



Syllabus for
Ph.D. (Processing and Food
Engineering)
Faculty of Agricultural Engineering
Bidhan Chandra Krishi Viswavidyalaya
Mohanpur, Nadia, West bengal

Detail Syllabus of Ph.D. (Processing and Food Engineering)

SEMESTER-I

PFE-701: Advanced Heat and Mass Transfer 4(3+1)

Conduction shape factors, dimensional analysis in heat transfer, numerical methods for steady state and unsteady state heat transfer, boundary layer flow and turbulence in heat transfer, Forced convection heat transfer inside pipes and outside various geometries, Natural convection heat transfer, advanced radiation heat transfer principles. Mass transfer coefficient for various geometries, mass transfer to suspension of small particles, Diffusion in porous solids and capillaries, numerical methods for steady state and unsteady mass transfer, dimensional analysis in mass transfer, boundary layer flow and turbulence in mass transfer.

Practical

Development of software to solve the problems on numerical methods for steady state and unsteady state heat and mass transfer, boundary layer flow and turbulence in heat and mass transfer, natural and forced convection, dimensional analysis in heat and mass transfer etc.

PFE-702: Textural & Rheological Characteristics of Food Materials 3(2+1)

Texture classification. Relation of food texture with structure and rheology. Principles and practices of objective texture measurements, viscosity measurements. Sensory methods of texture and viscosity measurements and their correlation. Rheological properties of foods. Mathematical models and their application along with pipe line design and pump selection for non-Newtonian fluids. Recent advances in textural, rheological and viscoelastic characteristics of foods and their associated mathematical models.

Practical

Determination of viscosity of liquid foods, guminess, chewiness, springiness and hardness of various fruits, vegetables and processed foods using texture profile analysis. Determination of force-distance relationship. Sensory evaluation/ subjective measurement and correlation between subjective and objective measurements of foods.

PFE 703:**Advances in Drying of Food Materials****4(3+1)**

Importance of drying, principles of drying, moisture determination, equilibrium moisture content, determination of EMC, methods and isotherm models, psychrometry, psychrometric terms, construction and use of psychrometric charts. Air flow and resistance, principles and equipments for air movement and heating, drying methods and theory of drying, driers, classification and other allied equipment, thin layer drying of cereal grains, deep bed and continuous flow drying, drying models. Heat requirements and thermal efficiency of drying system, aeration, tempering and dehydration, operation of driers and their controls, selection of driers, performance testing of grain driers, drying characteristics of cereals, pulses and oilseeds, microwave drying, radio frequency drying and tunnel drying, principles and equipment. Drying of liquid foods, spray drying, drum drying, freeze drying, foam mat drying, heat pump drying, osmotic dehydration; Principles, methods, construction and adjustments, selection of dryers, heat utilization factor and thermal efficiency.

Practical

Experiments on batch type thin layer drier, fluidized bed drier, continuous flow mixing type drier, continuous flow non mixing type drier, sand medium drier (conduction type drying), agricultural waste fired furnace drier, spray dryer, drum dryer, foam mat drying and osmotic dehydration, to evaluate the thermal efficiency and heat utilization factor.

SEMESTER-II**PFE-751:****Cold Storage of Food Products****3(2+1)**

Introduction- Purpose of cold storage and store requirements, Loading density, stacking, methods and optimum storage conditions for different fruits and vegetables and other processed products, storage compatibility.

Cold storage design and construction- method of storage, size of the storage compartment, store insulation, optimum insulation, vapour barrier, construction of floor, walls and roof. Cooling systems- different methods of cooling and freezing, cooling load calculation, refrigerant selection, design and selection of components of refrigeration system. Operation and maintenance of cold storage-unit operations/practices during loading and unloading of product, Temperature and humidity control in store, losses of stored products and preventive measures, cold store maintenance.

Practical

Determination of cold storage dimensions and optimum insulation thickness, Plant lay out, Measurement of loading density, free space, refrigeration load requirement per unit mass of the product, demonstration of working of refrigeration system in the cold store, quality evaluation of cold stored product, cold storage operation and maintenance schedule.

PFE-752: Food Plant Instrumentation and Control 3(3+0)

Generalized mathematical model of measurement systems, zero order, first order and second order instruments, strain gauges, LVDT, Piezoelectric transducers, Nozzle flapper transducers, Manometer, Vacuum measurement, Pitot tube, Anemometer, Turbine meter, Temperature measurement, Liquid level measurement, Humidity measurement. Laplace transform, linear close loop system, controllers and final control elements, close loop transfer functions, Transient response of simple control system, control system design by frequency response, sampling and z-transforms, modified z-transforms, design of sampled data controllers.

SEMESTER-III**PFE-801: Computational Methods in Food Engineering 3(2+1)**

Mathematical models- Mathematical classification of equations (linear, elliptic, parabolic and hyperbolic), Finite difference equations for nodes using Taylor's series, Boundary condition for conduction, convection and radiation heat transfer surfaces, selection of grid, discretization, control volume method, differential equation methods, solution of differential equations by explicit scheme, implicit scheme and Crank-Nicholson scheme, stability analysis, SIMPLE algorithm, SIMPLEC algorithm, Application of computational methods to different modes of heat transfer and different flow conditions.

Practical

Development of computer programs to solve various differential equations (linear, elliptic, parabolic and hyperbolic) by different finite difference methods.

PFE 802 Agricultural Waste and By-products Utilization 3(2+1)

Generation of by-products, agricultural and agro industrial byproducts/wastes, properties, on site handling, storage and processing. Collection of wastes, utilization pattern as fuel, agricultural waste fired furnaces: Mechanism, construction and efficiency, suitability of wastes as fuel, fuel briquettes, briquetting process, equipment, factors affecting briquetting. Utilization of wastes for paper production, production of particle board, utilization, by-products from rice mill, rice husk, rice bran, utilisation. Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process.

Practical

Exercises on stepped grate and fixed grate rice husk furnaces, waste fired furnace, briquette machine, production of alcohol from waste materials, production and testing of paperboards and particleboards from agricultural wastes.

SEMESTER-IV

FE-851: Aseptic Packaging of Food 3(3+0)

Introduction to aseptic processing of food, continuous flow pasteurization plants for homogeneous low viscosity food- milk and dairy products, heating and cooling of particulate food- physical principles, pasteurization of particulate food stuffs with a liquid phase. Destruction kinetics of microorganisms on packaging materials, evaluation criteria for aseptic filling and packaging systems, packaging materials for aseptic packaging, carton laminates and plastic laminates for aseptic packaging, Aseptic packaging systems, aseptic processing and packaging of foods in cans, aseptic processing in food industry.

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| PFE-799 | Seminar-I | 1(0+1) |
| PFE-899 | Seminar-II | 1(0+1) |
| PFE-999 | Seminar-III | 1(0+1) |