

ES4D9-15 Heat Transfer Theory and Design

26/27

Department

School of Engineering

Level

Undergraduate Level 4

Module leader

Evgeny Rebrov

Credit value

15

Module duration

10 weeks

Assessment

30% coursework, 70% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

ES4D9-15 Heat Transfer Theory and Design

[Module web page](#)

Module aims

To provide a knowledge of heat transfer that is of vital importance in many industrial sectors from process industries, through vehicles, etc., power plant, to building technology.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The theoretical background to heat and mass transfer by conduction, convection, radiation, condensation and boiling is given. The design applications developed concentrate on more realistic mixed mode or complex heat transfer, e.g. fins (heat sinks for electronic components,

compact heat exchangers), flat plate solar collectors, heat exchangers.

Introduction: Problems in heat transfer.

Convection: Continuity, momentum, energy equations as applied to boundary layers. Laminar and turbulent flow. Dimensional analysis. Forced convection heat transfer and pressure drops: in tubes, across tube banks, on flat plates. Natural convection.

Conduction: Steady state conduction. 2-D and 3- D conduction with heat generation. 1- , 2 and 3- D transient conduction.

Mixed conduction and convection - fin effectiveness.

Radiation heat transfer.

Condensation, boiling and sublimation heat transfer.

Applications:

Heat exchangers. Heat exchanger types. LMTD and E-NTU design methods. Heat exchanger design optimisation.

Mixed radiation and convection - flat plate solar collector. Heat pipes. Building heat transfer.

CAD methods in heat transfer design - introduction about the role of numerical modelling techniques in heat transfer design and overview of some frequently used commercial software packages.

Learning outcomes

By the end of the module, students should be able to:

- Apply comprehensive knowledge of the basic heat transfer processes. [M1, M2]
- Critically examine the roles of numerical techniques in conceptualizing heat transfer designs, and interpret the usefulness of frequently used commercial software packages. [M2, M3, M4]
- Autonomously evaluate heat transfer rates using correlations of non-dimensional groups, complex analytical techniques or numerical techniques. [M3, M6]
- Autonomously model real-life processes for the purposes of approximate calculation. [M6, M13]
- Evaluate the compromises between effectiveness and cost inherent in the design optimisation of heat transfer equipment. [M6, M13]

Indicative reading list

[Reading lists can be found in Talis](#)

Subject specific skills

Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality

Ability to seek to achieve sustainable solutions to problems and have strategies for being creative and innovative

Transferable skills

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions

Overcome difficulties by employing skills, knowledge and understanding in a flexible manner

Apply problem solving skills, information retrieval, and the effective use of general IT facilities

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour (7%)
Seminars	10 sessions of 1 hour (7%)
Supervised practical classes	3 sessions of 1 hour (2%)
Online learning (independent)	20 sessions of 30 minutes (7%)
Private study	117 hours (78%)
Total	150 hours

Private study description

117 hours private study

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group DC

Assessment component	Weighting	Study time	Eligible for self-certification
Design assignment	30%		Yes (extension)

Weighting Study time Eligible for self-certification

The coursework assignment includes a design problem. The length of the report is 6 pages maximum.

Reassessment component is the same

Assessment component

Centrally-timetabled examination (On-campus)	70%	No
Written Standard		

- Answerbook Green (8 page)
- Students may use a calculator
- Engineering Data Book 8th Edition

Reassessment component is the same

Feedback on assessment

- Feedback via written and verbal comments on the assignment;
- The publication of solutions to past examination papers;
- Worked examples in examples classes;
- Student support through advice and feedback hours;
- Cohort level feedback on examinations.

[Past exam papers for ES4D9](#)

Availability

Pre-requisites

N/A

To take this module, you must have passed:

- All of
 - [ES2C5-15 Dynamics and Fluid Mechanics](#)

Courses

This module is Core for:

- UESA-H316 MEng Mechanical Engineering
 - Year 4 of H315 Mechanical Engineering BEng
 - Year 4 of H316 Mechanical Engineering MEng
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year
- Year 1 of TESA-H341 Postgraduate Taught Advanced Mechanical Engineering

This module is Optional for:

- Year 4 of UESA-H114 MEng Engineering
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- Year 1 of TESA-H642 Postgraduate Taught Energy and Power Engineering