SRM Institute of Science and Technology

Faculty of Engineering and Technology

Department of Chemical Engineering

Course Code & Title: **15CH208 Basic Thermodynamics and Heat Transfer**

Course Strategy Description

Course description:

This course deals with the transformation of energy from one form to another and the limitations imposed on such transformations. The calculation and prediction of energy related properties.

The different modes of heat transfer, their resistances, with emphasis on steady and unsteady state conduction.

Compulsory/Elective course: Compulsory for B.Tech. Chemical Engineering

Credit hours: 4 credits

Course coordinator(s): Mr. V. Ganesh, Assistant Professor (Sr.G.), Department of Chemical Engineering

Instructor(s):

Name of the instructor	Room number	Email (@ktr.srmuniv.ac.in)	Consultations (day order/periods)
Mr. V. Ganesh	PGA 204	ganesh.v	Day – 1: 2 and 3
Dr. K. Suresh	PGA 204	suresh.k	Day – 3: 4 and 5
Dr. Sam David	CRE lab	samdavid.s	Day – 5: 3 and 4

Relationship to other courses

Course category: Professional core

Prerequisite: Nil Co-requisite: Nil

Following courses: 15CH301 Chemical Engineering Thermodynamics, 15CH302 Process Heat Transfer

Text book(s) and/or required materials:

1. Smith, J.M., Van Ness, H.C., and Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics", 7thEdn., McGraw Hill
2. Holman J.P., "Heat Transfer", 10thEdn., Tata McGraw Hill., New Delhi.

Reference book(s):

3. Y.V.C. Rao, "Chemical Engineering Thermodynamics", Universities Press (India) Private Limited, 1997.
4. K.V. Narayanan, "A Textbook of Chemical Engineering Thermodynamics, PHI Learning Private Limited, 2001.
5. Binay K. Dutta, "Heat Transfer: Principles and Applications", PHI Learning Private Limited, 2001.

Class schedule: A Slot; Four 50 minutes lecture sessions per week, for 15 – 16 weeks

DAY ORDER: HOUR	**TIMING**
DAY - 1: 6 AND 7	12.30 PM – 2.15 PM
DAY - 2: 5	11.35 AM – 12.25 PM
DAY - 5: 8	2.20 PM – 3.10 PM

Instructional Objectives (IOs) and Student Outcomes (SOs)

S.No.	Instructional Objectives	Student Outcomes				
1.	Understand and analyze the basic concepts and Laws of thermodynamics as applied to various systems and processes	a	e	k		
2.	Understand and evaluate the volumetric and thermodynamics properties of fluids	a	e	k		
3.	Understand the various modes of heat transfer and evaluate the rate of heat transfer	a	e	k		
4.	Analyze steady and unsteady state conduction and evaluate heat transfer coefficient	a	e	k		

Teaching plan

Session	Topics	L / T	Text book/chapter	IOs	SOs	Problem solving (Y/N)
Unit – I: First Law of Thermodynamics and P-V-T Interactions		13				
1 - 3	Introduction and Basic Concepts – Energy, system, Properties, processes, Phase Rule and Equilibrium	2/1	[4] Chapter(s) – 1.1, 1.2, 1.3.3, 1.4 and 1.7 [3] chapter(s) – 2 [1] chapter(s) – 1.7, 1.8, 1.9, 2.6, 2.7, 2.8	1	a, e, k	Y
4	State and path functions.	1	[1] chapter(s) – 2.5	1	a	N
5-6	First law of thermodynamics - energy balance for closed systems.	1/1	[1] chapter(s) – 2.3, 2.4, 2.9	1,2	a, e, k	Y
7-9	Enthalpy and first law for open systems. Limitations of I law.	2/1	[1] chapter(s) – 2.10, 2.11, 2.12 [4] chapter – 2.6, 2.7	1,2	a, e, k	Y
10	PVT behavior of pure substances.	1	[1] chapter – 3.1 [4] chapter – 3.1	2	a	N
11-13	Ideal Gas Law. Formulations for process calculations involving an ideal gas: isothermal, isobaric, isochoric, adiabatic and polytropic process	1/2	[1] chapter – 3.3	1,2	e, k	Y
Unit – II: Equation of State and Second Law of Thermodynamics		**13**				
14 - 16	Equations of State (EOS). Van der Waals EOS and Cubic EOS	1/2	[1] chapter – 3.5	2	a, k	Y
17-18	Virial EOS. Generalized compressibility charts. Principle of corresponding states	2	[1] chapter – 3.7	2	a, k	Y
19-20	Second Law of Thermodynamics. Heat Engine and Heat Pump	1/1	[1] chapter – 5.1, 5.2	1	a	Y

21-22	Carnot cycle and Carnot equation.	1/1	[1] chapter – 5.3	1,2	a, k	Y
23-24	Entropy. Mathematical statement of the second law	1/1	[1] chapter – 5.4, 5.6	1,2	a, k	Y
25	Entropy balance for open systems	1	[1] chapter – 5.7	1,2	a, k	N
26	Third law of thermodynamics.	1	[1] chapter – 5.10	1	a	Y
Unit III: Thermodynamic Properties and Relationships		**11**				
27	Fundamental properties	1	[1] chapter – 6.1	2	a	N
28-29	Maxwell relations and cyclic rules	1	[1] chapter – 6.1	2	e	N
30-31	Property relations for a homogeneous fluid of constant composition in a closed system.	2	[1] chapter – 6.1	2	e	N
32-33	Enthalpy, Entropy changes in terms of measurable properties.	1/1		2	a, e	Y
34-35	Two-phase systems: temperature dependence of the vapor pressure of liquids, two-phase liquid/vapor systems.	1/1	[1] chapter – 6.4	1,2	a, k	Y
36	Joule-Thomson expansion.	1	[1] chapter – Example 7.5	1,2	a	N
37	Thermodynamic diagrams.	1	[1] chapter – 6.5	2	a	N
Unit IV: Conduction Heat Transfer		**12**				
38-39	Introduction to various modes of heat transfer	2	[5] Chapters 1.1 [2] Chapters 1	3	a	N

40	Concept of resistance to heat transfer.	1	[5] Chapters 2.1	3	a	N
41	Fourier's law of heat conduction	1	[5] Chapters 2.1	3	a	Y
42	Effect of temperature on thermal conductivity	1	[5] Chapters 2.2	3	a	N
43-44	Steady state conduction and expression for heat flux through different geometry	1/1	[5] Chapters 2.3	3	a, e, k	Y
45-46	Effective resistance for conduction through composite solids	1/1	[5] Chapters 2.4	3	a, e	N
47-49	Steady state conduction in bodies with heat sources - Shell balance approach.	2/1	[5] Chapters 2.5	3,4	a, e, k	Y
Unit V: Heat Transfer Coefficient						
50-51	Combined conductive and convective heat transfer - Heat Transfer Coefficient	1/1	[5] Chapters 3.1	3,4	a, e, k	Y
52-53	Heat transfer between fluids separated by different solid walls.	1/1	[5] Chapters 3.2	3,4	a, e	Y
54-55	Insulation, critical insulation thickness, applications	1/1	[5] Chapters 3.5	3	a, k	N
56	Heat transfer from Fins	1	[5] Chapters 3.3	3	a, e, k	N
57	Unsteady state heat conduction - Introduction	1	[5] Chapters 10 (Introduction)	3,4	a, e	N
58-60	Unsteady state heat conduction - cartesian, cylindrical and spherical coordinate systems	2/1	[5] Chapters 10.1	3,4	a, e, k	Y

Evaluation methods

S.NO.	Test	Topics covered	Marks	Test/Exam duration (min)
1.	Cycle test – I	Unit I and II	15	100
2.	Cycle test – II	Unit III, IV and V	25	180
3.	Surprise test	Questions from any units	5	20
4.	Assignment	Questions from any units	5	-
5.	Final exam	All the units	50	180

Surprise test

The surprise test will not be announced. The questions for this test will be covered until the previous class.

Home assignments

A few units will have home assignment. All the assignments should be submitted on or before the last date of submission.

Teaching Methodology

Chalk and talk for the entire course

Prepared by: Dr. K. Suresh, Associate Professor, Department of Chemical Engineering

Dated:

Revision no.: 1 **Date of revision:** **Revised by:** Mr. V. Ganesh, AP/Chemical

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Course Coordinator Academic Coordinator HoD/Chemical