

AGRICULTURAL PROCESS ENGINEERING (IPCC)

Course Code	21AG43	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Objectives:

- To train the students on unit operations of agricultural process engineering
- To acquaint with the engineering properties of agricultural materials
- Enable the students to understand the concepts of cleaning of cereals, size reduction and rice milling

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Arrange visits to show the live working models other than laboratory topics.
- Adopt collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
- Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

8 HOURS

Physical characteristics of different food grains: fruits and vegetables – importance, Shape and size – criteria for describing shape and size, Roundness and sphericity – Volume and density – Specific gravity – Bulk density Porosity – surface area.

Rheology – basic concepts, ASTM standard definition of terms, Rheological Properties – Force deformation behavior, stress and strain behavior, Visco elasticity – time effects, Friction – basic concepts, effect of load sliding velocity, Rheological models - Kelvin and Maxwell models, electrical equivalence of mechanical models, Rheological equations – Generalized Maxwell and Kelvin models

Teaching-Learning Process

- PowerPoint Presentation
- Chalk and Talk are used for Problem Solving (In-general)
- Video demonstration or Simulations
- Laboratory Demonstrations and Practical Experiments

Module-2

8 HOURS

Frictional Properties: Friction in agricultural materials – measurement – rolling resistance – angle of internal friction and angle of repose, Aerodynamics of agricultural products – drag coefficient – frictional drag and profit drag or pressure drag and terminal velocity.

Electrical properties – Di electrical properties, Thermal Properties – specific heat – thermal conductivity-thermal diffusivity, Application of engineering properties in handling and processing equipment and also storage structures.

Teaching-Learning Process

- PowerPoint Presentation
- Chalk and Talk are used for Problem Solving (In-general)
- Video demonstration or Simulations
- Laboratory Demonstrations and Practical Experiments

Module-3

8 HOURS

Theory of separation: Types of separators, Cyclone separators, Size of screens applications, Separator based on length, width and shape of the grains, specific gravity, density, Air-screen grain cleaner principle and types, Design considerations of air screen grain cleaners, Sieve analysis-particle size determination, Ideal screen and actual screen-effectiveness of separation and related problems, Pneumatic separator, Cleaning and separation equipment's.

Teaching-Learning Process

- PowerPoint Presentation
- Chalk and Talk are used for Problem Solving (In-general)
- Video demonstration or Simulations

4. Laboratory Demonstrations and Practical Experiments	
Module-4	8 HOURS
Scope and importance of crop processing: Principles and methods of food processing- cleaning and grading of cereals, Size reduction –principle of comminution/ size reduction, mechanisms of comminution of food, particle shape, average particle size, Characteristics of comminuted products, crushing efficiency, Determination and designation of the fineness of ground material, screen analysis, Empirical relationships (Rittinger's, Kick's and Bond's equations), Work index, energy utilization, Methods of operating crushers, Classification based on particle size, Nature of the material to be crushed, Size reduction equipment – Principal types, crushers (jaw crushers, gyratory, smooth roll), Hammer mills, Attrition mills, Burr mill, Tumbling mills, Action in tumbling mills, Size reduction equipment –Ultra fine grinders (classification hammer mills, colloid mill), Cutting machines (slicing, dicing, shredding, pulping), Energy requirement of size deduction	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	8 HOURS
Rice milling: Principles and equipments, Paddy parboiling methods and equipment, Wheat milling, Milling of Pulses and Oilseeds, Theory of filtration, Rate of filtration, Pressure drop during filtration, Applications, Constant rate filtration and Constant-pressure filtration derivation of equation, Filtration equipment, Plate and frame filter press, Rotary filters, Centrifugal filters and Air filters	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Sl.NO	Experiments
1	Preparation of flow charts and layout of a food processing plant
2	Mixing index and study of mixers
3	Determination of fineness modulus and uniformity index
4	Determination of mixing index of a feed mixer
5	Determination of the efficiency of cyclone separator
6	Tutorial on extraction by McCabe and Thiele plot
7	Tutorial on use of psychometric chart
8	Tutorial Problems on distillation
9	Tutorial on power requirement in size reduction of grain using Ratzinger's law, Kicks law and Bond's law
10	Performance evaluation of hammer mill and attribution mill.
11	Separation behaviour in pneumatic separation
12	Evaluation of performance of Indented cylinder

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Be proficient in the scope of the process engineering and the use of processing machinery
- Understand the physical properties, rheological properties and frictional properties of agricultural materials
- Summarising the thermal properties, electrical properties and the terms related to the machine design aspects
- Some of the basic concepts related to cleaning and size reduction equipments
- To acquaint the students with the milling of rice, parboiling technologies and milling of pulses and oil seeds
- Understand the filtration equipments

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the

academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour)**

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (**duration 03 hours**) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. *Post Harvest Technology of Cereals, Pulses and oil seeds*, Chakraverty A 1988. Oxford and IBH Publishing Co. Ltd., Calcutta.
2. *Unit Operations of Agricultural Processing*, Sahay KM and Singh KK 1994, Vikas Publishing House Pvt. Ltd., New Delhi
3. *Unit Operations of Chemical Engineering*, McCabe WL, Smith JC and Harriott P 2017 McGraw-Hill Book Co., Boston.

4. Transport Processes and separation Process Principle, Geankoplis C J 2015 Prentice-Hall Inc., New Jersey.
5. Unit operations in Food processing, Earle R L 1983. Pergamon Press, New York
6. file:///C:/Users/DELL/Downloads/AlabmanualonAgriculturalProcessingandStructures.pdf
7. Post Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A 1988. Oxford and IBH Publishing Co. Ltd., Calcutta.
8. Unit Operations of Agricultural Processing, Sahay KM and Singh KK 1994, Vikas Publishing House Pvt. Ltd., New Delhi.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects



H.O.D.

Dept. of Agricultural Engineering
Alva's Institute of Engg. & Technology
Mijar, Moodubidire - 574225