Lateral Entry Curriculum

Admission Year 2026-27

Bachelor of Technology in Food Technology

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

SEMESTER 03

Course Name: Food Chemistry II
Course Code: 20105213

Prerequisite: Basic knowledge of chemistry, including general principles of organic, inorganic, and physical chemistry, and an understanding of biological sciences such as biochemistry and microbiology.

Rationale: This course introduces students to the chemical nature and functional properties of bioactive compounds in foods, with a focus on flavours, pigments, vitamins, minerals, and enzymes. It emphasizes their roles in food quality, nutrition, and sensory appeal, while exploring how processing affects their stability and functionality. Students will gain an understanding of natural and synthetic food colours, flavour chemistry, nutrient retention, and enzyme applications in food systems. This knowledge is essential for developing safe, nutritious, and appealing food products in modern food processing industries.

Course Learning Objective:

CLOBJ 1	Study chemical aspects of food and bio- materials and their importance in food processing
CLOBJ 2	Gain an understanding of chemicals responsible for flavour, pigments and colorants
CLOBJ 3	Have an idea of about the effect of processing on these biomolecules
CLOBJ 4	Gain the knowledge about role of enzymes in food processing

Course Learning Outcomes:

CLO 1	Study chemical aspects of food and bio- materials and their importance in food processing
CLO 2	Gain an understanding of chemicals responsible for flavour, pigments and colorants
CLO 3	Have an idea of about the effect of processing on these biomolecules
CLO 4	Gain the knowledge about role of enzymes in food processing

Teaching and Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
				External		**Internal**			
Lect Hrs/ Week	**Tut Hrs/**	**Lab Hrs/ Week**		**T**	**P**	**T**	**CE**	**P**	
2	-	1	3	40	-	20	20	20	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** - Practical

Contents:

Sr. No	**Topic**	**Weightage**	**Teaching Hrs.**

1	Philosophy and definitions of flavour, Chemistry of food flavour; flavourmatics/ flavouring compounds, sensory assessment of flavour, technology for flavour retention.	15%	5
2	Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs.	18%	6
3	Popular colors used in food and their fictional properties; Regulatory use of regulatory dyes; Colour losses during thermal processing.	7%	2
4	Vitamin functions in body and deficiency conditions, Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins, optimization and retention of vitamins.	18%	6
5	Important minerals and their function in body and deficiency conditions, Requirements, allowances, enrichment, restorations, fortifications, losses of minerals, optimization and retention of minerals. Various anti-nutritional factors their mode of action and inactivation.	22%	7
6	Enzymes in Food Processing: Carbohydrases, proteasase, lipases; Modification of food using enzymes: Role of endogenous enzymes in food quality, enzymes use as processing aid, enzyme specificity, Michaelis-Menten equation, regulation mechanism.	20%	6
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

List of Practical:

1. Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations)
2. Estimation of calcium
3. Determination of phosphorus
4. Determination of iron
5. Estimation of magnesium
6. Estimation of tannins and phytic acid from food
7. Determination of vitamin A (Total carotenoids), C, E
8. Determination of ascorbic acid by dye method
9. Determination of thiamin and riboflavin
10. Determination of food colors
11. Assessment of hydrocolloids as food additives
12. Assessment of various pectinases from fruits and vegetables.

Suggested Readings

1. Belitz, H.-D., Grosch, W. and Schieberle, P. 2009. Food Chemistry, 4th edn. Springer-Verlag Berlin Heidelberg.
2. Fennema, O.R. 1996. Food Chemistry, 3rd edn. Marcel Dekker, Inc., New York, USA.

SEMESTER 03

Course Name: Fluid Mechanics
Course Code: 20105214

Prerequisite: Fluid mechanics helps in understanding the behavior of milk during pumping, mixing, pasteurization, homogenization, and transportation through pipelines. Knowledge of fluid

properties such as viscosity, density, and flow types (laminar or turbulent) is essential to ensure efficient equipment operation, energy conservation, and maintaining product quality. Therefore, mastering fluid mechanics is vital for food technologists to innovate and troubleshoot within various processing and production environments.

Rationale: The study of fluid mechanics in food technology is essential for understanding and optimizing the movement and processing of liquid food products such as milk, cream, and whey. It provides the foundational knowledge required to design and operate equipment like pumps, pipes, heat exchangers, and homogenizers efficiently. By applying fluid mechanics principles, dairy and food technologists can ensure consistent flow rates, minimize energy usage, reduce product losses, and maintain product quality during processing.

Course Learning Objective:

CLOBJ 1	Get idea about types of fluids and their properties
CLOBJ 2	Gain knowledge about the flow behaviour of the fluids
CLOBJ 3	Differentiate about various types of pumps and their use in food processing

Course Learning Outcomes:

CLO 1	Get idea about types of fluids and their properties
CLO 2	Gain knowledge about the flow behaviour of the fluids
CLO 3	Explain the principles of Bernoulli's theorem and derive the Navier–Stokes equations in cylindrical coordinates, including appropriate boundary conditions for fluid flow analysis.
CLO 4	Differentiate about various types of pumps and their use in food processing

Teaching and Examination Scheme:

Teaching Scheme			Credit	Examination Scheme					Total
				External		Internal			
LectHrs/Week	Tut Hrs/	LabHrs/Week		T	P	T	CE	P	
2	-	1	3	40	-	40	-	20	100

Lect- Lecture,**Tut** - Tutorial, **Lab** - Lab, **T** - Theory,**P**- Practical, **CE**- CE, **T** - Theory,**P**- Practical

Contents:

Sr. No	Topic	Weightage	Teaching Hrs.
1	**Units and dimensions**- Properties of fluids. Compressible and non-compressible fluids. Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer.	**18.75**	**6**

2	**Fluid flow-** Classification, steady uniform and non-uniform flow, Laminar and turbulent, continuity equation, Bernoulli's theorem and its applications. Flow through pipes: Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity.	**25.00**	**8**
3	**Flow through mouthpieces-** Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge.	**28.13**	**9**
4	**Dimensional analysis-**Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude.	**18.75**	**6**
5	**Pumps:** Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing.	**9.37**	**3**
***Continuous Evaluation:** **It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.**			

List of Practical:

1. Study of various types of pipes and pipe fittings
2. Study of different types of valves
3. Study of reciprocating pump
4. Study of rotary gear pump
5. Study of piezometer
6. Study of U tube Manometer
7. Study of inclined tube Manometer
8. Study of Venturimeter
9. Determination of frictional coefficient of given pipe.
10. Determination of minor head loss
11. Study of Pitot tube
12. Study the construction and working principle of centrifugal pump
13. Study of reciprocating pump.
14. Study and measurement of flow of liquid by V- notch.

Suggested reading

1. Jain, A. K. (1995). Fluid Mechanics. 8th edn. Khanna Publishers, New Delhi.
2. Kumar, K. L. (1996). Engineering Fluid Mechanics. S. Chand & Co., New Delhi.
3. Kumar, D.S. (1998). Fluid Mechanics. S.K. Kataria and Sons, New Delhi.
4. Rajput, R.K. (1998). A Textbook of Fluid Mechanics. S. Chand & Co., New Delhi.

SEMESTER 03

Course Name: Heat and Mass Transfer in Food Processing
Course Code: 20105215

Prerequisite: Knowledge of chemistry and Mathematics up to 12th science level.

Rationale: Understanding Heat and Mass Transfer in Food Processing facilitates optimal preservation, cooking, and storage techniques by comprehending how thermal and molecular processes impact food quality and safety. The learner will gain knowledge of heat & mass transfer principles, associated dimensional numbers, and types of heat exchangers.

Course Learning Objective:

CLOBJ 1	Differentiate about various types of pumps and their use in food processing
CLOBJ 2	Get knowledge of dimensionless numbers involved in heat and mass transfer
CLOBJ 3	Differentiate between different types of heat exchangers

Course Learning Outcomes:

CLO 1	Have knowledge about the mechanism of heat and mass transfer
CLO 2	Get knowledge of dimensionless numbers involved in heat and mass transfer
CLO 3	Differentiate between different types of heat exchangers
CLO 4	Analyze heat transfer mechanisms in flowing fluids, including conduction, convection, and radiation through black and grey surfaces, and evaluate properties such as emissivity, absorptivity, transmissivity, and shape factors.

Teaching and Examination Scheme

Teaching Scheme			Credit	Examination Scheme					Total
				External		Internal			
Lect Hrs/ Week	Tut Hrs/	Lab Hrs/ Week		T	P	MSE	CE	P	
2	-	1	3	40	-	20	20	20	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** – Continuous Evaluation, **MSE** – Mid Sem Evaluation, **P** - Practical

Contents

Sr. No	Topic	Weightage	eaching Hrs.
1	**Basic heat transfer processes:** heat transfer coefficients, properties related to heat transfer, food properties measurements and errors. **One-dimensional steady state conduction:** Theory of heat conduction, Fourier's law and its derivation, Concept of electrical analogy and its application for thermal circuits, heat transfer through composite walls and insulated pipelines.	10%	3
2	**One-dimensional steady state heat conduction with heat generation:** Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation, development of equations of temperature distribution with different boundary conditions. **Steady-state heat conduction with heat dissipation to environment:** Introduction to extended surfaces (fins) of uniform area of cross-section and with Equation of temperature distribution with different boundary conditions; Effectiveness and efficiency of the fins	20%	7
3	**Introduction to unsteady state heat conduction:** System with negligible internal resistance and in various geometries; Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer. **Dimensionless numbers:** Concept of Nusselt number, Prandtl number,	26.67%	8

	Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heisler charts and calculations; Heat transfer to flowing fluids. **Radiation:** Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors		
4	**Heat Exchangers:** General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design; Efficiency and NTU analysis; Application of different types of heat exchangers in dairy and food industry	23.33%	7
5	**Mass transfer:** Fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolal diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry	20%	7
Total		100%	32
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

List of Practical

1. Heat transfer analysis during conduction and convection
2. Study on various types of heat exchangers used in food industry
3. Preparation and calibration of thermocouples
4. Determination of thermal conductivity of different food products
5. Study of working principle and constructional details of plate heat exchanger
6. Study of working principle and constructional details of shell and tube heat exchanger
7. Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry
8. Studies on heat transfer through extended surfaces
9. Studies on temperature distribution and heat transfer in HTST pasteurizer
10. Mass transfer coefficient in foods
11. Glass transition temperature of food sample
12. Mass transfer during leaching process

Suggested Readings

1. Cao, E. 2010. Heat Transfer in Process Engineering. The McGraw-Hill Companies, Inc., New York, USA.
2. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
3. Geankoplis, C. J. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th edn. Prentice-Hall, NY, USA.
4. Holman, J.P. 2010. Heat Transfer, 10th edn. McGraw-Hill Book Co., Boston, USA.
5. Lienhard IV, J.H. and Lienhard V, J.H. 2008. A Heat Transfer Textbook. Phlogiston Press, Cambrige, MA, USA.
6. McCabe, W.L., Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th edn. McGraw-Hill, Inc., NY, USA.
7. Ozişik, M.N. 1993. Heat Conduction, 2nd edn. John Wiley and Sons, NY, USA.
8. Pandey, H., Sharma, H.K., Chauhan, R.C., Sarkar, B.C. and Bera, M.B. 2010. Experiments in food process engineering. New Delhi: CBS Publisher and Distributors Pvt Ltd.
9. Rajput, R.K. 2008. Heat and Mass Transfer. S. Chand and Co., New Delhi
10. Richardson, J F., Harker, J.H. and Backhurst, J.R. 1999. Coulson and Richardson's Chemical

11. Engineering, Vol. 1, Fluid Flow, Heat Transfer and Mass Transfer, 6th edn. Butterworth–Heinemann, Oxford, UK.

SEMESTER 03

Course Name: Basic Electronic Engineering
Course Code: 20105216

Prerequisite: Basic knowledge of physics and mathematics, especially in electricity, magnetism, and algebra, is a prerequisite for Basic Electronic Engineering.

Rationale: The rationale for studying Basic Electronic Engineering is to understand the fundamental principles of electronic components and circuits, which are essential for designing and analyzing modern electronic systems.

Course Learning Objective:

CLOBJ 1	Study basic concepts of electronics and their relevance in food industry
CLOBJ 2	Get idea about various electronic components
CLOBJ 3	Knowledge about electronic device and their concept in measurement

Course Learning Outcomes:

CLO 1	Analyze heat transfer mechanisms in flowing fluids, including conduction, convection, and radiation through black and grey surfaces, and evaluate properties such as emissivity, absorptivity, transmissivity, and shape factors.
CLO 2	Get idea about various electronic components
CLO 3	Knowledge about electronic device and their concept in measurement
CLO 4	Evaluate the working principles, characteristics, selection criteria, and applications of various transducers, sensors, and actuators used in measurement and control systems.

Teaching and Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
				External		**Internal**			
Lect Hrs/ Week	**Tut Hrs/**	**Lab Hrs/ Week**		**T**	**P**	**T**	**CE**	**P**	
2	-	1	3	40	-	20	20	20	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** - Practical

Contents:

Sr. No	**Topic**	**Weightage**	**eaching Hrs.**

1	Semiconductors, P-n junction, V-I characteristics of P-n junction, diode as a circuit element, rectifier; Diode circuits for OR and AND (both positive and negative logic); voltage multiplier, filter circuits	22%	7
2	Bipolar junction transistor: Operating point, classification (A, B and C) of amplifier, various biasing methods (fixed, self, potential divider); Ideal OP-AMP characteristics, linear and nonlinear applications of OP-AMP integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), Zener diode voltage regulator, transistor series regulator, current limiters, OP-AMP voltage regulators;	28%	9
3	Basic theorem of Boolean algebra; Combinational logic circuits (basic gates, SOP rule and K-map) and sequential logic circuits binary ladder D/A converter and A/D converter;	22%	7
4	Transducers: Classification, selection criteria, characteristics, sensors and actuators construction, working principles, applications of following transducers- Potentiometers RTD, thermocouples, thermistors, LVDT, strain gauges, capacitive and inductive transducers, piezoelectric transducers, photoelectric transducers, self-generating transducers, variable parameter type, digital, actuating and controlling devices.	28%	9
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

List of Practical:

1. Study of diode characteristics; Study of triode characteristics;
2. Study of Zener diode
3. Study of V-I characteristics of P-n junction diode
4. Study of RC coupled amplifier
5. Study of RC phase shift oscillator
6. Study of full wave rectifier
7. Verification of logic gates
8. Determination of energy gap in a junction diode
9. Study of transistor characteristics in CE configuration
10. Study of OP-Amp IC 741 as differential amplifier
11. Study of half wave rectifier
12. Study of OP-AMP IC 741 as an active rectifier
13. Study of transistor characteristics
14. Study of temperature characteristics of resistor
15. Study of diode as clipper and clamper.

Suggested Readings

1. Anand Kumar. 2014. Fundamentals of Digital Circuits. PHI Pvt. Ltd., New Delhi.
2. Gupta, S. 2002. Electronic Devices and Circuits. Dhanpat Rai Publications (P) Limited, New Delhi.
3. Mehta, V.K. and Mehta, R. 2008. Principles of Electronics. S. Chand and Co., New Delhi.
4. Roy, D.C. 2003. Linear Integrated Circuits. John Wiley International, NY.
5. Sawhney, A.K. 2010. Course in Electrical and Electron

SEMESTER 03

Course Name: Food Microbiology

Course Code: 20105217
Prerequisite: Knowledge of Biology, chemistry and Mathematics up to 12th science level.

Rationale: This course introduces knowledge of Microbiology in food which is essential for Food Technology students. After learning this course students will be able to understand the shelf-life dependency of food on microbiological aspects.

Course Learning Objective:

CLOBJ 1	Microbiology of different foods
CLOBJ 2	Food borne toxins
CLOBJ 3	Understand spoilage of food

Course Learning Outcomes:

CLO 1	Explain the importance and role of microorganisms in food science, including sources of contamination and methods for their effective control.
CLO 2	Analyze the intrinsic and extrinsic factors affecting the growth and survival of microorganisms in foods, and evaluate the microbiological quality of different food groups.
CLO 3	Assess the chemical changes caused by microorganisms in food components and determine shelf life using appropriate methods, including accelerated testing and simulation of package–environment interactions.
CLO 4	Evaluate microbial toxins and food-borne diseases, including intoxications, infections, and viruses, with respect to their sources, characteristics, symptoms, and impact on food safety.

Teaching and Examination Scheme:

Teaching Scheme (Hrs/Week)			**Cr**	**Examination Scheme**					**Total**
				External		**Internal**			
L	**T**	**P**		**TH (E)**	**P.A**	**Theory**	***C.E.**	**Practical**	
2	0	1	3	40	-	20	20	20	100

L- Lectures; T- Tutorial/Teacher Guided Student Activity; **P-** Practical; Cr- Credit; **E –** End SemesterTheo. Exam, **V -** End Semester Viva Exam, **M** - Mid - Sem Exam, **P.A.-**Practical Assessment

Contents:

Sr. No.	**Topic**	**Weightage**	**Teaching Hrs.**
1	Importance and significance of microbes in food science; Sources of microorganisms in foods and their effective control	**10%**	**4**
2	Factors affecting growth and survival of microorganisms in foods; Intrinsic factors i.e., pH, water activity, nutrients, redox potential, oxygen etc., Extrinsic factors: Relative humidity, temperature, gaseous atmosphere etc.	**15%**	**5**
3	Normal Microbiological quality of Foods and its significance: milk and milk products, fruits and vegetables, cereals and cereal products, meat and meat products, fish and other sea foods, poultry	**15%**	**5**

	and eggs; sugar and sugar products, slats and spices and canned foods		
4	Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances	**15%**	**5**
5	Shelf life: Calculation of shelf life, Shelf-life requirements, deteriorative reactions, accelerated testing; Simulations of product: Package environment interaction, shelf-life simulation for moisture, oxygen, and light sensitive products; Microbial toxins; Bacterial toxins, fungal toxins, algal toxins and mushroom toxins	**25%**	**7**
6	Food borne intoxications and infections: types of food involved, toxicity and symptoms, chemical properties, environmental conditions; Food borne viruses: types of food involved, noroviruses, rota viruses, prion diseases, toxicity and symptoms.	**20%**	**6**
*Continuous Evaluation: Assignment/ Seminars/ Presentations/ Quizzes/ Surprise Tests (Summative/MCQ) etc.			

List of Practical:

1. Isolation of bacteria and molds from foods;

2. Microbial examination of cereal and cereal products

3. Identification, isolation and confirmation; Microbial examination of vegetable and fruits:

4. Identification, isolation and confirmation; Microbial examination of meat and meat products:

5. Identification, isolation and confirmation; Microbial examination of fish and other sea foods:

6. Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification,

7. Isolation and confirmation; Microbial examination of milk and milk products:

8. Microbial examination of sugar, salts and spices

9. Microbial examination of canned products:

10. Identification, isolation and confirmation; Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/ Enterococcus)

11. Thermal death time determination;

12. Detection of Salmonella from food sample;

13. Detection of coliforms from water by MPN method;

14. Detection of Staphylococcus aureus from food sample.

Suggested Readings

1. Adams, M.R. and Moss, M.O. 2008. Food Microbiology, 3rd edn, The Royal Society of Chemistry, Cambridge, UK.

2. Banwart, G.J. 1989. Basic Food Microbiology, 2nd edn. Chapman and Hall, New York, USA.

3. Frazier, W.C. and Westfoff, D.C. 1987. Food Microbiology, 4th edn. Tata McGraw-Hill Education, New Delhi.

4. Jay, J.M. 2000. Modern Food Microbiology, 6th edn. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.

SEMESTER 03

Course Name: Engineering Mathematics I
Course Code: 20105218

Prerequisite: Knowledge of Physics & Mathematics up to 12th science level.

Rationale: Engineering Mathematics - I subject is crucial for providing students with the mathematical foundation essential for analysing and solving complex problems in food processing, quality control, and research, enabling them to apply advanced mathematical concepts to optimize processes and ensure the efficiency and safety of food production.

Course Learning Objective:

CLOBJ 1	Gain knowledge about curves and their expression in mathematical form
CLOBJ 2	Develop equations for a process and its integration

Course Learning Outcomes:

CLO 1	Apply Taylor's and Maclaurin's expansions, evaluate indeterminate forms, and analyze curvature, asymptotes, and tracing of curves for single and multivariable functions.
CLO 2	Solve problems involving partial differentiation, homogeneous and implicit functions, Jacobians, error evaluation, and optimization of functions of several variables.
CLO 3	Evaluate definite, double, and triple integrals, including change of order of integration, and apply them to determine areas, volumes, and properties of curves and surfaces using Gamma and Beta functions.
CLO 4	Analyze and solve ordinary and higher-order differential equations using various methods, and apply vector calculus concepts including gradient, divergence, curl, and integral theorems in physical applications.

Teaching and Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
				External		**Internal**			
Lect Hrs/ Week	**Tut Hrs/**	**Lab Hrs/ Week**		**T**	**P**	**T**	**CE**	**P**	
2	-	-	2	40	-	30	30	-	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** - Practical

Contents:

Sr. No	Topic	Weightage	eaching Hrs.
1	**Series Expansions and Curve Analysis:** Taylor's and Maclaurin's expansions, indeterminate forms: Curvature, asymptotes	6.5%	2
2	**Multivariable Functions and Differentiation:** Tracing of curves function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives	9.5%	3
3	**Implicit Differentiation and Jacobians:** Derivative of an implicit function, change of variables, Jacobians, error evaluation,	6.5%	2
4	**Optimization and Special Functions:** Maxima and minima; Reduction formulae,	6.5%	2
5	**Applications of Integration:** Gamma and Beta functions: Rectification of standard curves, volumes and surfaces of revolution of curves Double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume;	15.5%	5
6	**Differential Equations - First Order:** Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation;	6.5%	2
7	**Higher Order Differential Equations:** Differential equations of higher orders, methods of finding complementary functions and particular integrals, Method of variation of parameters simultaneous linear differential equations with constant coefficients, Cauchy's and Legendre's linear equations, Bessel's and Legendre's differential equations series solution techniques;	12.5%	4
8	**Vector Calculus and Integral Theorems in Vector Calculus:** Differentiation of vectors, scalar and vector point functions, vector differential operator Del: Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, Identities involving Del, second order differential operator Line, Surface and volume integrals, Stoke's, divergence and Green's theorems.	36.5%	12
***Continuous Evaluation:** **It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.**			

Suggested Reading:

1. Grewal, B.S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
2. Narayan, S. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
3. Narayan, S. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
4. Narayan, S. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi

SEMESTER 03

Course Name: Agricultural Informatics and Artificial Intelligence

Course Code: 20105219

Prerequisite: Basic knowledge of agriculture, computer science, and data analysis is a prerequisite for Agricultural Informatics and Artificial Intelligence.

Rationale: Agricultural Informatics and Artificial Intelligence aim to enhance productivity and sustainability in agriculture through data-driven decision-making. Integrating AI with agricultural practices enables efficient resource management, early problem detection, and precision farming.

Course Learning Objective:

CLOBJ 1	To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
CLOBJ 2	To provide basic knowledge of computer with applications in agriculture
CLOBJ 3	To make the students familiar with Agricultural-Informatics, its components and applications in agriculture

Course Learning Outcomes:

CLO 1	Explain the fundamentals of computers, including anatomy, memory concepts, operating systems, and the use of MS-Office tools for documentation, data presentation, analysis, and database management.
CLO 2	Apply basic programming concepts and standard input/output operations using languages such as C/C++, Java, and Visual Basic for problem-solving in agricultural applications.
CLO 3	Analyze the role of information and communication technologies in agriculture, including e-agriculture, computer models, geospatial technologies, decision support systems, and mobile applications for farm management.
CLO 4	Evaluate advanced technologies such as artificial intelligence, IoT, and big data in smart agriculture, including their applications in crop management, livestock monitoring, automation, and food processing systems.

Teaching and Examination Scheme:

Teaching Scheme (Hrs/Week)			**Cr**	**Examination Scheme**					**Total**
				External		**Internal**			
L	**T**	**P**		**TH (E)**	**P.A**	**Theory**	***C.E.**	**Practical**	
2	0	1	3	40	-	20	20	20	100

L- Lectures; T- Tutorial/Teacher Guided Student Activity; **P-** Practical; Cr- Credit; **E –** End Semester Theo. Exam, **V -** End Semester Viva Exam, **M** - Mid - Sem Exam, **P.A.-**Practical Assessment

Contents:

Sr. No.	**Topic**	**Weightage**	**Teaching Hrs.**
1	Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a	**15%**	**5**

	document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components.		
2	Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations.	**10%**	**4**
3	e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation.	**15%**	**5**
4	IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information.	**15%**	**5**
5	Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.	**25%**	**7**
6	Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.	**20%**	**6**
*Continuous Evaluation: Assignment/ Seminars/ Presentations/ Quizzes/ Surprise Tests (Summative/MCQ) etc.			

List of Practical:

1. Study of computer components, accessories, practice of important DoS Commands.

2. Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management.

3. Use of MS-WoRD and MS Power-point for creating, editing and presenting scientific documents.

4. MS- EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros.

5. MS-ACCESS: Creating Database, preparing queries and reports.

6. Demonstration of Agri- information system, REPORT OF THE ICAR SIXTH DEANS' COMMITTEE 29 Introduction to World Wide Web (WWW) and its components.

7. Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++

8. Hands-on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost.

9. Preparation of inputs file for CSM and study of model outputs.

10. Computation of water and nutrient requirements of crop using CSM and IT tools.

11. Use of smart phones and other devices in agro-advisory and dissemination of market information.

12. Introduction of Geospatial Technology.

13. Hands on practice on preparation of Decision Support System.

14. Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Suggested Readings

1. Fundamentals of Computers by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory A g r i Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.
6. Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013. 7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa.

SEMESTER 03

Course Name: Physical Education, First Aid, Yoga Practices and Meditation
Course Code: 20105220

Prerequisite: Basic understanding of concepts of physical education, first aid, yoga practices and meditation.

Rationale: To make the students aware about Physical Education, First Aid and Yoga Practices. To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general well being through yoga.

Course Learning Objective:

CLOBJ 1	To make the students aware about Physical Education, First Aid and Yoga Practices
CLOBJ 2	To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through yoga

Course Learning Outcomes:

CLO 1	Explain the concepts of physical education, training and coaching, various methods of training, and the effects of exercise on different body systems.
CLO 2	Apply principles of balanced diet, nutrition, and exercise to enhance sports performance, manage ageing effects, and maintain overall health and fitness.
CLO 3	Analyze psychological aspects such as personality, motivation, learning theories, and adolescent issues, and evaluate the role of sports in personality development and behavior management.
CLO 4	Demonstrate knowledge and practice of yoga, including asanas, pranayama, meditation, kriyas, and mudras, and assess their role in promoting physical fitness,

	mental well-being, and sports performance.

Teaching and Examination Scheme:

Teaching Scheme			Credit	Examination Scheme					Total
				External		Internal			
Lect Hrs/ Week	Tut Hrs/	Lab Hrs/ Week		T	P	T	CE	P	
-	-	2	2	-	-	30	20	50	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** - Practical

List of Practical:

Sr. No	Topic	Weightage	Teaching Hrs.
1	**Physical education** Training and Coaching - Meaning and Concept Methods of Training; aerobic and aerobic exercises Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process Personality, its dimensions and types Role of sports in personality development Motivation and Achievements in Sports: Learning and Theories of learning Adolescent Problems and its Management Posture: Postural Deformities, Exercises for good posture.	25%	4
2	**Yoga; History of Yoga, Types of Yoga, Introduction to Yoga.** Asanas (Denition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg - right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan Suryanamskar Pranayama (Denition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari Meditation (Denition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh Mudras (Denition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra. Role of yoga in sports. Teaching of Asanas – demonstration, practice, correction and practice	32%	6
3	**III History of sports and ancient games** Governance of sports in India	18%	3

	Important national sporting events Awards in Sports History, latest rules, measurements of playeld, specications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.		
4	**First AID** First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.	25%	5
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

Suggested Readings

1. Sharma, V.K. 2012. *Essentials of Physical Education*. Friends Publications, New Delhi, India.
2. Iyengar, B.K.S. 2001. *Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority*. 1st edn. HarperCollins Publishers, New York, USA.
3. Wuest, D.A. and Bucher, C.A. 2006. *Foundations of Physical Education, Exercise Science and Sport*. 16th edn. McGraw-Hill, New York, USA.
4. Desikachar, T.K.V. 1999. *The Heart of Yoga: Developing a Personal Practice*. Inner Traditions International, Rochester, Vermont, USA.
5. Dick, F.W. 2007. *Sports Training Principles*. 5th edn. A&C Black Publishers Ltd., London, UK.

Semester 4
[29]

a. **Course Name:** Food Quality, Safety, Standards, and Certification
b. **Course Code:** 20105263
c. **Prerequisite:** Basic understanding of food science and technology, including concepts of food composition, processing, and preservation. Students should have

prior knowledge of microbiology and food chemistry, which are essential for understanding quality and safety parameters.

d. **Rationale:** Food quality and safety are critical components of the food industry, influencing consumer health, marketability, and regulatory compliance. This course is designed to provide students with comprehensive knowledge of quality evaluation techniques, defect analysis, and national and international food laws and certifications. Students will gain insight into the principles of Quality Control, Quality Assurance, and Total Quality Management systems, as well as food safety management frameworks. The course bridges the gap between scientific knowledge and industrial application, preparing students for roles in food production, auditing, quality assurance, and regulatory affairs.

a. Course Learning Objective:

CLOBJ 1	To familiarize the students with quality and safety of food and the standards and certification available
CLOBJ 2	Understand quality and its assessment
CLOBJ 3	Learn good ma Learn different food laws and FSMS 22000nufacturing practices

b. Course Learning Outcomes:

CLO 1	Apply principles of food quality attributes and defect analysis to evaluate the quality of raw and processed food products.
CLO 2	Analyze food quality using sensory, physical, chemical, and microbiological assessment methods under different processing and storage conditions.
CLO 3	Evaluate and implement Quality Control (QC), Quality Assurance (QA), and Total Quality Management (TQM) tools in food industries.
CLO 4	Apply national and international food laws, standards, and Food Safety Management Systems (FSMS, ISO 22000) for food safety, certification, and regulatory compliance.

c. Teaching & Examination Scheme:

Teaching Scheme			C	Examination Scheme					Total
				Internal			ESE		
L	T	P		T	CE	P	T	P	
2	-	-	2	50	-	-	50	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

d. Course Content:

Sr. No.	Topics	W (%)	T (Hours)

1	**Introduction:** Definition, its role in food industry, Quality attributes; Quality Defects: Classification, Genetic-physiological defects: Structural, off color, character; Entomological defects: Holes, scars, lesions, off coloring, curled aves, pathological defects; Mechanical defects, extraneous or foreign material defects. Measurement of defects by different techniques;	**15**	**5**
2	**Quality Assessment;** Quality assessment of food materials on the basis of sensory evaluation, Physical, chemical microbiological methods; Quality of products during processing and after processing; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products.	**15**	**5**
3	**Role of QC and QA Quality:** Quality Control, Quality Assurance, Concepts of quality control and quality assurance functions in food industries; Quality Improvement Total Quality management: Quality evolution, quality gurus, defining TQM, principals of TQM, stages in implementation, TQM road map. Quality improvement tools, customer focus, cost of quality.	**15**	**5**
4	**Food Laws;** Food Laws and Standards: National and International food laws. Mandatory and voluntary food laws. Indian Food Regulations and Certifications: Food Safety and Standards Act FSSAI Rules, food adulteration, misbranding, common adulterants in foods, Duties and responsibilities of Food Safety Authorities.	**15**	**5**
5	**AGMARK, BIS, FPO, Weights and Measures Act, CODEX;** Agricultural Marketing and Grading Standards (AGMARK), Bureau of Indian Standards (BIS) and their certification, FPO –standards and certification process Weights and Measures Act and Packaged commodity rules; Role of CODEX in food safety and standards, Food safety issues and risk analysis;	**20**	**6**
6	**FSMS 22000**, Food Safety Management Systems, ISO 22000 – 2005 and other Global Food safety management systems. Principles, implementation; documentation, types of records; Auditing, certification procedures, certifying bodies, accrediting bodies.	**20**	**6**
	Total =	**100%**	**32 h**
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

e. Text Book and Reference Book:

1 Alli, I. 2004. Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.

2 Hester, R.E. and Harrison, R.M. 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK

3 Schmidt, R.H. and Rodrick, G.E. 2003. Food Safety Handbook. John Wiley and Sons, Inc., Hoboken. New Jersey, USA.

f. Experiment List:

S.No.	Experiment Title
1	Explain the concepts of food quality, its attributes, and various types of quality defects in

	raw and processed foods.
2	Apply appropriate methods for measurement and assessment of food quality using sensory, physical, chemical, and microbiological techniques.
3	Analyze the factors affecting food quality during different stages of production, processing, and storage.
4	Examine the principles and implementation of Quality Control (QC), Quality Assurance (QA), and Total Quality Management (TQM) in food industries.
5	Interpret and apply national and international food laws, standards, and certification systems including FSSAI, AGMARK, BIS, FPO, ISO 22000, and CODEX.

Semester 4
[30]

a. **Course Name:** Engineering Mathematics
b. **Course Code:** 20105264
c. **Prerequisite:** Basic understanding of calculus, algebra, and trigonometry, Fundamental knowledge of matrices, determinants, and their applications. Familiarity with basic differential equations and complex numbers.
d. **Rationale:** The course develops advanced mathematical tools essential for engineering applications. It equips students with analytical techniques to solve complex linear systems, understand transformations, analyze periodic signals using Fourier series, and model physical phenomena using partial differential equations (PDEs). These concepts are foundational for higher-level courses in engineering fields such as electrical, mechanical, civil, computer, and communication engineering.

e. **Course Learning Objective:**

CLOBJ 1	To familiarize the students with basic concept of mathematics
CLOBJ 2	Gain knowledge about matrix and their transformation
CLOBJ 3	Develop partial differential equations and their applications

f. **Course Learning Outcomes:**

CLO 1	Understand fundamental mathematical concepts relevant to engineering applications.
CLO 2	Apply matrix operations and transformations, including solving linear systems and eigenvalue problems.
CLO 3	Formulate and solve partial differential equations (PDEs) and apply them to real-world engineering problems.
CLO 4	Analyze periodic functions using Fourier series and complex variables, supporting signal processing and analytical modeling.

g. Teaching & Examination Scheme:

Teaching Scheme			C	Examination Scheme					Total
				Internal			ESE		
L	T	P		T	CE	P	T	P	
2	-	-	2	50	-	-	50	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T (Hours)
1	**Elementary transformation and rank of a matrix**, reduction to normal form, Gauss-Jordan method to find inverse of a matrix; Consistency and solution of linear equations; Eigen value and vectors, Cayley-Hamilton theorem;	**20**	**6**
2	**Linear and orthogonal transformations;** Diagonalization of matrices, Bilinear, Quadratic forms; Limit, continuity, derivative of function of complex variable; Analytical function, C-R equations, conjugate function, harmonic functions;	**20**	**6**
3	**Fourier series:** Infinite series and its convergence, periodic function, Euler's formulae for calculating Fourier coefficients, Dirichlet's conditions; Fourier series of functions with arbitrary period; Fourier series of odd and even functions; Half range sine and cosine series, Harmonic analysis;	**20**	**7**
4	**Formation of partial differential equations;** Lagrange's linear equation; Higher order linear partial differential equation with constant coefficients; Solution of non-linear partial differential equation (Charpit's method); Application of partial differential equations:	**20**	**7**
5	**One-dimensional wave** e.g., one-dimensional heat equation, two-dimensional steady state heat equation i.e. Laplace equation.	**20**	**6**
	Total =	**100%**	**32 h**
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

i. Text Book and Reference Book:

1 Ramana, B.V. 2008. Engineering Mathematics. Tata McGraw-Hill Book Co., New Delhi

2 Grewal, B.S. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.

3 Narayan, S. 2004. A Textbook of Matrices. S. Chand and Co. Ltd., New Delhi.

j. Experiment List:

S.No.	Experiment Title
1	Apply matrix algebra techniques, including elementary transformations, rank, and Gauss-Jordan method, to solve systems of linear equations and find matrix inverses.
2	Determine eigenvalues, eigenvectors, and use the Cayley-Hamilton theorem for matrix

	diagonalization and transformations.
3	Analyze functions of a complex variable for continuity, differentiability, analyticity, and evaluate their derivatives using Cauchy-Riemann equations.
4	Develop Fourier series representations of periodic functions and apply them for harmonic analysis of engineering signals.
5	Formulate and solve partial differential equations (PDEs) including Lagrange's and Charpit's methods, and apply them to physical systems such as wave, heat, and Laplace equations.

Semester 4
[31]

a. **Course Name:** Food Plant Utilities Mathematics
b. **Course Code:** 20105265
c. **Prerequisite:** Students should have prior knowledge of Basic Engineering Concepts, Principles of Food Processing and Dairy Engineering, Thermodynamics and Heat Transfer as applied to food plant operations
d. **Rationale:** Food industries rely heavily on utilities and services such as electrical systems, steam, refrigeration, compressed air, water, and waste management for efficient and safe production. This course provides knowledge of these utilities' design, operation, and energy-efficient management. Students will learn how to assess system performance, identify inefficiencies, and implement conservation measures to reduce operational costs and environmental impact skills critical for modern food industry professionals.

e. Course Learning Objective:

CLOBJ 1	Gain knowledge of various Utilities and services required in a food processing plant
CLOBJ 2	Understanding working of different services
CLOBJ 3	Understand cleaning, maintenance and trouble shooting

f. Course Learning Outcomes:

CLO 1	Gain knowledge of various utilities and services required in a food processing plant.
CLO 2	Understand the working principles of different utility systems such as electrical, refrigeration, steam, and compressed air systems.
CLO 3	Develop skills in cleaning, maintenance, and troubleshooting of plant utilities and services.
CLO 4	Evaluate and improve energy efficiency of utility systems for cost reduction and sustainable operation.

g. Teaching & Examination Scheme:

Teaching Scheme			C	Examination Scheme					Total
				Internal			ESE		
L	T	P		T	CE	P	T	P	
2	-	2	3	40	-	20	40	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T (Hours)
1	**Classification of Various Utilities and Services in food Plant/ industry**. Commercial energy Pricing; Electrical System- Introduction to electric power supply systems, electrical billing, electrical load management and maximum demand control, power factor improvement and benefits, transformers, system distribution losses, harmonics, trouble shooting of electrical power system. Electrical motors- Types, losses in Introduction motor, motor efficiency, factors affecting motor performers, performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.	**20**	**6**
2	**Compressed air system** - Requirement, types, compressor efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and efficiency.	**15**	**5**
3	**HVAC and Refrigeration system** - Requirement, vapor compression refrigeration cycle, refrigerants, coefficient of performance, capacity, factors affecting refrigeration and air conditioning system performance and saving opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with VCR system, saving potential; Fans and blowers - Requirement, types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities,	**20**	**6**
4	**Pumps and pumping systems** - Requirement, types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. DG set system- Requirement, introduction, factors affecting selection;	**20**	**5**
5	**Fuels and combustion** - Introduction to fuels; properties of fuel oil, coal and gas; storage; handling and preparation of fuels; principles of combustion, combustion of oil, coal and gas; draft system. Boilers- Boiler specification, Indian boiler regulation, system components, types, combustion in boilers, performance terms, analysis of losses, feed water treatment, blow down, energy conservation opportunities;	**20**	**5**
6	**Steam system** - Properties of steam, assessment of steam distribution losses, steam leakage, steam trapping, condensate and flash steam recovery system, opportunities for energy savings; Waste heat recovery - Classification, advantages and application, commercially viable waste heat recovery devices, saving potential; Other utilities and services: - Lighting, CIP system, waste water/drainage, water treatment, dust removal, fire protection and maintenance system.	**15**	**5**
	Total =	**100%**	**32 h**
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

i. Text Book and Reference Book:

1 Energy Efficiency and Management in Food Processing Facilities by Lijun Wang. Published by CRC Press, 2008.
2 Energy-saving Techniques for the Food Industry by M. E. Casper. Published by Noyes Data Corp., 1977.
3 Chilton's Food Engineering. Published by Chilton Co., 1979.
4 A Survey of Water Use in the Food Industry by W. E. Whitman, S. D. Holdsworth. Published by British Food Manufacturing Industries Research Association.

j. Experiment List:

S.No.	Experiment Title
1	Understand and classify various utilities and services essential in a food plant, including electrical, thermal, mechanical, and environmental systems.
2	Explain the working principles, components, and performance parameters of major utility systems like electrical power supply, compressed air, boilers, refrigeration, HVAC, and DG sets.
3	Evaluate the efficiency and performance of different plant utilities such as motors, compressors, boilers, and pumps, and identify opportunities for energy conservation and optimization.
4	Apply principles of energy management and auditing to reduce system losses and improve energy utilization in food industries.
5	Integrate sustainable practices and safety standards in managing utilities such as water treatment, waste heat recovery, and fire protection systems to ensure efficient, safe, and eco-friendly plant operations.

Semester 4
[32]

a. **Course Name:** Entrepreneurship Development and Management
b. **Course Code:** 20105266
c. **Prerequisite:** Basic knowledge of economics and management concepts. Awareness of current business environment and social issues. Ability to comprehend fundamentals of commerce, finance, and communication.
d. **Rationale:** Entrepreneurship contributes significantly to economic growth, job creation, and innovation. This course provides students with the skills and information needed to grasp entrepreneurial ideas, motivating and environmental variables, identifying opportunities, and the role of institutions in firm growth. It also emphasizes successful small-business planning, organization, and management. The topic combines academic principles with practical applications to help students develop entrepreneurial skills, risk-taking abilities, and self-reliance.

e. Course Learning Objective:

CLOBJ 1	To provide student an insight into the concept and scope of entrepreneurship.
CLOBJ 2	To expose the student to various aspects of establishment and management of a small business unit.
CLOBJ 3	To enable the student to develop financially viable agribusiness proposal.

f. Course Learning Outcomes:

CLO 1	Understand the concept and scope of entrepreneurship, including its role in economic development.
CLO 2	Gain knowledge of the establishment and management of small business units, including planning and operational aspects.
CLO 3	Develop the ability to prepare financially viable agribusiness proposals for funding and implementation.
CLO 4	Analyze entrepreneurial opportunities and business environments to support effective decision-making and venture creation.

g. Teaching & Examination Scheme:

Teaching Scheme			C	Examination Scheme					Total
				Internal			ESE		
L	T	P		T	CE	P	T	P	
2	-	2	3	40	-	20	40	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T (Hours)
1	**Development of entrepreneurship** – motivational, social & environmental factors; characteristics of entrepreneurs, attributes & competencies; concept, need and importance of entrepreneurial development	15	2
2	**Evolution of entrepreneurship**; objectives, types and functions of entrepreneurs; importance and process of entrepreneurship development	20	2
3	**Environment scanning & opportunity identification** – need for scanning, spotting opportunities, product/service identification, starting a project; factors influencing opportunity sensing	15	3
4	**Infrastructure & support systems: government policies**, schemes, role of financial institutions & agencies; steps in functioning of an enterprise – product/service selection, ownership, registration, site, capital sources, manufacturing know-how, packaging & distribution	20	10
5	**Planning of an enterprise:** project identification, selection & formulation, project report preparation; enterprise management: production management (products, mix, quality, cost control, materials & inventory control), personnel management (manpower, turnover, wages/salaries)	20	10
6	**Financial management & accounting** (funds, capital, costing, pricing, book-keeping, taxation, financial statements), marketing management (market types, strategies, assistance), crisis management (raw materials, production, leadership, market, finance, natural crises)	10	5
	Total =	**100%**	**32 h**
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

i. Text Book and Reference Book:

1 Charantimath P.M. 2009. Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.

2 Desai, V. 2015. Entrepreneurship: Development and Management, Himalaya Publishing House.

3 Desai, Vasant. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House

4 Grover, Indu. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.

5 Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.

6 Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.

7 Mehra, P. 2016. Business Communicationfor Managers. Pearson India, New Delhi.

8 Pandey, M. and Tewari, D. 2010. The Agribusiness Book. IBDC Publishers, Lucknow.

j. Experiment List:

S.No.	Experiment Title

1	Visit to small scale industries/agro-industries, interaction with successful entrepreneurs/ agric-entrepreneurs.
2	Visit to small scale industries/agro-industries, interaction with successful entrepreneurs/ agric-entrepreneurs.
3	Preparation of project proposal for funding by different agencies

Semester 4
[33]

a. **Course Name:** Personality Development
b. **Course Code:** 20105267
c. **Prerequisite:** Basic understanding of human behavior, communication skills, and general awareness of self and society.
d. **Rationale:** The course on Personality Development aims to equip students with a comprehensive understanding of human personality, behavior, and motivation in both personal and organizational contexts. By integrating psychological theories with practical applications, the course enables learners to enhance self-awareness, interpersonal effectiveness, and professional competence. It further helps students understand the linkage between personality traits, behavior, perception, learning, motivation, and emotional intelligence in achieving success in academic, social, and workplace environments.

e. Course Learning Objective:

CLOBJ 1	To make students realize their potential strengths
CLOBJ 2	To cultivate their inter-personal skills and improve employability

f. Course Learning Outcomes:

CLO 1	Identify and realize personal strengths and potential for self-development.
CLO 2	Develop interpersonal skills and enhance employability in professional environments.
CLO 3	Understand personality traits, behavior, and motivation in individual and organizational contexts.
CLO 4	Apply concepts of emotional intelligence, communication, and teamwork for personal and professional effectiveness.

g. Teaching & Examination Scheme:

Teaching Scheme			C	Examination Scheme					Total
				Internal			ESE		
L	T	P		T	CE	P	T	P	
1	-	2	2	40	-	20	40	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T (Hours)
1	**Personality Definition**, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance,	20	5
2	**Type A and Type B Behaviours**, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior,	20	3
3	**Perception and attributes and factors affecting perception**, Attribution theory and case studies on Perception and Attribution.	20	3
4	**Learning:** Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values,	20	3
5	**Intelligence-** types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.	20	2
	Total =	**100%**	**16 h**
***Continuous Evaluation:** It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.			

i. Text Book and Reference Book:

1 Andrews, Sudhir, 1988, How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw- Hill.
2 Heller, Robert, 2002, Effective Leadership. Essential Manager series. DK Publishing.
3 Kumar, Pravesh, 2005, All about Self- Motivation. New Delhi. Goodwill Publishing House.
4 Lucas, Stephen, 2001, Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5 Smith, B, 2004, Body Language. Delhi: Rohan Book Company
6 Hindle, Tim, 2003, Reducing Stress. Essential Manager series. DK Publishing.
7 Mile, D.J., 2004, Power of Positive Thinking. Delhi. Rohan Book Company.
8 Shaffer, D. R.,2009, Social and Personality Development (6th edn). Belmont, CA: Wadsworth

j. Experiment List:

S.No.	Experiment Title
1	MBTI personality analysis
2	Learning styles and strategies

3	Motivational needs
4	FIRO-B
5	Interpersonal communication
6	Teamwork and team building
7	Group dynamics
8	Win-win game
9	Conflict management
10	Leadership styles
11	Case studies on personality and organizational behaviour

Semester 4
[34]

a. **Course Name:** Skill Enhancement Course (SEC)-VI (Introduction to Processing of Extruded Foods)
b. **Course Code:** 20105280
c. **Prerequisite:** Basic knowledge of food processing operations, unit operations in food engineering, and physical and chemical properties of food materials.
d. **Rationale:** This course provides a practical and application-oriented understanding of extrusion processing, a rapidly growing technology in food manufacturing. Students will acquire hands-on experience in operating extruders, controlling process variables, and evaluating product quality attributes. The course bridges theoretical food engineering principles with industrial practices, enhancing students' technical competency and innovation skills in developing nutritionally enriched, safe, and market-ready extruded foods.

e. **Course Learning Objective:**

CLOBJ 1	To provide practical knowledge of extrusion equipment, operational parameters, and safety practices involved in the processing of extruded food products.
CLOBJ 2	To develop skills in evaluating the physical, functional, nutritional, sensory, and shelf-life characteristics of extruded foods and in formulating value-added extruded products.

f. **Course Learning Outcomes:**

CLO 1	Understand the construction, working, and safety aspects of extrusion equipment.
CLO 2	Analyze the effect of process parameters on the physical properties of extruded products.
CLO 3	Evaluate functional and textural properties of extruded foods using standard analytical methods.
CLO 4	Assess nutritional, sensory, and shelf-life attributes of extruded food products.

g. **Teaching & Examination Scheme:**

Teaching Scheme			**C**	**Examination Scheme**					**Total**
				Internal			**ESE**		
L	**T**	**P**		**T**	**CE**	**P**	**T**	**P**	
0	-	4	2	-	-	50	-	50	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

S.No.	Experiment Title
1	Familiarization with extrusion equipment and safety protocols
2	Study of extruder components and screw configurations
3	Calibration and pre-start checks of extruder
4	Effect of feed moisture content on extrudate properties
5	Effect of screw speed on product expansion and density
6	Effect of barrel temperature profile on extrudate quality
7	Effect of die geometry on extrudate structure and texture
8	Study of raw material preparation and feeding systems
9	Study of raw material preparation and feeding systems
10	Measurement of expansion ratio, bulk density, and true density
11	Measurement of expansion ratio, bulk density, and true density
12	Analysis of porosity and crispiness in extrudates
13	Analysis of porosity and crispiness in extrudates
14	Determination of Water Absorption Index (WAI)
15	Determination of Water Absorption Index (WAI)
16	Determination of Water Solubility Index (WSI)
17	Determination of Water Solubility Index (WSI)
18	Texture profile analysis of extruded products
19	Texture profile analysis of extruded products
20	Nutritional evaluation: starch gelatinization degree
21	Nutritional evaluation: starch gelatinization degree
22	Assessment of protein denaturation during extrusion
23	Assessment of protein denaturation during extrusion
24	Sensory evaluation of extruded snacks
25	Sensory evaluation of extruded snacks
26	Shelf-life testing and packaging of extruded foods
27	Shelf-life testing and packaging of extruded foods
28	Case study: Optimization of extrusion parameters using Response Surface Methodology (RSM)
29	Mini-project: Development of fortified extruded snack
30	Mini-project: Development of fiber-enriched extruded product
31	Project work: Gluten-free extruded product
32	Project work: Protein-rich extruded product

i. Text Book and Reference Book:

1 Riaz, M. N. (2000). Extruders in Food Applications. CRC Press, Boca Raton.

2 Guy, R. (Ed.) (2001). Extrusion Cooking: Technologies and Applications. Woodhead Publishing Limited, Cambridge.

3 Frame, N. D. (1994). The Technology of Extrusion Cooking. Blackie Academic & Professional, Glasgow.

4 Harper, J. M. (1981). Extrusion of Foods, Volume I & II. CRC Press, Boca Raton.

5 Heldman, D. R., & Lund, D. B. (2007). Handbook of Food Engineering. CRC Press,

Taylor & Francis Group.