

Choice Based Credit Based System

Scheme & Syllabus of Master of Technology- Food Technology/ (M. Tech.- Food Technology)

For
University Main Campus, Constituent Campuses
And Affiliated colleges

Batch 2021 onwards



By

Board of Study (Food Science & Engineering)

Department of Food Science & Technology Main Campus

**IK Gujral Punjab Technical
University**

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Eligibility for Admission: B. Tech./ B.E. (Food Engineering/ Food Technology/ Food B. Tech./ B.E. (Food Engineering/ Food Technology/ Food Engineering & Technology/ Food Process Engineering/ Food Process Technology/ Dairy Technology/ Dairy Engineering/ Food Biotechnology/ Agri. Process Engineering/ Agri. Engineering/Biotechnology) **or B.Sc. (Hons) in Food Technology, BSc (Hons) Agriculture (with elective/honours in Food Technology/Food Process Engineering)** or any equivalent degree with **at least 50% (45% in case of candidate belonging to reserved category) marks in aggregate**

OR

M.Sc. (Food Science/ Food Technology/ Food Science and Technology/ Food Processing and Technology/ Biotechnology/**Agriculture**) or any equivalent degree with **at least 50% (45% in case of candidate belonging to reserved category) marks in aggregate.**

Courses & Examination Scheme:

Program Core (PC)	Program Elective (PE)	Open Elective (OE)	Research Project	Total Credits
24	24	04	26	78

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Semester First

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-511-19	Advances in Food Engineering	PC	4	0	0	40	60	100	4
UC-MTFT-512-19	Food Safety and Quality Assurance (Theory)	PC	4	0	0	40	60	100	4
UC-MTFT-513a-19 or 514a-19	Program Elective I (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-515a-19 or 516a-19	Program Elective II(Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-517-19	Food Safety and Quality Assurance(Lab-I)	PC	0	0	4	30	20	50	2
MTA-xxx	Audit course I		2	0	0	Satisfactory/ Un-Satisfactory [#]			Non-credit
MTRM101-18	Research methodology and IPR	PC	2	0	0	20	30	50	2
UC-MTFT-513b-19 or 514b	Program Elective I (Lab)	PE	0	0	4	30	20	50	2
UC-MTFT-515b-19 or 516b	Program Elective I I(Lab)	PE	0	0	4	30	20	50	2
	Total		20	0	12	280	320	600	24

*Select any audit course from the audit course list.

the concerned teacher will evaluate the students internally (only) as per marks distributions pattern followed for the other subjects/courses.

Program elective I*

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-513a-19	Technology of Milk and Milk Products (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-513b-19	Milk and Milk Products(Lab-II)	PE	0	0	4	30	20	50	2
UC-MTFT-514a-19	Food Additives and Contaminants (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-514b-19	Food Additives and Contaminants (Lab-III)	PE	0	0	4	30	20	50	2

Note: * Select any one subject from Elective-I. The elective subject for theory & practical will be same.

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Program elective II**

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-515a-19	Advances in Post-harvest Technology of Fruits and Vegetable (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-515b-19	Advances in Post-harvest Technology of Fruits and Vegetable(Lab-IV)	PE	0	0	4	30	20	50	2
UC-MTFT-516a-19	Advances in Cereal Science and Technology(Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-516b-19	Cereal Science & Technology (Lab-V)	PE	0	0	4	30	20	50	2

Note: ** Select any one subject from Elective-II. The elective subject for theory & practical will be same.

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Semester Second

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-521-19	Advanced Food Processing Technology (Theory)	PC	4	0	0	40	60	100	4
UC-MTFT-522-19	Advances in Food Analysis(Theory)	PC	4	0	0	40	60	100	4
UC-MTFT-527-19	Advances in Food Analysis(Lab VI)	PC	0	0	4	30	20	50	2
UC-MTFT-523a-19 or 524a-19	Program Elective-III (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-523b-19 or 524b-19	Program Elective-III (Lab.)	PE	0	0	4	30	20	50	2
UC-MTFT-525b-19 or 526b-19	Program Elective-IV (Lab.)	PE	0	0	4	30	20	50	2
MTAXX-18	Audit course II	PC	2	0	0	Satisfactory/ Un-Satisfactory [#]			Non-credit
UC-MTFT-528-19	Mini project with seminar	PC	0	0	2	30	20	50	2
	Total		14	0	14	250	300	550	22

the concerned teacher will evaluate the students internally (only) as per marks distributions pattern followed for the other subjects/courses.

Program Elective-III ***

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-523a-19	Novel Food Packaging(Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-523b-19	(Novel Food Packaging (Lab-VII)	PE	0	0	4	30	20	50	2
UC-MTFT-524a-19	Nutraceuticals and Functional Foods (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-524b-19	Nutraceuticals and Functional Food (LabVIII)	PE	0	0	4	30	20	50	2

Note: ***Select any one subject from Elective-III. The elective subject for theory & practical will be same.

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Program Elective-IV ****

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-525a-19	Technology of Frozen Foods (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-525b-19	Frozen Food Technology (Lab-IX)	PE	0	0	4	30	20	50	2
UC-MTFT-526a-19	Advances in Meat, Fish, Poultry and Egg processing (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-526b-19	Advances in Meat, Fish, Poultry and Egg processing (Lab -X)	PE	4	0	0	40	60	100	4

Note: ***** Select any one subject from Elective-IV. The elective subject for theory & practical will be same.

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Semester Third

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-611-19 or 612-19	Program Elective-V	PE	4	0	0	40	60	100	4
UC-MTFT-613-19	Open elective [#]	OE	4	0	0	40	60	100	4
UC-MTFT-614-19	Dissertation -I/ Industrial Project	RP	0	0	20	60	40	100	10
	Total		8	0	20	140	160	300	18

Program Elective-V*****

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-611-19	Food Rheology and Texture (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-612-19	Bio Process Engineering (Theory)	PE	4	0	0	40	60	100	4

Note: ***** Select any one subject from Elective-V.

open elective: The student is required to register for one “Open Elective” paper (in Semester III) of his/her choice from any department other than the parent department

Open Elective –

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Semester Fourth

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-621-19	Dissertation-II	RP	0	0	32	60	40	100	16
	Total		0	0	32				16

Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

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Important Notes: -

1. The credit requirement for the M. Tech (Food Technology) degree is 85 credits inclusive of the 10 elective course credits.
2. The department will offer the following open elective courses for the students of other Engineering departments:
 - i. Food Safety and Quality Assurance
 - ii. Advances in Food Analysis
3. Theory courses will be of 04 hours and practical will be of 04 hours duration per week. For all lecture courses, one credit per lecture/week/semester will generally be adopted. One laboratory hour per week per semester will be assigned half credit.
4. No elective course will be run unless the number of students registered for the elective course is five or more.
5. Each theory paper examination will be of 3 hours duration and practical examination will be of 4 hours duration.
6. A student is required to undertake a Research Project of 16 credits on a topic approved by the supervisor and the Departmental Research Committee (DRC). The student is required to prepare his/her research project synopsis and should make a presentation to the DRC before the commencement of the final examination of third semester.
7. The research project shall be evaluated by the external examiner at the end of the Semester IV.
8. The student is required to register for one "Open Elective" paper (in Semester III) of his/her choice from any department other than the parent department.
9. A Supervisor will be allotted by the Chairperson for every student in the beginning of third semester.

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Program outcomes

1. Ability to apply principles of food engineering in industry.
2. Understand, identify and analyze a problem related to food industry and ability to find an appropriate solution for the same.
3. Design, implement and evaluate a research based project to meet demands of the society.
4. Use appropriate techniques, skills, and modern tools in the food industry and in academic profession.
5. Understanding of professional, ethical, legal, security and social issues and responsibilities for entrepreneurship skills.
6. Ability to function effectively as an individual and in a group.

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SEMESTER

FIRST

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UC-MTFT-511-19: ADVANCES IN FOOD ENGINEERING

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To illustrate various aspects of food engineering.
2. To develop understanding about fluid flow and its applications.
3. To understand mechanism of heat transfer in food processing
4. To explain method of freezing process.

Course outcome: On successful completion of the subject, the students will be able to

1. Apply knowledge of food engineering to design new process.
2. Understand pump selection and velocity of flowing fluids.
3. Able to calculate through different dimensions.
4. Able to calculate freezing time.

Course Content:

UNIT-I

Engineering properties of foods, their significance in equipment design. Constraints and need of innovation. Challenges for food engineering. Tools and concepts in process design microbial survivor curves, general method for process calculation. Sterilization of continuous flowing fluid.

UNIT-II

Fluid flow handling systems for Newtonian liquids, force balance on a fluid element flowing in a pipe, derivation of Bernoulli equation. Measurement of viscosity, capillary tube viscometer. Flow characteristics of non Newtonian fluids. Properties of non-Newtonian fluids. Velocity profile of a power law. Pumps-characteristics, types and selection.

UNIT-III

Thermal properties of foods. Steady state and unsteady state heat transfer: Conduction in multilayered systems. Estimation of convective heat-transfer coefficient. Forced and free convection. Estimation of overall heat-transfer coefficient. NTU method for designing heat changers. Design of a plate heat exchanger, Design of a tubular heat exchanger.

UNIT-IV

Pressure-enthalpy charts. Frozen-food properties. Freezing point curves, phase diagrams, methods of freeze concentration, design problems. Freezing of foods, freeze concentration and drying, freezing time: plank's equation and Pham's method, theory of ultra-filtration and reverse osmosis, selection and types of membranes and properties, Properties of steam. Steam traps Methods of estimating steam consumption.

Recommended Readings:

1. Rao, M. A., Rizvi, S. S. H. and Datta A.K. (2005). *Engineering Properties of Foods*: CRC Press.
2. Heldman, D. R. (2007). *Food Process Engineering*: AVI Publications.
3. Toledo, R. T. (1997). *Fundamentals of Food Process Engineering* (2 ed.): CBS Publications, New Delhi.

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4. Rizvi, S. S. H. and Mittal, G. S. (1992). *Experimental Methods in Food Engineering*: Van Nostrand Reinhold.
5. Chanes J.W., Gustavo (2002) *Engineering and Food for the 21st Century* CRC Press.
6. Theodoros V.C., *Food Engineering Handbook* (2011) CRC Press

Mapping of course “Advances in Food Engineering – MTFT-511-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	3	3	2	2	1
	CO 2	3	3	3	3	1	1
	CO 3	3	3	3	3	1	1
	CO 4	3	3	3	2	2	1

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UC-MTFT-512-19: FOOD SAFETY AND QUALITY ASSURANCE

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To illustrate the importance of food safety, food quality, food laws and regulations in Food industry.
2. To describe the food quality management systems.
3. To explain the national and international food laws and regulations.
4. To exemplify different food adulterants.

Course Outcomes: After the completion of the course, the students will be able to:

1. Understand various areas of Food Safety & Quality Assurance.
2. Grasp knowledge of the quality assessments of food products.
3. Comprehend food quality management systems.
4. Apprehend the Indian and International food laws.
5. Implementation of food safety & quality assurance in one's own domain.

Course Content:

UNIT-I

Definition, objective, scope and functions of food safety and quality assurance, Quality enhancement models, Statistical Quality Control for food industry, Quality control tools, Quality control charts, Causes of failure of Food Safety Programs, Introduction of Food Quality Management Systems, Production planning and Control.

UNIT-II

WTO, FAO, WHO, Codex Alimentarius Commission, GMP, GHP, Cleaning and disinfection Principles. Implementation of quality control programmes, HACCP, ISO – 22000 series, Introduction of FSSAI, Introduction to USFDA & BRC,

UNIT-III

ISO–9000 series, Total quality control, GLP, ISO-17025. Intellectual Property: concept and fundamental- Patent Laws, copy right, trade mark and IPR. Introduction to BIS, AGMARK , Organic food, Functions of EIC in export of food product.

UNIT-IV

Sensory evaluation: Introduction, panel screening, selection methods, interaction and thresholds Food adulteration: Types of adulterants, Common adulterants for foods like milk and milk products, honey, wheat flours, edible oils, cereals, condiments (whole and ground) pulses, coffee, tea, confectionery, baking powder, non-alcoholic beverages, vinegar, besan and curry powder

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Recommended Readings:

1. Lawless, H. T. and Heymann, H. (2013). *Sensory Evaluation of Food: Principles and Practices*: Springer, New Delhi.
2. Shapton, D. A. and Shapton, N. F. (1993). *Principles and Practice for the Safe Processing of Foods*: Heinemann, Oxford.
3. Schmidt, R. H. and Rodrick, G. E. (2003). *Food Safety Handbook*: John Wiley, New Jersey.
4. Rees, N. and Watson, D. (2000). *International Standards for Food Safety*: Aspen, America.
5. Anjaneyulu, Y. and Marayya, R. (2009). *Quality Assurance and Quality Management in Pharmaceutical Industry*: Pharma, Hyderabad.
6. Ho, S. K. M. (1999). *Operations and Quality Management*: ITP, London.

Mapping of course “Food Safety and Quality Assurance- MTFT-512-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	3	2	3	3	2
	CO 2	2	2	1	3	2	2
	CO 3	2	2	2	3	2	2
	CO 4	1	2	2	2	2	2
	CO 5	1	3	1	3	1	2

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UC-MTFT-517-19: Lab-II (FOOD SAFETY AND QUALITY ASSURANCE)

Total Marks: 50

L	T	P
0	0	4

Objectives:

1. To exemplify applications of food safety and quality assurance.
2. To describe the quality assessment of food products.
3. To demonstrate the sensory evaluation techniques.
4. To elucidate the adulterants in food products.

Course Outcomes: After the completion of the course, the students will be able to:

1. Understand the practical application of food safety and quality assurance in raw and processed foods.
2. Apprehend the quality assessment of food products using various instruments.
3. Perceive the sensory evaluation techniques.
4. Comprehend the detection methods of the adulterants in food products.
5. Grasp the implementation of HACCP.

Course Content:

Techniques of sampling and quality assessment of fruits, vegetable, cereals, dairy products, meat, poultry, milk and other processed products, Measurement of the water activity (aw) of raw and cooked food using A_w meter, Assessing the texture of raw and cooked food using penetrometer, Extraction of pigments from various fruits and vegetables and influence of heating time and pH, Performance of the sensitivity tests for four basic tests (Sweet, salty, sour and bitter), Identification and ranking of food product attributes using Sensory evaluation scales (Hedonic rating, Ranking difference, Triangle test), Sensory evaluation of milk and detection of flavor defects in milk, Qualitative tests for fats and oils, spices and condiments, Inspection of quality as per National and International standards for various foodstuffs- pulses, spices, etc., Detection of adulteration in food products viz. honey, other sweetening agents, spices (whole and powder), pulses, oils, cereals, sweets, tea, coffee, Implementation of HACCP, ISO: 22000.

Mapping of course “Lab-II (Food Safety and Quality Assurance) - MTFT-517-19”outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
		Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	3	2	3	2	2
	CO 2	1	2	1	3	2	1
	CO 3	2	1	1	3	2	2
	CO 4	1	2	2	3	2	2
	CO 5	2	3	2	2	3	2

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RESEARCH METHODOLOGY AND IPR

Teaching Scheme : Lectures: 1hrs/week

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth individuals & nation, it is needless to emphasize the need of information about
6. Model Curriculum of Engineering & Technology PG Courses [Volume-I][16]
7. Intellectual Property Right to be promoted among students in general & engineering in particular.
8. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course contents

Unit I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit V

: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit VI

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New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- 1 Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- 2 Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- 3 Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- 4 Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- 5 Mayall, "Industrial Design", McGraw Hill, 1992.
- 6 Niebel, "Product Design", McGraw Hill, 1974.
- 7 Asimov, "Introduction to Design", Prentice Hall, 1962.

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ELECTIVE-I

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UC-MTFT-513a-19: TECHNOLOGY OF MILK AND MILK PRODUCTS

Total Marks: 100

L	T	P
4	0	0

Objective:

1. To illustrate the technologies of processing of milk and milk products.
2. To describe the different physico-thermal properties and their applications.
3. To elucidate the thermal processing of milk and quality changes therein.
4. To explain the hygiene and sanitation practices in milk plant.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the processes related to storage, processing and distribution of milk and milk Products.
2. Perceive the different properties of milk and milk products.
3. Apprehend the thermal processing of milk.
4. Grasp the technology of fat rich dairy products.
5. Comprehend the technology of condensed milk, dried milk, cheese, yoghurt and indigenous products will be understood.
6. Have knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Course Content:

UNIT-I

Technology of Market Milk: Dairy Industry in India: present status and scope; Milk: definition, composition and nutritive value; grading of milk; factors affecting composition of milk; physico-chemical properties of milk; FSSAI standards and legislations for market milk. Liquid milk processing: filtration/clarification; bactofugation; standardization; homogenization; pasteurization (LTLT, HTST); sterilization; UHT processing; aseptic packaging; storage and distribution. Technology of special milks: Technology of sterilized/ flavored milk, acidophilus milk, bulgarian milk, kumis, kefir; reconstituted & recombined milk, toned, double toned milk.

UNIT-II

Technology of fat rich dairy products: Cream: definition and legal standards, consumer cream products, standardization & production of cream, processing of cream (neutralization & pasteurization), butter: definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream & butter, defects in cream & butter. Ice-cream: definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

UNIT-III

Technology of condensed and dried milk: Definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, concept of heat stability & its control, defects in condensed and evaporated milks, Quality of raw milk for dried milks, definition and legal standards for dried milks, milk drying system (film, roller, drum, spray, foam spray drying), method of manufacture of dried milks (WMP & SMP), defects in dried milk, Technology of yoghurt and cheese: Yoghurt - Definition and technology of yoghurt manufacturing, technology of different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening of cheese, yield of cheese; manufacture of processed cheese, defects in cheese, accelerated ripening of cheese.

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UNIT-IV

Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets, miscellaneous traditional dairy foods, Dairy industry by-products and sanitation: By-products: introduction, definition, composition, Importance and food applications, whey protein concentrates & isolates, Dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

Recommended Readings:

1. Winton, A. L. and Winton, K. B. (2000). *Milk and Milk Products*: Agrobios, India.
2. Kuttu, C. I. and Khamer, S. (2004). *Milk Production and Processing*: Daya, Delhi.
3. Fox, P. F. and McSweeney, P. L. H. (1998). *Dairy Chemistry and Biochemistry*: Kluwer Academic, New York.
4. Kurmann, J. A., Rasic, J. L. and Kroger, M. (1992). *Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products*: CBS Publications, New Delhi.
5. Davis, J. G. (1994). *Milk Testing: The Laboratory Control of Milk*: Agro Botanical, Bikaner.

Mapping of course “Technology of Milk and Milk Products- MFTT-513a-19”outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	2	3
	CO 2	2	2	2	3	3	2
	CO 3	2	2	1	3	1	3
	CO 4	3	2	2	3	2	3
	CO 5	3	2	2	3	1	3
	CO 6	1	2	2	3	2	3

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UC-MTFT-513b-19: Lab-VII (MILK AND MILK PRODUCTS QUALITY)

Total Marks: 50

L	T	P
0	0	4

Objective:

1. To exemplify the quality of milk and milk products.
2. To depict the detection of adulterants in milk.
3. To demonstrate the manufacturing various dairy products.
4. To illustrate the quality of dairy products.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand different methods of milk quality analysis.
2. Grasp the detection methods of adulterants in milk.
3. Apprehend the manufacturing of different dairy products.
4. Perceive the quality analysis of dairy products.

Course Content:

Analysis of milk: total solids, fat, SNF, protein, lactose, acidity, ash, total bacterial count, analysis of adulteration of milk (sugar, carbohydrate, urea, neutralizer, water), turbidity test for sterilized milk, preparation of sterilized flavoured milk, Cream preparation, preparation of butter from sour cream, salt analysis in butter, overrun in butter, yield of butter, preparation of ghee from cream/ butter, FFA value of ghee, preparation of ice-cream, overrun of ice cream (by weight/by volume), preparation of cheddar/gouda/mozzarella cheese, moisture of milk powder, bulk/true density of milk powder, solubility of milk powder, preparation of prebiotic yoghurt/ dahi, compositional analysis of traditional dairy products, manufacturing of sodium caseinate/calcium caseinate.

Mapping of course “Lab-VII (Milk and Milk Products Quality)- MTFT-513b-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	2	3
	CO 2	2	2	2	3	2	2
	CO 3	1	2	1	3	2	2
	CO 4	2	2	2	3	2	2

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UC-MTFT-514a-19: FOOD ADDITIVES AND CONTAMINANTS

Total Marks: 100

L	T	P
4	0	0

Objective:

1. To describe various food additives and contaminants.
2. To illustrate the functionality of food additives.
3. To exemplify the limits of permissible additives in processed foods.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the role of food additives in manufacturing of food products.
2. Have the knowledge regarding permissible additives and their limits in the processed food
3. Perceive the contaminants from various sources.
4. Comprehend the effects of contaminants on human health.

Course Content:

UNIT-I

Additives in food processing and preservation: Classification, need, properties, functions and safety, quality evaluation of additives, Food labeling, Laws and regulations for food additives.

UNIT-II

Chemistry, uses and functions: Chemical preservative, bio-preservatives, fortification, antioxidants, emulsifiers, humectants, stabilizers, chelating agents, pH control agents and acidulants, texturizing agents, plasticizers, flavor enhancers, enzymes, coloring agents, sweeteners, flavoring agents.

UNIT-III

Food contaminants: biological, chemical, physical and environmental contaminants, Inorganic and organometallic food contaminants, Sources and their impact on human health.

UNIT-IV

Food contaminants from industrial wastes: Heavy metals, polychlorinated polyphenyls, dioxins, Toxicants formed during food processing polycyclic aromatic hydrocarbons, nitrosamines, veterinary drug residues and melamine contaminations, Pesticide residues in food

Recommended Readings:

1. Branen, A. L., Davidson, P. M. and Salminen, S. (2002). *Food Additives*: Marcel Dekker, New York.
2. Wood, R., Foster, L., Damant, A. and Pauline, K. (2004). *Analytical Methods for Food Additives*: Boca Raton, New York.
3. Watson, D. H. (2014). *Food Chemical Safety: Additives*: WP, New Delhi.
4. Steinhart, E., Doyle, M. E. and Cochrane, B. A. (1995). *Food Microbiology and Toxicology*: Marcel Dekker, New York.

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Mapping of course “Food Additives and Contaminants- MTFT-514a-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	1	2	1	2
	CO 2	1	2	1	2	2	2
	CO 3	1	1	1	2	2	2
	CO 4	1	2	1	2	1	3

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UC-MTFT-514b-19: Lab-VI (FOOD ADDITIVES AND CONTAMINANTS)

Total Marks: 50

L	T	P
0	0	4

Objective:

1. To demonstrate the various methods to detect and estimate the food additives.
2. To describe the estimation and identification of contaminants.
3. To exemplify the processing and working of the testing laboratories.

Course Outcome: After the completion of the course, the students will be able to:

1. Grasp the knowledge about the chemical detection and estimation methods of food additives in market food products.
2. Comprehend instrumental techniques of food additives and food contaminants analysis.
3. Differentiate between the natural and synthetic food colors.
4. Understand the processing and working of the testing laboratories.

Course Content:

Detection of non-permitted food additives in market food samples, sweets, ice-creams and beverages products, estimation of antioxidants, Estimation of residual sulphur dioxide in beverages, Estimation of benzoic acid in tomato sauce and fruit beverage, Analysis of edible common salt for moisture content and total chlorides, Determination of caffeine and saccharine by HPLC, Identification of natural colors, Isolation and estimation of synthetic food colors, Estimation of contaminants, chemical residues and aflatoxins, pesticides and heavy metals contaminants in foods, Estimation of pesticide residues in food/water, Visits to the testing laboratories of the food industry, educational institutions and testing centers.

Mapping of course “Lab-VI (Food Additives and Contaminants)- MTFT-523b-18” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	1	3	2	2
	CO 2	2	2	2	3	2	2
	CO 3	1	1	1	2	3	2
	CO 4	1	2	2	2	3	2

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ELECTIVE-II

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UC-MTFT-515a-19: ADVANCES IN POST-HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To illustrate the relationship of Indian economy with respect to the fresh and processed fruits and vegetables and their spoilages.
2. To acquaint with the post-harvest handling technologies of fruits and vegetables to reduce post-harvest losses and their value addition.

Course outcomes: After the completion of the course, the students will be able to:

1. Attain an overview on post-harvest losses and its impact on the Indian economy.
2. Understand about fruit and vegetable physiology, metabolic processes and various nutritional changes in fruits and vegetables along with post-harvest handling techniques.
3. Gain knowledge on different pre-processing operations involved before processing of fruits and vegetables.
4. Develop an understanding on various post-harvest disorders and diseases of fruits, minimising the losses by suitable packaging and minimal processing operations.
5. To development of attitude for new food product based on fruits & vegetables technology.

Course Content:

UNIT-I

Fruit and vegetable production, classification, structure and composition; Importance and scope of post-harvest management of fruits and vegetables in Indian economy, Pre-harvest factors affecting post-harvest quality, post-harvest losses, Maturity indices and standards for selected fruits and vegetables, instrumental methods of maturity determination, standards and specifications for fresh fruits and vegetable, Assessment of Fruit Quality, advances in non-destructive quality measurement of fruits and vegetables.

UNIT-II

Advanced harvesting tools and their design aspects, advances in Post-Harvest Handling operations; Cleaning, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Sorting and grading: Sorting, grading, methods of grading, Size grading, color grading, specific gravity grading, screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance, Separation: Magnetic separator, de stoners, electrostatic separators, pneumatic separators.

UNIT-III

Post-harvest physiological and biochemical changes in fruits and vegetables; ripening of climacteric and non-climacteric fruits; changes during ripening; Role of ethylene in fruit ripening, ripening chambers, Field heat of fruits and vegetables and primary processing operations Post harvest treatments, advances in pre-cooling, equipment Commodity pretreatments-chemicals, types of coating, pre-packaging, irradiation, blanching, peeling and other pre-processing operations;

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transportation and storage operations, Mechanism and Advances in CA and MA, hypobaric storage, cold storage design, Zero energy cool chamber

UNIT-IV

Post-harvest disorders chilling injury and diseases, Biological, Physical and Chemical Control of postharvest Diseases, advances in drying and packaging of fruits and vegetables, cushioning materials used in packaging of fresh fruits, Minimal processing.

Recommended readings:

1. Haard, N.F. and Salunkhe, D.K. (1975). *Postharvest Biology and Handling of Fruits and Vegetable*: AVI, Westport.
2. Kader, A. A. (1992). *Post-harvest Technology of Horticultural Crops*, (2ed.): University of California, Division of Agriculture and National Resources, California.
3. Salunkhe, D.K. and Kadam, S.S. (2005). *Handbook of Fruit Science and technology, Production, Composition, Storage, and Processing*: Marcel Dekker, USA.
4. Thompson, A.K. 1995. *Post-Harvest Technology of Fruits and Vegetables*: Blackwell publication.
5. Wills-Ron B.H. and Golding, J.B. (2015). *Advances in Postharvest Fruit and Vegetable Technology*: Taylor and Francis, CRC Press.
6. Siddiqui, M. W., (2015). *Post-Harvest Biology and Technology of Horticultural Crops: Principles and Practices for Quality Maintenance*: Apple Academic Press Inc.
7. Alzamora, S.M., Tapia, M. S. and Lopez- Malo, A., (2005), *Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications*: Springer.
8. Arthey, D. and Ashwat P.R. (2005). *Fruit Processing: Nutrition, Products, and Quality Management*, (2 ed.): Springer.

Mapping of course “Post-Harvest Technology of Fruits and Vegetables – MTFE-515a-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
		Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	3	2	3	2	2
	CO 2	1	2	3	3	2	1
	CO 3	1	1	2	3	2	2
	CO 4	1	2	2	2	2	1

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UC-MTFT-515b-19: Lab-III (POST-HARVEST TECHNOLOGY OF FRUITS & VEGETABLES)

Total Marks: 50

L	T	P
0	0	4

Objectives:

1. Practical exposure of students in the area of post-harvest technology of fruits and vegetables.
2. To acquaint the students regarding effects of pre-processing treatments on shelf-life of fruit.
3. To understand the techniques of processing & preservation of fruits and vegetables.

Course Outcomes: On completion of the course the students are expected to:

1. Identify the specific processing technologies used for vegetable, fruits and products derived from these materials.
2. Understand the application of scientific principles in the processing technologies, product specification and regulations.
3. Study the changes in the composition of the raw material with respect to the type of processing technology used.
4. Determine the effects of pre-cooling and types of storage on quality and shelf-life of fruits and vegetables.

Course Content:

Studies on morphological features of some selected fruits and vegetables, maturity indices and quality evaluation of fresh fruits, physico-chemical analysis of fresh fruits, Effects of pre-cooling and types of storage on quality of fruits and vegetables, studies on use of chemicals for ripening and Studies of regulations of ripening of banana, mango, papaya etc., Effects of pre-processing treatments on shelf-life of fruit, edible coating, preparation of fruit juice concentrate, powders and their quality evaluation, estimation of browning and various pigments in pulp and products, estimation of chemical additives in processed fruit products, dehydration of fruits and measurements of dehydration and rehydration ratio, Studies on minimal processing of fruits.

Mapping of course “Lab-III (Post-Harvest Technology of Fruits & Vegetable) – MTFT-515b-18” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	3	2	3	1	2
	CO 2	2	3	2	3	2	1
	CO 3	1	1	2	2	1	1
	CO 4	3	1	2	2	1	1

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UC-MTFT-516a-19: ADVANCES IN CEREAL SCIENCE AND TECHNOLOGY

Total Marks: 100

L	T	P
4	0	0

Objective:

1. To illustrate the recent developments in the cereals science and technology.
2. To explain modern processing techniques of cereals in food industries.
3. To impart knowledge regarding various processed product lines in food industries.

Course Outcome: On successful completion of the subject, the students will be able to:

1. Comprehend the recent advancement in the major cereal grains quality and processing aspects.
2. Understand the mechanism underlying the interaction of various flour components and their role in end use quality.
3. Grasp the basic and advanced milling methods for wheat, rice, maize.
4. Know about by-product utilization of various grains.

Course Content:

UNIT-I

Present status and future prospects of cereal grains in India, food grain production and consumption trends. Coarse grain processing. Wheat kernel structure, wheat grading, roller flour milling, influence of wheat type and grain quality on flour yield, grain hardness and its relevance to end product quality, advances in wheat cleaning, conditioning and milling, wheat flour component interactions (protein-starch, protein-lipid and starch-lipid) and their influence on end product quality, advances in isolation, biochemical characterization, micro-structural and functionality of wheat gluten proteins.

UNIT-II

Advances in role of wheat proteins in dough and gluten visco-elasticity, micro-structure of dough, conversion of dough foam structure to bread sponge structure during bread baking, concept of gas retention in wheat dough during fermentation and baking, advances in bread making processes, effect of wheat components and ingredients on the growth of yeast during fermentation operation, bread staling and its prevention, production of variety biscuits, breads and pasta products.

UNIT-III

Paddy varieties, their composition and quality characteristics, advances in methods of paddy parboiling, advantages and limitation of parboiling, paddy dehusking processes, Rice ageing, accelerated ageing, modern rice milling, factors affecting head rice yields and losses at different stages of milling, rice mill machinery, Rice based products and their quality. Methods of rice bran oil extraction and refining.

UNIT-IV

Dry and wet milling of maize, modern methods of maize processing, gluten and starch separation, maize starch conversion into value added products, acid hydrolysis, enzyme hydrolysis, processing for dextrose, malto-dextrin and other products, Barley varieties, composition and quality characteristics, malting process and industrial applications of barley malt and malt products.

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Recommended Readings:

1. Kulp K. & Ponte J. G. (2014). *Handbook of Cereal Science & Technology*, 2nd edition: CRC press.
2. Wrigley C.W. & Batey I. L. (2010). *Cereal grains, assessing and managing quality*, CRC press.
3. Dendy D. A. V. & Dobsasoczyk B. J. (2001). *Cereal and Cereal Products, Chemistry and Technology: An ASPEN publication*.
4. Owens G. (2000). *Cereal Processing Technology*: CRC Press.
5. Faridi H. & Faubin J. M. (1997). *Dough Rheology & Baked product Texture*: CBS Publishers.

Mapping of course “Advances in Cereal Science and Technology- MTFT-516a-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	2	2	3	1	1
	CO 2	2	2	2	3	1	1
	CO 3	2	2	2	3	1	1
	CO 4	2	2	2	2	2	2

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UC-MTFT-516b-19: Lab-IV (CEREAL SCIENCE AND TECHNOLOGY)

Total Marks: 50

L	T	P
0	0	4

Objective:

1. To learn the techniques to assess the quality of cereal grains and processed food products.
2. To illustrate the dough rheological properties.

Course Outcome: On successful completion of the subject, the students will be able to:

1. Understand the recent methods of quality assessment of raw materials.
2. Knowledge about rheological characterization of dough through advanced rheological instruments.
3. Aware of role of ingredients and processing parameters on processed products.
4. Understand methods to evaluate the processed food quality.

Course Content:

Grading of wheat varieties, milling quality of hard and soft wheat varieties, effect of conditioning on the flour extraction rates, effect of grains parameters on the flour yield and quality, quality assessment of wheat gluten, damaged starch and bread flour quality, effect of damaged starch of flour on biscuit quality, factors affecting water absorption of wheat flour, effect of ingredients and processing parameters of yeast growth, assessment of dough rheology using dough Lab and mixolab, bread, biscuits, noodles making potential of different wheat flours, quality assessment of bakery products.

Mapping of course “Lab-IV (Cereal Science and Technology)- MTFT-516b-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	1	2
	CO 2	2	3	1	3	2	1
	CO 3	1	2	2	3	2	2
	CO 4	2	2	2	2	2	1

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SEMESTER SECOND

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UC-MTFT-521-19: ADVANCED FOOD PROCESS TECHNOLOGY

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To acquire knowledge of emerging / alternative technologies applied to food processing.
2. To enable a student to know the relative advantages / disadvantages over existing technologies.
3. To understand the economics and commercialization of newer technologies.
4. To study about microbial safety of foods by emerging methods.

Course Outcome: On completion of the subject, the students will be able to:

1. Develop an appreciation about need of different emerging techniques used in food processing and preservation.
2. Apply their knowledge on high pressure processing, pulsed electric processing, irradiation and hurdle technology in various food industries.
3. Understand the concepts related to membrane technology, supercritical fluid extraction and quality assessment of food using ultrasonic techniques.
4. Get an overview on principles, mechanism and application of nanotechnology in food.

Course Content:

UNIT-I

Membrane Technology: Introduction to pressure activated membrane processes, RO/UF/NF applications and technology, Food Irradiation: radiation sources, absorbed dose, regulations, advantage and limitations of food irradiation - nutritional and microbiological changes in irradiated foods.

UNIT-II

Supercritical Fluid Extraction: Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application, Microwave Energy in Foods: working principle of magnetron, microwave blanching, sterilization and finish drying, Ohmic and Ultrasound Processing of Foods: Principle of ultrasound – fundamentals – ultrasound as a processing and preservation method–Effect on properties of foods, Properties and generation of ultrasonic, ultrasonic imaging, application of ultrasonic as an analytical tool and processing techniques, Basics of ohmic heating, electrical conductivity- generic configurations-treatment of products.

UNIT-III

High Pressure Processing of Foods: Principles and concept – applications to food systems effect on quality, textural, Nutritional and microbiological quality – factors affecting the quality, applications in food processing, Pulsed Electric field Processing of Food(PEF): Principles Mechanism of action-PEF treatment systems, main processing parameters – PEF Technology – equipments – mechanism of microbial and enzyme inactivation- safety aspects– processing of liquid foods using PEF –process models – comparison of high pressure processing and PEF –Enzymatic inactivation by PEF, examples – microbiological and chemical safety of PEF foods, Oscillating magnetic field.

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UNIT-IV

Hurdle Technology: Concept, chemical and biochemical hurdles- organic acids–plant derived antimicrobials, Antimicrobial enzymes, bacteriocin, applications of hurdle technology, Advanced Techniques in Food Processing: Application of technologies of high intensity light, Nanotechnology: Principles and mechanism Radio-frequency heating and drying applications; Hybrid drying technologies- combined microwave vacuum drying, combining microwave vacuum drying with other processes.

Recommended Readings:

1. Sun, Da-Wen (2005). *Emerging Technologies for Food Processing*: Academic Press.
2. Barbosa- Canovas, G. V., Tapia, M. S. and Cano, M. P. (2004). *Novel Food Processing Technologies*: CRC Press.
3. Leistner L. and Gould G. (2002). *Hurdle Technologies –Combination Treatments for Food Stability, Safety and Quality*: Kluwer Academics /Plenum Publishers, New York.

Mapping of course “Advanced Food Process Technology- MTFT–521-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	2	1	3	2	2
	CO 2	3	2	2	3	1	1
	CO 3	3	2	2	3	1	1
	CO 4	2	2	2	2	1	1

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UC-MTFT-522-19: ADVANCES IN FOOD ANALYSIS

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To develop an understanding about the advanced analytical and instrumental techniques.
2. To illustrate the principle and mechanism of analytical instruments.
3. To describe bio-chemical analysis of food components.

Course Outcomes: After the completion of the course, the students will be able to:

1. Have a thorough knowledge about the applications various analytical and instrumental techniques.
2. Understand the mechanisms and principle behind various analytical techniques.
3. Acquaint with the spectroscopic and microscopic techniques
4. Grasp technical exposure in chromatographic techniques
5. Comprehend the field of electrophoresis and PCR-based analysis of DNA

Course Content:

UNIT-I

Spectroscopy: UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometry, Fluorescence spectroscopy, Emission spectroscopy, Mass-spectroscopy, Fourier Transform Infra-Red.

UNIT-II

Methods of separation and analysis of biochemical compounds and macromolecules: Principles and applications of Gas Chromatography, High Performance Liquid Chromatography, Thin layer chromatography.

UNIT-III

Microscopic techniques: Light microscopy, Scanning electron microscopy, Transmission electron microscopy, particle size analysis, Thermal techniques in food analysis: Differential scanning calorimetry and Thermo gravimetric analysis.

UNIT-IV

Electrophoresis: Different kinds of electrophoresis, western blotting, gel documentation, DNA analysis: DNA purification, PCR-based analysis, DNA fingerprinting.

Recommended Readings:

1. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier
2. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* (3 ed.): CBS Publications, New Delhi.
3. Winton, A. L. (2001). *Techniques of Food Analysis*: Agrobios, Jodhpur.
4. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
6. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons.

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Mapping of course “Advances in Food Analysis- MTFT-522-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	1	1
	CO 2	2	2	2	3	1	1
	CO 3	2	2	2	3	1	1
	CO 4	2	2	2	3	1	1
	CO 5	2	2	2	3	1	1

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UC-MTFT-527-19: Lab-VI (ADVANCES IN FOOD ANALYSIS)

Total Marks: 50

L	T	P
0	0	4

Objectives:

1. To demonstrate the applications of current analytical and instrumental techniques.
2. To describe the advanced analytical methods.
3. To illustrate principle and mechanism of analytical instruments.

Course Outcomes: After the completion of the course, the students will be able to:

1. Grasp basic preparation of solutions and buffers.
2. Perceive advanced analytical methods.
3. Understand the functioning and principle of various analytical instruments
4. Interpret the spectrophotometric and chromatographic techniques.
5. Comprehend microstructural and DNA isolation techniques.

Course Content:

Preparation of solutions and buffers, Determination of titratable acidity in foods using a potentiometric titration, Diastatic activity of honey, UV-Visible Spectro-photometric analysis of a carotenoid, determination of hydroxymethylfurfural in honey, Atomic absorption spectroscopic analysis of heavy metals in foods, Secondary structure analysis of starch and proteins using Fourier Transform Infra-Red (FTIR), Gas chromatography (GC) quantification of alcohol content in beverages using the internal standard method, High performance liquid chromatography (HPLC) quantification of sugars in foods and beverages, Separation and identification of food constituents using HPLC, thin layer chromatography (TLC) of food colors, Microstructural and partial size analysis of starch, Determination of thermal properties of food samples, Extraction of different types of proteins and identification using electrophoresis, DNA isolation and fingerprinting of plant tissues.

Mapping of course “Lab-I (Advances in Food Analysis)- MTFT-527-19”outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	2	1	1
	CO 2	2	2	3	3	2	2
	CO 3	3	2	3	3	2	2
	CO 4	3	2	2	3	1	1
	CO 5	3	2	2	3	1	1

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ELECTIVE-III

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UC-MTFT-523a-19: NOVEL FOOD PACKAGING

Total Marks: 100

L	T	P
4	0	0

Objective:

1. The purpose of this course is to explain the various recent techniques of food packaging, applications, principles and requirements of these techniques.
2. Identify the purpose, principle and advance knowledge related to the various packaging technology systems.
3. Awareness of students about the recycling of packaging materials, biodegradable packaging materials and safety and legislative aspects.

Course Outcome: On successful completion of the subject, the students will be able to:

1. Comprehend advance knowledge on the properties and production of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality
2. Understand various types of scavengers and emitters for improving the food shelf life.
3. Learn about consumer response about new packaging systems and safety and legislative requirements
4. Acquaint about food-package interaction between package-flavour, gas storage systems for food storage, recycling and use of green plastics for reducing the pollution and their effect on food quality.

Course Content:

UNIT-I

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: Oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

UNIT-II

Advantages of non-migratory bioactive polymers, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, defining and classifying time temperature indicators (TTIs), requirements for TTIs, development of TTIs, maximizing the effectiveness of TTIs to monitor shelf-life during distribution, use of freshness indicator in packaging: Compounds indicating the quality of packaged food products, pathogen indicators, moisture regulation: Silica gel, clay, molecular sieve, humectants, irreversible adsorption.

UNIT-III

Developments in modified atmosphere packaging (MAP): Novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, Applying high O₂ MAP. Combining MAP with other preservation techniques, packaging-flavor interactions: Factors affecting flavor absorption, role of the food matrix, role of differing packaging materials.

UNIT-IV

Modern packaging systems: Green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, Integrating intelligent packaging:

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role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and time temperature indicators, traceability: radio frequency identification, recycling packaging materials: recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, methods for testing consumer responses to new packaging concepts.

Recommended Readings:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.
2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*: CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.

Mapping of course “Novel Food Technology- MTFE-523a-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	1	1
	CO 2	2	2	2	3	1	1
	CO 3	1	2	2	2	1	2
	CO 4	1	2	1	2	2	1

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

UC-MTFT-523b-19: Lab-V (NOVEL FOOD PACKAGING)

Total Marks: 50

L	T	P
0	0	4

Objective:

1. To provide practical knowledge of various recent techniques
2. To illustrate fundamental understanding of food packaging techniques used in industries.

Course Outcome: On successful completion of the subject, the students will be able to:

1. Understand different types of food packaging materials.
2. Aware of symbols used in food industries.
3. Understand the role and effectiveness of various packaging systems.
4. Shelf life evaluation of packaged foods.

Course Content:

Testing of properties of different packaging materials (paper, plastic, glass and metal), study of symbols and labels used on food packages, vacuum packaging, form-fill- seal packaging, determination of changes in packaged foods, packaging of foods under different conditions, preparation and application of edible coatings, comparative evaluation of different packages for fragile foods, estimation of shelf life of food under different packaging materials.

Mapping of course “Lab-V (Food Packaging)- MTFT-523b-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	1	2
	CO 2	1	1	1	2	2	2
	CO 3	1	2	2	2	2	2
	CO 4	2	1	2	2	2	1

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Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To impart the concept of nutraceuticals and functional ingredients in foods, and to determine their role in health and disease prevention.
2. To learn about various phytochemicals-their sources, functions and usefulness.
3. To understand basics of Extraction methods of Phyto-chemicals and development of functional foods.
4. To study the usefulness and effects of Probiotics & Prebiotics in gastrointestinal health.

Course outcomes: On completion of the subject, the students will be able to:

1. Acquire knowledge on various bio molecules showing health benefits.
2. Understand various physiological and biochemical aspects of life threatening and chronic diseases.
3. Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
4. Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Course Content:

UNIT-I

Nutraceuticals and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc.

UNIT-II

Photochemical and their usefulness: Antioxidants and Flavonoids, Omega-3 Fatty Acids, Carotenoids, Dietary fibres, Phytoestrogens, Glucosinolates, Organosulphur Compounds etc. their effectiveness in specific disease conditions; other functional ingredients in foods such as peptides, fatty acids, Cereal products as functional foods – oats, wheat bran, rice bran etc, Functional vegetable products, oil seeds, sea foods and sea weeds, antimicrobial compounds, Coffee, tea and other beverages as functional foods/drinks and their protective effect, Effects of processing, storage and interactions of various environmental factors on the potentials of such foods, health benefits.

UNIT-III

Extraction of Phyto-chemicals and development of functional foods: Extraction methods for maximum recovery, Stability studies, Developing functional foods, Use of bioactive compound in appropriate form with protective substances and activators, Effect of environmental conditions in food matrix on activity of bioactive compound, Effects of processing conditions and storage, Development of biomarkers to indicate efficacy of functional ingredients, delivery of immune-modulators/vaccines in functional foods.

UNIT-IV

Prebiotics and Probiotics: Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits, Examples of useful microbes and their benefits, Prebiotic ingredients in foods, types of prebiotics and their effects on gut microbes, Probiotic foods and their functional role, Marketing and regulatory issues for functional foods and nutraceuticals.

IK Gujral Punjab Technical University
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Recommended readings:

1. Mine, Y and Fereidoon, S. (2006). *Nutraceutical Proteins and Peptides in Health and Disease*: TF, Boca Raton.
2. Bagchi, D. (2008). *Nutraceutical and Functional Food Regulations in United States and Around the World*: Elsevier, London.
3. Shi, J. (2007). *Functional Food Ingredients and Nutraceuticals: Processing Technologies*: CRC Press, London.
4. Guo, M. (2009). *Functional Food: Principles and Technology*: WP, New Delhi.

Mapping of course “Nutraceuticals and Functional Foods- MTFT-524a-19” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	2	1
	CO 2	1	2	2	3	2	1
	CO 3	1	2	2	3	1	1
	CO 4	1	3	2	2	1	2

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Total Marks: 50

L	T	P
0	0	4

Objectives:

1. To gain knowledge about the nutraceutical constituents present in various food products.
2. To understand the techniques of analysis plant based nutraceuticals.
3. To prepare and evaluate probiotic foods.
4. To acquire knowledge on estimation and identification of nutraceutical and functional food compounds by various advanced analytical techniques.

Course Outcome: On completion of the subject, the students will be able to:

1. Acquire knowledge on various nutraceutical components and their health benefits.
2. Understand various extraction and estimation methods of nutraceuticals.
3. Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
4. Study and demonstrate various aspects regarding safety, quality and toxicology of food products including, nutraceutical and functional foods.

Course Content:

Extraction and estimation of nutraceuticals, isoflavones, capsaicinoids, organosulfur cereals and monosaturated fatty acids and lecithins, Isolation and determination of lycopene in tomato and tomato products, Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques, Preparation and evaluations of probiotic foods, Extraction, estimation and identification of nutraceutical and functional food compounds by GLC and HPLC, Study and demonstration of the antimicrobial effects of plant tannins, alkaloids and sulfur compounds, Market survey of existing functional foods, study of labels of existing health foods.

Mapping of course “Lab-VI (Nutraceuticals and Functional Foods)- MTFT-524b-18” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	2	2
	CO 2	2	2	2	3	1	2
	CO 3	3	2	3	3	2	1
	CO 4	2	2	2	2	2	2

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ELECTIVE-IV

UC-MTFT-525a-19: TECHNOLOGY OF FROZEN FOODS

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

Total Marks: 100

L	T	P
4	0	0

Objectives:

1. To understand important aspects of freezing such as thermo physical properties, glass transition temperature, microbiology of frozen food, freezing loads and freezing time calculations.
2. To acquire in depth knowledge on cold chain facility for the frozen foods and innovations in the freezing processes.
3. To study on quality and safety of frozen foods and learn about various techniques to measure and control the quality of frozen foods.
4. To understand suitability of different packaging materials for frozen foods.

Course Outcome: On completion of the subject, the students will be able to:

1. Acquire knowledge on different properties and microbiology of frozen foods.
2. Understand calculations of freezing load, freezing time, glass transition temperature phenomenon in frozen foods and its manipulation.
3. Know about different freezing methods, equipment and transportation of frozen foods.
4. Gain knowledge on quality and safety of different frozen foods.

Course Content:

UNIT-I

Food freezing :importance and potentialities, nutritive values of frozen foods, Microbiology of frozen foods , Freezing methods and equipment, sharp freezers the Quick freezing systems –Freezing cabinets and walk in freezers, Frozen food locker plants, Glass transitions in frozen foods and biomaterials, Thermo-physical properties of frozen foods, Freezing loads and Freezing time calculation, Innovations in freezing process.

UNIT-II

Cold Chain: Cold store design and maintenance, Packaging and machineries, Transportation, Retail display equipments and management, Household refrigerators and freezers, Monitoring and control of the cold chain, Cold storage and thawing of foods – Adaptability of vegetables to freezing, preparation and freezing of meat, poultry and fish, freezing of Dairy products, precooked frozen foods, storage of frozen food.

UNIT-III

Quality and Safety of Frozen Foods: Importance of quality control and standards in the frozen food industries, Quality and safety of frozen meat and meat products, frozen fish, Shellfish, and related products, frozen vegetables, frozen fruits, frozen dairy products, frozen ready meals, frozen bakery products, frozen eggs and egg products, Sensory analysis of frozen foods, Monitoring and Measuring Techniques for Quality and Safety, Chemical Measurements, Food borne illnesses and detection of pathogenic microorganisms, Shelf-life prediction of frozen foods.

UNIT-IV

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Packaging of Frozen Foods: Introduction to frozen food packaging, Plastic packaging of frozen foods, Paper and card packaging of frozen foods, Packaging of frozen foods with other materials, Packaging machinery.

Recommended readings:

1. Sun, Da-Wen (2012). *Handbook of Frozen Food Processing and Packaging*: Taylor & Francis, United State of America.
2. Kennedy, C. J. (2000). *Managing Frozen Foods*: CRC Press, New York.
3. Potter, S. (2006). *Food Science*: Sage, New Delhi.

Mapping of course “Technology of Frozen Foods- MTFT-525a-18” outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	2	1	2
	CO 2	1	2	2	3	1	2
	CO 3	2	2	2	3	1	1
	CO 4	1	1	2	3	2	2

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M. Tech of Food Technology (Batch 2019 onward)

Total Marks: 50

L	T	P
0	0	4

Objectives:

1. To determine effective cooling and freezing time.
2. To evaluate frozen food quality and their shelf life.
3. To standardize methods for preparation of frozen vegetables.
4. To understand suitability of different packaging materials for packing of frozen foods.

Course Outcome: On completion of the subject, the students will be able to apply their knowledge on:

1. Cold storage of perishable products and their quality evaluation.
2. Calculating freezing load and freezing time for different foods.
3. Determination of mineral impurities in frozen food.
4. Packaging of frozen food and their shelf life evaluation.

Course Content:

Determination of effective freezing time, cooling and half cooling time, Quality evaluation of frozen foods, mechanism and driving force for freezer burn, adequacy of thawing, Demonstration of components of a refrigerator, Standardization of procedure for preparation of frozen peas and corn, Frozen food packaging and shelf –life evaluation, Tests of adequacy of blanching of raw material before freezing, Mineral impurities in frozen vegetables, Color grading of fresh and frozen fruit juices, Packaging of frozen food.

Mapping of course “Lab-VI (Frozen Food Technology)- MTFT-525b-19”outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	2	1
	CO 2	3	2	2	3	1	2
	CO 3	2	2	2	2	1	2
	CO 4	2	2	2	3	2	2

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Total Marks: 100

L	T	P
4	0	0

Objective:

1. To understand the importance of livestock, egg and poultry industry.
2. To describe structure, composition and nutritional quality of animal products.
3. To comprehend the various post-mortem changes related to muscle and various other tissues.
4. To illustrate the processing technology of meat, poultry, fish and eggs.
5. To explain value addition and packaging of meat, fish and poultry products.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the technology for raw material characteristics, handling, processing, and preservation.
2. Grasp by-product utilization of meat, poultry, fish and egg products.
3. Apprehend the hygiene, sanitation and mechanized practices of meat, fish, poultry and egg industry.
4. Comprehend the food standards in relation to these food commodities.
5. Perceive the knowledge regarding transportation and storage practices.
6. Prepare various value added products.

Course Content:

UNIT-I

Production, Processing and consumption trends, Prospects of meat industry, Meat spoilage, Endogenous and exogenous infections, Hygiene and sanitation, Meat composition from different sources, Post-mortem muscle chemistry and composition, Intramuscular fat, Rigor mortis, The conversion of muscle into meat: Animals' stunning methods, ante-mortem and post-mortem examination, Design of handling facilities: Slaughtering and dressing, Consequences of circulatory failure, Proteolytic and other chemical changes, Operational factors affecting meat quality, Effects of processing on meat tenderization, Chilling, freezing and preservation, prepared meat products, intermediate moisture and dried meat products, The eating quality of meat: color, flavors and retention, water holding capacity, juiciness, texture and taste, meat eating and health, Inedible by-products.

UNIT-II

Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products

UNIT-III

Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling.

UNIT-IV

Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks, Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other by-products

IK Gujral Punjab Technical University
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Recommended Readings:

1. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6 ed.): Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology*: Champan& Hill, London.
3. Carmen, R. O. and George, J. M. (1997). *Poultry Meat and Egg Production*: CBS Publications, New Delhi.
4. Winton, A. L. and Barberwinton, K. (1999). *Fish and Fish Products*: Agrobios, Bikaner.
5. Winton, A. L. and Winton, K. B. (1993). *The Structure and Composition of Animal Product*: Agro Botanical, Bikaner.

Mapping of course “Advanced Meat, Fish, Poultry and Egg Technology- MTFT-617-18”outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	1	2
	CO 2	2	1	2	3	1	2
	CO 3	3	2	2	2	2	2
	CO 4	2	2	2	2	3	2
	CO 5	2	2	2	2	1	2
	CO 6	2	2	1	3	2	2

SEMESTER THIRD

UC-MTFT-614-19: Dissertation-I

L	T	P
0	0	8

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The student is required to prepare his/her research project synopsis and should make a presentation to the DRC before the commencement of the final examination of third semester.

ELECTIVE-V

UC-MTFT-611-19: FOOD RHEOLOGY AND TEXTURE

Total Marks: 100

L	T	P
4	0	0

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

Objective:

1. To understand the concepts of food rheology and food texture
2. To depict rheological properties of foods and measuring methods.

Course Outcome: After the completion of the course, the students will be able to:

1. Comprehend various rheological and textural properties of solid and liquid foods.
2. Apprehend different models and tests related to food rheology.
3. Grasp knowledge regarding various instruments used in determination of food rheology.

Course Content:

UNIT-I

Food rheology concept, scope of food rheology, texture of foods – type of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson's ratio, definition and importance of texture, texture-related concepts.

UNIT-II

Determination of rheological properties and measuring methods: destructive and non-destructive measurements, creep recovery and stress relaxation, dynamic mechanical tests, Modeling food texture: introduction, factor affecting texture, models to predict texture.

UNIT-III

Rheological properties of fluid food: viscosity, factors affecting viscosity, flow of material- Newton's law of viscosity, viscous fluids (Newtonian fluids, non-Newtonian fluids), plastic fluids (Bingham plastic, non-Bingham plastic fluids), fluid behavior in steady- shear flow: time dependent and time independent material function, viscosity measurement- capillary flow viscometers, orifice type viscometers, falling ball viscometers, rotational viscometers- concentric cylinder (coaxial rotational) viscometers, cone and plate viscometers, parallel plate viscometers, single-spindle viscometers (brookfield viscometer).

UNIT-IV

Rheological properties of solid food: deformation of material, viscoelastic behavior, Failure and glass transition in solid foods: failure in solid foods, glass transition of solids foods (measurement, factors affecting, importance), Texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis, dough testing instruments- farinograph and mixograph, extensograph and alveograph, amylograph.

Recommended readings:

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. *Engineering Properties of Foods*: CRC Press.
2. Heldman, D. R. (2007). *Food Process Engineering*: AVI Publications.
3. Faridi, H. and Faubion, J. M. (1997). *Dough Rheology and Baked Products*: CBS Publications, New Delhi.
4. Rao, M. A. (2007). *Rheology of Fluid and Semisolid Foods: Principles and Applications* (2 ed.): Springer, USA.

Mapping of course "Food Rheology and Texture- MTFT-611-18" outcomes and Program outcomes:

IK Gujral Punjab Technical University
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Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	1	2	3	1	2
	CO 2	3	1	2	2	1	2
	CO 3	2	2	1	2	1	2

UC-MTFT-612-19: BIOPROCESS ENGINEERING

Total Marks: 100

L	T	P
4	0	0

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Objective:

1. To acquaint the students with recent concepts of Bioprocess Engineering.
2. To illustrate the functioning of various devices involved in formation and recovery of bio-processed products.

Course Outcome: After the completion of the course, the students will be able to:

1. Aware of the status of bio-processing in food industry.
2. Comprehend the fermentation technology involving design and processing.
3. Perceive knowledge regarding instrumentation involved in production of bio-processed products.
4. Apprehend about the recovery of bio-processed products.

Course Content:

UNIT-I

Introduction to bioprocessing, historical developments, bioenergetics, enzyme kinetics- Michaelis-Menten model, effect of temperature on reaction rate, microbial growth kinetics- batch culture, continuous culture, fed batch culture and application of fed batch culture, Sterilization and sanitation: thermal death kinetics, medium sterilization (batch and continuous design), sterilization of fermenter, feed and wastes; filter sterilization of media, air and exhaust air; theory of depth filters, isolation, preservation (storage on reduced temp, storage under liquid nitrogen, storage on agar slopes, storage in dehydrated form) and improvement of industrially important micro-organisms.

UNIT-II

Fermenter design- basic functions of fermenters, types of fermenter, construction material, pipes and tubes, valves and steam traps, agitator and impeller, stirrer and bearing (seals and drives), sparger, baffles, achievement and maintenance of aseptic conditions (sterilization of air, exhaust gas and fermenter), sampling port, controlling devices.

UNIT-III

Product recovery- foam separation, precipitation, filtration (batch, continuous, cross flow filtration), filter aids, filtration equipment, filtration theory, centrifugation, centrifuge equipment, centrifugation theory, liquid- liquid extraction- solvent recovery, two phase aqueous extraction, supercritical fluid extraction, chromatography, (adsorption chromatography, gel permeation, ion exchange chromatography, HPLC, RPC, continuous chromatography), membrane processes (ultrafiltration, reverse osmosis, liquid membranes), drying, crystallization, whole broth processing.

UNIT-IV

Bioprocess instrumentation- Offline analytical methods, physical, chemical and biosensors, online sensors.

Recommended readings:

1. Doran, P. M. (1995). *Bioprocess Engineering Principles*: Academic press, New Delhi.
2. Shuler, M. L. (2002). *Bioprocess Engineering Basic Concepts* (2 ed.): PHI, New Delhi.
3. Sablani, S. S., Rahman, M. S., Datta, A. K. and Mujumdar, A. S. (2007). *Handbook of Food and Bioprocess Modeling Techniques*: CRC Publications, New York.

Mapping of course “Bioprocess Engineering- MTFT-612-18” outcomes and Program outcomes:

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Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	2	2	1
	CO 2	2	2	1	3	1	2
	CO 3	2	2	2	2	1	2
	CO 4	1	2	2	3	1	2

OPEN ELECTIVES

Business Analytics
Course objective

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1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT VI

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

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4. Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVES
Industrial Safety

UNIT I

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, Model Curriculum of Engineering & Technology PG Courses [Volume-I] principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES

Operations Research

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2019 onward)

Teaching Scheme : Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to

1. Students should be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students should be able to apply the concept of non-linear programming
3. Students should be able to carry out sensitivity analysis
4. Student should be able to model the real world problem and simulate it.

Course Contents:

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

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UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective
Cost Management of Engineering Projects

IK Gujral Punjab Technical University
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Teaching scheme :Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing. Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective
Composite Materials

Teaching scheme : Lecture: - 3 h/week

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UNIT-I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. **Manufacturing of Ceramic Matrix Composites:** Liquid Metal Infiltration – Liquid phase sintering. **Manufacturing of Carbon – Carbon composites:** Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and preregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective

Waste to Energy

Teaching scheme : Lecture: - 3 h/week

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Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion – Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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SEMESTER FOURTH

IK Gujral Punjab Technical University
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UC-MTFT-621-19: Dissertation-II

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A student is required to undertake a Research Project of 16 credits on a topic approved by the supervisor and the Departmental Research Committee (DRC). The research project shall be evaluated by the external examiner at the end of the Semester IV.

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AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

Course content

UNIT I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT III

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT V

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT VI

useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
Model Curriculum of Engineering & Technology PG Courses [Volume-I] [41]

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course content

UNIT I

Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Type And Magnitude.

UNIT II

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV

Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal book Company. Model Curriculum of Engineering & Technology PG Courses [Volume-I] 42]
2. Sahni, Pardeep Et. Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

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AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects . enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course content

UNIT I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II

Order ,Introduction of roots, Technical information about Sanskrit Literature

UNIT III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

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AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course content :

UNIT I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Suggested reading

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

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AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course content:

Unit I

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT II

Philosophy of the Indian Constitution: Preamble ,Salient Features

UNIT III

Contours of Constitutional Rights & Duties: Fundamental Rights ,Right to Equality ,Right to Freedom , Right against Exploitation ,Right to Freedom of Religion ,Cultural and Educational Rights, Right to Constitutional Remedies Directive Principles of State Policy ,Fundamental Duties.

UNIT IV

Organs of Governance: Parliament ,Composition ,Qualifications and Disqualifications Powers and Functions, Executive , President , Governor, Council of Ministers ,Judiciary, Appointment and Transfer of Judges, Qualifications ,Powers and Functions

UNIT V

Local Administration: District's Administration head: Role and Importance,, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT VI

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

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1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. Discuss the passage of the Hindu Code Bill of 1956.

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AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- 2.. Identify critical evidence gaps to guide the development.

Course content:

UNIT I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education Conceptual framework, Research questions. Overview of methodology and Searching.

UNIT II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT III

Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV

Professional development: alignment with classroom practices and follow-up support ,Peer support ,Support from the head teacher and the community. Curriculum and assessment ,Barriers to learning: limited resources and large class sizes

UNIT V

Research gaps and future directions Research design ,Contexts , Pedagogy, Teacher education ,Curriculum and assessment Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes

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Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- 2..What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

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AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Course content:

UNIT I

Definitions of Eight parts of yog. (Ashtanga)

UNIT II

Yam and Niyam. Do's and Don't's in life. ,Ahinsa, satya, astheya, bramhacharya and aparigraha , Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III

Asan and Pranayam: Various yog poses and their benefits for mind & body ,Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

1. 'Yogic Asanas for Group Training-Part-I' :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

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AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course content:

UNIT I

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (don't's)
- Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties.

- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, . Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.