

## Department of Agricultural Process Engineering

APE 243      **Heat and Mass Transfer**    1 + 1 = 2

**Theory-** Introductory concepts. Modes of heat transfer. Thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes and spheres. Electrical analogy. Insulation materials, critical thickness of insulation. Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free convection. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection. Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, gray bodies and emissive power, solid angle, intensity of radiation. Types of heat exchangers, fouling factor, log mean temperature difference. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Fick's law, mass transfer coefficients. Types of mass transfer.

### **Practical-**

Determination Thermal conductivity of solid Composite wall, Determination of thermal conductivity of a food material. Determination of overall heat transfer coefficient, Determination of heat transfer coefficient of a boiling liquid, Determination of thermal conductivity through plat composite wall, in packed beds, Determination of overall heat transfer coefficient in parallel flow and counter flow heat exchangers. Measurement of emissivity of a surface. Study of heat exchanger (plate type, tubular,) To verify Stefan-Boltzman relationship; To determine the emissivity of a given material.

APE 244      **Crop Process Engineering**    2 + 1 = 3

Scope and importance of food processing, principles and methods of food processing. Processing of farm crops: cereals, pulses, oil seeds, fiber crops, fruits and vegetables and their products for food and feed. Principal of size reduction, grain shape, size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick's and Bond's equation, fineness modulus. pressure drop during filtration. Theory of mixing, types of mixtures for dry and paste. materials, rate of mixing and power requirement, mixing index. Theory of separation, size and un-sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation. Theory of filtration, study of different types of filters, rate of filtration, Scope & importance of material handling devices. Study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, Design consideration, capacity and power requirement.

### **Practical-**

Preparation of flow and layout charts of a food processing plant; Determination of fineness modulus and uniformity index; Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of cleaning equipment; Study of fruit washers. Study of grading and sorting equipment; Evaluation of performance of indented cylinder and screen pre-cleaner; Study of mixers; Study of conveying equipments; Performance evaluation of bucket elevator. Visit to crop processing plant.