Programme	B.Sc. (Engg.) Energy Engineering	Course Code	EE 211	Credit Hours	3 + 1 = 4
Course Title	**Heat and Mass Transfer**				

Course Introduction

Heat and mass transfer are crucial to understanding and optimizing various industrial and scientific processes. This course begins with the basics of heat transfer, covering key topics such as conduction, convection, and radiation, along with the analogies between momentum and heat transfer. It also delves into the dynamics of boiling and condensation. In the realm of mass transfer, the course explores the fundamental laws, diffusivities of different phases, and mass transfer velocities, including both steady and unsteady-state conditions. Additionally, the course examines heat and mass transfer equipment, focusing on classification, coefficient estimation, and troubleshooting. By integrating theoretical concepts with practical considerations, this course equips students to effectively analyze and improve heat and mass transfer systems.

Mapped SDGs	SDG-7: Affordable and Clean Energy SDG-9: Industry, Innovation, and Infrastructure

Learning Outcomes

1. **Illustrate** the modes of heat and mass transfer in engineering systems. (C2)
2. **Compare** the rates of heat and mass transfer in solids and fluid flow systems by various modes of transfer. (C4)
3. **Apply** the problem-solving skills essential to heat and mass transfer in engineering-based scenarios. (C3)

Course Content		Assignments/Readings
Week 1	**Unit-I Basics of Heat Transfer** 1. Introduction 1.1. Thermodynamics and Heat Transfer 1.2. Engineering Heat Transfer 1.3. Heat and Other Forms of Energy 1.4. The First Law of Thermodynamics 1.5. Heat Transfer Mechanisms	The teacher may assign home assignments/problem-based learning/reading materials/learning activity etc.
Week 2	**Unit-II Conduction** 2.1. One dimensional heat conduction equations and their solutions for different geometries	
Week 3	2..2. Steady heat conduction in thermal resistance networks and multilayer surfaces	
Week 4-5	2.3. Transient heat conduction 2.3.1. Lumped System Analysis	

	2.3.2. Transient Heat Conduction in Large Plane Walls, Long Cylinders, and Spheres with Spatial Effects	
Week 6-7	**Unit-III Convection** 3.1. Fundamentals of convection 3.2. Free (Natural) convection 3.3. Forced convection	
Week 8	**Unit-IV Radiation** 4.1. Fundamentals of thermal radiation 4.2. Radiation heat transfer	
Week 9	**Unit-V Heat Transfer Equipments** 5.1. Heat Exchangers 5.2. Selective equipments	
Week 10	**Unit-VI Basics of Mass Transfer** 6.1. Introduction 6.2. Steady state moleculer diffusion in fluids at rest and in laminar flow	
Week 11	**Unit VII: Mass Transfer Coefficients** 7.1. Mass transfer coefficients in laminar flow and turbulent flow 7.2. Mass and heat transfer analogies	
Week 12	**Unit VIII: Interphase Mass Transfer** 8.1. Mass transfer between phases 8.2. Two-film theory and equilibrium stages	
Week 13-14	**Unit IX: Mass Transfer Equipments** 9.1. Introduction to mass transfer equipments 9.2. Design considerations for absorbers and other equipments	
Week 15	**Unit X: Simultaneous Heat and Mass Transfer** 10.1. Evaporation and condensation mechanisms. 10.2. Boiling and sublimation. 10.3. Heat and mass transfer during phase change.	
Week 16	10.4. Case study	
Textbooks and Reading Material		
1. Karwa, R. (2021). Heat and Mass Transfer. Switzerland: Springer Nature Singapore. 2. Faghri, A., & Zhang, Y. (2020). Fundamentals of Multiphase Heat Transfer and		

Flow. Springer.
3. Karwa, R. (2020). Mass Transfer. In Heat and Mass Transfer (pp. 1041-1066).Springer,Singapore.
4. Çengel, Y. A., Ghajar, A. J. (2019). Heat and Mass Transfer: Fundamentals & Applications. United Kingdom: McGraw-Hill Education.
5. Flynn, A. M., Akashige, T., Theodore, L. (2019). Kern's Process Heat Transfer. United Kingdom:
6. Wiley.Wetzel, T., & Boeckh, P. V. (2012). Heat Transfer: Basics and Practice. Springer.
7. Sinha, A. P., & De, P. (2012). Mass transfer: principles and operations. PHI Learning Pvt. Ltd.
8. Raju, K. S. (2011). Fluid mechanics, heat transfer, and mass transfer: chemical engineering practice. John Wiley & Sons.
9. Massarotti, N. & Mauro, A. (2019). Heat and mass transfer in energy systems. MDPI.

Teaching Learning Strategies

The learning and teaching strategies will be comprised of lectures via multimedia, white/blackboard and online modes, group discussions to enhance critical thinking, individual and group assignments, project based learning, reading and writing assignments, and presentations.

Assignments: Types and Number with Calendar

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Activity	-	-	-	Assignment 1	-	-	-	-

Week	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Activity	-	-	-	-	Assignment 2	-	-	-

The abovementioned schedule of assignments/quizzes/presentations is tentative. The schedule will be provided to the students at the start of semester.

Assessment

Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written assessment at the mid-point of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper,

			research proposal development, field work, report writing, and viva-voce examination, etc.
2.	Sessional Assessment	25%	This assessment may include classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written assessment at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc.