Proforma of information to be collected for the University departments/ADR/ Research satation/ for uploading on University website

1. **Name of the Department/Section :** This should act as the front page of the Department/Section. The salient features of the Department/Section including the historical background should find the place on this page. One or two photographs providing the glimpses of the Department/Section should also be provided.

Department of PHM of Meat, poultry and fish, P.G.Institute of Post Harvest Technology and Management, Killa-Roha was established in the year 2010-11 at Roha campus of Dr. BSKKV Dapoli. The department is engaged in Teaching at PG level students in the field of PHM of MPF. Apart from the academic research at PG, the Department has undertaken some need based research of the meat-fish based commodities to cater the needs of a common man of Konkan region of Maharashtra. The Department also provides the Extension services to the farmers, small scale processors, Self Help Groups in the area of food processing, fisheries processes and new product development and demonstrations. The Department also provides need based training services. The research work on the issues related to the department are been undertaken by Dr.S.B.Patange Professor and Head, Dr R C Ranveer, Asso Professor and Shri N B Rathod, Asstt Professor.

PGI-PHTM, Killa-Roha has developed various value addition technologies which are very much appreciated at vatious platforms one of the Recommended technology of the Department of Post Harvest Engineering for the Alphonso mango pulp powder has been appreciated by Sh.Rameshji Bais Hon. Governer of Maharashtra and Sh.Abdulji Sattar Hon.Agriculture Minister along with Dr.S.D.Sawant Hon.Vice-Chancellor, Dr.B.S.Konkan Krishi Vidyapeeth, Dapoli on 41st Convocation of Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli on 15.03.2023.

2. **About Department** (About Department HISTORICAL PERSPECTIVE OF THE DEPARTMENT)

The department of PHM of MPF has been started in 2010-11 till date around 14 students has been completed their M.Sc.(Post Harvest Management) degree programme in the discipline of Meat poultry and Fish The List of students have completed their P.G. Degree in this disciplines are as follows.

3. **Academic** Programmers: Provide the details of each doctoral programme as

The Department of Post Harvest Engineering, PGI-PHTM, Killa-Roha presently running only M.Sc.(Post Harvest Technology) in the Discipline of Post Harvest Engineering. The department of Post Harvest Engineering, PGI-PHTM, Killa-Roha is also planning to start the Ph.D. (Post Harvest Technology) in Post Harvest Engineering.

a. **Doctoral Programmes**

Name of the programme:

Semester No.	**Term No.**	**Course No.**	**Credits**	**Title of the course offered by the department**
Not Yet Started	**Not Yet Started**	**Not Yet Started**	**Not Yet Started**	**Not Yet Started**

Course Curricula and syllabi:

b. **Masters Programmes**

Name of the programme: M.Sc.(Post Harvest Technology) in Meat, poultry and fish
New Restructured and Revised Post Graduate Syllabi of PG programmes at PGI-Post Harvest Technology and Management (DBSKKV), Roha

Course Curricula and syllabi:
Requirement

Course	**Credit Load**
Major	20
Minor	08
Supporting	06
Non-credit Compulsory / Common Courses	05
Seminar	01
Thesis Research	30
Total	**70**

MAJOR COURSES: 20 CREDITS

Courses from the Discipline in which a student takes admission. Among the listed courses, the core courses (12 credits) compulsorily to be taken is given *mark rest of the eight credits should be offered from remaining major courses.

Sr. No.	Proposed Course Code	Course Code as per BSMA	Title of the course	Credits
1	*MPF -501	FPT 507 (FT)	Meat, poultry, fish and egg processing	3(2+1)
2	*MPF -502	LPT 603	Processing and preservation of meat	3(2+1)
3	*MPF -503	FPT 501	Low Temperature Preservation of Fish and Shell Fish	3(2+1)
4	*MPF -504	FPT 504	Fish Quality assurances, management and certification	3(2+1)
5	MPF -505	FPT 506	Value Added Fishery Products	2(1+1)
6	MPF -506	FPT 502	Thermal Processing of Fish and Fishery Products	3(2+1)
7	MPF – 507	LPT 606	Microbiology and quality control	2(1+1)
8	MPF -508	LPT 605 and FPT 511	Packaging of fish and fish product, and livestock products	3(2+1)
9	MPF -509	FPT 512	Fish by-products and waste utilization	2(1+1)
10	MPF -510	LPT 602	Fresh meat technology	2(1+1)
11	MPF -511	LPT 601	Abattoir practices and meat plant operations	3(2+1)
12	MPF -512	LPT 609	Egg and egg products technology	2(1+1)
13	MPF -513	LPT 607	Slaughter house byproducts technology	3(2+1)

* Core courses

*Compulsory. Rest of the courses will be decided by the students advisory committee keeping the minimum limits set for award of degree

MINOR COURSES: 08 CREDITS

From the subjects closely related to a student's major subject.

Sr. No.	Proposed Course Code	Course Code as per BSMA	Title of the course	Credits
1	FHQC - 501	PFE 509	Food quality and safety	3 (2+1)
2	FHQC - 502	FSQ 503	Advanced food chemistry	3 (2+1)

3	FHQC - 503	FSQ 502	Microbiology of food spoilage and pathogens	3 (2+1)
4	FHQC - 504	FSQ 504	Global food laws and regulations	2 (2+0)
5	FHQC - 505	FSQ 506	Process and products monitoring for quality assurance	2 (2+0)
6	FHQC - 506	FSQ 501	Techniques in food quality analysis	4(2+2)
7	PHFPE – 520	ME 502 (Processing and Food Engg)	Refrigeration systems	3 (2+1)

Note

The major and minor courses have been taken from relevant courses from ICAR-NCG-BSMA 2020 committees for the disciplines of Food Sciences Technology, Agricultural Engineering & Technology, Livestock Products Technology and Fisheries Science.

SUPPORTING COURSES: 06 CREDITS

The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

Sr. No.	Proposed Course code	Course Code as per BSMA	Title of the course	Credits
1	PHMC 501	STAT 501	Statistical Methods for Research Works	3 (2+1)
2	PHMC 502	STAT 502	Experimental designs	2 (1+1)
3	PHMC 503	BSH 502	Food informatics	
4	PHMC 504	FBM 502	Food business management	2 (2+0)
5	PHMC 505	FBM 503	Food Processing Entrepreneurship and Start up	2 (1+1)
6	PHMC 506	FSQ 505	Food Safety Management Systems and Certification	2 (2+0)

NON-CREDIT COMPULSORY / COMMON COURSES: 05 CREDITS

Sr. No	Course No.	Title of the course	Credits
1	PGS-501	Library and information services	1 (0+1)

2	PGS-502	Technical writing and communications skills	1 (0+1)
3	PGS-503	Intellectual property and its management in agriculture	1 (1+0)
4	PGS-504	Basic concepts in laboratory techniques	1 (0+1)
5	PGS-505	Agricultural research, research ethics and rural development programmes	1 (1+0)

*Compulsory These courses are available in the form of e-courses/MOOCs. The students may be allowed to register these courses/similar courses on these aspects, if available online on SWAYAM or any other platform. If a student has already completed any of these courses during UG, he/she may be permitted to register for other related courses with the prior approval of the HoD/BoS

SEMINAR: 01 CREDITS

Sr. No	Course No.	Course Code as per BSMA	Title of the course	Credits
1	MPF -591	FPT 591	Seminar	1(0+1)

RESEARCH: 30 CREDITS

Sr. No	Course No.	Course Code as per BSMA	Title of the course	Credits
1	MPF- 599	FPT 599	Thesis Research	30(0+30)

DETAILED SYLLABUS- MAJOR COURSES

1	*MPF -501	FPT 507 (FT)	Meat, poultry, fish and egg processing	3(2+1)

Theory

Meat Industry: Meat and meat products in India-an Industrial profile. Meat production and trade practices. Prospects and problems in production of fresh meat in India, Research and Development activities on meat, fish and poultry products. Gross and microstructure of muscle. Mechanism of muscle contraction and relaxation: Organization of skeletal muscle from gross structure to molecular level. Muscle Communication (sarcolemma, sarcoplasmic reticulum, Innervation). Muscle metabolism. Different types of connective tissues and their relevance to properties of meat. Myofilament proteins and their major functions. Nervous tissue, nerves and the nature of stimuli, membrane potential in nerve and muscle, Events that occur during relaxation and contraction. Cattle and beef, sheep and mutton, pig and pork and their fabrication: Breeds, Pre- slaughter care, ante and post mortem, slaughter, handling of offal (edible and inedible). Cuts of beef, pork and mutton. Meat inspection and grading: Application and Enforcement of inspection laws, elements of inspection (sanitation, antemortem inspection, post-mortem inspection, condemnation, product inspection, laboratory inspection, labelling). Identification of inspected products, product inspection, types of grades, factors used to establish quality grades, conformation, fleshing and finish. Properties of fresh meat: Perception of tenderness, Factors effecting tenderness, connective tissue, collagen, sarcomere contractile state, Myofibrillar tenderness, marbling. Methods to improve tenderness (Electrical stimulation, aging, Meat colour, Pigments associated with colour, Chemical state of pigments, methods to improve meat colour. Water holding capacity (Net charge effect and stearic effect) Molecular Techniques in meat products, cultured meat etc. Poultry meat: Kind of poultry, processing of poultry. Special

poultry products, Breaded poultry, Smoked turkey, packaged precooked chicken, Freeze dried poultry meat. Egg and egg processing: Egg quality, egg preservation, egg powder production. Meat analogues and restructured meat products: Textured plant proteins, processes for preparation of meat analogues and restructured meat products. Fish processing and fish products: Chemical/Nutritional composition of Fish, Fish in human diet: protein, carbohydrates, lipids, vitamins etc. Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates. Irradiation of fish and fisheries products, packaging of fish products, quality control and quality assurance. Allergens, toxins and infectious diseases from meat, poultry and fish products.

Practical

To study the effect of low and high oxygen atmosphere on meat colour. To study the chemistry of myoglobin as it relates to the colour of the molecule. To understand and compare the action of two meat tenderizing enzymes by applying the technique of electrophoresis. To study the structure of the muscle under compound microscope. Perform the slaughtering of the poultry birds. Identification of different internal organs of poultry birds and their utilization for product preparation. Dressing of Fish. Determination of total volatile acids in fish, Determination of buffering capacity of fish muscle. Rapid estimation of hypoxanthine concentration in chill stored fish. Determination of glycine in fish muscle. Determination of protein fractions in fresh fish. Cut out test for canned fishery products. Determination of glycogen in fish muscle. Industrial visit to meat industry.

Suggested Reading

- Henricksons. 1978. Meat Poultry and Sea Food Technology/ Prentice Hall.
- Robert RJ. 2012. Fish Technology/ Wiley-Blackwell. Mountney GJ. 1988. Poultry Meat and Egg Production/ Springer, Netherlands.
- Kerry J, Kerry J. 2002. Meat Processing/ Woodhead Publishing and David Ledwood.
- Levie A. 1979. Meat Hand Book, Avi Pub.
- Weiss GH. 1971. Poultry Processing. Noyes Data Corporation.
- Wheaton FW and Lawson TB. 1985. Processing of Aquatic Food Products John Wiley & Sons.
- Mead G. 2004. Poultry meat processing and quality Woodhead Publishing.
- Sinha R. 2017. HACCP in Meat, Poultry and Fish Processing/ Random Publications.
- Sahoo J and Chatli MK. 2015. Textbook on Meat, Poultry and Fish Technology/

Daya Pub. House.

- Badapanda KC. 2012. Basics of Fisheries Science/ Narendra Publishing House.
- Sahoo J, Sharma DK and Chatli MK. 2016. Practical Handbook on Meat Science and Technology/ Daya Pub. House

2	*MPF -502	LPT 603	Processing and preservation of meat	3(2+1)

Theory

Basic principles of meat preservation – dehydration, chilling, freezing, freeze-drying, thermal processing, direct microbial inhibition, irradiation, use of chemicals and antimicrobials - Curing and smoking - Hurdle technology concept. Principles of Meat Processing - Meat and non-meat ingredients and their roles - Additives - Processing techniques - comminution, chopping, blending, marination, massaging, tumbling, etc. - Cooking methods including microwaving – Development of meat products including ham, bacon, tandoori and barbeque - Emulsion formation– factors affecting emulsion formation - Emulsion based meat products - sausages, nuggets and patties - Enrobed, restructured, fermented and intermediate moisture meat products – Ready-to-cook, ready-to-eat and shelf-stable meat products – Canned and retort meat products – Traditional and ethnic meat products - Functional meat products. Sensory evaluation – Sensory physiology, types, methods, quality attributes - Factors influencing sensory measurements - Types of sensory panels - Selection of sensory panellists- Sensory evaluation tests- Layout and designing of sensory evaluation laboratory.

Practical

Estimation of tyrosine value, nitrite content, TBARS value, peroxide value - Preparation of Meat Products - Minced meat products - Emulsion based meat products – sausages, nuggets and patties - Ham and Bacon - Meat Pickles – Enrobed, restructured, fermented and shelf-stable meat products - Canned/ retorted Meat Products - Traditional and ethnic Meat Products - Kebabs - Sensory evaluation of meat products - Subjective and objective method of sensory evaluation - differential, descriptive, training tests, etc. – Test practices and training in the sensory lab - Determination of emulsion stability - Cooking yield - Texture Profile Analysis.

Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Amerine MA, Pangborn RM and Roessler EB. 1965. Principles of Sensory Evaluation of Food. Academic Press, New York.
- Barbut S. 2005. Poultry Products Technology. CRC Press.

- Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate Publishers, INC.
- Kerry J, Kerry J and Ledward D. 2005. Meat Processing- Improving Quality. Woodhead. Publishing Ltd., UK.
- Lawless HT and Heymann H. 2010. Sensory Evaluation of Food - Principles and Practices, 2nd ed, Springer-Verlag, New York Inc.
- Mountney GJ and Parkhurst CR. 2017. Poultry Products Technology, 3rd ed. Food Products Press, New York.
- Pearson AM and Gillett TA. 1996. Processed Meats, 3rd ed. Chapman and Hall, Inc, New York.
- Sharma BD, Wani S and Sharma N. 1997. Sensory Evaluation Manual for Meat and Meat Products. IVRI Publication.
- Toldrá F. 2010. Handbook of Meat Processing. Wiley-Blackwell.

3	*MPF -503	FPT 501	Low Temperature Preservation of Fish and Shell Fish	3(2+1)

Theory

Postmortem changes: Structural and chemical features of fish and shellfish as raw material for processing, Factors affecting quality of fresh fish, intrinsic and extrinsic factors, Handling of fish onboard, Landing centres and farm sites-different types of chilling methods, Depuration of bivalves, Assessment of post-harvest loss. **Chilled storage and transportation of fish**: Heat load calculation, Storage methods-insulated boxes and insulation thickness, Different types of ice, Physical, Chemical, Microbiological and Sensory changes during chill storage, Melanosis and its prevention, Iced storage shelf life, Cold shock, Transportation- live fish/shell fish, transportation of raw fish to local markets and processing centres, Improvements needed in transportation, Refrigerated transport systems, Classification of transport vehicles, cold chain. **Freezing of fish and shellfish:** Structure of water and ice, Influence of solutes on the structure of water and ice, Phase equilibria and freezing curves of pure water and binary solutions, freezing curves for fish, Determination of freezing points from time-temperature plots, Calculation of freezing time; Crystallization, Nucleation- homogeneous and Heterogeneous nucleation; Super cooling, Crystal growth, Eutectic point, Location of ice crystals in tissue, Changes during freezing. **Freezing methods:** Technological aspects of freezing-methods of freezing (plate freezing, IQF, etc), Selection of a freezing method, Product processing and packaging, packing of fresh and frozen fish for consumers, Modified atmosphere packaging, Controlled packaging, Cold storage management-arrangements within a cold storage, handling and stacking systems. **Changes in frozen storage:** Physical changes, freezer burn and recrystallisation, Different types

of recrystallisation, Chemical changes in lipids, Proteins and nucleotides, Freeze denaturation and theories on denaturation, Changes in pH, Bacterial changes, Sensory changes, texture, taste, odour, effect of post-mortem condition on sensory qualities. **Prevention of quality loss during frozen storage:** Treatments prior to freezing, Antioxidants, Cryoprotectants and other additives, Theories of cryoprotection, Glazing- importance and methods.

Practical

Handling of fish, crustaceans and mollusks, Evaluation of freshness of fish, crustaceans and molluscs, freezing curve, determination of freezing point, Filleting of fish, treatments, glazing, packaging, freezing, Processing of shrimp, lobster, squid, cuttle fish, crab etc. in different styles, Depuration-treatment with chemicals, Packaging and Freezing, Chemical tests (Histamine, k value) on frozen products and Studies on physical and sensory changes for determination of shelf life.

Suggested Reading

- AOAC manual. Balachandran KK. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publ. House.
- Clucas IJ. 1981. Fish Handling, Preservation and Processing in the Tropics. Parts I, II. FAO.
- Fennema K, Powrie WD and Marth EH. 1973. Low Temperature Preservation of Foods and Living Matter. Marcel Dekker.
- Gopakumar K. (Ed.). 2002. Text Book of Fish Processing Technology. ICAR..
- Hall GM. (Ed). 2011. Fish Processing –Sustainability and New Opportunities. Wiley- Blackwell.
- Judith A. Evans. 2008. Frozen Food Science and Technology, Blackwell Publishing Inc. (Malden). SEAFDEC manual.
- Nalan Gokoglu, Pinar Yerlikaya. 2015. Seafood Chilling, Refrigeration and Freezing: Science and Technology, John Wiley and Sons (Chichester).
- Sen DP. 2005. Advances in Fish Processing Technology. Allied Publ.
- Venugopal V. 2006. Seafood Processing. Taylor and Francis.

4	*MPF -504	FPT 504	Fish Quality assurances, management and certification	3(2+1)

Theory

Hazards in fish and fishery product: Physical, Chemical, Biological, Quality management, Total quality concept and application in fish trade. **Quality assessment of fish and fishery products:** Physical, Chemical, Organoleptic and Microbiological

quality standards. **Inspection and quality assurance:** Fish inspection in India, Traceability and authenticity; Factory sanitation and hygienization: National and international requirements, SSOP. Quality management, total quality concept and application in fish trade. Quality assessment of fish and fishery products - physical, chemical, organoleptic and microbiological quality standards. Inspection and quality assurance: Fish inspection in India, process water quality in fishery industry, product quality. Water quality and standards. Sensory evaluation of fish and fish products, basic aspects, different methods of evaluation, taste panel selection and constitution, statistical analysis. HACCP and Good manufacturing practices. HACCP principles, practical aspects of planning and implementation, verification, validation and audit. National and International standards: ISO 9000: 2000 series of quality assurance system, *Codex alimentarius,* USFDA and EU regulations for fish export trade, IDP and SAT formations in certification of export worthiness of fish processing units, regulations for fishing vessels, pre-processing and processing plants, EU regulations. ISO 22000:2006. Factory sanitation and hygiene: National and international requirements, SSOP, Sanitary and Phytosanitary measures. Food laws in India, integrated food law.

Practical

Evaluation of fish / fishery products for organoleptic, chemical and microbial quality. Methods for analysis for bacterial quality parameters, chemical parameters and filth. Evaluation of sanitary conditions in fish processing units. Analysis of typical hazards. Study of correction and corrective action. SQC: Introduction, statistical principles involved, process control, control charts, variable and attribute control charts, Acceptance sampling, basic ideas, sampling by attributes single and double sampling plants, Basic concepts of decision making. Familiarization with water quality analysis.

Suggested Reading

- Anthony TT. 1988. *Handbook of Natural Toxins. Marine Toxins and Venom*. Vol. III. Marcel Dekker.
- Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ. House.
- Connell JJ. 1995. *Control of Fish Quality*. Fishing News Books.
- Fennema K, Powrie WD & Marth EH. 1973. *Low Temperature*
- *Preservation of Foods and Living Matter*. Marcel Dekker**.**
- Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
- Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
- Hui YH, Merle DP & Richard GJ. (Eds.). 2001. *Food Borne Disease*
- *Handbook. Seafood and Environmental Toxins*. Vol. IV. Marcel Dekker.
- Huss HH, Jakobsen M & Liston J. 1991. *Quality Assurance in the Fish Industry*. Elsevier.

- John DEV. 1985. *Food Safety and Toxicity*. CRC Press.
- Krenzer R. 1971. *Fish Inspection and Quality Control*. Fishing News. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.
- Vincent K & Omachonu JER. 2004. *Principles of Total Quality.* CRC Press.

5	MPF -505	FPT 506	Value Added Fishery Products	2(1+1)

Theory

Significance of value addition: Protein deficiency and need for fortification of food, Digestibility and nutritive value of fish meat, Overview of value-added products; Present market trends, Scope of value addition, Types of value addition, important value-added products. **Minced fish meat:** Equipment for mince preparation, Effect of mincing on physical and chemical properties; Different types of mince-based products, Surimi. **Surimi:** Basic concepts, Different unit operations, Cryoprotectants in surimi- hypothesis and mechanisms, Packaging, freezing and storage, Quality evaluation of surimi, Kamaboko and analogue products. **Battered and breaded products:** Ingredients for batter and breading systems and their functionalities, Freeze dried products, Shelf life and specialties of AFD products, Machinery and equipment for freeze drying. **Ready-to-eat and ready-to-cook products:** Extruded fish products; Mechanism of extrusion, Types of extruders; Single screw, Twin screw, Mechanical and chemical changes during extrusion, Parameters affecting quality of extruded product, Cook- chill products. **Seaweeds:** Resources, global and Indian scenario, Biochemical components in Seaweeds, Edible seaweeds – Nutritive value of seaweeds, Products from seaweeds

Practical

Preparation of Surimi from low value fish; Evaluation of Surimi gel strength; Evaluation of ATPase activity of actomyosin based products; Preparation of analog products from surimi, battered and breaded products, extruded products, cook-chill products and seaweed-based product.

Suggested Reading

- Balachandran KK. 2001. Post-Harvest Technology of Fish and Fish Products. Daya Publ.
- Gopakumar K. (Ed.). 2002. Text Book of Fish Processing Technology. ICAR.
- Hall GM. (Ed.). 1992. Fish Processing Technology. Blackie.
- Hui YH, Merle DP and Richard JG. (Eds.). 2001. Food Borne Disease Handbook. Seafood and environmental Toxins. Vol IV, Marcel Dekker.
- Nambudiri DD. 2006. Technology of Fishery Products. Fishing Chimes.
- Sen DP. 2005. Advances in Fish Processing Technology. Allied Publ.
- T Borresen 2008, Improving Seafood Products for the Consumer, Woodhead Publishiong Limited (Cambridge)
- Venugopal V. 2005. "Seafood Processing: Adding Value Through Quick Freezing Retortable Packaging, and Cook-Chilling", Taylor and Francis (Boca Raton)
- Wheaton FW and Lawson TB. 1985. Processing Aquatic Food Products. John Wiley and Sons.

6	*MPF -506	FPT 502	Thermal Processing of Fish and Fishery Products	3(2+1)

Theory

Principles of thermal processing and classification of foods: Mechanisms of heat transfer; Unsteady state of transfer; conduction, convection, radiation; Dielectric and microwave heating, Heat penetration, cold point; Low acid, medium acid and acid foods, Absolute sterility, Statistical sterility, Commercial sterility, Pasteurization and Sterilization, sous-vide. **Canning process:** Steps involved, Process flow, Additives, Principles and process details, Canning machinery and equipment, Canning process for fish/shellfish, Value added canned products; Spoilage of canned food, physical, Chemical and microbial, Examination of cans and seams, Effect of canning on nutrient profile. **Basis of Thermal Process**: Heat resistance of bacteria and spores, Decimal reduction time, Thermal death time, "D", "Z" and "F0" values, 12 D value, Significance of survivor curve and Thermal death curve.

Thermal process calculations: Determination of process time and F value; Graphical, formula, Nomogram methods. **Emerging trends in containers and heat treatment processes**: HTST, UHT processing and aseptic canning, Flexible packing, Retort pouch processing of fish and fishery products principles and techniques; Combination and synergistic effects. **Canning plant location:** Practical considerations, Canning plant facilities, Layout and design, Automation in canning lines.

Practical

Operation of over pressure retort for canning, Canning operations for commercial important fin fishes, Canning of shrimp and Cephalopods, Retort pouch processing of table fishes, bivalves, crustaceans, Examination of canned fishery products, Sensory evaluation of canned foods, Examination of can seams, Sterility test of canned products, Isolation of Clostridium spp, from canned foods, Heat Penetration Curve and Calculation of F0 Value, Z value, process time.

Suggested Reading

- Da-Wen Sun 2005, *Thermal Food Processing: New Technologies and Quality Issues*, Taylor and Francis (Boca Raton).
- Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
- Hersom AC and Hulland ED. 1980. *Canned Foods*. Chemical Publ. Co.
- Holdsworth SD. 1997. *Thermal Processing of Packaged Foods*, Blackie Academic and Professional.
- Larousse J and Brown BE. 1997. *Food Canning Technology*. Wiley VCH.

- Venugopal V. 2006. *Seafood Processing*. Taylor and Francis.
- Warne D. 1988. *Manual on Fish Canning*. FAO Fisheries Tech. Paper 285.
- Zeathen P. 1984. *Thermal Processing and Quality of Foods*. Elsevier.

7	MPF – 507	LPT 606	Microbiology and quality control	2(1+1)

Theory

Microorganisms associated with spoilage of livestock products - Factors affecting microbial growth - Contamination of livestock products - Microbial spoilage of meat, poultry, eggs, milk and their products - Physical and chemical changes produced by microbes in milk, meat, eggs and their products - Meat and milk-borne infections and intoxications - Control of microbial growth in livestock products - Antimicrobial resistance (AMR). Introduction to Good Laboratory Practices (GLP), Good Hygienic practices (GHP) and Good Manufacturing Practices (GMP), Sanitary and Phytosanitary measures (SPS) and Food Safety System Certification (FSSC) - Quality Control – Quality Assurance - principles and practices - Quality Management Systems – Food Safety and Standards Act (FSSAI, 2006 Act) - Codex regulation for food products safety- ISO 9001 - ISO 22000 - HACCP concepts - Risk-based quality assessment - Microbial quality control - FSSAI/ BIS standards for milk, meat and poultry, Chemical residues in livestock products and their effects on the health of the consumer.

Practical

Basic requirements for setting up of quality control laboratory - Sampling methods for the microbiological examination of different processing plants, products and equipment - Development of HACCP plan for milk and meat processing plants - Microbial evaluation of market samples of milk, meat and egg – Total Viable Count, coliform, etc. - Pathogens of Public Health importance - *E. coli, Salmonella, Staphylococcus aureus, Campylobacter* - Rapid detection methods of food pathogens.

Suggested Reading

- Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Bell C, Neaves P and Williams AP. 2005. *Food Microbiology and Laboratory Practices*, 1sted. Blackwell Publishing.
- Collins DS and Huey RJ. 2015. *Gracey's Meat Hygiene*, 11th ed. John Wiley and Sons Ltd.,UK.
- Frazier WC and Westhoff DC. 2013. *Food Microbiology*, 5th ed.

McGraw Hill Publication.

- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences,* 2nd ed. Elsevier Academic Press, UK.
- Jay JM, Loessner MJ and Golden DA. 2006. *Modern Food Microbiology,* 7th ed. Springer.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences,* Vol. I, II and III, 1st ed., Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM and Dutson TR. 1995. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.

8	MPF -508	LPT 605 and FPT 511	Packaging of fish and fish product, and livestock products	3(2+1)

Theory

Principles of packaging - objectives and functions - Product characteristics affecting packaging requirements - Packaging materials and their characteristics - Different packaging systems for fresh, cured, dehydrated, freeze-dried and shelf-stable products of milk, meat and chicken - Aseptic packaging of milk - UHT milk - Vacuum packaging – MAP and role of different gases - Retort pouch processing - Active and intelligent/ smart (biosensors) packaging - Edible and biodegradable packaging - Nanotechnology for food packaging - Recycling of packaging materials Labelling requirements – Barcoding and its importance - Packaging standards and regulations – Economics of different packaging systems. Marketing of Livestock Products - Types of markets - Marketing hannels of live meat animals and Poultry - Existing systems - constraints and possible solutions Value Chain of meat, poultry and processed products - strategies and interventions for better profitability – Meat retailing and establishment of retail outlets for meat and poultry - FSSAI, APEDA, EIA, GOI/ WTO regulations for the domestic market, import and export of livestock products. **Food packaging:** Purposes and procedures; Technological aspects of packaging fishery products; Packaging for transport, Shipping and Institutional supplies; Packaging materials; Basic films and laminates, Their manufacture and Identification; Resistance of packaging materials; Development of protective packaging for fishery products. **Transportation:** Packaging requirements for transportation of live fish and shellfish, Methods of testing for packaging materials for their physical properties; Containers and their testing and evaluation; Package designs; Resistance of packages to hazards in handling; Transport and storage. **Standards:** Packaging standards for domestic and international trade. **Labeling and printing of packaging materials:**

FSSAI requirements and BIS guidelines, Intelligent packaging; Edible packaging; Disposal and recycling of packaging materials.

Practical

Different packaging materials and their properties - Determination of thickness, bursting strength, piercing strength, water vapour transmission rate, gas transmission rate, headspace gas analysis - Vacuum, shrink, MAP and retort packaging of meat and milk products - Visit milk and meat processing plants - Study of the value chain of livestock products including online marketing. Determination of grammage of paper and board, bursting strength and burst factor, punctures resistance, water proofness, stiffness of the board, ring stiffness of paper and board, flat crush, tensile strength and elongation at break of plastic films, density of plastic films, breaking length, impact strength of plastic films, tearing strength of paper and plastic films, water vapour transmission rate, oxygen transmission rate, heat seal strength, suitability of plastic films for food contact applications and Identification of plastic films.

Suggested Reading

- Balachandran KK. 2001. *Post-Harvest Technology of Fish and Fish Products*. Daya Publ.
- Da-Wen Sun 2012. *Handbook of Frozen Food Processing and Packaging*, CRC Press (Boca Raton).
- Gordon L Robertson. 2005. *Food Packaging: Principles and Practices*, "Marcel Dekker, Inc." (New York).
- Gordon L Robertson. 2010. *Food Packaging and Shelf Life: A Practical Guide*, CRC Press Inc. (Florida).
- Gordon L Robertson. 2013. *Food Packaging: Principles and Practice*, CRC Press (Boca Raton).
- Jerry D'Souza, Jatin Pradhan. 2010. *Handbook of Food Processing Packaging and Labeling*, SBS Publiahers and Distributors Pvt. Ltd. (New Delhi).
- Ponnuswami V. 2012. *Nano Food Packaging: A New Post-harvest Venture*, Narendra Publishing House (Delhi).
- S Subasinghe. 1999. *Retail Packaging of Fish and Fishery Products*, InfoFish
- TK Srinivasa Gopal. 2007. *Seafood Packaging*, Central Institute of FIsheries Technology (Cochin).
- W Steven Otwell, Hordur G Kristinsson, Murat O Balaban. 2006. *Modified Atmospheric. Processing and Packaging of Fish: Filtered Smokes, Carbon Monoxide, and Reduced Oxygen Packaging*" "Blackwell Publishing Inc., " (Malden).

9	MPF -509	FPT 512	Fish by-products and waste utilization	2(1+1)

Theory

Fish processing wastes and utilization: Overview of fish processing wastes, by catch and its composition, Liquid and solid wastes in fish processing, Bioremediation, Anaerobic treatment, Production of animal feed, Biodiesel. **Fish meal, silage and oils:** Fish meal production (dry and wet process), Nutritional importance and Quality requirements, Specifications, Packaging and storage, Fish silage; Acid silage and Fermented silage, Advantages over fish meal, Nutritional value of silage; ; Fish Oil; Fish body and liver oils, Extraction, Purification, Preservation and storage, Industrial and Nutritional applications of fish oils; production of concentrates of PUFAs, preparation of fatty alcohols and amides, extraction of shark lover oil, squalene, shark cartilage, ambergris. **Fish wastes and utilization:** Protein recovery - collagen, gelatin, extraction of enzymes; Shellfish Waste; sources and composition, Conventional uses, Chitin, Chitosan, Glucosamine hydrochloride, Carotenoids from Fish protein hydrolysates- Production and utilization, Biochemical composition and importance in food and nutrition, Functional properties of bioactive peptides; Shellfish waste and its applications, Biogas production from fish waste. **Novel products from fish waste and uses:** Uses of Gelatin, Collagen, Shark cartilage, Glucosamine, Carotenoids, Astaxanthin, Bioactive peptides.

Practical

Extraction of collagen from fish waste, gelatin from fish waste and enzymes from fish waste. Preparation of hydrolysates from fish and shellfish wastes. Extraction of chitosan and glucosamine from shrimp shell waste, Recovery of fish oil from fish waste

Suggested Reading

- Balachandran KK. 2001. *Post-Harvest Technology of Fish and Fish Products*. Daya Publ. Elvevoll EO.
- *Fish Waste and Functional foods*, Norwegian College of Fishery Science, Department of Marine Biotechnology, Norway. edele@nfh.uit.no.
- Fereidoon Shahidi. 2007. *Maximizing the Value of Marine By-Products*, CRC PressInc. (Florida).
- Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR. 198.
- Venugopal V. 2014. *Fish Industry Byproducts as Source of Enzymes and Their Applications in Seafood Processing, in 'Fish Processing Byproducts: Quality Assessment and Applications*', Sachindra NM, Mahendrakar NS (Eds), Studium Press LLC, USA.
- Wheaton FW and Lawson TB. 1985. *Processing Aquatic Food Products*. John Wiley and Sons.

10	MPF -510	LPT 602	Fresh meat technology	2(1+1)

Theory

History, current development and prospects of meat and poultry industry in India Skeletal muscle development – pre- and post-natal- Structure and chemistry of muscle including poultry – Muscle Proteins - sarcoplasmic and myofibrillar proteins - Stromal proteins – Types of muscle fibres - Post mortem changes – Rigor mortis- Conversion of Muscle to meat - Pre and post-slaughter factors affecting meat quality – Defects during the conversion of muscle to meat – PSE/ DFD/ Cold Shortening – Off odour development. Composition and nutritive value of meat and poultry - Qualities of fresh meat – pH, WHC, colour, odour, juiciness, texture/ tenderness and firmness - Chilling, ageing and conditioning of meat - Electrical stimulation - Carcass evaluation, grading and fabrication- Tenderization of meat.

Practical

Evaluation/ estimation of physicochemical properties of fresh meat pH, colour, water holding capacity, ERV, shear force value, glycogen, R-value and myoglobin, Proximate analysis of meat - Estimation of drip loss - Determination of sarcomere length, fibre diameter and myofibrillar fragmentation index - Fractionation of sarcoplasmic, myofibrillar and stromal proteins - Carcass evaluation and grading Meat cutting, retail and wholesale cuts.

Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. *Principles of Meat Science*, 5th ed., Kend All/ Hunt Publishing Company, IOWA.
- Bender A. 1992. *Meat and Meat Products in Human Nutrition in Developing Countries*. FAO, Rome.
- Carlson CW, Greaser ML and Jones KW. 2001. *The Meat We Eat*, 14th ed. Interstate Publishers, INC.
- Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Lawrie RA and Ledward DA. 2006. *Lawrie's Meat Science*, 7th ed. Woodhead Publishing Limited, Cambridge, England.
- Pearson AM. 1994. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Springer, New York.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham University Press.

11	MPF -511	LPT 601	Abattoir practices and meat plant operations	3(2+1)

Theory

Handling and transportation of meat animals including poultry - Pre-slaughter handling

and care of food animals – Ante-mortem inspection - Humane slaughter - Principles and methods of stunning - Ritual methods of the slaughter of food animals and poultry - Machinery for slaughter and dressing of food animals - Post- mortem inspection - Handling, disposal and condemnation of unfit materials. Abattoir - layout, designing, organization and operation - Maintenance of meat and poultry processing plants - Record keeping - Legislations and regulations for establishment and operation of slaughterhouses and meat processing plants. Sanitation of slaughterhouse - Sanitary practices in meat plant and its benefits - Solid and liquid waste management of slaughterhouse - Different methods of effluent treatment and designs of effluent treatment plants - State and Central Pollution Control Board norms.

Practical

Design and outlay of modern abattoir including poultry processing and effluent treatment plants for different capacities - Judging and grading of food animals - Procedure for the slaughter of food animals and poultry - Ante-mortem and post- mortem inspection - Recording of carcass data - carcass yield, meat bone ratio, etc. Measurement of effluent characteristics - pH, BOD, COD, suspended solids, etc. Visit slaughterhouse, poultry processing and effluent treatment plants - DPR for the establishment of an abattoir.

Suggested Reading

- Collins DS and Huey RJ. 2015. *Gracey's Meat Hygiene*, 11th Ed. John Wiley and Sons Ltd., UK.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences* Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing- Improving Quality*. Woodhead Publishing Ltd., UK.
- Sahoo J, Sharma DK and Chatli M. 2011. *Practical Handbook on Meat Science and Technology*, 1st ed., Daya Publishing House.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.
- Warriss P. 2010. *Meat Science: An Introductory Text*, 2nd ed. Oxford Press.

12	MPF -512	LPT 609	Egg and egg products technology	2(1+1)

Theory

Status of egg production and processing in India - Structure, composition, nutritive value and functional properties of eggs - Grading, preservation, packaging and marketing of shell eggs - Quality evaluation of shell eggs and factors influencing egg quality - Defects and Spoilage of eggs. Layout and design of egg processing Unit - Principles and procedures involved in pasteurization, chilling, freezing, desugarization and drying of egg products - Quality standards of egg products - Packaging of egg products - Designer egg products.

Practical

Evaluation of physical, chemical, functional and microbial quality of egg and egg products - Preservation of eggs - Preparation of value-added egg products - Visit egg-processing plant.

Suggested Reading

- Romanoff AL and Romanoff AJ. 1949. *Avian Egg*. John Wiley and Sons.
- Stadelman WL and Cotterill OJ. 2002. *Egg Science and Technology*, 4th ed. CBS. *Selected articles from Journals.*

13	MPF -513	LPT 607	Slaughter house byproducts technology	3(2+1)

Theory

Status and scope of slaughterhouse by-products utilization - Trade practices - Planning, design and layout of by-products plant - Classification of by-products - edible and inedible - Rendering methods and products - Yield and characteristics of rendered fat and meat cum bone meal. Utilization of blood, horns and hooves, intestine, bones, feathers, bristles, glandularby-products and ruminal contents - Value-added by-products from slaughterhouse and poultry processing plants - Processing of animal by-products for pet foods - High-value low volume by-products – collagen sheets, scaffolds, bone morphogenic proteins, biopeptides, biodiesel, etc.- Legislation and regulations related to animal by-products. Flaying - Classification and factors affecting the quality of hides and skin - Physical and chemical characteristics of hide and skin - Grading and processing of hide and skin for the manufacture of leather - Preparation and quality control of gelatine and glue.

Practical

Preparation of casing, neats foot oil, gelatin and glue - Demonstration of preparation of carcass meal, meat meal, bone meal, blood meal, feather meal, slime meal - Grading of casings - Collection and preservation of glandular by-products - Preparation of pet foods -Visit local by-products processing units - Quality evaluation of rendered animal fat.

Suggested Reading

- Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed., Elsevier Academic Press, UK.
- Mann I. 1962. *Animal By-products: Processing and Utilization*. FAO, Rome.
- Ockerman HW and Hansen CL. 1999. *Animal By-product Processing and Utilization*. CRC Press.

DETAILED SYLLABUS- MINOR COURSES

1	FHQC 501	PFE 509	Food quality and safety	3 (2+1)

Theory

Food safety:Need for quality control and safety, strategy and criteria, microbiological criteria for safety and quality, scope of food toxicology, toxic potential and food toxicants, biological and chemical contaminants. Food additives and derived substances, factors affecting toxicity, designing safety in products and processes, intrinsic factors, establishing a safe raw material supply, safe and achievable shelf life. Process equipment and machinery auditing, consideration of risk, environmental consideration, mechanical quality control. Personnel hygienic standards, preventative pest control, cleaning and disinfesting system, biological factors underlying food safety. Preservation and stability, contaminants of processed foods, adulteration, prevention and control, FSSAI, ISO, Codex, GMP, BIS and HACCP. Practices, principles, standards, specifications, application establishment and implementation, HACCP and quality management system. Food Safety Management Systems (FSMS), Traceability.

Practical

Microbiological examination of food, hazard analysis, premises design, HACCP project plan, CCP, CCP Decision tree, HACCP control chart. HACCP case studies: Survey, BIS, FPO, Codex standards and specifications. Visits to food industries to study the various quality and safety aspects adopted.

Suggested Reading

- Herschdoerfer, SM. 1984. *Quality Control in the Food Industry.* Vol. 1 Academic Press.
- Herschdoerfer SM. 2012. *Quality Control in the Food Industry.* Vol. 2 Elsevier Science.
- Hubbard MR. 2003. *Statistical Quality Control for the Food Iindustry.* Springer.
- Mahadeviah M and Gowramma R V. 1996. *Food Packaging Materials*. Tata McGraw Hill.
- Mehmet M. 2011. *Biosensors in Food Processing, Safety, and Quality Control.* CRC Press.
- Palling SJ. 1980. *Developments in Food Packaging*. Applied Science Publisher.
- Sacharow S and Grittin RC. 1980. *Principles of Food Packaging*. AVI Publisher.
- Yanbo H, Whittaker AD and Lacey RE. 2001. *Automation for Food Engineering.* Food Quality Quantization and Process Control-CRC Press.

2	FHQC 502	FSQ 503	Advanced food chemistry	3 (2+1)

Theory

Composition, nutritional and functional value of food: Water activity and sorption phenomenon, Engineered foods and influencing water activity and shelf-life; Chemical reactions of carbohydrates–oxidation, reduction, with acid & alkali; Maillard reaction, Caramelization, Ascorbic acid oxidation, Resistant Starch, Soluble and Insoluble fibre, Pigments and approaches to minimize the impact of food processing, Molecular Mobility. Structure and Properties of proteins; electrophoresis, sedimentation, amphoterism, denaturation, viscosity, gelation, texturization, emulsification, foaming, protein-protein and other interactions in food matrix; Lipids: melting point, softening point, smoke, flash and fire point, turbidity point, polymorphism and polytypism; polymerization and polymorphism, flavor reversion, auto-oxidation and its prevention, fat in food matrix like fat globule in milk, PUFA, MUFA, CLA, Z - fatty acids, trans fatty acids, phytosterol, etc. Description of food flavours; Flavour enhancers, Food acids their tastes and flavours, Principles and techniques of flavour encapsulation, types of encapsulation; Factors affecting stabilization of encapsulated flavour and their applications in food industry. Processing and packaging induced chemicals and their control – acrylamide, nitrosamines, carcinogenic and genotoxicchlorpropanols such as 3-monochloropropane-1, 2-diol (3-MCPD), PAHs (in grilled and smoked products), dioxine, histamine, ethyl carbamate, furan, bisphenol A or phthalates from plastic materials, microplastics, 4-methylbenzophenone and 2-isopropylthioxanthone from inks, mineral oil from recycled fibres or semicarbazide from a foaming agent in the plastic gasket.

Practical

Estimation of protein content in food samples using spectroscopic methods. Study of effect of heat on protein denaturation using enzymes. Study of effect of various salt solutions on solubility of proteins. Separation of milk proteins by salting out method. Separation of proteins using chromatographic methods. Fractionation of proteins. Extraction and purification of essential oil/ flavouring compound of a natural source. Study the process of starch retrogradation, gelatinization and modification. Estimation of crude and dietary fibres in given food sample. Analysis of resistant starches. Estimation of various antioxidants, polar compounds and free fatty acids in frying oils. Extraction and purification of natural plant pigment. Functional properties and isoelectric point of proteins. Qualitative and quantitative evaluation of processing and packaging induced chemicals. Qualitative identification of different flavouring compounds

Suggested Reading

- Fennema OR, Ed., 2008. *Food Chemistry*, Marcel and Dekker, Inc., New York, NY.
- Belitz HD, Grosch W and Schieberle P. 2009. *Food Chemistry*. Springer.
- Varelis P, Melton L and Shahidi F. 2019. *Encyclopedia of Food Chemistry*. Elsevier.
- Cheung P, Mehta CK and Bhavbhuti M. 2015. *Handbook of Food Chemistry*. Springer

3	FHQC 503	FSQ 502	Global food laws and regulations	2 (2+0)

Theory

Food Borne Pathogens, Host Invasion, Pathogenesis, Significance to public health Food hazards and risk factors, Pathogenic foodborne microorganisms – *Salmonella*, *Pathogenic Escherichia coli* and other *enterobacteriaceae*, *Staphylococcus aureus*, *Listeria monocytogenes, Clostridium botulinum, Clostridium perfringens and Bacillus cereus* Other Gram-positive pathogens, *Campylobacter, Brucella, Aeromonas*, *Vibrio cholerae, Mycobacterium, Shigella.* Fungal and viral food-borne disorders, Food-borne important animal parasites, Mycotoxins, Incidence and behavior of microorganisms in meat, poultry, milk and milk products, fresh agro produce, sea foods. Controlling pathogens and microbial toxin via food processing, Microbial growth and shelf life, Modeling of microbial growth, Safety concerns of food processed through non thermal processing, management of microbial risk and toxin in foods through HACCP, Risk in antimicrobial nano materials, Risk assessment and predictive modeling. Molecular approaches for detection and identification of food borne pathogens, Enzyme Immunoassay (EIA), Enzyme-linked immune sorbent assay (ELISA), Radioimmunoassay (RIA) - instrumentation and applications of each immunoassay technique. DNA: DNA purification, DNA Fingerprinting. PCR/RTPCR (Real time) based analysis and sequencing, Biosensors, Recombinant DNA technology; Microchip based techniques, cDNA and genomic libraries, immunochemical techniques.

Practical

Preparation of common laboratory media and special media for cultivation of bacteria, yeast & molds. Isolation and identification of pathogens. Coliforms analysis of milk and water samples. Identification tests for bacteria in foods: IMVIC urease, catalase, coagulase, gelatin and fermentation (acid/gas). Determination of thermal death characteristics of bacteria. Determination of DNA and RNA of spoilage microorganism using PCR. Detection of DNA of trace components allergens, like nuts using ELISA. DNA/RNA based microarray experiment. Demonstration of DNA fingerprinting. Determination of growth and activity of microorganisms in incubator. Determination of

preservatives and food colours using Biosensor. Process time calculation for an indicator organism. Microbes responsible recall – case studies.

Suggested Reading

- Ray B and Bhunia A. 2007. *Fundamental Food Microbiology*, 4th Ed. CRC Press,
- Boca Ratan, FL. Food and Drug Administration.
- *Food-Borne Pathogenic Microorganisms and Natural Toxins Handbook: The Bad Bug Book.*
- Fratamico PM, Bhunia AK and Smith JL. 2005. *Food-Borne Pathogens: Microbiology and Molecular Biology.*
- Caister Academic Press. Juneja VK, Dwivedi HR and ofos JN. (Eds) 2017, *Microbial Control and Food Preservation.- Theory and Practice*, Springer.
- Schmidt RH and Rodrick GE. 2013 *Food Safety Handbook* Wiley

4	FHQC 504	FSQ 504	Global food laws and regulations	2 (2+0)

Theory

International Plant Protection Convention, world organization for animal health (OIE), sanitary and phytosanitary measures (SPS), Codex Alimentarius, FAOLEX, OECD Agriculture and Fisheries, International Trade Centre's Standards Map, FAO Food safety and quality emergency Prevention, JFSCA, Fundamental Principles of food safety governance, Risk Analysis as a Method to Determine the Regulatory Outcome, Increasing Responsibility of Businesses (Private) Risk Assessors, Concept of harmonization of global food laws. EU Food Safety Standards - Regulation 178 of 2002, The European food safety authority (EFSA), A critical overview of the EU food safety policy and standards, COMESA Food Safety Standards - An overview, Case Studies in Food Safety Standards in EU-COMESA Trade, Private voluntary standards (PVS) and EU food safety standards, FDA Food safety modernization Act (FSMA), FSPCA Preventive Controls for Human Food, Foreign Supplier Verification Programs (FSVP), Food Facility Registration, FDA - Current Good Manufacturing Practices (CGMPs). Hazard Analysis & Critical Control Points (HACCP) guidelines, Foreign Food Facility Inspection Program, International and Interagency Coordination, Registration of Food Facilities, Seafood Imports and Exports, Regulation on GM Foods, Regulations on Irradiated foods, Global Regulations on Health Foods, International Law on Adequacy of thermal processing, Grain Fumigation for Export, Law of trading horticultural Products, Safety Frame Applied to Food Applications of Nanotechnology. Review of Indian Regulatory Scenario in Food and Food Products - Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, Agricultural Produce Act, 1937 (Grading and Marketing), Export (Quality Control & Inspection), Act, 1963 and Rules, Bureau of Indian Standards relevant to food safety, Legal Metrology Act, International Food Control Systems/ Laws

Suggested Reading

- Osiemo O. 2018. *Food Safety Standards in International Trade: The Case of the EU and the COMESA*, CRC.
- Villarreal AM. 2018. *International Standardization and the Agreement on Technical Barriers to Trade*, Cambridge University Press.
- Meulen B, Bremmers H, Purnhagen K, Gupta N, Bouwmeester HL and Geyer L. 2014. *Governing Nano Foods: Principles-Based Responsive Regulation.*
- Understanding the Codex Alimentarius, 3rd ed., 2006.
- Vapnek J and Spreij M. 2005. *Perspectives and Guidelines on Food Legislation, with a new model food law for the Development Law Service* FAO Legal Office.
- US FDA Website.
- European Food Safety Authority (EFSA) website

5	FHQC 505	FSQ 506	Process and products monitoring for quality assurance	2 (2+0)

Theory

Variability of the Production Process - Control chart of the middle values and ranges, Medians and ranges, Middle values and standard deviations, Largest and smallest selected value and other individual values. Automation of the Control of Production Processes, Fluorescence cytometry for the rapid analysis of food microorganisms, Infrared spectroscopic methods, Machine vision for the food industry, Ultrasonic methods, Sampling procedures for on line quality. Evaluation the Capability of Production Process and Machine, Chemical sensors RFID, Analysis of the Current State of the Regulation of Manufacturing Processes

Suggested Reading

- Rodríguez MEP. 2018. *Process Monitoring and Improvement Handbook,* Second Edition 2018 by ISBN: 978-0-87389-974-1.
- *Food Process Monitoring Systems* 1993, Springer

6	FHQC 506	FSQ 501	Techniques in food quality analysis	4(2+2)

Theory

Sampling Procedures, Calibration and Standardization: Sub- sampling and its procedures, LOD, LOQ, Internal standards, Reference standards and certified reference materials. Spectroscopy techniques: Operation, calibration and standardization procedures as applicable to particular technique. Principles and applications of pH Meter, Digital analyzer, Auto-analyzer, Ultraviolet-visible spectroscopy (UV-VIS), Infra-Red, Fourier-Transform Infrared Spectroscopy (FTIR), Near Infra Red (NIR), Atomic Absorption spectroscopy (AAS). Chromatography Techniques: Principles, Components and

applications of (i) Paper Chromatography-Ascending and Descending-One dimensional & Two dimensional (ii) Thin layer chromatography (iii) Ion Exchange (iv) GC (v) GLC (vi) HPLC (vii) HPTLC (viii) GCMS (ix) LCMS (x) Amino acid Analyzer. Separation Techniques: Dialysis, Gel filtration, Electrophoresis: Principles, components and applications of (i) Paper (ii) Starch (iii) Gel (iv) Agar-gel (v) Polyacrylamide gel (vi) Moving boundary (vii) Immuno electrophoresis. Centrifugation: Types of centrifuge – Ordinary and Ultracentrifuge- Principle and applications. Principle, Components and Applications of (i) Differential scanning calorimetry (DSC) (ii) Thermogravimetric analysis (TGA) (iii) Isothermal microcalorimetry (IMC) (iv) Thermomechanical analysis (TMA) (v) Isothermal titration caloritmetry (ITC) (vi) Dynamic elemental thermal analysis (DETA) (vii) Nuclear magnetic resonance (NMR) (viii) Scanning electron microscopy (SEM) (ix) Transmission electron microscopy (TEM) (x) X-ray diffraction technique (XRD) (xi) Rapid visco-analyzer (xii) Texture analyzer and (xiii) Micro-dough lab.

Practical

Analysis and characterization of pigment in fruits by UV-VIS. Characterization of starches by FTIR spectroscopy. Assessment of microstructure of food components by SEM/Reviewing a micrograph obtained through SEM. Study of thermal denaturation of proteins and food enzymes by DSC. Quantization of allergenic proteins by LCMS. Separate and identification of pesticides in food samples by HPLC. Identification and molecular characterization of proteins by SDS-PAGE. Quantization of lipids and fatty acids using TLC. Assessment of pasting properties of starches and flours/flour-blends using RVA. Analysis of textural properties of food products with texture analyzer. Comparative rheological study of wheat flour samples of different varieties. Differential thermal analysis (DTA) and Thermogravimatric Analysis of a food samples A rapid, visual demonstration of protein separation by gel filtration chromatography. Amino acid profiling of food samples

Suggested Reading

- Ongkowijoyo P, Luna-Vital DA, de Mejia EG. 2018. *Extraction Techniques and Analysis of Anthocyanins from Food Sources by Mass Spectrometry: An Update Food chemistry*.
- Trimigno A, Marincola FC, Dellarosa N, Picone G and Laghi L. 2015. *Definition of Food Quality by NMR-based Foodomics, Current Opinion in Food Science* 4:99-104.
- Pare JRJ and Bélanger JMR. 2015. *Instrumental Methods of Food Analysis*: Elsevier.
- Cifuentes A. 2012. *Food Analysis: Present, Future, and Foodomics,* ISRN Analytical Chemistry. Skoog DA, Holler FJ and Nieman TA. 1998. *Principles of*

Instrumental Analysis (5 Ed.): Harcourt, Singapore.

7	PHFPE 520	ME 502 (Processing and Food Engg)	Refrigeration systems	3 (2+1)

Theory

Reversed Carnot cycle, Carnot, Brayton and aircraft refrigeration systems. Vapour compression refrigeration systems: Use of p-h chart, effect of pressure changes on COP, sub cooling of condensate on COP and capacity, super heating, single stage, multi-stage and cascade systems. Vapour absorption systems: Theory of mixtures, temperature-concentration and enthalpy concentration diagrams, adiabatic mixing of two systems, diabatic mixing, throttling process, ammonia water and water lithium-bromide systems. Thermoelectric refrigeration systems: Advantages, comparison with vapour compression system. Vortex tube refrigeration system and its thermodynamic analysis. Ultra low temperature refrigeration. Ejection refrigeration. Water refrigeration: Centrifugal and steam jet refrigeration systems, characteristics of steam jet refrigeration system, effect of boiler efficiency on overall COP, actual steam jet system, two-fluid jet refrigeration

Practical

Numerical on air refrigeration cycle, Study of vapour compression refrigeration systems, Determination of the coefficient of performance of the refrigeration system, Study of vapour absorption (electrolux) refrigeration systems, Study and application of P-V, T-s and P-h chart in refrigeration, Study and performance testing of domestic refrigerator, Study of domestic water cooler, Study of actual and theoretical COP of Cascade Refrigeration System, Visit to cold storage plants.

Suggested Reading

- Ahmadul A. *Refrigeration and Air Conditioning*. PHI India. Arora CP. *Refrigeration and Air Conditioning*. McGraw-Hill India Publishing Ltd.
- Arora R. *Refrigeration and Air Conditioning*. Prentice Hall of India. Crouse and Anglin. *Automobile Air Conditioning*. McGraw Hill Publications.
- Dossat RJ. *Principles of Refrigeration*. Pearson Education. Jordon and Prister. *Refrigeration and Air Conditioning*. Prentice Hall of India Pvt. Ltd.
- Prasad M. *Refrigeration and Air Conditioning*. New Age International Publisher. Stocker WF and Jones JW. *Refrigeration and Air Conditioning*. McGraw-Hill.

SUPPORTING COURSES

1	PHMC 501	Statistical Methods for Research Works	3 (2+1)

Theory

Probability and probability distributions. Principle of least squares. Linear and non-linear regression. Multiple regression. Correlation analysis. Selection of variables. Validation of models. Sampling techniques. Determination of sample size. Sampling distribution of mean and proportion. Hypothesis testing. Concept of p-value. Student's t-test. Large sample tests. Confidence intervals. ANOVA and testing of hypothesis in regression analysis. Analysis of variance for one way and two way classification (with equal cell frequency).Transformation of data. Advantages and disadvantages of nonparametric statistical tests. Scales of measurements. Run-test. Sign test. Median test. Wilcoxon-Mann Whitney test. Chi-square test. Kruskal-Walli's one way and Friedman's two way ANOVA by ranks. Kendall's Coefficient of concordance.

Practical

Fitting of distributions. Sample and sampling distributions. Correlation analysis. Regression analysis (Multivariate, quadratic, exponential, power function, selection of variables, validation of models, ANOVA and testing of hypothesis). Tests of significance (Z-test, t-test, F-test and Chi-square test). Analysis of variance. Non- parametric tests.

Suggested Reading

- Anderson T W 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.
- Dillon W R and Goldstein M. 1984. *Multivariate Analysis - Methods and Applications*. John Wiley.
- Electronic Statistics Text Book: http://www.statsoft.com/textbook/stathome.html
- Goon A M, Gupta M K and Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
- Goon A M, Gupta M K and Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I.
- The World Press. Hoel P G. 1971. *Introduction to Mathematical Statistics*. John Wiley.
- Hogg R V and Craig T T. 1978. *Introduction to Mathematical Statistics*. Macmillan.
- Montgomery and Runger 2014. *Applied Statistics and Probability for Engineers*. John Wiley.
- Morrison D F. 1976. *Multivariate Statistical Methods*. McGraw Hill.
- Siegel S, Johan N and Casellan Jr. 1956. *Non-parametric Tests for Behavior Sciences*. John Wiley.

2	PHMC 502	Experimental designs	2 (1+1)

Theory

Basic principles of experimental designs. Uniformity trials. Completely randomized design, randomized block design and latin square designs. Multiple comparison tests. Missing plot techniques. Analysis of covariance. Factorial experiments:2^2, $2^3$and 3^2. Split plot design. Strip plot design. Factorial in split plot design. Crossover designs. Balanced incomplete block design. Response surface designs. Groups of experiments.

Practical

Uniformity trials. Completely randomized design. Randomized block and latin square designs. Missing plot and analysis of covariance Split plot designs. Factorial in split plot design. Strip plot designs. Cross over and balanced incomplete block designs. Groups of experiments.

Suggested Reading

- Cochran WG and Cox GM 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D 1999. *Design and Analysis of Experiments*. Springer. Design Resources Server: www.iasri.res.in/design. *Examination of Theory and Practice*. John Wiley.
- Federer WT 1985. *Experimental Designs*. MacMillan. Fisher RA 1953. *Design and Analysis of Experiments*.
- Oliver & Boyd. Montogomery 2013. *Design and analysis of experiments*. John Wiley & Sons.
- Nigam AK and Gupta V K 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
- Pearce SC 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley & Sons

3	PHMC 503	Food informatics	2 (2+0)

Theory

Informatics: Meaning and purpose, Making food-related information available for food researchers, Smart Data searching, Data Retrieval, File search or text search in file on a system, Meta Search Engines. Major centers of food research in India and abroad, Data bases and Management in Food Processing, Data storage and distribution by using various information technology tools and methods, Computer vision for food detection, segmentation and recognition, 3D reconstruction for food portion estimation Augmented reality for food monitoring. Evaluation protocols of dietary monitoring/management systems, Mobile computing for dietary assessment Smartphone technologies for dietary behavioral patterns, Dietary behavioral pattern modelling using sensors and/or smartphones Laboratory Information Management System (LIMS) introduction and applications, LIMS in the food safety workflow, Wearable Food Intake Monitoring

Technologies, Computerized food composition (nutrients, allergens) analysis. Chemometric techniques - to gain fundamental understanding Of complex foods systems through the combination of data from independent measurement techniques, Product lifecycle tracing and tracking – ICT tools and technique.

Suggested Reading

- *Food Informatics: Applications of Chemical Information to Food Chemistry* Martinez- Mayorga,. Karina-Medina-Franco,.
- *Food Informatics: Sharing Food Knowledge for Research and Development* Nicole J.J.P. Koenderink1, J. Lars Hulzebos1, Hajo Rijgersberg1 and Jan L. Top

4	PHMC 504	Food business management	2 (2+0)

Theory

Business management; introduction, theories and functions, food industry management; marketing management and human resource development, personal management. Sectors in food industry and scale of operations in India. Human resource management, study the basics about HR and related policies and capacity mapping approaches for better management. Consumer Behavior towards food consumption, consumer surveys by various institutes and agencies, Various journals on consumer behaviour and market research, Internet based data search. Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ). Personnel management – recruitment, selection and training, job specialization. Marketing management – definitions, planning the marketing programmes, marketing mix and four P' s. Financial management – financial statements and rations, capital budgeting. Project management – project preparation evaluation measures. International trade; basics, classical theory, theory of absolute advantage. theory of comparative, modern theory, free trade- protection, methods of protection, quotas, bounties, exchange control, devaluation, commercial treaties, terms of trade, balance of payments, EXIM policy, foreign exchange, mechanics of foreign exchange, GATT, WTO, role of WTO, International Trade in agriculture. World trade agreements related with food business, export trends and prospects of food products in India. World consumption of food; patterns and types of food consumption across the globe. Ethnic food habits of different regions. Govt. institutions related to international ad trade; APEDA, Tea board, spice board, wine board, MOFPI etc. management of export import organization, registration, documentation, export import logistics, case studies. Export and import policies relevant to horticultural sector. Project: Consumer Survey on one identified product - both qualitative and quantitative analysis (say, Consumer behavior towards Pickles and Chutneys).

Suggested Reading

- David D and Erickson S. 1987. *Principles of Agri Business Management*. Mc Graw Hill Book Co., New Delhi.
- Acharya SS and Agarwal NL. 1987. *Agricultural Marketing in India*. Oxford & ISH Publishing Co., New Delhi.
- Cundiff Higler. 1993. *Marketing in the International Environment*, Prentice Hall of India, New Delhi.
- Batra GS and Kumar N. 1994. *GAD Implications of Denkel Proposals* - Azmol Publications Pvt., New Delhi.
- Phill Kottler. 1994. *Marketing Management* - Prentice Hall of India, New Delhi.

5	PHMC 505	Food Processing Entrepreneurship and Start up	2 (1+1)

Theory

Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business/ entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; Social Responsibility of Business. SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/ SSIs. Export and Import Policies relevant to food sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of horti inputs industry. Characteristics of Indian food processing and export industry. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Study of a regulated market, Study of a fruit and vegetable market, Study of State and Central Warehousing Corporation. Study of functioning of a regional rural bank and commercial bank for loan. Study of food processing enterprise, Formulation of project reports for financing food Industry, Working out repayment plans, Legal Issues in Product Development, Marketing and Market Segments. Case studies: Innovations in

Dairy industry, Bakery industry, fats and oils industry, fruit and vegetable industry, primary and secondary processing of cereals, brewing industry.

Suggested Reading

- Hu, R. 2005. *Food Product Design A Computer-Aided Statistical Approach*, Technomic Publishers.
- Moskowitz H R, Saguy S. and Straus T. 2006. *An Integrated Approach to New Food Product Development,* CRC Press.
- Moskowitz H R, Porretta S. and Silcher M. 2006. *Concept Research in Food Product Design And Development*, Blackwell Publishing Ltd.
- Peters MS and Timmerhaus KD. 2005. *Plant Designs and Economics for Chemical Engineers*, McGraw Hill, 5th Edition,
- Ahmad T. 2009. *Dairy Plant Engineering and Management*., Kitab Mahal, 8th Edition

6	PHMC 506	Food Safety Management Systems and Certification	2 (2+0)

Theory

Food safety management systems and its requirements for any organization in the food chain, Block chain concept, Global food safety initiative (GFSI), PAS 220, Prerequisite programs on food safety for food manufacturing, Audits: Introduction, objectives, documentation, responsibilities. Food safety plan overview, Good manufacturing practices and other prerequisite programs, GAP and GMP, Preliminary Steps in Developing a food safety plan, Resources for food safety plans, HACCP, TACCP and VACCP. Biological/ Chemical/ Physical and Economically motivated food safety hazards, Process preventive controls, Food allergen preventive controls, Sanitation preventive controls, supply chain preventive controls, verification and validation Procedures, Record Keeping Procedures, Recall Plan FSMS and FSSC 22000. ISO 22003, ISO 20005 and traceability in food chain, ISO 14000 series – certification and its importance, ISO 17025 - General requirements for the competence of testing and calibration laboratories, BRC Standard, BRC Storage and Distribution, SQF, Southern Rocklobster Seafood, Retailer programs like Woolworths, Coles, Costco and ALDI, Concept of Auditing.

Suggested Reading

- Salazar E. 2013. *Understanding Food Safety Management Systems: A Practical Approach to the Application of ISO-22000:2005*, Create Space Independent Publishing Platform.
- ISO 22000 *Standard Procedures for Food Safety Management Systems*, 2008,

- Bizmanualz, Inc. Dillon M and Griffith C (ed). 2001. *Auditing in the Food Industry - From Safety and Quality to Environmental and Other Audits*, CRC Press.
- Inteaz A. 2003. *Food Quality Assurance: Principles and Practices*, CRC Press.

Respective certification documents

NON-CREDIT COMPULSORY / COMMON COURSES

1	PGS-501	Library and information services	1 (0+1)

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

2	PGS-502	Technical writing and communications skills	1 (0+1)

Practical

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations, etc.; Commonly used abbreviations in the theses and research communications; Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article; Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech; Participation in group discussion; Facing an interview; Presentation of scientific papers.

Suggested reading

- Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
- *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- *Collins' Cobuild English Dictionary*. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
- Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- Richard WS. 1969. *Technical Writing*.
- Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. *High School English Grammar and Composition*.S. Chand & Co.

3	PGS-503	Intellectual property and its management in agriculture	1 (1+0)

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, Geographical indications, Designs and layout, Trade secrets and Traditional knowledge, Trademarks, protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, Protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested reading

- Erbisch FH and Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw- Hill. *Intellectual Property Rights: Key to New Wealth Generation.*

2001.

- NRDC and Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V.*Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - *Patents Act, 1970 and amendments; Design Act*, 2000;
- Trademarks Act, 1999; *The Copyright Act, 1957 and amendments;* Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; *National Biological Diversity Act*, 2003.

4	PGS-504	Basic concepts in laboratory techniques	1 (0+1)

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/ chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested reading

- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
- Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

5	PGS-505	Agricultural research, research ethics and rural development programmes	1 (1+0)

Theory

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural

Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), Partnership with NARS, Role as a partner in the global agricultural research system, Strengthening capacities at national and regional levels; International fellowships for scientific mobility. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested reading

- Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
- ao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*.
- Mittal Publ. Singh K. 1998. *Rural Development - Principles Policies and Management.* Sage Publ.

COMPULSARY NON-CREDIT DEFICENCY COURSES*

Sr. No.	Course Code as per 5th Deans	Title of the course	Credits
1	FRM	Taxonomy of finfish	3(1+2)

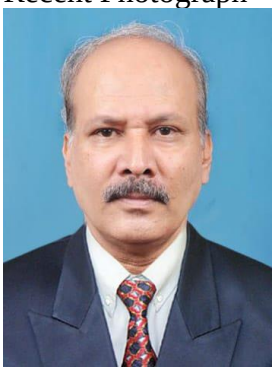
Theory

Principles of taxonomy. Nomenclature, types. Classification and interrelationships. Criteria for generic and specific identification. Morphological, morphometric and meristic characteristics of taxonomic significance. Major taxa of inland and marine fishes up to family level. Commercially important freshwater and marine fishes of India and their morphological characteristics. Introduction to modern taxonomic tools: karyotaxonomy, DNA barcoding, protein analysis and DNA polymorphism.

Practical

Collection and identification of commercially important inland and marine fishes. Study of their external morphology and diagnostic features. Modern taxonomic tools - Protein analysis and electrophoretic studies; Karyotaxonomy - chromosome preparation and identification. DNA barcoding, DNA polymorphism; Visit to fish landing centres to

study commercially important fishes and catch composition.

Recent Photograph 	Name of the Faculty	Dr.S.B.Patange
	Post Held	Professor and Head, Department of PHM of MPF, PGI-PHTM, Killa-Roha
	Date of Birth	29.05.1967
	Qualification	Ph.D.(Fish Post Harvest Technology)
	Area of Specialization	Fish Post Harvest Technology, Quality control and seafood safety.
	Experience (Years)	30 Years and 6 Months
	Research Projects guided PhD M.Sc./M.Tech	 02 no. 22 no.
	Present area of research	Fish post harvest management and value addition.
	Contact details Land line No. Mobile Fax Email	 82752 71600 patange29@gmail.com

4. Infrastructure

a. **Laboratories**
The Department of PHM of MPF, P.G.I.P.H.T.M., Killa-Roha has a PG Laboratory.

b. **Name of the important instruments/facilities**:Autoclave sterilizer, muffle furnace, hot ai oven, ice machine etc.
(1)Tray Dryer; (2) Centrifuge; (3) Pulverizer; (4) Planatory Mixer; (5) Hot air oven; (6) Mixer cum grinder; (7) Hand operated Jackfruit cutting machine; (8) Hand Operated Jackfruit bulb cutting machine; (9) Power Operated Jackfruit bulb cutting machine; (10) Jackfruit frying system; (11) Ribbon Blending machine; (12) Band Sealer (Continious); (13) Vacuum Packaging Machine; (14)Vertical autoclave; (15)Oil Bath.

5. Faculty

a. **Academic staff:** Assistant Professor and above with the details of the staff as given below

6. Research Activities and Achievements (including projects)

a. Postgraduate research projects supervised in the department

Sr. No.	Name of student	Thesis Title
1	Killekar V C	Extraction and characterization of gelatin from black king

		(*Ranchycentron canadus*) fish
2	Rathod N B	Preparation of Battered & Breaded product from freshwater fish (*Pangasianodon hypophthalmus*)
3	Wartha G C	Preparation of fish soup powder from Tilapia
4	Patil S S	Development of fish mince pakora from Pink perch (*Nemipterus japonicus*)
5	Gaurat P V	Effect of different cooking methods on physic-chemical and nutritional properties of mackrel (*Rasterlliger kanagurta*) and Catla (*Catla catla*)
6	Gurav S S	Effects of extraction methods on functional properties of roe protein concentrate from tilapia
7	Bhingarde O R	Effect of different concentration of pepsin enzyme on extraction of fish protein hydrolysate from Malabar sole fish
8	Bandre P G	Development of predusting mix for coating of battered and breaded squid (*Loligo duvauceli*) rings
9	Bichukale A D	Extraction and characterization of gelatin form poultry waste
10	Jadhav R M	Utilization of different plant extracts for tenderization of meat
11	Kudale A S	Preparation of Battered & Breaded product from jawala (*Acetes indicus*)
12	Phadtare M C	Extraction of fish protein concentrate from pink perch (*Nemipterus japonicus*) and its incorporation in fish finger value added products
13	Shinde K R	Development of edible films from egg yolk fractions
14	Ms Bambale S G	Storage stability of dried tiny shrimp (*Nematopalaemon tenuipes*) at refrigerated storage
15	Shendage R H	Utilization of chicken shank for development of soup
16	Ms Chavan D R	Microwave drying of Bombay duck fish
17	Ms Chande Nikita	Effect of IQF on performance and storage characteristics of white leg shrimps
18	Ms Mhaske Rutuja	Antimicrobial edible coating on poultry meat
19	MsMotghare Sanjivenee	Studies on the preservation of minced chicken meat
20	Bhujbal Prateek	Freezing and storage performance of Tilapia fish fillets

b. **Research Recommendations:** Provide the details of the research recommendations approved in Joint Agresco along with relevant photographs.

Sr.No.	**Title**	**Year**
1	Tenderising and preservative effect of	2018

Sr.No.	Title	Year
	Betel leaf extract on Chevon. (The process developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for tenderizing and preserving chevonupto 6 days by using *Betel* leaf extract in the proportion of 1:1 is recommended).	
2	Development of Instant Chicken Paya (Shank) Soup Powder. (As per the process developed by DBSKKV, it is recommended to prepare instant broiler chicken paya [shank] soup by using shank broth [66.29%], monosodium glutamate [0.5%], citric acid [0.11%] and corn flour [10%] with shelf life of 90 dyas which could be reconstituted using 10 gram powder in 100 ml hot water).	2020

c. **Ongoing Research Projects/Programmes/Schemes:** Only provide the name of the on going Research Projects/Programmes/Schemes. The details of the on going Research Projects/Programmes/Schemes will have to be provided by the concerned in charge in the separate format provided for this purpose. The link will be provided here with those details.

Joint Agreco University assisted research projects:

1. Development of Edible film from egg yolk fractions
2. Development of antimicrobial edible coating for poultry meat
3. Microwave drying of Bombay duck fish
4. IQF freezing and storage performance of Vennamei shrimps

7. Extension Activities

a. **The training lectures delivered as a resource person**

(1) Participated in university organized exhibitions at different places organized from time to time

(2) Dr. S. B. Patange & Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has submitted the training material (Literature) one marathi article for Bhat pik kadhni paschyat tantradnyan to the Principal, RAMETI, Karjat for development of training material for state level training programmes organized throughout the year (02.03.2023).

(3) Dr. S. B. Patange & Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered has visited to Sh.Lakshman Janu Bhoir near by village Rabgaon Tal.Sudhagad, Dist Raigad on 11.11.2022 under the campaign **ßek>k ,d fnol ek÷;k cGhjktklkBhÞ**.

(4)

Dr.S.B.Swami Professor and Head, Department of Post Harvest Engineering, Post Graduate Institute of Post Harvest Management, Killa-Roha has attended the online Webinar on Nutricereals organized by DSAO, Raigad, Alibaug and explained about the various activities can be conducted for Millet Processing and Training in Raigad during celebration of International Year of Millets.

(5) Dr.S.B.Swami Professor and Head, Department of Post Harvest Engineering, Post Graduate Institute of Post Harvest Management, Killa-Roha has attended the online meeting organized by Principal, RAMETI, Khopoli for the development of Training Literature on rice processing and guided the meeting on 01.12.2022.

(6) Dr.S.B.Patange Professor and Head Department demonstrated the poster and product in the exhibition organized at Dr.B.S.K.K.V.Dapoli on 14-16th December, 2022 at Dr.B.S.K.K.V.Dapoli

b. **Publications:** Provide the details of the following publications published by the Department/Section in bibliographical form

Books
Booklet/bulletin
Folders
Souvenir/Proceedings of Seminar/Symposia/Conference/Workshop Organized
Training manuals of the training programme organized
Journal Research papers
Full length research papers published in Proceedings of Seminar/Symposia /Conference/Workshop

Publication of Books/ Book Chapter

Sr No	Name of article	Date of publication	Name of Publication	ISSN No
1	Present Status of Brackish Water Aquaculture in Ratnagiri - S.T. Sharangdhar, S.G. Belsare, S.B. Patange and M.T. Sharangdhar	(2002), 8(1) : 93-95.	*Eco. Env. & Cons.*	0971 – 765X
2	Frozen Storage Characteristics of Treated and Untreated Meat From Male and Female Mussel *(Perna viridis)* – S.S. Sawant and S.B. Patange	(2002), 39(1) : 27-33.	*Fish. Technol.*	0015 – 3001
3	Studies on Frozen Storage Characteristics	(2002),	*J. Maha. Agri.*	0378 –

	of a Fresh Water Fish *Catla catla* (Bloch) – B.P. Bhosale and S.B. Patange	27(2) : 191-196.	*Univ.*	2395
4	Isolation and Identification of Histamine-forming Enterobacteria in Freshly Landed Tuna (*Euthynnus affinis*) Using a Dichotomous Scheme – S.B. Patange, M.K. Mukundan and S. Sanjeev	(2004), 41(2): 149-152	*Fish. Technol.*	0015 – 3001
5	A Simple and Rapid Method for Colorimetric Determination of Histamine in Fish Flesh – S.B. Patange, M.K. Mukundan and K. Ashok Kumar	(2005), 16(5):465-472.	*Food Control*	0956 – 7135
6	An appraisal of Environmental Hazards and Seafood Safety – S.B. Patange, S.T. Sharangdher and M.T. Sharangdher	(2007), 13(2): 411-418.	*Eco. Env. & Cons*	0971 – 765X
7	Development of Prawn Pickles – S.T. Sharangdher, J.M. Koli, V.P. Joshi, and S.B. Patange	(2009), 15(1): 167-168	*Eco. Env. & Cons*	0971 – 765X
8	Safety and Shelf Stability of Hurdle Processed Soft-moist Prawns - T. E. Baug, S. B. Patange, and S. T. Sharangdhar	(2009), 15(3): 593-598	*Eco. Env. & Cons*	0971 – 765X
9	Development of Fish Pickles From Low Cost Fish - S.T. Sharangdher, J.M. Koli, V.P. Joshi, and S.B. Patange	(2009), 15(2): 259-261	*Eco. Env. & Cons*	0971 – 765X
10	Biochemical and Functional Properties of Enzymic Protein Hydrolysate from Croaker (*Otolithus ruber*) – D.V. Sawant, S.B. Patange, V.R. Joshi, S T Sharangdhar, G.N. Kulkarni	(2010), 16(4): 541-547	*Eco. Env. & Cons*	0971 – 765X
11	Effect of Process Parameters on Properties of Chitosan from Shrimp and Prawn Shell Waste – S.B. Patange, Naveen Kumar, and S.T. Sharangdhar	(2010), 16(4): 577-587	*Eco. Env. & Cons*	0971 – 765X
12	Preparation and Characterization of Gelatin from Pink Perch Skin – S.B. Patange, S.T. Sharangdhar, J.M. Koli and V.R. Joshi	(2011), 17(1): 37-40	*Eco. Env. & Cons.*	0971 – 765X
13	Descrimination of *Nemipterus japonicus* (Bloch, 1791) Stock From Maharashtra and	(2011), 40(3): 471-475	*Ind. J. Geo-Mar. Sci.*	0379-5136

	Goa States of India – Pawar HB, Shirdhankar MM, Barve SK and Patange SB			
14	Melanosis Inhibition and SO2 Residual Levels in Farmed Tiger Shrimp (penaeus monodon) Following Different Sulfite-based Treatments – Surasani VKR and Patange SB	(2012), 21(4):330-337	*J. Aquat. Food Prod. Technol.*	1049-8850
15	Functional Characteristics of Gelatin Extracted From Skin and Bone of Tiger-toothed Croaker (*Otolithus ruber)* and Pink Perch (*Nemipterus japonicus*) – JM Koli, S Basu, BB Nayak, SB Patange, AU Pagarkar and V Gudipati	(2012) , 90:555-562	*Food Bioprod. Process.*	0960-3085
16	Physico-chemical and Textural Properties of Gelatins and Water Gel Desserts from Skin of Marine Water Fishes – JM Koli, SB Patange, BB Nayak and V Gudipati	(2012), 18(2): 313-318	*Eco. Env. & Cons.*	0971 – 765
17	Design, Operation and Technical Specifications of Sajachi (spike) Dol Nets of Ratnagiri, Maharashtra – N Warhekar, AS Mohite, MT Sjarangdhar and SB Patange	(2012), 13 (2): 153-159	*AQUACULT*	0972-2262
18	Operational Characteristics, Design and Technical Specifications of Rampan Nets of Ratnagiri, Maharshtra - N Warhekar, AS Mohite, MT Sharangdhar and SB Patange	(2012), 7(2):78-84	*Asian J. Animal Sci.*	0973-4791
19	Fish Products and Their Value Addition – JM Koli, ST Sharangdhar, SY Metar, VV Vishwasrao, SB Patange and MT Sharangdhar	2012, 5:45-48	*Beverage & Food World*	0970-6194
20	Commercially Important Fishery Byproducts - JM Koli, ST Sharangdhar, SY Metar, VV Vishwasrao, SB Patange and MT Sharangdhar	2012, 5:56-57	*Beverage & Food World*	0970-6194
21	Design and Operational Characteristics of Sajachi (spike) Dol Nets operated Off Ratnagiri, Maharashtra – N Warhekar, AS Mohite, MT Sharangdhar and SB Patange	(2013), 40:34-42	*GEOBIOS*	0251-1223
22	Development of Fish Cutlet From Low Cost Fish Mince – ST Sharangdhar, JM Koli, SB Patange, SY Metar, MT Sharangdhar	(2013), 19(1): 151-153	*Eco. Env. & Cons.*	0971 – 765X
23	Physiocochemical and Functional Properties of Chitosan Extracted From Crab (*Scylla serrata*) By Different	2015, 2(7): 77-85	*Int. J. Sci. Appl. Res.*	2394 – 2401

	Chemical Processing Sequence – B V Gaikwad, J M Koli, S T Sharangdhar and S B Patange			
24	Physiocochemical and Functional Characteristics of Muscle Proteins From Ribbon Fish (*Trichiurus* spp) of Different Weight Groups – G D Posture, S B Patange, R R Mugale, and S T Sharangdhar	2015, 2(10): 18-26	*Int. J. Sci. Appl. Res.*	2394 – 2401
25	Development of Fish By-products by Using Fish and Shellfish Waste for Upliftment of Socio-economic Status of Fisher Folk – J M Koli, S T Sharangdhar, S B Patange, S Y Metar, and A R Jain	2015, 2(1): 1- 20	*Int. J. Ani. Vet. All. Sci.*	2394 – 4498
26	Storage Characteristics of Fish Ball Prepared From Minced Meat of Tilapia (O. *mossambicus*) at 0 to 2 ^{o}C – R R Mugale, S T Sharangdhar, M T Sharangdhar, J M Koli and S B Patange	2015, 2(12): 96 - 102	*Int. J. Sci. Appl. Res.*	2394 – 2401
27	Preparation of Battered and Breaded Products from Dhoma Fish – A S Pilankar, S T Sharangdhar, S B Patange, M T Sharangdhar, J M Koli and A R Jain	2016, 2:476	*Proc. Rec. Adv. Sci Tech.*	978-93-63046-31-7
28	Packaging Technology for Traditional Konkan Style Mackerel Fish Curry – S B Patange, S T Sharangdhar and S S Patil	2016, 2:483	*Proc. Rec. Adv. Sci Tech.*	978-93-63046-31-7
29	Physico-chemical and Functional Characteristics of Muscle Proteins from Robbon Fish (*Trichiurus* spp.) of Different Weight Groups – G D Posture, S B Patange, M T Sharangdhar,, J M Koli, and V R Joshi	2016, 1(1): 1-11	*Accent J. Econ. Ecol. Engg.*	2456-1037
30	Effect of Vacuum Packaging and Potassium Sorbate on the Shelf Life of Eel Fish (*Mastacembalus armatus*) During Chilled Storage – R R Mugale, S B Patange, V R Joshi, G N Kulkarni, and M M Shirdhankr	2017, 17(1):199-204	*Biochem. Cell. Arch.*	0972-5075
31	Proximate Composition and Fatty Acid Profiling of Indian Mackerel (*Rastrelliger kanagurta*) off Ratnagiri, West Coast of India - Ajay Eknath Sonavane, J. M. Koli, S. B. Patange, S. D. Naik and A. S. Mohite	2017, 5(4):920-924	*Int. J. Pure Appl. Biosci.*	2320-7051
32	Effects of Modified Atmosphere Packaging on Shelflife of Indian Mackerel (*Rastrelliger kanagurta*) During Chilled Storage - S B Patange, S T Sharangdhar, S	2017, 7(5):271-278	*Int. J. Agril. Sci. Res.*	2321-0087

	S Sawant, J M Koli and V V Vishwasrao			
33	Seasonal Variations in Cholesterol Content and Proximate Composition of Indian Mackerel (*Rastrelliger kanagurta*) – Hafsa Maqbool, S B Patange, Mudassir Azhar, J M Koli and M.T. Sharangdhar	2017, 54:190-196	*Fish. Technol.*	0015-3001
34	Textural and sensory characteristics of eel steaks processed during thermal processing in brine medium to optimise Fo value – Rohini Mugale, S B Patange, V R Joshi, G N Kulkarni and M M Shirdhankar	2018, 7(2): 849-859	*Int. J. Curr .Microbiol. Appl. Sci.*	2319-7706
35	Isolation of acid and pepsin soluble collagens from skin of Idian mackerel *Rastrelliger kanagurta* (Cuvier, 1817) – A E Sonawane, J M Koli, S B Patange, S D Naik and A S Mohite	2018, 6(2): 2508-2511	*J. Entomol. Zoology*	2320-7078

List of Journal Papers

8. Contact Information

Name of the Head	**:**	Dr.S.B.Patange
Name of the Department	**:**	Department of PHM of MPF
Postal Address	**:**	P.G.Institute of Post Harvest Technology and Management, Killa-Roha 402 116, Dist:Raigad (MS)
Landline Number	**:**	--
Mobile Number	**:**	8275271600
Email	**:**	Patange29@gmail.com sbpatange@dbskkv.ac.in