielaSteier&KiranK.Patel(Eds.)SpringerNature;1stEdition. 2016

WeblinksandVideoLectures(e-Resources):

1. https://onlinecourses.swayam2.ac.in/nou19_ag07/course
2. https://vimeo.com/343624655
3. https://foodsafetyhelpline.com/introduction-to-food-safety-and-standards-act-2006/
4. https://vimeo.com/345007583
5. https://www.youtube.com/watch?v=YlTtVcQgVaU

SkillDevelopmentActivitiesSuggested

1. NGSandMicroarraydataAnalysis
2. Proteomicdatanetworkanalysis.
3. AVpresentationbystudents(onspecifictopics).
4. Discussionofcasestudiesbasedonresearchfindings

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Describethekeyfoodsafetylawsandregulationsrelevanttofoodsafety management.	L1
CO2	Applyfoodsafetymanagementsystemsandregulationstoensurecompliancein foodprocessing.	L2
CO3	Analyzetheimpactof variousfoodlawsandcertificationsonfoodsafetyandquality indifferentcontexts.	L3
CO4	Develop and propose strategies for implementing effective food safety management systems based on regulatory requirements and standards.	L4
CO5	Evaluateandcritiquetheeffectivenessofnationalandinternationalfoodsafety regulations and certifications in achieving desired safety and quality outcomes.	L5

ProgramOutcomeofthiscourse

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics,naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineeringproblemsanddesignsystem componentsorprocesses thatmeet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeand researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesisoftheinformationtoprovidevalidconclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineering and ITtools includingpredictionandmodelingtocomplexengineering activitieswithanunderstandingofthelimitations	PO5
6	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,and need for sustainable development.	PO7
7	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththeengineering communityandwithsocietyatlarge,suchas,beingabletocomprehendand writeeffectivereportsanddesigndocumentation,makeeffectivepresentations,andgive and receive clear instructions	PO10
8	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	PO11
9	**Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3		1			2						
CO2		2		2			2					
CO3			2	3						2		
CO4					2	3					3	
CO5				3			2					3

FOOD SAFETY AND QUALITY ASSURANCE LABORATORY			
CourseCode	**MFDTL207**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:2	SEEMarks	50
Credits	2	ExamHours	3

Courseobjectives:

- Toequipstudentswiththeknowledgeandskillsnecessarytoperform essentialfoodanalysistechniques, including sensory evaluation, chemical, and microbiological assessments.
- TofamiliarizestudentswiththeuseofadvancedanalyticalinstrumentssuchasFTIR,GC,andHPLCinthe detection and quantification of food components and contaminants.
- Todevelopstudents'abilitytoanalyzeexperimentaldatausingappropriatestatisticalandcomputational methods, including fuzzy logic and spectrophotometric techniques.
- Toprovidestudentswithhands-onexperienceinassessingandensuringthequalityandsafetyofvarious food products through standard laboratory practices.
- Toenhancestudents'problem-solvingskillsbyengagingtheminexperimentsthatrequirecritical thinkingandtheapplicationoftheoreticalknowledgetopracticalsituations.

Sl.NO	Experiments
1	**SensoryEvaluationandDataAnalysisofFruitJuicesUsingFuzzyLogic:** • Conductsensoryevaluationofdifferentfruitjuices. • Analyzethedatausingfuzzylogictodetermineconsumerpreferences.
2	**QuantitativeDeterminationofProteinConcentrationinVariousFoodSamples** • Measureandcomparetheproteincontentindifferentfooditemsusingstandardbiochemical metho
3	**QuantificationofTotalDietaryFiberandTotalFatinFoodProducts** • Assessthetotaldietary fiberandfatcontentinselectedfoodsamplesusingenzymatic-gravimetric and Soxhlet extraction methods.
4	**DeterminationofAscorbicAcidContentinFreshandProcessedFruitJuices** • MeasurethevitaminC(ascorbicacid)concentrationinvariousfruitjuicesusingtitrationor spectrophotometric methods.
5	**QualitativeandQuantitativeAnalysisofOilsandFats** • Performqualitativetests(e.g.,iodinevalue,saponificationvalue)andquantifyfatcontentin edible oils.
6	**MicrobialEnumerationandQualityAssessmentofMilkSamples** • Determinetotalmicrobialcountsinmilksamplesusingstandardplatecountmethodsandassess milk quality parameters.
7	**DetectionandAnalysisofAdulterantsinMilk** • Identifyandquantifycommonadulterantsinmilkusingchemicalandphysicaltests.
8	**AssessmentofAntioxidantActivityinFoodandBeverages** • Determine the antioxidant capacity of selected food and beverage samples using DPPH assay orother relevant methods.
9	**MeasurementofBrix-AcidRatio(BAR)inFruitBeverages** • CalculatetheBrix-AcidRatioinfruit-basedbeveragestoevaluatesweetnessandacidity balance.
10	**Colorimetric/SpectrophotometricDeterminationofLactoseinMilk-BasedConfectioneries** • Analyzelactosecontentinmilksweetsusingcolorimetricorspectrophotometrictechniques.
11	**IdentificationandQuantificationofFoodAdditivesUsingFTIR,GC,orHPLC** • Identifyandquantifyfoodadditivessuchaspreservatives,colorants,orflavorenhancersusing FTIR, Gas Chromatography (GC), or High-Performance Liquid Chromatography (HPLC).
12	**VerificationandCharacterizationofPackagingMaterialsbyFTIRSpectroscopy** • Analyzepackagingmaterialsfortheircompositionand qualityusingFourierTransformInfrared (FTIR) Spectroscopy.

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. RecalltheproceduresforpreparingmolecularbiologylabbufferssuchasTAE,TBE,andTE.
2. UnderstandthetechniquesforisolatingandquantifyingDNAandRNAfromvarioussourcesandtheir application in Southern and Northern blotting.
3. ApplytechniquessuchasPCRforDNAamplificationand restrictiondigestionforplasmidanalysisin molecularcloning.
4. AnalyzetheresultsofproteinisolationandquantificationusingWesternblotting,andevaluatethe efficiency of gene ligation and transformation in bacterial cells.
5. Criticallyevaluatetheoutcomesofgenetictransformationsandtheroleofmoleculartechniquesin biotechnological applications.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**markscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce20%ofmaximummarks.SEEforpracticalshallbeevaluatedfor100marksandscoredmarksshall bescaleddownto50marks(however,basedoncoursetype,rubricsshallbedecidedbytheexaminers)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero.
ThedurationofSEEis03hours

SuggestedLearningResources:
1.

Courseoutcome(CourseSkillSet)
Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	Identify and describe the principles of sensory evaluation and basic food analysis techniques.	L1
CO2	Apply basic chemical and microbiological methods to evaluate the quality of food samples.	
	L2CO3 PerformandinterprettheresultsfromadvancedinstrumentaltechniquessuchasFTIR,	L3
CO4	GC,andHPLCinfoodanalysis. Analyze experimental data using statistical and computational tools, and evaluate the	L4
CO5	implications for food quality and safety. Design and implement quality control procedures for food products based on experimental results, ensuring compliance with industry standards.	L5

Programoutcomeofthiscourse

Sl no	Description	PO
1	**Engineeringknowledge:**Applytheknowledgeofmathematics,science,engineeringfundamentals,and anengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesofmathematics, naturalsciences,andengineeringsciences.	PO2
3	**Design/developmentofsolutions**:Designsolutionsforcomplexengineeringproblemsand designsystemcomponentsorprocessesthatmeetthespecifiedneedswithappropriate considerationforthepublichealthandsafety,andthecultural,societal,andenvironmental considerations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisofthe informationtoprovidevalidconclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineeringandITtoolsincludingpredictionandmodelingtocomplexengineeringactivities withanunderstandingofthelimitations	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgetoassess societal,health,safety,legalandculturalissuesandtheconsequentresponsibilitiesrelevantto theprofessionalengineeringpractice.	PO6
7	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,andneed forsustainabledevelopment.	PO7
8	**Ethics:**Applyethicalprinciplesandcommittoprofessionalethicsandresponsibilitiesandnorms oftheengineeringpractice	PO8
9	**Individualandteamwork:**Functioneffectivelyasanindividual,andasamemberorleaderin diverseteams,andinmultidisciplinarysettings	PO9
10	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththe engineeringcommunityandwithsocietyatlarge,suchas,beingabletocomprehendandwrite effectivereportsanddesigndocumentation,makeeffectivepresentations,andgiveandreceive clearinstructions	PO10
11	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2		1								
CO2	2	3						1				
CO3		3		3					2			
CO4					3	2				1		
CO5			3				2					1

FOOD BIOTECHNOLOGY LABORATORY			
CourseCode	**MFDT27A**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- To provide students with a solid foundation in basic biotechnology laboratory procedures, including safetyprotocols,equipmentusage,foodsampling,andstoragemethodsrelevanttothefoodindustry.
- To introduce students to bioinformatics tools and techniques for analyzing food pathogen-related genes, markers,andsinglenucleotidepolymorphisms(SNPs),enhancingtheirabilitytointerpretandapplydata in food safety contexts.
- To equip students with hands-on experience in genomic DNA isolation, purification, and quantification, alongwithprimerdesign,PolymeraseChainReaction(PCR),andgelelectrophoresistechniques,critical for food biotechnology research and quality control.
- To train students in the quantitative determination of proteins using Bradford's method, SDS-PAGE for proteinmolecularweightdetermination,andnativePAGEforisoenzymeanalysis,enablingthemtoassess protein-related attributes in food products.
- Toenablestudentsto apply avarietyofbiotechnologicalmethodsto addresschallengesinfoodsafety, includingenzymeactivityassays,DNAandproteinanalysis,andthedetectionoffoodbornepathogens, ensuringacomprehensiveunderstandingoffoodbiotechnologyapplications.

Sl.NO	Experiments
1	Foodbiotechnologytechniques(Basiclabprocedures,equipment's,safetyandfoodsamplingandstorage)
2	Bioinformatics(Foodpathogensrelated-genes,markerandsinglenucleotidepolymorphism(SNP)analysis using online tools)
3	GenomicDNAisolationandpurificationfromfoodsamples
4	SpectrophotometricDetermination(DNAquantificationandpurity)
5	Primerdesigning&PolymeraseChainReaction(PCR)
6	AgarosegelelectrophoresisofDNA
7	RFLP&DNAMolecularSizeDeterminationProteins
8	QuantitativedeterminationofTotalproteinsbyBradfordmethod
9	SDS-Polyacrylamideslabgelelectrophoresis
10	ProteinMolecularweightDetermination
11	Enzymelinkedimmunosorbentassay(ELISA)
12	FoodIsoenzymesdetectionandanalysisbyNativePAGE

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethe studentwillbeableto:

1. Understandthebasiclaboratoryprocedures,equipment,safetyprotocols,andfoodsamplingandstorage methods.
2. Explaintheprinciplesbehindbioinformaticstoolsusedforanalyzingfoodpathogen-relatedgenes, markers, and single nucleotide polymorphisms (SNPs).
3. PerformgenomicDNAisolationandpurificationfromfoodsamples,followedbyspectrophotometric determination of DNA concentration and purity.
4. DesignprimersandcarryoutPolymeraseChainReaction(PCR)forgeneamplification,followedby agarose gel electrophoresis and RFLP analysis.
5. Evaluateproteinconcentrationusing Bradford'smethod,performSDS-PAGEforproteinmolecularweight determination,andanalyzefoodisoenzymesusingnativePAGE.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shallbe scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero. The duration of SEE is 03 hours

SuggestedLearningResources:

1. "PrinciplesofFoodBiotechnology"byV.K.Joshi,AshokPandey-Springer.
2. "FoodBiotechnology" by KalidasShetty, GopinadhanPaliyath,Anthony Pometto, and Robert E.Levin - CRC Press.
3. "Molecular Techniques inFood Biology: Safety, Biotechnology, Authenticity & Traceability" by Aly Farag El Sheikha - Wiley.
4. "FoodMicrobiology:AnIntroduction"byThomasJ.Montville,KarlR.Matthews -ASMPress.
5. "HandbookofFoodAnalyticalChemistry"byRonaldE.Wrolstad-Wiley.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Understandthebasiclaboratoryprocedures,equipment,safetyprotocols,andfood sampling and storage methods.	L1
CO2	Explaintheprinciplesbehindbioinformaticstoolsusedforanalyzingfoodpathogen- related genes, markers, and single nucleotide polymorphisms (SNPs).	L2
CO3	PerformgenomicDNAisolationandpurificationfromfoodsamples, followedby spectrophotometric determination of DNA concentration and purity.	L3
CO4	DesignprimersandcarryoutPolymeraseChainReaction(PCR)forgeneamplification, followed by agarose gel electrophoresis and RFLP analysis.	L4
CO5	EvaluateproteinconcentrationusingBradford'smethod,performSDS-PAGEforprotein molecular weight determination, and analyze food isoenzymes using native PAGE.	L5

Programoutcomeofthiscourse

Sl no	Description	PO
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesofmathematics, natural sciences, and engineering sciences.	PO2
3	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisofthe informationtoprovidevalidconclusions.	PO4
4	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineeringandITtoolsincludingpredictionandmodelingtocomplexengineeringactivities with an understanding of the limitations	PO5
5	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththe engineeringcommunityandwithsocietyatlarge,suchas,beingabletocomprehendandwrite effective reports and design documentation, make effective presentations, and giveand receive clearinstructions	PO10
6	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	3		3								2
CO2	2	3			3					2		
CO3	3			3	3				2			
CO4	3			2	3				2			
CO5			3			2	3				2	3

FOODMICROBIOLOGYLABORATORY			
CourseCode	**MFDTL258B**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- Tounderstandandapplyfundamentalmicrobiologicaltechniquesintheanalysisoffoodsamples.
- Toevaluatethemicrobialqualityandsafetyofdifferentfoodproducts.
- Tostudytheeffectsofvariousenvironmentalfactorsonmicrobialgrowthinfood.
- Toexploretheroleofmicroorganismsinfoodfermentationandspoilage.
- Todevelopskillsinthedetectionandquantificationoffoodbornepathogensandtoxins.

Sl.NO	Experiments
1	**IsolationandEnumerationofYeastandMoldsfromFoodSamples** • Conductserialdilutionsandplatecountstoisolateandenumerateyeastandmoldspresentin various food samples.
2	**DetectionofColiformsinWaterandFoodSamplesUsingMostProbableNumber(MPN)Method** • Perform the MPN method to detect andestimate the presence of coliform bacteria in water andfood samples.
3	**DeterminationofThermalDeathTime(TDT)ofMicroorganismsinFood** • Analyzethetimerequiredtokillaspecificmicroorganismatagiventemperatureinfoodsamples.
4	**IdentificationofPathogenicBacteriainFoodSamplesUsingSelectiveMedia** • Use selective media such as MacConkey Agar or Salmonella-Shigella Agar to isolate and identifypathogenic bacteria from food samples.
5	**StudyofBacterialSpoilageinFoodProducts** • Observeandanalyzethespoilagepatternsindifferentfoodproducts,identifyingthebacteria responsible for spoilage.
6	**AntimicrobialActivityofFoodPreservatives** • Testtheeffectivenessofcommonfoodpreservatives(e.g.,sodiumbenzoate, potassiumsorbate) against various foodborne microorganisms.
7	**FermentationandMicrobialProductionofLacticAcid** • Perform the fermentation of milk or vegetables to produce lactic acid and quantify the microbial load.
8	**EnumerationofLacticAcidBacteria(LAB)inFermentedFoods** • IsolateandenumerateLABfromfermentedfoodproductslikeyogurt,sauerkraut,orkimchi.
9	**DetectionofMycotoxinsinFoodUsingEnzyme-LinkedImmunosorbentAssay(ELISA)** • DetectandquantifythepresenceofmycotoxinsinfoodsamplesusingtheELISAtechnique.
10	**AssessmentofBiofilmFormationbyFoodborneBacteria** • Studythebiofilm-formingcapabilitiesoffoodbornebacteriaondifferentsurfacescommonly found in food processing environments.
11	**ExaminationofMicrobialContaminationonFoodContactSurfaces** • Swabandanalyzemicrobialcontaminationlevelsonfoodcontactsurfacessuchascuttingboards, countertops, and utensils.
12	**QuantificationofMicrobialLoadinReady-to-EatFoods** • Performtotalviablecount(TVC)assaystoquantifythemicrobialloadinvariousready-to-eatfood products.

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. Identifybasicmicrobiologicaltechniquesandterminologiesusedinfoodmicrobiology
2. Explaintheroleofmicroorganismsinfoodspoilage,fermentation,andsafety
3. Applymicrobiologicalmethodstoanalyzeandevaluatethemicrobialqualityoffoodsamples

4. Analyzetheimpactofenvironmentalfactorsonmicrobialgrowthinfood
5. Designandexecuteexperimentstodetectandquantifyfoodbornepathogensandtoxinsusingmodern microbiological techniques

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin-60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero.

ThedurationofSEEis03hours.

SuggestedLearningResources:

1. Kumar,V.(2012).Laboratorymanualofmicrobiology.ScientificPublishers.
2. Harrigan,W.F.,&McCance,M.E.(2014).Laboratorymethodsinmicrobiology.Academicpress.
3. Sharma,K.(2007).ManualofMicrobiology.AneBooksPvtltd.
4. Saxena,J.,Baunthiyal,M.,&Ravi,I.(2015).LaboratoryManualofMicrobiology,BiochemistryandMolecular Biology. Scientific Publishers.
5. Mahasneh,A.M.,&Bdour,S.M.(2006).MicrobiologyLaboratoryManual.AlManhal.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Identifybasicmicrobiologicaltechniquesandterminologiesusedinfoodmicrobiology CO2	L1
	Explain the role of microorganisms in food spoilage, fermentation, and safety	L2
CO3 CO4	Applymicrobiologicalmethodstoanalyzeandevaluatethemicrobialqualityoffood samples Analyzetheimpactofenvironmentalfactorsonmicrobialgrowthinfood	L3
CO5	Designandexecuteexperimentstodetectandquantifyfoodbornepathogensandtoxins using	L4
	modern microbiological techniques	L5

Programoutcomeofthiscourse

Sl no	Description	PO
1	**Engineering knowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesofmathematics, naturalsciences,andengineeringsciences.	PO2
3	**Design/developmentofsolutions**:Designsolutionsforcomplexengineeringproblemsand designsystemcomponentsorprocessesthatmeetthespecifiedneedswithappropriate considerationforthepublichealthandsafety,andthecultural,societal,and environmentalconsiderations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisofthe informationtoprovidevalidconclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineeringandITtoolsincludingpredictionandmodelingtocomplexengineeringactivities withanunderstandingofthelimitations.	PO5
6	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineeringsolutionsins ocietalandenvironmentalcontexts,anddemonstratetheknowledgeof,andneed forsustainabledevelopment.	PO7
7	**Individualandteamwork:**Functioneffectivelyasanindividual,andasamemberorleaderin diverseteams,andinmultidisciplinarysettings	PO9
8	**Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththe engineeringcommunityandwithsocietyatlarge,suchas,beingabletocomprehendandwrite effectivereportsanddesigndocumentation,makeeffectivepresentations,andgiveandreceive clearinstructions	PO10
9	**Projectmanagementandfinance:**Demonstrateknowledgeandunderstandingofthe engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamemberand leaderinateam,tomanageprojectsandinmultidisciplinaryenvironments	PO11
10	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1	1		2								
CO2	2	2	1	2			2					
CO3	3	2		3	2		3					
CO4		3	2	3			3		2			
CO5	3	3	3	3	3					2	2	3

FOOD ANALYSIS LABORATORY			
CourseCode	**MFDTL258C**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- Tounderstandthefundamentalprinciplesofsensoryevaluationandproximateanalysisoffoodproducts.
- Toapplyvarioustechniquesforthesensoryandproximateanalysisoffoodsamples.
- Tointerpretandanalyzedataobtainedfromsensoryandproximateanalysisexperiments.
- Todevelopskillsinusinglaboratoryequipmentandinstrumentsforfoodanalysis.
- Toevaluateandcommunicatetheresultsofsensoryandproximateanalyseseffectively

Sl.NO	Experiments
1	SensoryEvaluationofFlavorandTasteUsingTriangleTest
2	TextureCharacterizationofFoodProductswithaTextureAnalyze
3	QuantitativeColorAnalysisofFoodUsingaColorimeter
4	AromaProfileAssessmentthroughOlfactometryTechniques
5	OverallAcceptabilityEvaluationofFoodProductsUsingHedonicScaling
6	DetailedSensoryProfilingwithaTrainedPanel
7	MoistureContentDeterminationinFoodSamplesUsingOvenDrying
8	CrudeProteinAnalysisinFoodUsingtheKjeldahlMethod
9	CrudeFatExtractionandQuantificationviaSoxhletMethod
10	AshContentMeasurementinFoodSamplesUsingMuffle Furnace
11	CrudeFiberAnalysisinFoodProducts
12	TotalCarbohydrateEstimationinFoodProductsbyDifferenceMethod

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. Describetheprinciplesandmethodsofsensoryandproximateanalysisoffoodproducts.
2. Demonstratetheuseoflaboratorytechniquesandinstrumentsforsensoryevaluationandproximate analysis.
3. Performsensoryandproximateanalysesaccuratelyandrecorddatasystematically.
4. Analyzeandinterpretdatafromsensoryandproximateanalysisexperimentstodrawmeaningful conclusions.
5. Communicatetheresultsofsensoryandproximateanalysesinaclearandconcisemanner.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Studentscanpickonequestion(experiment)fromthequestionslotpreparedbytheinternal/external examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shallbe scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero. The duration of SEE is 03 hours

SuggestedLearningResources:

1. "FoodAnalysis"byS.SuzanneNielsen,Springer,2017(4thedition)
2. "Introduction to Food Engineering" by R. Paul Singh and Dennis R. Heldman, Academic Press, 2014 (5thedition)
3. "SensoryEvaluationTechniques"byM.Meilgaard,G.V.Civille,andB.T.Carr,CRCPress,2016(5thedition)
4. "FoodChemistry"byH.Damodaran,A.Paraf,andO.R.Fennema,CRCPress,2017(5thedition)
5. "PrinciplesofFoodChemistry"byJohnM.deMan,Springer,2018(4thedition)

Courseoutcome(CourseSkillSet)
Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	BloomsLevel
CO1	Describetheprinciplesandmethodsofsensoryandproximateanalysisoffood products.	L1
CO2	Demonstratetheuseoflaboratorytechniquesandinstrumentsforsensory evaluation and proximate analysis.	L2
CO3	Performsensoryandproximateanalysesaccuratelyandrecorddatasystematically.	L3
CO4	Analyzeandinterpretdatafromsensoryandproximateanalysisexperimentsto drawmeaningfulconclusions.	L4
CO5	Communicate the results of sensory and proximateanalyses in a clear and concise manner.	L5

Programoutcomeofthiscourse

Sl no	Description	PO
1	**Engineering knowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreaching substantiatedconclusions using first principlesofmathematics, natural sciences, and engineering sciences.	PO2
3	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesis ofthe information to providevalid conclusions.	PO4
4	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activitieswith an understanding of the limitations.	PO5
5	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgetoassess societal,health,safety,legalandculturalissuesandtheconsequentresponsibilitiesrelevantto theprofessionalengineeringpractice.	**PO6**
6	**Ethics:**Applyethicalprinciplesandcommittoprofessionalethicsand responsibilitiesandnorms of the engineering practice	PO8
7	**Individualandteamwork:**Functioneffectivelyasanindividual,andasamemberorleaderin diverseteams,andinmultidisciplinarysettings	PO9
8	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effectivereportsanddesigndocumentation,makeeffectivepresentations,andgiveandreceive clearinstructions	PO10
9	**Projectmanagementandfinance:**Demonstrateknowledgeandunderstandingofthe engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamemberand leaderinateam,tomanageprojectsandinmultidisciplinaryenvironments	PO11

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	3	2		2	2	1						
CO2		3		2		2		2	2			
CO3	2	3			2	2			3			
CO4			3	3	2		2			2		
CO5	2		3					2	2		2	

BIOSTATISTICS AND TOOL LAB			
CourseCode	**MFDTL258D**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- Toprovideastrongfoundationinbasicstatisticalprinciples,includingdata collection,analysis,and interpretation.
- Toenablestudentstoperformandinterpretvariousstatisticaltestsandapplythemtoreal-world problems.
- Toequipstudentswiththeskillstodesign,conduct,andanalyzeexperimentsusingvariousstatistical methods and designs.
- Totrainstudentsintheuse ofstatisticalsoftwarelikeSPSS,Minitab,orotherrelevanttoolsfordata analysis and experiment design.
- Tofostertheabilitytousestatisticalmethodsandtoolstosolvecomplexengineeringandscientific problems.

Sl.NO	Experiments
1	MeasurementandSampling:Toselectasimplerandomsamplefromthepopulationandenter thesedataintoSPSS/Minitab/oranyotherstatisticalsoftware.
2	Diagrammatic&Graphicalrepresentation:Toplotline diagrams,bardiagram.Piechart, Histogram and frequency distribution of the collected data.
3	SummaryStatistics:Tocalculateandinterpretsummarystatisticsforthedatainyoursample.
4	Correlation:Calculation&interpretationofcorrelationandregressionbetweenvariables
5	Randomization:Useofopen-sourcerandomizationtoolsandsamplesizeestimation.
6	Hypothesistesting:Totestahypothesisbydeterminingasignificancedifferenceformeanand proportion.
7	t–test:Touset-testfordeterminingasignificancedifferencebetweentwogroups.
8	Chi–Squaretest:UseofChi –SquaretestofindependentofAttributesfor2X2contingency table.
9	ExperimentalDesign:Designandanalysisofexperimentsbasedonfactorial designand calculate main effect, interaction effect.
10	ExperimentalDesign:Designandanalysisofmixtureexperimentsusingdifferentfactors.
11	ExperimentalDesign:DesignandanalysisofscreeningexperimentsusingPlackett–Burman designs
12	ExperimentalDesign:Designandanalysisofexperimentsbasedonresponsesurface methodology (RSM).

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. Studentswillbeabletorecallthebasicconceptsof measurementandsampling,includingtheselectionof random samples and entry of data into statistical software.
2. Studentswillbeabletounderstandandcreatediagrammaticandgraphicalrepresentationssuchasline diagrams, bar diagrams, pie charts, and histograms.
3. Studentswillbeabletoapplysummarystatisticstocalculateandinterpretthecollecteddata,andperform

correlationandregressionanalysisbetweenvariables.

4. Studentswillbeabletoanalyzeexperimentaldatausingvarioushypothesistestsliket-tests,Chi-square tests, and design experiments based on factorial, mixture, and screening designs.
5. Studentswillbeabletocriticallyevaluateandinterprettheresultsofexperiments,particularlythose based on response surface methodology (RSM), to provide valid conclusions.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shallbe scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero. The duration of SEE is 03 hours

SuggestedLearningResources:

1. FundamentalsOfStatistics(Paperback,SCGUPTA)Edition,6;Publisher,Himalaya,1984.
2. DesignofExperiments1stEditionBradleyJones,DouglasC.Montgomery/
3. FundamentalsofBiostatisticsPaperback–1December2009byV.B.Rastogi(Author).

Courseoutcome(CourseSkillSet)
Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO1	Studentswillbeabletorecallthebasicconceptsofmeasurementandsampling,including theselectionofrandomsamplesandentryofdataintostatisticalsoftware.	L1
CO2	Studentswillbeabletounderstandandcreatediagrammaticandgraphical representations such as line diagrams, bar diagrams, pie charts, and histograms.	L2
CO3	Students will be able to apply summary statistics to calculate and interpret the collecteddata, and perform correlation and regression analysis between variables.	L3
CO4	Students will be able to analyze experimental data using various hypothesis tests like t-tests, Chi-square tests, and design experiments based on factorial, mixture, and screening designs.	L4
CO5	Studentswillbeabletocriticallyevaluateandinterprettheresultsofexperiments, particularlythosebasedonresponsesurfacemethodology(RSM),toprovidevalid conclusions.	L5

Programoutcomeofthiscourse

Slno	Description	PO
1	**Engineering knowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalysecomplex engineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciplesof mathematics, naturalsciences,andengineeringsciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	PO5
6	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	2											
CO2	2	3										
CO3		3	2									
CO4				3	2							
CO5				3			2					

BIOHAZARDSANDBIOSAFETYLAB			
CourseCode	**MFDTL258E**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- Tofamiliarizestudentswiththedesignandlayoutofvariousbiosafetylevels(BSL1to BSL4)andthe specific safety measures required for each level.
- Toenablestudentstoprepareandimplement SOPsforthesafehandlinganddisposalofmicroorganisms and hazardous materials in laboratory settings.
- Toemphasizetheimportanceofpersonalprotectiveequipment(PPE)andtheresponsibleuseof laboratory facilities to ensure a safe working environment.
- Toteachstudentshowtocreateandmaintainessentialsafetydocuments,suchasSafetyDataSheets (SDS),emergencyprocedures,andincidentreports,ensuringcompliancewithregulatorystandards.
- Toequipstudentswiththeabilitytoassessandmitigatesafetyhazardsinlaboratory environments, particularlythoseassociatedwithhigherbiosafetylevels(BSL2,BSL3,BSL4).

Sl.NO	Experiments
1	LayoutofLabsofBSL1,BSL2,BSL3and BSL4
2	PrepareSOPforproperwearing,removal,anduseofgloves,mouthmask,labwears
3	Safeandresponsibleuseofmicroorganisms.
4	SafetyhazardsofBSL1,BSL2,BSL3andBSL4laboratory
5	Developingonepagelabsafetymanualtohighlightcriticallyimportantissuesofsafety
6	Preparingstudent-signedsafetyagreements/safetyquizesattheinstitution.
7	Handlingbloodbornepathogens
8	PreparationoflaboratorymanualspecifictoBSL1,BSL2,BSL3andBSL4
9	Prepare,maintain,andpostpropersignage
10	PreparationofDocumentallinjuriesandspills
11	MakingSafetyDataSheets(SDS)
12	Preparationofemergencyprocedures

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. Recallthespecificlayoutandsafetyrequirements ofBSL1,BSL2,BSL3,andBSL4laboratories.
2. Explaintheproceduresforproperwearing,removal,anduseofpersonalprotectiveequipment(PPE)in laboratory settings.
3. Applyknowledgeofbiosafetyprotocolstodevelopandmaintainlaboratorysafetymanualsandsafety data sheets (SDS).
4. Analyzetherisksassociatedwithhandlingblood-bornepathogensandmicroorganismsinBSL2toBSL4

laboratoriesandproposeappropriatesafetymeasures.

5. Evaluatetheeffectivenessofemergencyproceduresand theaccuracyofsafetydocumentation,suchas incident reports and safety agreements..

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shallbe scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero. The duration of SEE is 03 hours

SuggestedLearningResources:

1. GuidelinesforBiosafetyinTeachingLaboratories,AmericanSocietyforMicrobiology,2019
2. NIH/CDC:BiosafetyinMicrobiologicalandBiomedicalLaboratories
3. NIH:ResearchInvolvingRecombinantorSyntheticNucleicAcidMolecules
4. AmericanSocietyforMicrobiology(ASM):BiosafetyinTeachingLaboratories

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	RecallthespecificlayoutandsafetyrequirementsofBSL1,BSL2,BSL3,andBSL4 laboratories.	L1
CO2	Explaintheproceduresforproperwearing,removal,anduseofpersonalprotective equipment (PPE) in laboratory settings.	L2
CO3	Apply knowledge of biosafety protocols to develop and maintain laboratory safety manuals and safety data sheets (SDS).	L3
CO4	Analyze the risks associated with handling blood-borne pathogens and microorganisms in BSL2 to BSL4 laboratories and propose appropriate safety measures.	L4
CO5	Evaluatetheeffectivenessofemergencyproceduresandtheaccuracyofsafety documentation, such as incident reports and safety agreements.	L5

Programoutcomeofthiscourse

Slno	Description	PO
1	**Engineering knowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	PO5
6	**Theengineerandsociety:**Applyreasoninginformedbythecontextualknowledgetoassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	2											
CO2		2										
CO3			3									
CO4				3								
CO5					2							

NUTRACEUTICALANALYSISLABORATORY			
CourseCode	**MFDT258F**	CIEMarks	50
TeachingHours/Week(L:T:P:S)	0:2:0	SEEMarks	50
Credits	1	ExamHours	2

Courseobjectives:

- Tounderstandthefundamentalprinciplesofnutraceuticalsandtheirhealthbenefits.
- Togainproficiencyinvariousanalyticaltechniquesusedfortheidentificationandquantificationof bioactive compounds in nutraceuticals.
- Todevelopskillsinassessingtheantioxidantandantimicrobialactivitiesofnutraceuticalproducts.
- Toenhancetheabilitytodesignandformulatefunctionalfoodproductsincorporatingnutraceutical ingredients.
- Tocriticallyanalyzeandinterpretexperimentaldatarelatedtothequalityandefficacyofnutraceuticals.

Sl.NO	Experiments
1	IsolationandCharacterizationofFlavonoidsfromCitrusFruits
2	EstimationofTotalCarotenoidContentinCarrotExtract
3	QuantificationofSaponinsinQuinoaSeeds
4	AnalysisofVitaminCContentinFunctionalBeverages
5	MicroencapsulationofProbioticsforFunctionalFoods
6	EvaluationofOmega-3FattyAcidsinFlaxseedOil
7	FormulationandSensoryEvaluationofaFunctionalSnackBar
8	EstimationofTotalPhenolicCompoundsinPlantExtracts
9	EstimationofAntioxidantActivityUsingDPPHRadicalScavengingAssay
10	EstimationofAntimicrobialActivityofNutraceuticalCompounds
11	FunctionalFoodProductDevelopmentandNutritionalAnalysis
12	HPLCAnalysisofCurcumininTurmericSupplements

Courseoutcomes(CourseSkillSet):

Attheendofthecoursethestudentwillbeableto:

1. Identifythekeybioactivecompoundspresentinvariousnutraceuticalsandtheirhealthbenefits.
2. Explaintheprinciplesandproceduresofanalytical techniquesusedfortheestimationofbioactive compounds in nutraceuticals.
3. Applyanalyticalmethodstodeterminetheantioxidantandantimicrobialactivitiesofnutraceutical samples.
4. Analyzeandinterprettheexperimentaldataobtainedfromnutraceuticalanalysistoassesstheirquality and efficacy.
5. Evaluatetheformulationoffunctionalfoodproductsbasedonnutraceuticalingredientsandoptimize theirsensoryandnutritionalproperties.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

ContinuousInternalEvaluation(CIE):

CIEmarksforthepracticalcourseis**50Marks**.

Thesplit-upofCIEmarksforrecord/journalandtestareintheratio **60:40**.

- Eachexperimenttobeevaluatedforconductionwith anobservationsheetandrecordwrite-up.Rubricsfor the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Recordshouldcontainallthespecifiedexperimentsinthesyllabusandeachexperimentwrite-upwillbe evaluated for 10 marks.
- **Totalmarksscoredbythestudentsarescaleddownto30marks**(60%ofmaximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Departmentshallconduct01testsfor100marks,testshallbeconductedafterthe14thweekofthesemester.
- Intest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarrya weightage of 60% and the rest 40% for viva-voce.
- Thesuitablerubricscanbedesignedtoevaluateeachstudent'sperformanceandlearningability.
- **Thetestmarksisscaleddownto20marks**(40%ofthemaximummarks).

TheSumof**scaled-down**marksscoredinthereportwrite-up/journalandmarksoftestisthetotalCIEmarks scored by the student.

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute,examinersareappointedbythe University.

Alllaboratoryexperimentsaretobeincludedforpracticalexamination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.**OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shallbe scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Changeofexperimentisallowedonlyonceand 10%Marksallottedtotheprocedureparttobemadezero. The duration of SEE is 03 hours

SuggestedLearningResources:

1. HandbookofNutraceuticalsandFunctionalFoods,RobertE.C.Wildman,2ndEdition,CRCPress,2016, ISBN: 978-0849324750
2. MethodsofAnalysisforFunctionalFoodsandNutraceuticalsEditedbyW.Jeffrey,
3. Hursts,RoutledgePublishers.
4. Nutritional Evaluation of Food Processing Third Edition; E. Karmas and R.S. Harris, AVIBoon, New York, 1988
5. LehningerAlbert,2001,PrinciplesofBiochemistry,KalyaniPublishers,NewDelhi.
6. NutraceuticalsbyL.RapportandB.Lockwood,PharmaceuticalPress.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl.No.	Description	Blooms Level
CO1	Identifythekeybioactivecompoundspresentinvariousnutraceuticalsandtheirhealth benefits.	L1
CO2	Explain the principles and procedures of analytical techniques used for the estimation of bioactive compounds in nutraceuticals.	L2
CO3	Applyanalyticalmethodstodeterminetheantioxidantandantimicrobialactivitiesof nutraceutical samples.	L3
CO4	Analyze and interpret the experimental data obtained from nutraceutical analysis to assess their quality and efficacy.	L4
CO5	Evaluate the formulation of functional food products based on nutraceutical ingredients and optimize their sensory and nutritional properties.	L5

Programoutcomeofthiscourse

Sl no	Description	PO
1	**Engineering knowledge:**Applytheknowledgeofmathematics,science,engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineeringproblems.	PO1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations	PO3
4	**Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearch methodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisofthe informationtoprovidevalidconclusions.	PO4
5	**Moderntoolusage:**Create,select,andapplyappropriatetechniques,resources,andmodern engineeringandITtoolsincludingpredictionandmodelingtocomplexengineeringactivities withanunderstandingofthelimitations.	PO5
6	**Environmentandsustainability:**Understandtheimpactoftheprofessionalengineering solutions in societal and environmental contexts, and demonstrate theknowledge of, andneed for sustainable development.	PO7
7	**Life-longlearning:**Recognizetheneedfor,andhavethepreparationandabilitytoengagein independent and life-long learning in the broadest context of technological change	PO12

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	1	1	1									
CO2	2	1	1									
CO3	2	2	2									
CO4		3	2	3								
CO5			3		2		2					3