



| S.No. | Topic | No. of Practicals |
|-------|--|-------------------|
| 11. | To find the graphical solution for calculation of thermal process time | 1 |
| 12. | To study different separation equipments | 1 |
| 13. | To study the size reduction equipments | 1 |
| | Total | 16 |

X. Suggested Reading

- Berk. 2018. *Food Process Engineering and Technology*, Academic Press, ISBN: 978-0-12-812018-7
- Brennan JG, Butters JR, Cowell ND and Lilly AEI. 1990. *Food Engineering Operations*. Elsevier.
- Fellows P 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.
- McCabe WL and Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.
- Sahay KM and Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.
- Singh RP and Heldman DR. 1993. *Introduction to Food Engineering*. Academic Press.
- Smith. 2011. *Introduction to Food Process Engineering*, Springer.
- Toledo. 2007. *Fundamentals of Food Process Engineering*, Springer.
- Varzakas. 2015. *Food Engineering Handbook*, CRC press.

I. Course Title : Field Crops Process Engineering

II. Course Code : PFE 503

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint and equip the students with the post harvest technology of cereals, pulses and oilseeds with special emphasis on equipment used in the milling and processing.

V. 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 physico-chemical 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.



VI. Practical

Physical properties of cereals and pulses, raw and milled products quality evaluations: Parboiling and drying, terminal velocities of grains and their fractions, study of paddy, wheat, pulses and oilseeds milling equipments, planning and layout of various milling plants. Development of value added products for cereals, pulses and oilseeds, visit to related agro processing industry.

VII. Learning outcome

Student's capability to mill and process (value added products) all kinds of field crops as per requirement of food industries.

VIII. Lecture Schedule

| S.No. | Topic | No. of Lectures |
|-------|--|-----------------|
| 1. | Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions. | 2 |
| 2. | Conventional, modern and integrated rice milling process, pre-milling treatments, rice parboiling, rice milling equipment and layout of rice milling plant. | 5 |
| 3. | Conventional and roller wheat flour milling process, pre-milling treatments, milling equipment and layout of wheat milling plant. | 4 |
| 4. | Preparation of oilseeds and pre- treatments, conventional and modern oil extraction methods viz expeller, solvent extraction and super critical fluid extraction. Milling equipment and layout of oil milling plant. | 4 |
| 5. | Processes for milling of pulses, pretreatments, milling equipment and layout of pulse milling plant. | 4 |
| 6. | Processes for milling of corn, oats and barley, pretreatments and milling equipments. Layout of milling plant. | 3 |
| 7. | Handling, packaging and storage of milled products, by-products and their utilization. | 2 |
| 8. | Assessment of processed product quality. Quality standards for various grains, processed products. Physico-chemical methods for evaluation of quality Value added products of cereals, pulses and oilseeds. | 3 |
| 9. | Design characteristics of milling equipment, selection, installation and their performance. | 3 |
| | Total | 30 |

IX. List of Practicals

| S.No. | Topic | No. of Practicals |
|-------|--|-------------------|
| 1. | Engineering properties of grains, raw and milled products | 2 |
| 2. | Physical, milling and cooking quality of grains | 2 |
| 3. | Study of paddy milling process and equipments. | 1 |
| 4. | Study of wheat milling process and equipments, | 1 |
| 5. | Study of oil extraction process and equipments, | 1 |
| 6. | Study of pulse milling process and equipments, | 1 |
| 7. | Planning and layout of various milling plants. | 3 |
| 8. | Development of value added products for cereals, pulses and oilseeds | 2 |
| 9. | Visit to various agro processing industry. | 2 |
| | Total | 15 |

X. 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.

I. Course Title : Horticultural Crops Process Engineering

II. Course Code : PFE 504

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint and equip the students with processing of fruits and vegetables and the design features of the equipment used for their processing.

V. 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.

VI. Practical

Determination of size, shape, density, area-volume-mass relationship of fruits and vegetables, sugar-acid ratio of fruits, evaluation of washer, grader and packaging methods, experiments on drying of fruits and vegetables, controlled atmosphere storage and quality evaluation.