LECTURE SCHEDULE

Department: Dairy Engineering

Course No. - DTE- 122

Course Title: Heat & Mass Transfer **Credit Hrs- 3 (2+1)**

Course Teacher: Dr. Jahangir Badshah

Theory

S. No.	Topics to be covered	No. of Classes
1	Basic heat transfer process: Thermal Conductivity, its variation with moisture and temperature.	01
2	The values of thermal conductivity with S. I. and MKS units. Numericals.	01
3	Law of convection: Natural and Forced convection process.	01
4	Boundary Layer Theory. Convective film co-efficient for different conditions. Empirical models with their conditions. Numerical Solution.	02
5	Derivation and Numerical solutions on conduction and convection for composite wall.	01
6	Derivation and Numerical solutions on conduction and convection for cylinders.	01
7	Derivation and Numerical solutions on conduction and convection for spheres.	01
8	Derivations for heat transfer in Stefan Boltzman's constant and equivalent radiation co-efficient.	01
9	Numerical on Radiation mode of heat transfer. Effects of wavelength and temperature.	01
10	Overall heat transfer co-efficient and related numerical.	01
11	Physical and thermal properties related to heat transfer and non-dimensional Numbers.	01
12	Working principles and application of Thermocouple instruments for measuring temperature.	01
13	Working principles and application of RTD, thermostat and pyrometer instruments for measuring temperature.	01
14	One-dimensional steady state conduction: Theory of heat conduction and Fourier's law.	01
15	Numerical on Fourier's law of heat conduction.	01
16	Derivation of Fourier's equation in Cartesian coordinates.	01
17	Linear heat flow through slab, cylinder and sphere. Related Numerical.	01
18	Heat flow through slab and cylinder with non-uniform thermal conductivity.	01

19	Heat flow through sphere with non-uniform thermal conductivity.	01
20	Concept of electrical analogy and its application for thermal circuits.	01
21	Heat transfer through composite walls and insulated pipelines.	01
22	Heat transfer through composite cylinders and spheres.	01
23	Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (FINS) of uniform area of cross-section.	01
24	Equation of temperature distribution with different boundary conditions.	01
25	Derivation for infinitely long FINS and related numerical.	01
26	Derivation for FINS insulated at the tip with numerical.	01
27	Effectiveness and efficiency of the FINS and related Numerical Solution.	01
28	Introduction to unsteady state heat conduction.	01
29	Derivation for Lumped parameter for Biot Number less than 0.1	01
30	Derivation of unsteady state heat conduction with external resistance neglible and biot number greater than 0.1.	01
31	Numerical on unsteady heat conduction and application in dairy and food industry.	01
32	Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer.	01
33	Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient.	02
34	Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers.	02
35	Shell and tube and plate heat exchangers, Heat exchanger design.	
36	Application of different types of heat exchangers in dairy and food industry. Mass transfer**:** Fick's Law of diffusion.	01
37	Steady state diffusion of gases and liquids through solids. Equimolal diffusion.	01
38	Mass transfer co-efficient and problems on mass transfer.	01
	Total	40

Practical (DTE -122)

S. No.	Practical to be covered	No. of Classes
1	Determination of thermal conductivity of water and milk.	01
2	Determination of thermal conductivity of solid dairy & food products.	01
3	Determination of overall heat transfer co-efficient of Shell and tube heat exchangers.	01
4	Determination of overall heat transfer co-efficient of plate heat exchangers.	01
5	Determination of overall heat transfer co-efficient of Jacketted kettle used in Dairy & Food Industry.	01
6	Studies on heat transfer through extended surfaces.	01
7	Studies on temperature distribution and heat transfer in HTST pasteuriser.	01
8	Design problems on heat exchangers for chilling, heating and evaporation.	01
9	Visit to dairy plants to study of various types of heat exchangers.	01
10	Design problems on Unsteady state heat transfer for jacketed kettle.	01
11	Mass Transfer and Heat transfer in tubular heat exchanger.	01
12	Co current/ Counter flow Heat transfer through composite wall.	01
13	Heat transfer through legged pipes.	01
14	Heat transfer through natural and forced convection.	01
15	Design of heat exchangers using LMTD method.	02
16	Design of heat exchanger using effectiveness- NTU methods.	02
17	Numerical on dimensional analysis for different non- dimensional numbers for free convection and forced convection	02
	Total	20

Suggested Reading:

1. Heat and Mass Transfer by R. K. Rajput (2007), S. Chand & Company Ltd., ram Nagar, New Delhi -110 055.
2. Heat Exchangers- selection, Rating and Thermal Design by Sadik Kakac and Hongtan Liu (2002), CRC Press LLc, Newyork, Washington, D.C. 890.
3. A Course in Heat and mass Transfer by S. C. Arora and S. Domkundwar (1997), Dhanpat Rai & Sons, Delhi.
4. Theoretical Concepts and Formulas in Food Process Engineering by Md. Irfan Ahmad Ansari (2010), Jain Brothers, Karol Bagh, New Delhi -110 005.