

PUNJABI UNIVERSITY,

PATIALA, PUNJAB, INDIA

(Established under Punjab Act No. 35 of 1961)



Syllabi

for

**MASTER OF VOCATION (M.Voc.)
(FOOD PROCESSING)**

PART 2 (Semester III & IV)

PROGRAMME CODE: FDPM2PUP

FOR
Session 2022-23, 2023-24

Under

CHOICE BASED CREDIT SYSTEM

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

By

SCHEME & SYLLABUS

MASTER OF VOCATION

M. Voc. (FOOD PROCESSING) PART II

(Semester III)

Programme Code: FDP2PUP

Session: 2022-23, 2023-24

Code	Course	Course Option	Credits (Theory + Practical)	Total Marks (Ext.+ Int.+ Prac.)
FDP2101 C	Food Product Development, Entrepreneurship and IPRs	Core VII	4+3=7	150 (74+26+50)
FDP2102 C	Food Packaging and Marketing	Core VIII	4+3=7	150 (74+26+50)
FDP2103 C	Advances in Fruit, Vegetable and Beverage Technology	Core IX	4+3=7	150 (74+26+50)
FDP2104C	Food Supply Chain and Statistics	Elective III	4+3=7	150 (74+26+50)
FDP2105C	Waste Management in Food Industry			
Option ii	Industrial Visit		2	Satisfactory/ unsatisfactory
			Total Credits=30	Total Marks= 600

MASTER OF VOCATION
M. Voc. (FOOD PROCESSING) PART II
(Semester IV)

Programme Code: FDPMM2PPUP

Session: 2022-23, 2023-24

Code	Course	Course Option	Credits Practical	Total Marks (External + Internal)
FDPMM 2201 L	Industrial/Institutional Project/Training	Core X	30	200 (100+100)*
	NSQF Level 9 (As per National Skill Qualification Framework)			Evaluation will be done by FICSI (Food Processing sector Skill Council of India)
			Total Credits=30	Total Marks= 200

*Distribution of marks for Industrial/Institutional Project/Training evaluation of is as following

Assessment Criteria	Parameters	Percentage
Internal (Total Marks-100)	Attendance	20%
	Content Assessment	80%
	Presentation	25%
External (Total Marks-100)	Report Writing	25%
	Subject Content	50%

M. Voc. (FOOD PROCESSING) PART I (Semester III)

Programme Code: FDPMP2PUP

Session: 2022-23, 2023-24, 2024-25

PAPER CODE: FDPMP2101C	FOOD PRODUCT DEVELOPMENT, ENTREPRENEURSHIP AND IPRs
<i>Theory</i> Max. Marks: 74 Credits: 4 Lectures to be delivered: 60 hrs. Time allowed: 3 Hours Pass Marks: 40%	<i>Internal Assessment</i> Max. Marks: 26
	<i>Practical</i> Max. Marks: 50 Credits: 3 Pass Marks: 40%

Instructions for the paper setters: The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section-C consists of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

Instructions for the candidates: Candidates are required to attempt two questions each from sections A and B of the question paper and the entire Section-C.

LEARNING OUTCOMES

On completing this subject, students will be able to:

1. Reflect the role of new product development.
2. Combine theoretical knowledge and practical skills to reproduce existing food products
3. As a part of team, create and evaluate a product using the development process.
4. Students learn about product development process.
5. Student will identify various schemes run by government to promote entrepreneurship and startups in India.
6. This will introduce basic concept involved and protection of intellectual property and related rights.

SECTION-A

1. **Concepts of product development:** Definition and need for product development, factors affecting food product development – corporate factors, market factors, technological pressures, government issues and legislations. Classes and characteristics of new food products. Reformulations. Ethics in food product development.

2. **Product development process:** Stages/ phases of new product development -- idea generation, screening, feasibility studies, consumer research, financial review, product design and formulation. Process development – recipe development and scale-up, consumer trials, market testing. Quality assessment of new developed products – sensory evaluation, shelf life testing. Economic evaluation of product. Product launch. Product life cycle.

SECTION-B

3. **Entrepreneurship:** Role of ministry of food processing industries (MOFPI); Schemes of MOFPI (Pradhan Mantri Kisan SAMPPDA Yojana & PLISFPI), Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Small Business Innovation Reserach Initiative (SBIRI) Importance of woman Entrepreneurship. Start Up India; Atal Innovation Mission (AIMI); NewGen Innovation and Entrepreneurship Development Centre (NewGen IEDC); Dairy Entrepreneurship Development Scheme promoted by National Bank for Agriculture and Rural Development (NABARD); Venture Capital Finance Assistance (VCA) Scheme promoted by Small Farmers' Agri-Business Consortium (SFAC); India Aspiration Fund. FSSAI's Contribution toward Startups.
4. **Intellectual Property Rights:** Need for the Introduction of Intellectual Property Rights regime, benefits of securing IPRs, Indian Legislations for the protection of various types of Intellectual Property, Fundamentals of Patents, Trademarks, Industrial Designs, Copyrights, Geographical Indications, Trade Secrets, Protection of Plant Varieties and Farmers' Rights. Traditional Knowledge and National Biodiversity Board.

REFERENCES

1. Gordon, W. (2011) *New Food Product Development –From Concept to Market place.* CRC Press .
2. Moskowitz, H.R. ; Saguy , I.S. & Straus, T. (2007). *An Integrated Approach to New Food Product* CRC Press.
3. Hisrich R.D & Peters M.P. (2007). *Entrepreneurship. Tata McGraw Hill.*
4. Prentice, H. & Nanban H, (2007). *Fundamentals of Entrepreneurship Management.* CRC Press.
5. Abraham, M.M. (2010). *Entrepreneurship Development and Project Management.* Prakash Publications and Printers.
6. Bare, Act (2013). *Indian Patent Act 1970 Acts & Rules.* Universal Law Pubs.
7. Rao, G.V.(2013). *Intellectual Property Rights: Patent Laws in India.* SSDN Publishers.
8. S.S. Khanka (2001). *Entrepreneurial development .S. Chand and company limited , New Delhi.*
9. Sharma (2017). *Food product development (PB 2018) CBS Publisher & distributors.*



PRACTICALS

1. Preparation of business plan and proposal writing
2. Selection and training of sensory panel.
3. Sensory evaluation of various food products using different scales, score cards and tests.
4. Idea and concept generation for development of new product.
5. To perform ranking tests for taste, aroma color and texture.
6. Entrepreneurial skill assessment test.
7. Techniques of development of entrepreneurial skills, positive self-image and locus of control.
8. Overview of patent data base.
9. Patent search on Indian, US patents and EPO patents.
10. To demonstrate the development of a small-scale vermicomposting bin for commercialization.
11. To study types of food product development.
12. A case study on clinical trials of drugs in India with emphasis on ethical issues.
13. Make presentation regarding successful startup in food technology.
14. Preparation of patent draft assessment.
15. Preparation of feasibility report.

PAPER CODE: FDPM2102C	FOOD PACKAGING AND MARKETING	
<i>Theory</i> Max. Marks: 74 Credits: 4 Lectures to be delivered: 60 hrs. Time allowed: 3 Hours Pass Marks: 40%	<i>Internal Assessment</i> Max. Marks: 26	<i>Practical</i> Max. Marks: 50 Credits: 3 Pass Marks: 40%

Instructions for the paper setters: The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section-C consists of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

Instructions for the candidates: Candidates are required to attempt two questions each from sections A and B of the question paper and the entire Section-C.

LEARNING OUTCOMES

On completing this subject, students will be able to:

1. Impart comprehensive overview of the scientific and technical aspects of food packaging.
2. Instill knowledge on testing and regulations of packaging
3. Demonstrate packaging machineries and systems of food industries.
4. Learn about the basics of food packaging and designing of packages for various foods.
5. Evaluate various packaging materials.
6. Learn and practice packaging of cereals, fruits, vegetables, milk and milk products.
7. Evaluate the shelf life of packaged food.
8. Learn about marketing aspects in food industry.

SECTION-A

1. **Introduction to food packaging:** Need of food packaging, role of packaging in extending shelf life of foods. Different forms of packaging, rigid, and semi-rigid, flexible forms of packaging. Different packaging system for-dehydrated foods, frozen foods, dairy products, fresh fruits, vegetables, meat, poultry, sea foods. Dispatching and sampling plans.
2. **Introduction of packaging materials and machines:** Types of packaging materials their characteristics and uses: paper, plastic, glass, metal. Package accessories and advances in packaging technology- introduction, active packaging, modified atmosphere packaging, aseptic packaging, form & fill sealing machine, aseptic packaging systems, retort pouches, bottling machines, carton making machines, package printing machines. Testing procedures for packaging materials thickness, tensile strength, puncture resistance, bursting strength, seal strength, water vapor permeability, CO₂ permeability, oxygen permeability, grease resistance.

SECTION-B

3. **Basics of food product marketing plan:** Introduction, need of food product marketing. Digital marketing in food industry. Types of marketing labels: natural, processed, organic, local, whole and vegan. Strategies for various food product marketing: cereals, beverages, dairy etc. Product life cycle. Understanding consumer: geographic, demographic, psychographic, behaviour.
4. **Marketing strategies:** Brand awareness, consumer preferences, establishing brand recognition, brand building: banners, advertisements, social media, marketing via sponsorships, digital marketing, disadvantages of food product marketing: misleading nutritional value, exposure of children to fast foods. Recent food marketing trends.



REFERENCES

1. Robertson, G.L. (2013). Food Packaging – Principles and Practice. CRC Press Taylor and Francis Group.
2. Paine, F.A. & Paine, H.Y. (2018). A Handbook of Food Packaging. Blackie Academic and Professional.
3. Coles, R & Kirwan, M.J. (2008). Food Packaging Technology. Blackwell.
4. Robertson, G.L. (2010). Food Packaging and Shelf Life: A Practical Guide. CRC Press Taylor and Francis Group.
5. Hernandez, R. & Cutler, J. (2000). Plastics Packaging: Properties, Processing, Applications, and Regulations. CRC Press.
6. Walter, S. (2014). Fundamentals of Packaging Technology-Fifth Edition. Institute of packaging professionals.
7. Martin, K. & Lindgreen, A. (2009). The New Cultures of Food: Marketing Opportunities from Ethnic, Religious and Cultural Diversity. Routledge.
8. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2015, General Guidelines on sampling. P12-24.

PRACTICALS

1. Identification of plastic films.
2. To find the chemical resistance of the packaging films.
3. To demonstrate vacuum and shrink packaging.
4. Identification of different types of packaging and packaging materials.
5. Determination of tin coating by Clarke's test.
6. Demonstration of can – seaming operation.
7. Measurement of thickness of packaging materials.
8. Determination of grammage of food packaging material.
9. Demonstration of sample taking and dispatching.
10. Determination of wax weight.
11. To demonstrate types of sampling plans.
12. To study product life cycle.
13. To study different steps involved in product development.
14. To study marketing communication process.

PAPER CODE: FDP2103C	ADVANCES IN FRUIT, VEGETABLE AND BEVERAGE TECHNOLOGY	
<i>Theory</i> Max. Marks: 74 Credits: 4 Lectures to be delivered: 60 hrs. Time allowed: 3 Hours Pass Marks: 40%	<i>Internal Assessment</i> Max. Marks: 26	<i>Practical</i> Max. Marks: 50 Credits: 3 Pass Marks: 40%

Instructions for the paper setters: The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section-C consists of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

Instructions for the candidates: Candidates are required to attempt two questions each from sections A and B of the question paper and the entire Section-C.

LEARNING OUTCOMES

On completing this subject, students will be able to:

1. Classify various of fruits and vegetables.
2. Develop a detailed understanding of the different packaging technology of fruits and vegetables.
3. Impart comprehensive overview of scavenging.
4. Instill knowledge of beverage technology.
5. Demonstrate various unit operations involved in the food beverage manufacturing.

SECTION-A

1. **Fruit and vegetable:** Classification and Nutritive value of Fruits and Vegetables. Physical and chemical techniques to increase the post-harvest life of fresh Fruits and Vegetables. Storage of fresh Fruits and Vegetables–Ambient, Refrigerated, Modified atmosphere, evaporative cool storage. Labeling requirements of Fruits and Vegetables products. Importance and scope of post-harvest management of fruits and vegetables in India economy.
2. **Advances in packaging of fruits and vegetables:** Packaging Technology in fruits and vegetables- ethylene scavengers, oxygen scavengers, antimicrobial packaging, Modified atmosphere packaging (MAP),



Controlled release of sulphur dioxide. Types of packaging material (CFB Box, Wooden boxes, Sacks, palletization, cushioning material & CAP). Vacuum packaging. Edible packaging.

SECTION-B

3. **Introduction to beverages:** Types of beverages and their importance, status of beverage industry in India, manufacturing technology for juice-based beverages, synthetic beverages; technology, isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks. Carbonated & non-carbonated beverages: ingredients, processing techniques, and standards. Fruit and vegetable-based beverages: ingredients, processing techniques, and standards.
4. **Distilled & non-distilled alcoholic beverages:** Distilled beverages (whisky, rum, brandy) non distilled beverages (beer, wine, sake), industrial setup for beverages preparation, procedures for recovery and purification of products, separation of biomass and insolubles (cell disruption, recovery & purification). Design and types of fermenter, basic control panels (aeration, agitation, pH and temperature etc).

REFERENCES

1. Stewart, G.G., & Priest, F.G. (Eds.). (2006). Handbook of Brewing (2nd ed.). CRC Press.
2. Hui, Y. H., Meunier-Goddik, L., Josephsen, J., Nip, W., & Stanfield, P. S. (2004). *Handbook of food and beverage fermentation technology*. CRC Press.
3. *Thompson, A. K. (2014). Fruit and vegetables: harvesting, handling / A.K. Thompson*
4. Ranganna, S. (2005). *Handbook of analysis and quality control for fruit and vegetable products*. Tata McGraw-Hill Education.
5. Varnam, A., & Sutherland, J. (2012). *Beverages: Technology, chemistry and microbiology*. Springer Science & Business Media.
6. Vine, R. P. (2012). *Commercial winemaking: Processing and controls*. Springer Science & Business Media.
7. Woodroof, J. (2012). *Commercial fruit processing*. Springer Science & Business Media.
8. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2019, Manual of methods of analysis of foods (alcoholic beverages). P4-56
9. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2015, Manual of methods of analysis of foods (fruits and vegetable products). P12-38.

PRACTICALS

1. Determination of fruit content.
2. Determination of extracts in wine.
3. Estimation of phenolic content in beverages.
4. Analysis of mineral content of bottled water.
5. Determination of acidity of fruit juices.
6. Detect the concentration of fruit and vegetable juice.
7. To prepare and preserve candy from different fruits.
8. Preparation of different types of potato chips
9. Determination of ethyl alcohol content.
10. Freezing of fruits and vegetables.
11. Visit to a fruits and vegetables processing industry.
12. Visit to a Brewing industry.
13. Visit to a Distillery.
14. Visit to a Winery industry.

PAPER CODE: FDP2M104C	FOOD SUPPLY CHAIN AND STATISTICS	
Option i		
<i>Theory</i>	<i>Internal Assessment</i>	<i>Practical</i>
<i>Max. Marks: 74</i>	<i>Max. Marks: 26</i>	<i>Max. Marks: 50</i>
<i>Credits: 4</i>		<i>Credits: 3</i>
<i>Lectures to be delivered: 60 hrs.</i>		<i>Pass Marks: 40%</i>
<i>Time allowed: 3 Hours</i>		
<i>Pass Marks: 40%</i>		

Instructions for the paper setters: The question paper will consist of three sections A, B and C.

Section-A and B will have four questions from the respective sections of the syllabus and Carry 11 marks each. Section-C consists of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

Instructions for the candidates: Candidates are required to attempt two questions each from sections A and B of the question paper and the entire Section-C.

LEARNING OUTCOMES

On completing this subject students will be able to:

1. Develop a sound understanding of the important role of supply chain management in today's business environment.

2. Become familiar with current supply chain management trends Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations.
3. Learn to use and apply computer-based supply chain optimization tools including the use of selected state of the art supply chain software suites currently used in business.
4. Develop and utilize critical management skills such as negotiating, working effectively within a diverse business environment, ethical decision making and use of information technology.
5. Demonstrate the use of effective written and oral communications, critical thinking, team building and presentation skills as applied to business problems.
6. Students will effectively use professional level technology tools to support the study of mathematics and statistics.
7. Students will clearly communicate quantitative ideas both orally and in writing to a range of audiences.

SECTION-A

1. **Food supply chain:** Introduction (meaning & overview), evolution of food supply chain, relationship between food & the economy, international definition of food supply chain, significance & drivers, the actors in food supply chain (FSC) – producers, processors, retailers & distributors, hospitality sectors, consumers, types of food chains, factors influencing food supply chain.
2. **Risk management:** Managing supply chain risks, managing risks in food supply, technology trends in food supply chain, sustainability & future challenges, attributes to consider when designing food supply chain. Perishability, seasonality in production, edible nature of product, heterogeneity, sustainable supply chains, sustainable food supply chains, developing sustainability within food supply chains- production, processing.

SECTION -B

3. **Descriptive statistics:** Measure of central tendency, measure of dispersion: range, mean deviation & standard deviation; skewness and kurtosis theoretical probability distribution: binomial, poisson and normal distribution; testing of hypothesis: null and alternative hypothesis, level of significance, student's distribution and its application, chi-square(χ^2) test & its application, 'F' test and its application.
4. **Introduction, logistics and supply chain management:** Scope, significance and drivers; basic model- primary and secondary activities; role and challenges of logistics and supply chain management in food industry, food sector & economic regeneration, logistics infrastructure, food cluster & enterprise zone, food parks & hubs.

REFERENCES

1. Dani, S. (2015). Food Supply Chain Management and Logistics: *From Farm to Fork*. Kogan Page
2. Wildman, R.E.C., Wildman, R., & Wallace, T.C. (Eds.). (2006). Handbook of Nutraceuticals and Functional Foods (2nd ed.). CRC Press. <https://doi.org/10.1201/9781420006186>
3. Sharples, D. (2001). Food supply chain management issues for the hospitality and retail sectors. *Butterworth Heinemann*. D.O.I -11/9780750647625.
4. Medeiro, D. (2000). Advanced human nutrition. *Bcoo Raton*: CRC Press D.O.I - 9.1205/9731400062
5. Gupta, SP. (2021). Statistical Methods. 46th revised edition. D.O.I -13/978-93-5161-176-9.
6. Fellow, P.J. (2002). Food Processing Technology- Principles and Practices, 2nd edition. *Woodhead publishing Ltd*. D.O.I -07/985646453.
7. Manay, S. (2008). Food Facts & Principles. 3rd Rev.ed. *New Delhi : New Age International*. D.O.I.- 6/956438656.
8. Agresti, A. & Francklin, C.A. (2009). Statistics: the art and science of learning from data (second edition) Boston, MA: Pearson Prentice Hall, ISBN 978-0-13-1513199-2.
9. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2016, Manual of methods of analysis of foods milk and milk products . P32-102.
10. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2015, General Guidelines on sampling.

PRACTICALS

1. Determination of moisture content of butter.
2. Determination of moisture content of khora.
3. To determine different legal sampling principles from different food items.
4. To perform chemical analysis of milk.
5. Demonstrate different levels of food supply chain management.
6. To perform microbiological analysis of fruits and vegetables.
7. To demonstrate different food preservation methods.
8. To examine physical impurities of water.
9. To select a simple random sample from the population and enter these data into SPSS.
10. To calculate and interpret binomial and normal probabilities.
11. To analyze the relation between correlation and regression.
12. To employ chi-square test for statistical studies.
13. To perform hypothesis testing: T&F test.

PAPER CODE: FDPM 2105C	WASTE MANAGEMENT IN FOOD INDUSTRY	
Option ii		
<i>Theory</i>	<i>Internal Assessment</i>	<i>Practical</i>
<i>Max. Marks: 74</i>	<i>Max. Marks: 26</i>	<i>Max. Marks: 50</i>
<i>Credits: 4</i>		<i>Credits: 3</i>
<i>Lectures to be delivered: 60 hrs.</i>		<i>Pass Marks: 40%</i>
<i>Time allowed: 3 Hours</i>		
<i>Pass Marks: 40%</i>		

Instructions for the paper setters: The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section-C consists of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

Instructions for the candidates: Candidates are required to attempt two questions each from sections A and B of the question paper and the entire Section-C.

LEARNING OUTCOMES

1. On completing this subject, students will be able to: Analyze different types of food industry wastes, their special characteristics and how they can be utilized effectively.
2. To develop the ability to differentiate primary, secondary and tertiary treatment of food industry waste.
3. The students will be able to understand the process of different type of wastes and their utilization.
4. Learn practically sound conditions in term of measuring qualitative, quantitative and microbial test of water (fresh and waste water).
5. Students will be able to demonstrate various treatments.

SECTION A

1. **Characterization and utilization:** Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from aforesaid food industries. National & international standards for emission or discharge of environmental pollutants from food processing industries, characterization of food industries effluents, in terms of parameters of importance, regulatory criteria for food industry.

Handwritten signatures and initials at the bottom of the page.

2. **Primary, secondary and tertiary treatment of food industry wastes:** Objectives, organisms, reactions, oxygen requirements, aeration devices. Primary wastewater treatment, Effluent Treatment Plants (ETP). Monod's equation in batch, continuous and semi-continuous cultures.

SECTION-B

3. **Secondary treatment:** Aerobic vs anaerobic treatment, effect on characteristic parameters of effluents in treatments using lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biological contactors and their variations and advanced modifications. anaerobic techniques- expanded granular sludge bed (EGSB), anaerobic baffled reactor (ABR), upflow anaerobic sludge blanket (USAB) digester, solid-state anaerobic digester (SSAD), upflow solid reactor (USR), plug flow reactor (PFR), factors affecting treatment efficiency.
4. **Solid waste management:** 4Rs in solid waste management. compost, vermicomposting, landfill techniques, pyrolysis. physical, physicochemical and chemical treatments. coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents conforming to EPA provisions. introduction to gaseous waste treatment and their benefits, carbon footprint method, wet scrubber, biofilters.

REFERENCES

1. Abbasi, S. A., & Ramasami, E. (2001). *Solid waste management with earthworms*. Discovery Publishing House.
2. Agarwal, K. C. (2001). *Environmental pollution: Causes, effects & controls*. Nidhi Publications.
3. Arceivala, S. J., & Asolekar, S. R. (2006). *Wastewater treatment for pollution control and reuse*. Tata McGraw-Hill Education.
4. Bui, X., Chiemchaisri, C., Fujioka, T., & Varjani, S. (2018). *Water and wastewater treatment technologies*. Springer.
5. Casida, L. E. (2005). *Industrial microbiology*. New Age Publication.
6. Cheremisinoff, N. P. (2002). *Handbook of Water & Wastewater Treatment Technologies*. Butterworth-Heinemann.
7. Juhasz, A. L. (2004). *Waste management*. CRC Press.
8. Mara, D., & Horan, N. J. (2003). *Handbook of water and wastewater microbiology*. Elsevier.
9. Qasim, S. R. (2017). *Wastewater treatment plants: Planning, design, and operation* (2nd ed.). Routledge.
10. Rao, C. S. (2007). *Environmental pollution control engineering*. New Age International.
11. Williams, P. T. (2013). *Waste treatment and disposal*. John Wiley & Sons.

 

12. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2016, manual of methods of analysis of foods (water analysis).
13. Food Safety and Standards authority of india (FSSAI), Ministry of Health and Family Welfare, Government of India New Delhi 2016, manual of methods of analysis of foods (metals), P 37

PRACTICALS

1. Organoleptic & physical-chemical parameters of waste water.
2. To find biological oxygen demand of waste sample.
3. To find chemical oxygen demand of waste sample.
4. Experiment on determination of total dissolved and suspended solids in water.
5. To study the characterization of food industries effluents.
6. Analysis of metals by spectrophotometer.
7. Study the factors influencing the generation of wastes.
8. Detection of *E. coli* and coliform.
9. Test methods for water for processed food industry
10. Visit to effluent treatment plant.
11. Visit to solid waste treatment plant.
12. Visit to liquid waste treatment plant.
13. Visit to gaseous waste treatment plant.

As /  *o Mon /*