Department of Food Engineering

Ph.D Programme

Course No.	Title of the course	Credits
	1ˢᵗ Semester	
FE-701	Advance Momentum Transfer	3+0
FE-702	Advance Heat and Mass Transfer	3+1
	2ⁿᵈ Semester	
FE-751	Computational Methods in Food Engineering	2+1
FE-752	Cold Storage of Food Products	2+1
FE-799	Seminar-I	1+0
	3ʳᵈ Semester	
FE-801	Aseptic Packaging of Food	2+1
FE-802	Food Plant Design and Layout	2+1
FE-849	Seminar-II	1+0
	4ᵗʰ Semester	
FE-851	Food Plant Instrumentation and Control	3+0
	Nil	
	5ᵗʰ Semester	
	Nil	
	6ᵗʰ Semester	
FE-999	Seminar-III	1+0
FE-1000	Doctoral Research	0+45

Programme Details:

FE-701   Advanced Momentum Transfer   3(3+0)

Overall momentum balance, shell momentum balance and velocity profile in laminar flow, Design equations for laminar and turbulent flow in pipes, compressible flow of gases, flow past immersed objects and packed and fluidized beds. Differential equations of continuity and momentum transfer or motion and their uses, methods for

solution, Boundary layer flow and turbulence, dimensional analysis in momentum transfer.

FE-702　　　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.

FE-751　　　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

FE-752　　　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.

FE-801   Aseptic Packaging of Food   3(2+1)
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.

FE-802   Food Plant Design and Layout   3(2+1)
Raw material production, procurement, processing and distribution subsystems, Economic and technical feasibility study. Assessment of availability of raw material, future prediction, location allocation problems, Transportation models, site selection, products demand and market survey, food plant input analysis, selection of probable, prospective raw material producing areas, development of road network, preparation of work schedule, time schedule, tank utilization schedule, steam and refrigeration requirement, electrical load schedule, layout design, design of other services like water, manpower etc.
Practical
Preparation of PERT and CPM chart, design of chilling plant, selection of equipment and layout design for a particular rated capacity. Detail design of a fluid milk plant, Visit to nearby dairy plants and alternative layout design. Preparation of time schedule, tank utilization, refrigeration, steam etc.

FE-851   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.