S.No.	Topic	No. of Lectures
8.	To study the various quality parameters of briquettes.	1
9.	To study the production of alcohol from waste materials.	1
10.	To study the production of paper boards and particle boards from agricultural wastes.	2
11.	To determine the properties of paper boards and particle boards from agricultural wastes.	2
	Total	**15**

X. Suggested Reading

- ASAE Standards. 1984. *Manure Production and Characteristics.*
- Bor SL. (Ed.). 1980. *Rice: Production and Utilization*. AVI Publ.
- Chahal DS. 1991. *Food, Feed and Fuel from Biomass.* Oxford & IBH.
- Chakraverty A. 1989. *Biotechnology and other Alternative Technologies for Utilisation of Biomass/Agricultural Wastes*. Oxford & IBH.
- Donald LK and Emert HG. 1981. *Fuels from Biomass and Wastes*. Ann. Arbor. Science Publ.
- Srivastava PK, Maheswari RC and Ohja TP. 1995. *Biomass Briquetting and Utilization*. Jain Bros.
- USDA. 1992. *Agricultural Waste Management Field Handbook*. USDA.

I. Course Title : Mathematical Modeling in Food Processing

II. Course Code : PFE 605

III. Credit Hours : 3+0

IV. Aim of the course

To acquaint and equip the students with the mathematical modeling techniques and their applications in food processing

V. Theory

Unit I

An overview of the modeling process.Introduction to mathematical, correlative and explanatory models.Formulation, idealization and simplification of the problems.

Unit II

Probability models, series and linear mathematical approximation, dynamic and interacting dynamic processes.

Unit III

Applications of mathematical modelling techniques to food processing operations like parboiling, convective drying, pasteurization, dehydration, shelf-life prediction, fermentaiton, aseptic processing, moisture diffusion, deep fat drying, microwave processing, infrared heating and ohmic heating.

Unit IV

Stochastic finite element analysis of thermal food processes. Neural networks approach to modelling food processing operations.

VI. Learning outcome

Student's capability to develop models for food processing operations for prediction and control of operations.

VII. Lecture Schedule

S.No.	Topic	No. of Lectures
1.	An overview of the modeling process.	2
2.	Introduction to mathematical, correlative and explanatory models. Formulation, idealization and simplification of the problems.	3
3.	Probability models, series and linear mathematical approximation	3
4.	Dynamic Mathematical Model, Analysis of Dynamic Mathematical Models, dynamic and interacting dynamic processes.	3
5.	Basic Concepts of Systems Analysis and Simulation.	2
6.	Common Heat and Mass Transfer Models Dimensional Analysis.	3
7.	Model-based techniques in food processing.	2
8.	Applications of mathematical modelling techniques to parboiling of rice, convective drying/ dehydration, deep fat drying etc.	4
9.	Applications of mathematical modelling techniques to pasteurization of milk and juices.	4
10.	Applications of mathematical modelling techniques to fermentation, aseptic processing, moisture diffusion.	4
11.	Applications of mathematical modelling techniques in shelf-life prediction of agricultural commodities.	3
12.	Applications of mathematical modelling techniques to microwave heating, infrared heating and ohmic heating.	3
13.	Stochastic finite element analysis of thermal food processes.	3
14.	Probability models, series and linear mathematical approximation	3
15.	Neural networks approach to modelling food processing operations.	3
	Total	**45**

VIII. Suggested Reading

- Fischer M, Scholten HJ and Unwin D. 1996. *Spatial Analytical Perspectives on GIS*. Taylor & Francis.
- Fish NM and Fox RI. 1989. *Computer Application in Fermentation Technology: Modelling and Control of Biotechnological Processes*. Elsevier.
- Gold HJ. 1977. *Mathematical Modelling of Biological Systems - An Introductory Guidebook*. John Wiley & Sons.
- Hunt DR. 1986. *Engineering Models for Agricultural Production*. The AVI Publ.
- Koeing HE, Tokad Y, Kesacan HK and Hedgers HG. 1967. *Analysis of Discrete Physical Systems*. McGraw Hill.
- Meyer JW. 2004. *Concepts of Mathematical Modeling*. McGraw Hill.
- Peart RM and Curry RB. 1998. *Agricultural Systems, Modelling and Simulation*. Marcel Dekker.
- Tijms HC. 1984. *Modelling and Analysis. A Congrtational Approach*. Wiley Publ.

I. Course Title : Bioprocess Engineering

II. Course Code : PFE 606

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint and equip the students with the basic principles of biochemical process engineering.

V. Theory

Unit I

Applications of engineering principles: Mass and energy balance, fluid flow principles, Unit operations of process engineering.