University departments/ADR/ Research satation:

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 Post Harvest Engineering, P.G.Institute of Post Harvest Technology and Management, Killa-Roha was established in the year 2015-16 at Roha campus of of Dr. BSKKV Dapoli. The department is engaged in Teaching at PG level students in the field of Post Harvest Engineering. Apart from the academic research at PG, the Department has undertaken some need based research of the agro-horti 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, agricultural processes and new product development and demonstration of Food Processing Machinery and Equipment's. The Department also provides need based consultancy services. The Department of Post Harvest Engineering, PGI-PHTM, Killa-Roha has undertaken the externally funded research projects which are relevant to the Konkan Region. The Department has also developed the MOU's with academic Institution with Indian Institute of Technology, Bombay, Powai on "Development of Process Technology for Extraction of Pectin from the Jackfruit Waste". The educational MOU was signed on 17.11.2022 at DBSKKV, Dapoli. The research work on the said topic is been undertaken by Dr.S.B.Swami Professor and Head, Deptt. of Post Harvest Engineering, PGI-PHTM, Killa-Roha.

Department of Post Harvest Engineering, 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 Post Harvest Engineering has been started in 2015-16 till date around 14 students has been completed their M.Sc.(Post Harvest Management) degree programme in the discipline of Post Harvest Engineering. The List of students have completed their P.G. Degree in this disciplines are as follows.

Sr No	Registration No	Name of Student	Title of Thesis	Year of Degree Award
1	PHMRM/15/121	Mr. Satpute Prashant Tanhaji	Development of Paneer from Soy Fortified Cow milk	2017-18
2	PHMRM/15/122	Miss. Sharayu Mahendra Rangnekar	*Development of Cookies From* Orange(Citrus Sinensis) Peel Powder	2017-18
3	PHMRM/15/123	Miss. Mali Ashwini Ramchandra	Development of Herbal Cookies from Finger millet malt and *Aloe vera* Powder	2017-18
4	PHMRM/15/124	Mr. Jadhav Sameer Sharad	Development of Powder From Sapota (*Sapodilla*) Slices By Different Drying Methods	2017-18
5	PHMRM/15/125	Mr. Nale Santosh Ankush	Studies on Drying of Beetroot Slices (*Beta Vulgaris)* And Its Quality Evaluation.	2016-17
6	PHMRM/16/137	Mr.Yadav Kunal Umakant	Effect of Pre-treatments and methods for drying of Grapes on Quality of Grape Raisins	2018-19

7	PHMRM/16/139	Mr.Sargar Yogesh Appaso	Development of Instant Soup Mixes from Leafy vegetables	2018-19
8	PHMRM/16/138	Ms.Mulani Aasma Jahangir	Utilization of Pomegranate peel powder and rice bran in development of slice bread	2018-19
9	PHMRM/16/136	Ms.Kamble Sayali Sunil	Development of cup cake from Jackfruit seed and finger millet flour	2018-19
10	PHMRM/17/0155	Ms. Jadhav Sonali Maruti	Osmo-Microwave-Convective Drying of Carrot and Development of Instant Carrot Halwa	2019-20
11	PHMRM/17/0154	Mr.Dhumal Akash Dnyaneshwar	Foam Mat Drying of Alphonso Mango Pulp for Powder Making	2019-20
12	PHMRM/17/0150	Ms. Bagmare Pooja Anandrao	Development of Multi grain Mixes for Indian Traditional Food (Thalipeeth, Sev) from Finger Millet Malt, Moth Bean Malt and Drum Stick (Moringa Spp.) Leaf Powder	2019-20
13	PHMRM/17/0153	Ms. Waghmare Kajal Gautam	Development of Toffee from Wood Apple Pulp Powder	2019-20
14	PHMRM/17/0151	Ms. Chaudhari Hemlata Suresh	Development of Instant Ice Cream Mix (Psidium Gujava L.) Powder	2019-20

The Paper presented on the students work of Department of Post Harvest Engineering, P.G.I.P.H.T.M., Killa-Roha has been awarded with the **Best Poster Presentation award** at ICAR Sponsored National Conference on Agro-Processing Based Entrepreneurship Development for Sustainable Livelihood was held during 22-23rd Feb. 2017 at Department of Agricultural Process Engineering and AICRP on Post Harvest Engineering and Technology, Dr.P.D.K.V.Akola for the poster on the topic presented by Dr.S.B.Swami for the paper entitled "Preservation of Beetroot (*Beta vulgaris L.)* by Various Methods".

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 Post Harvest and Food Process Engineering.

Semester No.	Term No.	Course No.	Credits	Title of the course offered by the department
Major				
I	**I**	*PHFPE-502	3(2+1)	Engineering Properties of Food Materials
		*PHFPE-507	3(2+1)	Horticultural Crops Process Engineering
		PHFPE-506	3(2+1)	Field Crops Process Engineering
II	**II**	*PHFPE-501	3(2+1)	Emerging Food Engineering Operations
		*PHFPE-503	3(2+1)	Transport Phenomenon
		PHFPE-508	3(2+1)	Storage Engineering and Handling of Agricultural Produce
		PHFPE-513	2(1+1)	Food Package Engineering
Minor				
I	**I**	FHQC-504	2(2+0)	Global food laws and regulations
		FHQC-506	4(2+2)	Techniques in food quality analysis
II	**II**	PHFPE-520	3(2+1)	Refrigeration Systems
Supporting				
I	**I**	PHMC-502	2(1+1)	Experimental Designs
II	**II**	PHMC -504	2(2+0)	Food Business Management
		PHMC-506	3(2+1)	Food Safety Management Systems and Certification
Non-Credit Compulsory Courses				
I	**I**	PGS-501	1(0+1)	Library and information services
		PGS-504	1(0+1)	Basic Concepts in Laboratory Techniques
II	**II**	PGS-502	1(0+1)	Technical writing and communication skills
		PGS-503	1(1+0)	Intellectual property & its management in agriculture
		PGS 505	1(1+0)	Agriculture Research, Research Ethics and Rural Development
III	**III**			Industry/Institute Training (One Month)
Non-Credit Deficiency Courses				
I	**I**	PHFPE 413	2(1+1)	Engineering Properties of Agricultural Produce
		PHFPE 414	3(2+1)	Post Harvest Engineering of Cereals, Pulses and Oil Seeds
II	**II**	PHFPE-412	2(1+1)	Heat and Mass Transfer
III	**III**	PHFPE-411	3(2+1)	Engineering Mathematics-I
Seminar				
IV	**IV**	PHFPE-591	1(0+1)	Seminar
Research Project				
I	**I**	PHFPE-599	3(0+3)	Thesis Research
II	**II**	PHFPE-599	1(0+1)	Thesis Research
III	**III**	PHFPE-599	16(0+16)	Thesis Research
IV	**IV**	PHFPE-599	10(0+10)	Thesis Research

Course Curricula and syllabi:

Major Courses

1 *PHFPE 502 Engineering Properties of Food Materials* 3(2+1)

I. Theory

Unit I

Physical characteristics of different food grains, fruits and vegetables; shape and size, volume and density, porosity, surface area, water activity. Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, phase transition, methods of determination, steady state, transient heat flow. Electrical properties; Dielectric loss factor, loss tangent, temperature dependent electrical conductivity and dielectric constant, method of determination, energy absorption from high-frequency electric field.

Unit II

Magnetic properties: paramagnetism, ferromagnetism, diamagnetism, magnetization, applications for magnetic field forces, magnetic resonance; Electromagnetic properties: electric polarization, temperature dependency, frequency dependency, microwave, conversion of microwaves into heat, penetration depth of microwaves, applications; Optical properties: refraction, colorimetry, near infrared, ultraviolet, applications; Acoustical properties: sound, ultrasonic sound and applications; Radioactivity: types of radiation, radioactive decay, measurement of ionizing radiation, natural radioactivity, applications.

Unit III

Contact stresses between bodies, hertz problems, firmness and hardness, mechanical damage, dead load and impact damage, vibration damage, friction, effect of load, sliding velocity and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity.

Unit IV

Rheological properties and classification of fluid foods: measurement methods and techniques; Mechanisms and relevant models; Effect of temperature; Compositional factors affecting flow behavior; Viscosity of food dispersions – dilute and semidilute systems, concentration effects.

Unit V

Rheology of semi-solid and solid food; Rheological characterization of foods in terms of stress-strain relationship; Viscoelasticity; Transient tests - Creep Compliance and Stress Relaxation; Mechanical models for viscoelastic foods: Maxwell, Kelvin, Burgers and generalized models and their application; Dynamic measurement of viscoelasticity.

Unit VI

Large deformations and failure in foods: fracture, rupture and other related phenomena; Relationship between instrumental and sensory data; Texture Profile Analysis; Instrumental measurements – Empirical and Fundamental methods; Rheometers and Texture Analyzers; Measurement of Extensional viscosity; Acoustic measurements on crunchy foods.

Unit VII

Food structuring: traditional food structuring and texture improvement, approaches to food structuring, extrusion and spinning, structuring fat products, structure and stability, gels, gelation mechanisms, mixed gels, the microstructure of gels, structure property relations angels.

Unit VIII

Examining food microstructures: light microscopy transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, image analysis: image acquisition, image processing and analysis.

II. Practical

- Viscosity measurements of fruit juices and semisolid food products • Comparative analysis of Newtonian and non-Newtonian fluids
- Development of stress and strain curve and to study viscosity of Newtonian and non-newtonian fluids
- Temperature dependent and shear dependent rheology
- Pasting analysis of food; Determination of thermal conductivity, specific heat and glass transition temperature using differential scanning colorimetry (DSC)
- Texture analysis of fruits and vegetable-based products
- Texture analysis of baked foods products (bread/ biscuit)
- Starch characterization using starch master; Dough rheology using doughlab or farinograph
- Determination of microstructures in selected foods using light microscopy
- TEM and SEM, image analysis and image processing techniques; Evaluation of phase transition in colloidal systems, evaluation of structure texture function relations
- Case studies on food properties and applications.

III. Suggested Reading

- Rao MA, Rizvi SS, Datta AK and Ahmed J. 2014. *Engineering Properties of Foods*. CRC press.
- Figura OL. and Teixeira AA. 2007. *Food Physics: Physical Properties - Measurement and Applications*. Springer Science & Business Media.
- Sahin S and Sumnu SG. 2006. *Physical Properties of Foods*. Springer Science and Business Media.
- Mohsenin NN. 1980. *Thermal properties of foods and agricultural materials*. New York. USA.

• Mohsenin NN. 1986. *Physical properties of plant and animal materials*. Gordon and Breach
Science Publishers.
• Peleg M and Bagley EB. 1983. *Physical Properties of Foods*. In *IFT basic symposium series*
(*USA*). AVI Pub. Co.
• Ronal J, Felix E, Bengt H, Hans F, Meffert Th., Walter EC and Gilbert V. 1983. *Physical*
Properties of Foods. Applied Science Publishers.
• Bourne M. 2002. *Food texture and viscosity: concept and measurement*. Elsevier.
• Norton IT, Spyropoulos F and Cox P. 2010. *Practical food rheology: an interpretive approach*. John Wiley & Sons.

2 *PHFPE 507 Horticultural Crops Process Engineering 3(2+1)

I. Theory

Unit I

Importance of postharvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.

Unit II

Harvesting and washing, pre-cooling, blanching, preservation of fruits and vegetables, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables.

Unit III

Cold storage of fruits and vegetables, controlled atmosphere and modified atmosphere packaging of fruits and vegetables, quality deterioration and storage.

Unit IV

Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.

Unit V

Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

II. List of Practical's

- Determination of size of fruits and vegetables
- Determination of shape of fruits and vegetables
- Determination of bulk density and true density of fruits and vegetables
- Determination of area-volume-mass relationship of fruits and vegetables
- Determination of sugar-acid ratio of fruits
- Evaluation of different types of washers for fruits and vegetables
- Evaluation of different types of graders for fruits and vegetables
- Different types of packaging methods for fruits and vegetables
- Determination of the water vapor permeability of packaging materials
- Different types of drying methods for fruits and vegetables
- Comparative evaluation of different dryers for fruits and vegetables
- Determination of solid gain and moisture loss during osmotic dehydration in fruits 1
- Study of components and design of controlled atmosphere storage
- Study of quality evaluation of fruits and vegetables

III. Suggested Reading

- Bhatti S and Varma U. 1995. *Fruit and Vegetable Processing*. CBS.
- Cruesss WV. 2000. *Commercial Fruit and Vegetable Products*. Agrobios Publisher.
- Danthy ME. 1997. *Fruit and Vegetable Processing*. International Book Publisher.
- Simson. 2016. *Post-Harvest Technology of Horticultural crops*. AAP.
- Singh. 2018. *Advances in Post-Harvest Technologies of Vegetable Crops*. AAP.
- Srivastava RP and Kumar S. 1994. *Fruit and Vegetable Preservation*. Principles and

Practices. International Book Distr.
- Thompson AK. 1996. *Post Harvest Technology of Fruits and Vegetables*. Blackwell.
- Verma LR and Joshi VK. 2000. *Post Harvest Technology of Fruits and Vegetables*. Vols. I-II. Indus Publisher.

3 PHFPE 506 Field Crops Process Engineering 3(2+1)

I. Theory

Unit I

Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions. Grain quality standards and physicochemical methods for evaluation of quality of flours.

Unit II

Pre-milling treatments and their effects on milling quality. Parboiling and drying, conventional, modern and integrated rice milling operations. Wheat roller flour milling.

Processes for milling of corn, oats, barley, gram, pulses, paddy and flour milling equipment.Layout of milling plants.

Unit III

Dal mills, handling and storage of by-products and their utilization. Storage of milled products.Expeller and solvent extraction processing. Assessment of processed product quality.

Unit IV

Packaging of processed products. Design characteristics of milling equipment, selection, installation and their performance. Quality standards for various processed products. Value added products of cereals, pulses and oilseeds.

II. List of Practicals

- Engineering properties of grains, raw and milled products
- Physical, milling and cooking quality of grains
- Study of paddy milling process and equipments
- Study of wheat milling process and equipments,
- Study of oil extraction process and equipments,
- Study of pulse milling process and equipments
- Planning and layout of various milling plants
- Development of value added products for cereals, pulses and oilseeds
- Visit to various agro processing industry.

III. Suggested Reading

• Asiedu JJ. 1990. *Processing Tropical Crops*. ELBS/MacMillan.
• Chakraverty A. 1995. *Post-Harvest Technology of Cereals, Pulses and Oilseeds.* Oxford and IBH.
• Golob 2002. *Crop Post-Harvest: Science and Technology* Vol. 1, Wiley-Blackwell.
• Hodges 2004. *Crop post-harvest: science and technology* Vol. 2, Wiley-Blackwell.
• Morris Lieberman. 1983. *Post-Harvest Physiology and Crop Preservation*. Plenum Press.
• Pandey PH. 1994. *Principles of Agricultural Processing*. Kalyani.
• Pillaiyar P. 1988. *Rice - Post Production Manual.* Wiley Eastern.
• Sahay KM and Singh KK. 1994. *Unit Operations in Agricultural Processing*. Vikas Publ. House.

4 *PHFPE 501 Emerging Food Engineering Operations* 3(2+1)

I. Theory

Unit I

Ionizing and non-ionizing radiation processing system operations: types of radiations, generation, microwave assisted processing systems, IR assisted processing systems, radio frequency systems, O3, UV and x-ray assisted processing systems, gamma irradiations systems, e-beam radiation systems and applications.

Unit II

Pulse electric field (PEF) generation system and applications, cold plasma generation systems and applications, high pressure processing systems and applications, ultrasonic processing systems and applications.

Unit III

Extrusion systems, batch and continuous ohmic heating systems and applications, inductive heating systems and applications, applications of nanotechnology.

Unit IV

Drying systems: superheated steam drying, refractance window drying, heat pump drying, freeze drying, spray drying, foam bed drying, microwave drying, instant pressure drop (DIC) drying and hybrid drying systems.

Unit V

Membrane processing systems: UF, MF, NF, reverse osmosis and vapour permeation, pervaporation, membrane distillation. Supercritical fluid extraction: concept, property of near critical fluids (NCF), extraction methods. Cryoprocessing-cryogens properties, systems and their different applications.

II. Practical

- To evaluate the characteristics of treated water and selected liquid foods using membrane systems (NF, UF, RO, etc)
- To study super critical fluid extraction system and application
- To study microwave system and microwave assisted food processing
- To study efficacy of hot water, steam, microwave, ultrasound blanching of selected fruits and vegetables
- To study the ultrasonicator and applications
- To study cryogenic processing applications
- To prepare Nano emulsion and study of their characteristics
- To study ohmic/inductive heating systems applications
- To study cold plasma applications
- To study gamma irradiation applications
- To study drying kinetics using different drying systems
- To study operations in 3 D printing
- Solving problems in food processing and case studies
- Visits of food industries utilizing advance food processing systems.

III. Suggested Reading

- Datta AK. 2001. *Handbook of Microwave Technology for Food Application*. CRC Press.
- Purkait MK and Singh R. 2018. *Membrane Technology in Separation Science*. CRC Press Taylor and Francis Group.
- Frame ND. 1994. *The Technology of Extrusion Cooking*. Blackie.
- Gould GW. 2012. *New Methods of Food Preservation*. Springer Science & Business Media.
- Berk Z. 2018. *Food process engineering and technology*. Academic press.
- Nema PK, Kaur BP and Mujumdar AS. 2019. *Drying technologies for foods: Fundamentals and applications*. CRC Press
- Meredith RJ. 1998. *Engineers' Handbook of Industrial Microwave Heating* (No. 25). Iet.
- Arvanitoyannis IS. 2010. *Irradiation of food commodities: techniques, applications, detection, legislation, safety and consumer opinion*. Academic Press.
- Yanniotis S. 2008. *Solving problems in food processing*

5 *PHFPE 503 Transport Phenomenon* 3(2+1)

I. Theory

Unit I

Introduction to transport phenomena – Molecular transport mechanism, transport properties and their proportionality constants in momentum, energy and mass transfer.

Unit II

Principles of Steady and unsteady state heat transfer and governing equations; transient heat transfer; Lumped system analysis; Estimation of Conductivity and other thermal properties of foods; overall heat transfer coefficient.

Unit III

Steady-state equations - Momentum transport equations for Newtonian and non-Newtonian fluids, continuity equation in different co-ordinates.

Unit IV

Equations of motion - Navier–Stokes equations and their application in viscous fluid flow between parallel plates and through pipes.

Unit V

Turbulent transport mechanism - Mathematical analysis; eddy viscosity and eddy diffusivity; velocity, temperature and concentration distribution; time smoothing equations. Inter-phase transport in isothermal system - friction factors for various geometries.

Unit VI

Mass transfer - Fick's law of diffusion, diffusion of gases and liquids through solids, equimodal diffusion, isothermal evaporation of water into air, mass transfer coefficients.

Unit VII

Dimensional analysis – Buckingham Pi-theorem and matrix method, application to transport phenomena, analysis among mass, heat and momentum transfer, Reynolds' analogy.

Unit VIII

Boundary layer concept - Theoretical and exact solutions for heat, mass and momentum transfer.

II. Practical

- Effects of water concentration and water vapor pressure on the water vapor permeability and diffusion of chitosan films
- Mass transfer description of the osmo dehydration
- Pre-treatment efficiency in osmotic dehydration
- Structural effects of blanching and osmotic dehydration pretreatments on air drying kinetics of fruit tissues
- Thermal processing of particulate foods by steam injection (1. Heating rate index for diced vegetables 2. Convective surface heat transfer coefficient for steam)
- Relating food frying to daily oil abuse (1. Determination of surface heat transfer coefficients with metal balls 2. A practical approach for evaluating product moisture loss, oil uptake, and heat transfer)
- Heat and mass transfer during the frying process; Influence of liquid water transport on heat and mass transfer during deep-fat frying
- Numerical simulation of transient two-dimensional profiles of temperature, concentration, and flow of liquid food in a can during sterilization
- Case studies on transport phenomenon and its applications.

III. Suggested Reading

- Bird RB, Stewart WE and Lightfoot EN. 2007. *Transport phenomena*. John Wiley & Sons.
- Treybal RE. 1980. *Mass transfer operations*. New York.
- Yuan SW. 1969. *Foundations of Fluid Mechanics*. Prentice Hall of India.
- Welti-Chanes J and Velez-Ruiz, JF. (Eds.). 2016. *Transport phenomena in food processing*. CRC press.
- Geankoplis CJ. 2003. *Transport processes and separation process principles:*(*includes unit operations*). Prentice Hall Professional Technical Reference.

6 PHFPE 508 Storage Engineering and Handling of Agricultural Produce 3(2+1)

I. Theory

Unit I

Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements.

Unit II

Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system.

Unit III

Grain markets, cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation, BIS standards.

Unit IV

Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators, principles of fluidization, recent advances in handling of food materials.

II. List of Practical's

- Determination of angle of repose
- Determination of coefficient of internal friction
- Determination of coefficient of external friction
- Physical factors influencing flow characteristics
- Determination of flow properties using Shear apparatus
- Determination of Yield locus, Time yield locus and effective yield locus from Mohr's circle
- Flow through hoppers, openings and ducts
- Design of belt conveyors
- Design of chain conveyors
- Design of screw conveyors
- Design of bucket elevators
- Design of roller conveyors
- Design of pneumatic conveyors
- Principles of fluidization
- Recent advances in handling of food materials

III. Suggested Reading

• Boumans. 1985. *Grain Handling and Storage.* Elsevier.
• FAO. 1984. *Design and Operation of Cold Stores in Developing Countries*. FAO.

• Golob. 2002. *Crop Post-Harvest: Science and Technology.* Vol 1 Wiley-blackwell.
• Hall CW. 1970. *Handling and Storage of Food Grains in Tropical and Sub-Tropical Areas*. FAO Publisher Oxford & IBH.
• Henderson S and Perry SM. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publisher.
• Hodges 2004. *Crop Post-Harvest: Science and Technology*. Vol 2, Wiley-blackwell.
• Ripp BE. 1984. *Controlled Atmosphere and Fumigation in Grain Storage*. Elsevier.
• Shefelt RL and Prussi SE. 1992. *Post Harvest Handling – A System Approach*. Academic Press.
• Vijayaraghavan S 1993. *Grain Storage Engineering and Technology*. Batra Book Service.

7 PHFPE 513 Food Package Engineering 2(1+1)

I. Theory

Unit I

Introduction of packaging: Package, functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods of prevention.

Unit II

Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks, corrosion of containers (tin plate).Flexible packaging materials and their properties. Aluminum as packaging material. Evaluation of packaging material and package performance.

Unit III

Packaging equipment: Food packages, bags, types of pouches, wrappers, carton and other traditional package. Retortable pouches: Shelf life of packaged foodstuff.

Unit IV

Methods to extend shelf life. Packaging of perishables and processed foods. Special problems in packaging of food stuff.

Unit V

Package standards and regulation: Shrink packaging, aseptic packaging, CA and MAP. Biodegradable packaging: Recent advances in packaging, active packaging, smart

packaging, antioxidant and antimicrobial packaging, edible films and biodegradable packaging, microencapsulation and nano encapsulation.

II. List of Practicals

- Familiarization of types of packaging material
- Determination of thickness of different types of packaging materials
- To determine water absorption capability of flexible packaging materials
- Determination of tensile strength of packaging material
- Determination of compressive strength of packaging material
- Determination of water vapour transmission rate of packaging material
- Determination of gas transmission rate of packaging material
- Identification of different types of plastic films
- Testing of chemical and grease resistance of packaging materials
- Determination of bursting strength of packages
- Drop test for food package strength
- Vacuum packaging of various food products
- Nitrogen packaging of food products
- To study the effect of shrink wrapping on shelf life of fruits and vegetables
- To study the effect of active modified atmosphere packaging on shelf life of fruits and vegetables
- Visit to relevant industries

III. Suggested Reading

- Crosby NT. 1981. *Food Packaging Materials*. Applied Science Publisher.
- Frank A. 1992. *A Handbook of Food Packaging*. Springer.
- Mahadeviah M and Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw
- Hill.Palling SJ. 1980. *Developments in Food Packaging*. Applied Science Publisher.
- Robertson GL. 2013. *Food Packaging - Principles and Practice*. 3rd Ed Taylor & Francis.
- Sacharow S and Grittin RC. 1980. *Principles of Food Packaging*. AVI Publisher.

Minor courses

1 FHQC 504 Global Food Laws and Regulations 2(2+0)

I. Theory

Unit I

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.

Unit II

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).

Unit III

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.

Unit IV

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.

II. 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

2 FHQC 506 Techniques in Food Quality Analysis 4(2+2)

I. Theory

Unit I

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).

Unit II

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.

Unit III

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.

Unit IV

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.

II 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

III. 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.

3 PHFPE 520 Refrigeration Systems 3(2+1)

I. Theory

Unit I

Reversed Carnot cycle, Carnot, Brayton and aircraft refrigeration systems.

Unit II

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.

Unit III

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.

Unit IV

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.

II. 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.

III. List of Practicals

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

IV. 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 502 Experimental Designs 2(1+1)

I. Theory

Unit I

Basic principles of experimental designs. Uniformity trials. Completely randomized design, randomized block design and latin square designs. Multiple comparison tests.

Unit II

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.

Unit III

Crossover designs. Balanced incomplete block design. Response surface designs. Groups of experiments.

II. 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.

III. List of Practicals

- Completely randomized design
- Randomized block design
- Latin square design
- Multiple comparison tests
- Missing plot techniques
- Analysis of covariance
- Factorial experiments
- Split plot design
- Strip plot design
- Factorial in split plot design
- Crossover designs
- Balanced incomplete block design
- Response surface designs
- Groups of experiments

IV. 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

2 PHMC 504 Food Business Management 2(2+0)

I. Theory

Unit I

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.

Unit II

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.

Unit III

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.

Unit IV

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).

II. 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.

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

I. Theory

Unit I

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.

Unit II

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.

Unit III

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.

Unit IV

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.

II. 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 Compulsary Courses

1 *PGS 501 Library and Information Services 1(0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

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 504 Basic Concepts in Laboratory Techniques 1(0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

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, oil bath;
- 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 Readings

- 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.

3 *PGS 502 Technical Writing and Communications Skills 1(0+1)

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- 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 Readings

- 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.

4	***PGS 503**	**Intellectual Property and its Management in Agriculture**	**1(1+0)**

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

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 biodiversity 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 Readings

- 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; The Biological Diversity Act, 2002.

5 *PGS 505 Agricultural Research, Research Ethics and Rural Development Programmes 1(1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

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.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

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 Readings

- 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.
- Rao 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.

Non-Credit Deficiency Courses

COMPULSARY NON-CREDIT DEFICENCY COURSES*

Sr. No.	Course No.	Course No. (UG courses as per Vth Deans Committee)	Title of the course	Credits	Courses to be offered to the Disciplines made eligible for P.G.Programme in Post-Harvest and Process Engineering
01	PHFPE 411	BS-MATH 111	Engineering Mathematics-I	**3(2+1)**	B.Sc.(Agri.)/B. Sc .(Hons)Agriculture/ B.Sc.(Hort.)/ B.Sc .(Hons)Horticulture
02	PHFPE 412	PFE 122	Heat and Mass Transfer	**2(1+1)**	
03	PHFPE 413	PFE 233	Engineering Properties of Agricultural Produce	**2(1+1)**	
04	PHFPE 414	PFE 244	Post Harvest Engineering of Cereals, Pulses and Oil Seeds	**3(2+1)**	
05	PHFPE 415	PFE 355	Dairy and Food Engineering	**3(2+1)**	
06	PHFPE 416	PFE 366	Post Harvest Engineering of Horticultural Crops	**2(1+1)**	
07	PHFPE 417	PFE 367	Refrigeration and Air Conditioning	**2(1+1)**	
		Total Credits		**17(10+7)**	

*The number of Deficiency Courses to be offered to a P.G. student will be decided by the Chairman of Student Advisory Committee. Total credits are offered i.e. 6-10 Credits

01 PHFPE 413 PFE 233 Engineering Properties of Agricultural Produce 2(1+1)

Theory

Importance of engineering properties of Agricultural Produce and Classification. Physical properties- shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables.

Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion, Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose.

Aero dynamics properties of agricultural products, drag coefficients, terminal velocity. Rheological properties; force, deformation, stress, strain, elastic, plastic and viscous behaviour, Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods. Electrical properties.

Practical

Study of moisture content measuring methods and determination, Determination of the shape and size of grains, fruits and vegetables, Determination of sphericity and roundness of fruits and vegetables, Determination of surface area of food materials, Determination of bulk density and true density of grains, Determination of density of fruits and vegetables, Determination of angle of repose of grains and friction co-efficient of grains, Determination of terminal velocity of grains, Study of thermal conductivity of food materials, Study of specific heat of food materials, Determination of hardness of food material and determination of viscosity of liquid foods, Visit to seed processing plant.

Suggested readings

Text Books

1. Mohsenin, N.N. Physical Properties of Plants & Animals, 1980 Gordon & Breach Science Publishers , New York.
2. Singhal OP & Samuel DVK. Engineering Properties of Biological Materials, 2011. Saroj Prakashan, 644-647, Katra, ALLHABAD – 211 002.

Reference Books

1. Rao, M.A. and Rizvi, S.H. Engineering Properties of Foods, 1995. Marcel Dekker Inc. New York

02 PHFPE 414 PFE 244 Post Harvest Engineering of Cereals, Pulses and Oil Seeds 3(2+1)

Theory

Introduction, Unit operations of grain processing. Cleaning and grading, aspiration, scalping. Screens and sieves-Types, classification, Ari screen cleaner- and capacity, effectiveness of screens. Various types of separators- specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone.

Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Sieve analysis and particle size.

Drying: moisture content; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination. Psychrometric chart and its use in drying.

Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period. Drying equations, Mass and energy balance. Methods of drying, types of grain dryers.

Milling of paddy, Type of rice milling machinery. Modern rice milling – unit operations and machines. Parboiling of paddy – importance and methods. milling of maize- methods and processed products, milling of wheat operations and machineries. Processing of sorghum and millets. Milling of pulses-Unit operation, methods and machines.

Processing of oilseeds- Unit operations. Mechanical expression and solvent extraction methods.

Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes.

Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Pneumatic conveying. Bucket Elevator. Cranes & hoists. Trucks (refrigerated/ unrefrigerated).

Practical

Performance evaluation of different types of cleaners and separators, Determination of separation efficiency, Study of different size reduction machines and performance evaluation, Determination of fineness modulus and uniformity index, Study of different types of conveying and elevating equipments, Study of different types of mixers. Measurement of moisture content: dry basis and wet basis, Study on drying characteristics of grains and determination of drying constant, Determination of EMC (Static and dynamic method), Study of various types of dryers, Study of different equipments in pulse mills and their performance evaluation, Visit to grain processing industries.

Suggested readings

Text Books

1. Sahay K. M. and K.K. Singh Unit Operations of Agricultural Processing. 2002. Vikas Publishing House Pvt. Ltd. 576, Masjid Road, Jangpura New Delhi – 110 014.
2. Chakraverty Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH Publishing Co. Pvt. Ltd., 66, Janpath, New Delhi – 110 001
3. Earle, R. L. Unit operations in Food processing. Pergamon Press, New York. USA

Reference Book

1. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London.
2. Pande P.H. Principles and Practices of Post Harvest Technology, 2007. Kalyani Publishers, Ludhiana.
3. Geankoplis C. J. Transport processes and unit operations, Prentice Hall of India Pvt Ltd, New Delhi

03 PHFPE 412 PFE 122 Heat and Mass Transfer 2(1+1)

Theory

Concept, modes of heat transfer, thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, cylinder and spheres. Electrical analogy. Insulation materials. Fins, Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Combined free and forced convection. Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, grey bodies and emissive power. Radiation exchange between black surfaces. Heat transfer analysis involving conduction, convection. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Fick's law, mass transfer coefficients. Fundamental transport processes.

Practical

Study of thermal conductivity apparatus, Determination of thermal conductivity of solid metal rod, Determination of thermal conductivity of solid composite wall, Numerical on thermal conductivity of cylinder and sphere, Study of tubular type heat exchanger, Study of plate type heat exchanger, Study of overall heat transfer coefficient in parallel flow heat exchanger and counter flow heat exchanger and numerical, Determination of heat

transfer through insulated pipe, Determination of Stefan-Boltzman constant, Determination of emissivity of a given material, Study of mass transfer coefficient of solid and liquid, Visit to nearby dairy and food processing industry.

Suggested Reading

Text Book

1. J. P.Holman. Heat Transfer. Tata McGraw-Hill Education Pvt. Ltd. (Ninth Edition).
2. Gupta C .P. and Prakash R. Engineering Heat Transfer. Nem Chand and Bros., Roorkee
3. P.L. Ballaney Thermal Engineering. Khanna Publications, (Twenty fourth Edition)
4. R Paul Singh &Dennis R Heldman. Introduction to Food Engineering. Academic press (Fourth Edition).

Reference Books

1. Christie Geankoplis. Transport Processes and Unit Operation, Prentice-Hall of India (Third Edition) Prentice-Hall of India (Third Edition)
2. Incropera F. P. and De Witt D. P. Fundamentals of Heat and Mass Transfer. John Wiley and Sons, New York.

04 PHFPE 411 BS-MATH 111 Engineering Mathematics-I 3(2+1)

Theory

Matrices and its applications: Rank of a matrix, Inverse of Matrix by Gauss-Jordan method, Normal form, Applications: Consistency of linear system of equations; linear transformations, orthogonal transformations, Eigen values with properties and Eigen vectors, Cayley-Hamilton theorem(without proof), diagonalization of matrices, quadratic forms, nature of a quadratic form.

Differential calculus and its applications: Expansions of functions by Maclaurin's and Taylor's series; Indeterminate form.

Partial differentiation and its applications: Functions of two or more independent variables, partial derivatives, homogeneous functions and Euler's theorem, total derivatives: chain rule; differentiation of implicit functions, change of variables, Application: maxima and minima.

Integral calculus and its applications: Gamma and Beta functions, Volumes and Surface areas of revolution, double and triple integrals, change of order of integration, application of double and triple integrals.

Vector calculus and its applications: Scalar and Vector point functions, Derivative of vector function,vector differential operator Del, Gradient of a scalar point function, geometrical meaning of gradient, Applications of vector differentiation and gradient, Divergence and Curl of a vector point function and their physical interpretations, applications of divergence and curl, identities involving Del(without proof), second order differential operator(without proof); line integral, work done, surface and volume integrals, Green's, Stoke's, and Gauss divergence theorems (without proofs).

Practical

Applications of Matrices, Applications of Eigen values and Eigen vectors, Applications of Cayley-Hamilton theorem, diagonalization of matrices, quadratic forms, nature of a quadratic form, Applications of Taylor's and Maclaurin's series, Applications of Indeterminate forms, Applications of Partial differentiation, Maxima and minima, Applications of Beta and Gama functions, Tracing of Cartesian curves, Applications of Volume and surface revolution, Applications of Double and Triple Integrals, Applications: mass of lamina, centre of gravity, centre of pressure, moment of inertia, Applications of derivative of vector function, Gradient, Directional derivatives, divergence and curl, solenoidal and irrotational field, Applications of Line, surface and volume integrals, work done, Applications of Greens , Stokes and Gauss Divergence theorem.

Suggested Reading

Text Book

1. Dr. Shinde K. J. *et.al*., 2017; A Text Book of Agricultural Engineering Mathematics –I

Reference Books

1. Narayan Shanti, 2004; Differential Calculus. S. Chand and Co. Ltd. New Delhi.
2. Narayan Shanti, 2004; Integral Calculus. S. Chand and Co. Ltd. New Delhi.
3. Grewal B. S., 2015; Higher Engineering Mathematics. Khanna Publishers Delhi.(43rd Edition)
4. Narayan Shanti, 2004;A Text Book of Vector Calculus. S. Chand and Co. Ltd. New Delhi.
5. Narayan Shanti, 2004; A Text Book of Matrices. S. Chand and Co. Ltd. New Delhi.

4. Infrastructure

a. **Laboratories**
The Department of Post Harvest Engineering, P.G.I.P.H.T.M., Killa-Roha has a Post Engineering Laboratory.

b. **Name of the important instruments/facilities**:
(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

Recent Photograph		
	Name of the Faculty	Dr.S.B.Swami
	Post Held	Professor and Head, Department of Post Harvest Engineering, PGI-PHTM, Killa-Roha
	Date of Birth	17.06.1975
	Qualification	Ph.D.(Agril and Food Engineering
	Area of Specialization	Post Harvest Engineering, Processing and Food Engineering, Agril.Process Engineering
	Experience (Years)	21 Years and 6 Months
	Research Projects guided PhD M.Sc./M.Tech B.Tech.	 02 no. 19 no. 11 no.
	Present area of research	Unripe Jackfruit bulb chips, Pectin extraction of Jackfruit waste
	Contact details Land line No. Mobile Fax Email	 9421610082 sbswami@dbskkv.ac.in, swami_shrikant1975@yahoo.co.in

6. Research Activities and Achievements (including projects)

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

Sr.No.	Title	Year	Recommendation
1	Development of Osmo-dehydrated ripe pineapple slices	2016	Process of osmo-convective drying of pineapple cubes of 1 cm at 50°B for 30 minutes and dried at 60oC in convective dryer for 680 minutes is recommended. **शिफारस:** अननसाचे १ सेमी. चे घनाकृती तुकडे द्रवाभिसरण प्रक्रियेने ५०° ब्रिक्स ने ३० मिनिटे वाळवुन कन्व्हेक्टीव्ह ड्राईग या पध्दतीने ६० अंश तापमानास ६८० मिनिटापर्यंत वाळवण्याच्या प्रक्रियेची शिफारस

Sr.No.	Title	Year	Recommendation
			करण्यात येते.
2	Development of Tuber Crop (Arrowroot-Lesser Yam-Potato) based extrudates	2016	Tuber crops (Arrowroot:Lesser Yam: Potato i.e.10:40:50) based extrudates prepared at 130°C temperature and 390 r.p.m is recommended. The extrudaes can be preserved up to 45 days in good condition. **शिफारस:** कंद पिकापासुन (आरारोट, कणगर व बटाटा जसे १०:४०:५०) कुरकुरे बनविण्यासाठी १३०° सेल्सियस तापमानास ३९० आर.पी.एम. एवढया गतीने कुरकुरे बनविण्याची शिफारस करण्यात येते. कुरकुरे ४५ दिवसापर्यंत चांगल्या स्थितीत साठवता येतात.
3	**Development of Edible film from Cassava Starch**	2018	Process developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth for preparation of edible film from 15% cassava starch in recommended. **शिफारस:** **डॉ बाळासाहेब सावंत कोकण कृषि विद्यापीठाने विकसीत केलेल्या प्रक्रियेने १५% कसावा स्टार्च पासुन खाद्यवेष्टण तयार करण्याची शिफारस करण्यात येते.**
4	**Process Standardization of Soy Fortified Paneer from Cow milk**	2018	Process developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth for preparation of Soy milk fortified with cow milk (25:75) Paneer cubes is recommended. **शिफारस:** **डॉ बाळासाहेब सावंत कोकण कृषि विद्यापीठाने विकसीत केलेल्या प्रक्रियेने सोयाबिन व गायीच्या दुधाच्या (२५:७५) मिश्रणापासुन पनीर बनविण्याच्या प्रक्रियेची शिफारस करण्यात येते.**
5	**Development of Edible film from Jackfruit seed Starch**	2018	Process developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth for preparation of edible film from 15% Jackfruit seed starch is recommended. **शिफारस:** **डॉ बाळासाहेब सावंत कोकण कृषि विद्यापीठाने विकसीत केलेल्या प्रक्रियेने 15% फणस बीयांच्या स्टार्च पासुन खाद्यवेष्टण तयार करण्याची शिफारस करण्यात येते.**
6	**Process Standardization of Soy Fortified Paneer from Cow milk**	2018	Process developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth for preparation of dehydrated Soy milk fortified with cow milk (25:75) paneer cubes of 50°c by microwave convection dryer is recommended **शिफारस:** **डॉ बाळासाहेब सावंत कोकण कृषि विद्यापीठाने विकसीत केलेल्या प्रक्रियेने सोयाबिन दुध व गायीच्या दुधाच्या मिश्रणापासुन (२५:७५) मायक्रोव्हेव कन्हेक्टीव्ह वाळवणी यंत्रात ५०° से. तापमानास वाळवलेले पनीरघन तयार करण्याची शिफारस करण्यात येते.**
7	**Development of Extruded product from Kulith (Horse Gram) based composite flour**	2018	The Process Technology for preparation of "KKV Crisp" using Twin Screw Extruder from maize, rice and horse gram in the proportion of 50:30:20 is recommended. **शिफारस:**

Sr.No.	Title	Year	Recommendation
			मका, तादुंळ, कुळीत यांच्या ५०:३०:२० मिश्रणापासून ट्विन स्क्रु एक्स्ट्रुडर सयंत्राने 'केकेव्ही क्रिस्प' बनविण्याच्या प्रक्रियेची शिफारस करणेत येत आहे.
8	**Development of Instant Soup Mixes from Leafy Vegetables**	2019	Process for Instant Soup Mixes from Leafy Vegetables using Amaranthus 6%, Spinach 28%, Arrowroot Starch 43% and other Spices 23% is recommended. The instant soup mixes can be stored in good condition in Aluminium Laminated Pouch up to 90 days. [Other Spices cumin 0.66, coriander 0.66, black pepper 1.06, chilli 5, salt 7.33, onion 2, garlic 1.33, citric acid 0.33 and carrot 4.66 %) **शिफारस:** पालेभाज्यांपासून माठ ६ टक्के, पालक २८ टक्के व अरारूट स्टार्च ४३ टक्के व इतर मसाले २३ टक्के वापरून तयार केलेले झटपट सुप मिश्रण तयार करण्याच्या प्रक्रियेची शिफारस करण्यात येते. झटपट सुप मिश्रण ॲल्युमिनीयम लॅमिनेटेड पिशवीत ९० दिवसांपर्यत चांगल्या स्थितीत रहाते. (इतर मसाले— जिरे पूड ०.६६ टक्के, इलायची पूड ०.६६ टक्के, काळी मिरी पूड १.०६ टक्के, मिरची पूड ५ टक्के, मिठ ७.३३ टक्के, कांदा पूड २ टक्के, लसूण पूड १.३३ टक्के, सायट्रीक आम्ल ०.३३ टक्के व गाजराचे काप ४.६६ टक्के मिश्रीत करावे.
9	**Development of carrot *pedha***	2019	Proportion of carrot pulp and sugar in 1: 1 proportion, with 67.5% milk powder, 5%, corn flour and 5% hydrogenated vegetable oil based on the sugar used for preparation of Carrot *Pedha* with the storage life of 15 days at ambient conditions. **शिफारस:** गाजराचा गर व साखर यांचे १:१ प्रमाण तसेच वापरण्यात येणाऱ्या साखरेच्या ६७.५ टक्के मिल्क पावडर, ५ टक्के कॉर्न फ्लोअर आणि ५ टक्के वनस्पती तूप वापरून १५ दिवस साठवण क्षमता असलेला गाजरपेढा तयार करण्याची शिफारस करण्यत येत आहे.
10	Development of Ripe Alphonso Mango Pulp Powder	2022	Recommendation: It is recommended to prepare ripe Alphonso mango pulp powder by addition of 0.5% foaming agent, dried at 50^{o}C by foam mat drying, stored at room temperature in glass bottles upto 150 days in good condition. **शिफारस—** पिकलेल्या हापूस आंब्याच्या गरापासून भुकटी बनविण्यासाठी त्यामध्ये ०.५ टक्के फोमिंग एजंट मिसळून ती ५० सेल्सिअस तापमानास फोम मॅट वाळवणी पध्दतीने वाळवून ती १५० दिवस वातावरणीय तापमानास सुस्थितीत राहण्यासाठी काचेच्या बरणीमध्ये साठवून ठेवण्याची शिफारस

Sr.No.	Title	Year	Recommendation
			करण्यात येते.

b. **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.

"Standardization of the Process Technology for preparation of jackfruit chips and its storage studies for Entrepreneurship Development in the Konkan region" through Rajiv Gandhi Science and Technology Commission, Govt. of Maharashtra with the approved budget is Rs.4,25,000/- for the year 2022-23 and 2023-24. Dr.S.B.Swami Professor and Head, Department of Post Harvest Engineering, PGI-PHTM, Killa Roha is Working as a Principal Investigator of the said project**.** The project has been started in June, 2022.

7. Extension Activities

a. The training delivered as a resource person

Dr.S.B.Swami Professor and Head, Department of Post Harvest Engineering, PGI-PHTM, Killa-Roha has organized around 29 extension training programmes (for students, unemployed youths, members of SHG's, small scale food Processors etc in the field of food processing.

(1) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered expert lecture on 13.02.2023 at Cidco Maidan Sector 27 Kandeshwar near railway station, Kamothe, Panvel on Phal va anna prakriya tantradnyan va vayasik sandhi during 11.00 to 12.30 am,

(2)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.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 **"माझा एक दिवस माझ्या बळीराजासाठी"**.

(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.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has 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

(7) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Fish Freezing Methods/Preservation/IQF at P.G.Institute of Post Harvest Management, Killa Roha on 13.07.2022 under 3days (13,14 and

15th July, 2022) training programme in Fish and Marine processing held under PMFME, Programme.

(8) Dr.S.B.Swami Professor and Head, Department of Post Harvest Engineering, Post Graduate Institute of Post Harvest Management, Killa-Roha has delivered an expert lecture in a one day workshop organized by the Food and Drug Administration, Govt. of Maharashtra, Raigad District on "Finger Millet Post Harvest Management and finger millet based processes and products", the event was organized at Lijat Papad Mahila Gruh Udyog, Kalan Samaj Sabhagruha, Panvel on 10th August, 2022 during celebration of Anna Suraksha Saptah (05.08.2022 to 12.08.2022) by Govt. of Maharashtra in Eat Right India II initiated by Food Safety and Standards Authority of India (FSSAI) to Commemorate 75th year of our Independence around 160 women participants of Lijat Papad Mahila Gruh Udyog, Panvel has been benefited by this lecture.

(9) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Food Processing and its opportunities at P.G.Institute of Post Harvest Management, Killa-Roha on 21.09.2022 at Beneficiary Training Category-I fund support from PMFME, Raigad.

(10) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Paddy Post Harvest Management at Regional Agricultural Extension Management Training Institute, RAMETI, Khopoli on 29.04.2022 for the Trainers Trenee programme.

(11) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Fish Freezing

Methods/Preservation/IQF at P.G.Institute of Post Harvest Management, Killa Roha on 26.05.2022.

(12) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Paddy Post Harvest Management at Regional Agricultural Extension Management Training Institute, RAMETI, Khopoli on 16.06.2022 for the Farmers-Scientists Interaction meet programme.

(13) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered Expert speaker talk on Textural Quality Evaluation of Processed Products of Fruits and Vegetables on 04.03.2022 organized at IDP Under NAHEP ICAR, New Delhi Skill development Training for Development of Processed Foods by Department of Processing and Food Engineering, C.T.E, M.P.U.A.T, Udaipur, Rajasthan.

(14) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has visited the Mauje Bhira, Tal. Mangaon on 22.10.2021 on the eve of Mahila Kisan Diwas and delivered a lecture on Enterprenuership development in Agricultural Processing and Value addition the programme was jointly organized by Taluka Agricultural office, Mangaon and N.R.L.M.section of Panchayat Samiti of Mangaon. For this function 23 mahila SHG's and gramsangh members around 123 Ladies were present.

(15) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has delivered a lecture on 07.12.2021 under Non-ODOP cashew, jackfruit, amla, kokum processing and value addition technologies. The one day workshop was organized PMFME, (Govt of India) under Nodal Agency, Govt of Maharashtra, Agricultural Developmental Trust's KVK, Baramati (SLTI), the online presentation was attended by 236 participiants all over the state of Maharashtra.

(16) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has attended the General Body Meeting of ATMA, Raigad at Rajaswa Sabhagraha, Collector office, Alibaugh on 21.12.2021 and presented the proposal of PGIPHM, Killa-Roha on various training programmes based on the (Kiman Kaushlyawar

adharit karyakrams) less skills to the SHG's, unemployed youths, and small scale food processing entreprenuers of the Ragad District. The proposal will be considered for the fund support.

(17) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has visited the Agril.Research Station, Shirgaon on 13.08.2021 for the evaluation of Mobile Seed Processing Unit and submitted the report on the evaluation to the Director of Research, Dr.B.S.K.K.V.Dapoli on 18.08.2021 for the efficient working, repairs and maintenance.

(18)Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has attended the meeting and given the valuable inputs in A brainstorming session organized through Video Conferencing has been scheduled on **14.09.2021,Tuesday at 2:30 PM** to discuss the model RFP drafted for selection and engagement of Pvt O&M agency for Incubation Center being established under PMFME Scheme organized by Deepti Dashora, PMFME, MoFPI.

(19)Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha along with Associate Dean, PGIPHM, Killa Roha has interacted with the Director of Extension Education and Hon.Vice-Chancellor, DBSKKV, Dapoli for the implementation of PMFME, Project under DBSKKV, Dapoli and related permissions about the Newly designed sheds and available space for exesting facilities for smooth implementation of the Project (10.06.2021).

(20) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has delivered expert lecture on Textural Quality Evaluation of Fruits and Vegetable at three weeks Online Certificate Course on Post-Harvest Management of Horticultural Crops, Organized by ICAR-National Agricultural Higher Education Project (NAHEP) and Centre for Advanced Agricultural Science and Technology (CAAST) for Climate Smart Agricultureand Water Management (CSAWM), M.P.K.V.Rahuri, the expert lecture was held on 22.04.2021

(21) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has attended the meeting and given the valuable inputes under the Chairmanship of Sh.Subash Nagre Director of Agricultural Processing and Marketing, Comissionerate of Agriculture, Govt.of Maharashtra, Pune and Nodal Officer, PMFME Project under Govt.of Maharashtra for improvements, revisions in the PMFME Project submitted to the Govt of Maharashtra by DBSKKV, Dapoli.

(22) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha along with Associate Dean, PGIPHM, Killa Roha has interacted with the Director of Extension Education and Hon.Vice-Chancellor, DBSKKV, Dapoli for the implementation of PMFME, Project under DBSKKV, Dapoli and related permissions about the Newly designed sheds and available space for exesting facilities for smooth implementation of the Project (10.06.2021).

(23) Dr.S.B.Swami Professor and Head Department of Post Harvest Engineering, PGIPHM, Killa-Roha has organized one day brain storming session on Post Harvest Management, Issues, Constraints and Way Forward on 08.01.2021 a Organizing Secretary for the said event the Experts from all over country has given the expert talk on the said occasion..

(24)Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha in collaboration with the Department of Agricultural Process Engineering, CAET, Dapoli has organized five days (22.02.2021 to 26.02.2021) training programme on ***Finger Millet Value addition and Bakery products*** for the Women participants of Raigad District Through fund support of ATMA, Raigad.

(25) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has interacted with the students and faculties of Diploma in Agril. Extension Services for Input Dealers, RAMETI, Khalapur (DESHI) and given the information about the PGIPHM, Killa-Roha (03.03.2021)

(26) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has delivered a Expert Talk on Fruit Processing at Agricultural Research Center, Karjat at General Entrepreneurship Development organized by Star Selfemployment training Institute, Raigad, RESTI and ARC, Karjat on 18.03.2021 at ARC, Karjat.

(27) Dr. S. B. Swami Professor and Head, Department of Post Harvest Engineering, PGIPHM, Roha has delivered the training on Jackfruit Processing on 04.12.2020 through Online Mode Through ATMA, Raigad.

(28) Dr. S. B. Swami submitted the Evaluation Report of Rice Mill of of M/s. Bhairvnath Shetkari Utpadak Gat, Yashwantkhar, Roha, Dist- Raigad to Taluka Krishi Adhikari, Roha (30.09.2020).

(29) As per the request of Taluka Agricultural Officer, Roha Dr. S. B. Swami, Professor and Head, Department of Post Harvest Engineering, and Er. S. B. Kalse, Senior Research Assistant, Department of

Post Harvest Engineering visited Bhairvnath Shetakari Utpadaka Gat, Yashwantkhar Roha for the evaluation of newly constructed rice mill plant 28.04.2020 and 04.05.2020.

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

Books (02 Nos.)

Sr.No.	Authors	Title of the Book	Publishers	ISSN No
01	डॉ. यु.डी.चव्हाण, डॉ.पी.जी.पाटील, डॉ.पी.एम.कोटेचा, डॉ.एस.बी.स्वामी, डॉ. ए.यू. पागरकर	कृषी क्षेत्रतील प्रक्रीया उद्योग कोश	शब्दालय प्रकाशन, श्रीरामपूर	ISBN:978-81-94459-15-6

Book Chapter

Sr.NO.	Item	Author	Title of Chapter in the Book	Publishers	ISBN No
1	**Book Chapter**	**Shrikant Baslingappa Swami**	**Title of Chapter:** *Refractance Window Drying System* in **Title of Book**: Drying Technologies for Foods: Fundamentals and Applications (Part II) **Editors**: Prabhat K.Nema, Barjinder Pal Kaur, Arun S.Mujumdar **Type of Book**: *Reference Book*	**New India Publishing Agency**	978-93-85516-39-9
2	**Book Chapter**	**S.B. Swami and S.B. Kalse**	**Title of Chapter: Jackfruit (Artocarpus heterophyllus):Biodiversity, Nutritional Contents, and Health** **Title of Book: Bioactive Molecules in Food, Reference Series in Phytochemistry, p.no.01-22.** **Type of Book:** *Reference Book*	**Springer Nature Switzerland AG 2018**	978-3-319-54528-8_87-1
3	**Book**	**S.B.Swami,**	**Title of Chapter: Bhat Prakriya and**	**Madhuri**	978-81-

Sr.NO.	Item	Author	Title of Chapter in the Book	Publishers	ISBN No
	Chapter (Marathi Book)	K.H.Pujari and S.B.Kalse	**Padarth** **Title of Book: Bhat Utpadan Tantradnyan** **Editors:** Dr.S.G.Bhave DEE, DBSKKV, Dapoli **Type of Book:** Marathi Articles	**Prints, Vaishali Mention, S.P.Marg, Mumbai 400 002**	937464-8-6

List of Journal Papers

No.	Author (s)	Year	Title of published paper	Journal with Volume number and page number	ISSN NO.	NAAS Rating
1	Kalse S.B., **Swami S.B.**	***2022***	Recent application of Jackfruit Waste in Food and Material Engineering: A Review.	Food Bioscience, 48, 101740, 1-11	(ISSN: 2212-4292)	11.32
2	Shrikant Baslingappa Swami, Nayan Singh J. Thakor, Asmita M. Gawai1	***2016***	Mechanical Properties of Cashew Nut Under Compression Loading at Varied Moisture Contents	Agricultural Research, 7(3), 347-359	2249-720X (Print) 2249-7218 (Online)	5.95
3	Shrikant Baslingappa Swami and Sandeep Baban Kalse	***2020***	Bioactive compounds in jamun (Syzygium cumini L.) Skeels	The Pharma Innovation Journal 9(11): 161-167	(ISSN (E): 2277- 7695; ISSN (P): 2349-8242)	5.23
4	Shrikant Baslingappa Swami, Santosh Namdevrao Ghgare, Seema Shrikant Swami, Kishore J Shinde, Sandeep Baban Kalse and Ishwar Lakhichand Pardeshi	***2020***	Natural pigments from plant sources: A review	The Pharma Innovation Journal 9(10): 566-574	(ISSN (E): 2277- 7695; ISSN (P): 2349-8242)	5.23
5	A. R. Hande, S. B. Swami, N.J. Thakor	***2016***	Open-Air Sun Drying of Kokum (Garcinia indica) Rind and Its Quality Evaluation	Agricultural Research,5, 373-383.	ISSN 2249-720X	5.95
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