



Course Specification

(Bachelor)

Course Title: Heat and Mass Transfer

Course Code: PHYS 0464

Program: BSc in Physics

Department: Physics

College: Science

Institution: Majmaah University

Version: 1

Last Revision Date: 30/12/2024



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A. General information about the course:

1. Course Identification

1. Credit hours: (3(3,0,0)

2. Course type

- A. University College Department Track Others
- B. Required Elective

3. Level/year at which this course is offered:

4. Course General Description:

The course introduces the basic concepts and principles of heat and mass transfer. Heat conduction, thermal resistance, natural and forced convection, heat exchangers, and radiation are investigated. The mass diffusion and Fick laws are also introduced. Some fundamental and industrial applications will be examined.

5. Pre-requirements for this course (if any):

Physics of Fluids PHYS 0313

6. Co-requisites for this course (if any):

none

7. Course Main Objective(s):

At the end of the course, the students should be able to:

1. Understand the mechanisms of heat transfer and related basic concepts.
2. Apply the concept of thermal resistance
3. Apply the concept of overall heat transfer coefficient
4. Use the lumped system analysis
5. Study the natural and forced convection
6. Understand the basic concepts of heat exchangers
7. Introduce the mass transfer and Fick laws
8. Develop solutions for real-world problems involving heat and mass transfer

2. Teaching mode (mark all that apply)



No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> • Traditional classroom • E-learning 		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.2	Use the basic relations related to each heat transfer mechanism	K2	Interactive lectures Problem-Solving Sessions	Quiz Midterm Exams Homework Assignments Presentation Final Exam
2.0	Skills			
2.1	Solve steady one-dimensional heat transfer problems analytically.	S1	Interactive lectures Problem-Solving Sessions Case Studies	Quiz Midterm Exams Homework Assignments





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.4	Design and analyze heat exchangers and cooling systems.	S4	Presentations Group Projects	Presentation Final Exam
3.0	Values, autonomy, and responsibility			
3.2	Animate a presentation on a topic related to the course.	V2	Interactive lectures Problem-Solving Sessions Case Studies Presentations Group Projects	Quiz Midterm Exams Homework Assignments Presentation Final Exam

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to heat transfer: Heat transfer modes, Fourier's law, Thermal conductivity, Heat transfer coefficient, Units and dimensions, Thermal resistance concept	6
2.	Steady-state heat conduction: Heat diffusion equation, boundary and initial conditions, Plate wall, Cylindrical and spherical systems, Composite wall, Conduction with energy generation, Fins	9
3.	Transient heat conduction: Lumped capacitance, Semi-infinite solid, Periodic heat conduction	6
4.	Convection heat transfer: Laminar and turbulent flows, Velocity boundary layer, Thermal boundary layer, Natural and forced convection, Dimensional analysis	9
5.	Heat exchangers: Heat exchanger, types, Overall heat transfer coefficient, Applications, Cooling systems	3
6.	Thermal radiation: Blackbody radiation, Emission from real surfaces	6
7.	Mass transfer: diffusion mass transfer, Fick's law of diffusion, Applications	6
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz	4	10
2.	Midterm Exam 1	6-7	15
3.	Midterm Exam 2	10-12	15
4.	Homework assignments	continue	10
5.	Presentation	12-15	10
6.	Final Exam	end	40

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).





E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Fundamentals of Heat and Mass Transfer by Frank P. Incropera and David P. DeWitt, 7th Edition.
Supportive References	Heat and Mass Transfer: Fundamentals and Applications by Yunus A. Cengel and Afshin J. Ghajar, 5th Edition. Heat and Mass Transfer by R. K. Rajput
Electronic Materials	Online simulations and animations related to heat and mass transfer.
Other Learning Materials	Research papers and case studies

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	Projector, smart board
Other equipment (depending on the nature of the specialty)	Internet. Library

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Internal Reviewer committee	Direct
Effectiveness of Students assessment	Faculty, Students	Direct (Exams, Rubrics), Indirect (Surveys)
Quality of learning resources	Students, Peer Reviewers	Indirect (Surveys)
The extent to which CLOs have been achieved	Faculty, Program Leaders	Direct (Exams, Rubrics)
Other	Students, Faculty, Alumni	Indirect (Questionnaires, Feedback Forms)

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Department council
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REFERENCE NO.

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DATE

30/12/2024

