

AMCT-05

UNIT OPERATIONS

OBJECTIVE

To enable the students to have a better understanding on the principles of unit operations like fluid mechanics, heat transfer and mass transfer.

OUTCOME

On completion of the course the students are expected to

- Have a thorough knowledge on the fluid statics and the fluid flow phenomena.
- Have studied the different equations involved in fluid flow and the changes that occur in a fluid flowing past immersed solids.
- Have understood the concepts involved in transfer of heat by conduction and convection.
- Have a clear idea on principle of heat transfer by radiation and radiative heat transfer between different surfaces.
- Have studied the basic mass transfer operations commonly come across in ceramic technology, like diffusion, humidification, drying of solids and crystallization.

UNIT I FLUID STATICS AND FLUID FLOW PHENOMENA

Fluid statics – hydrostatic equilibrium, applications of fluid statics – manometer, gravity & centrifugal decanter. Fluid flow phenomena – laminar flow, rheological properties of fluids, turbulence, boundary layers.

UNIT II FLUID FLOW EQUATIONS AND FLOW PAST IMMERSED SOLIDS

Fluid flow equation – Mass balance in a flowing fluid, mechanical energy equation for flowing fluid,. Flow past immersed solids – drag and drag coefficient, flow through a bed of solids, motion of particles through fluids.

UNIT III CONDUCTIVE AND CONVECTIVE HEAT TRANSFER

Conductive heat transfer – basic laws of conduction, steady state conduction, unsteady state conduction. Convective heat transfer – typical heat transfer equipments, energy balance, heat flux and heat transfer coefficient, heat transfer by forced convection in laminar flow, turbulent flow and transition region between laminar and turbulent flow, natural convection.

UNIT IV RADIATIVE HEAT TRANSFER

Emission of radiation, absorption of radiation by opaque bodies, radiation between surface, radiations to semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT V BASICS OF MASS TRANSFER OPERATIONS

Diffusion – theory of diffusion, prediction of diffusivities, transient diffusion, Humidification operation – definition, humidity chart, wet bulb temperature. Drying of solids – classification of dryers, solids handling in dryer, principles of drying, cross circulation drying, through circulation

drying, freeze drying, drying equipments for solids, pastes, solutions and slurries. Crystallization – crystal geometry, super saturation, mechanism of crystallization. Basic problems on material balance.

TEXT BOOKS

1. Warren L.McCabe, Julian C.Smith and Peter Harriott, Unit Operations of Chemical Engineering, 7th Edn., McGraw Hill International Edition, 2005.
2. Salil K.Ghosal, Shyamal K.Sanyal and Siddhartha Datta, Introduction to Chemical Engineering, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2003.

REFERENCES

1. Perry R.H and Green D (eds), Perry's Chemical Engineers' Handbook, 6th Edn., McGraw-Hill, New York, 1984.
2. Walas S.M, Chemical Process Equipment, Butterworths, Stoneham, MA, 1988.
3. Treybal R.E, Mass Transfer Operations, 3rd Edn., McGraw-Hill, New York, 1980.