MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME953 ENGINEERING ARTIFICIAL ENVIRONMENTS

Module Registrar: Dr N Kelly nick@esru.strath.ac.uk	**Taught To (Course): MSc Energy Systems and the Environment; MSc Advanced Mechanical Engineering / with Energy Systems / with Aerospace (all elective)**	
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 2**
Elective class	**Academic Level: 5**	**Suitable for Exchange: Y**

Required prerequisites

Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

Good maths skills:
Ability to differentiate and integrate, interpolate, manipulate algebraic equations, solve equations iteratively.

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
22	10						33	35	100

Educational Aim

The maintenance of habitable, artificial environments is critical to modern life - every time we enter a building, aircraft or vehicle, we are entering an artificial environment. At the most fundamental level these artificial environments keep us alive in hostile conditions such as 11,000m high in an aircraft. Alternatively, in buildings they help us to be comfortable and productive.

This module will provide students with the knowledge and design skills required for the establishment and control of habitable artificial environments in buildings, air and spacecraft. This will include learning about requirements for life support, the human thermoregulatory system and thermal comfort, control of contaminants and biohazards such as Legionella and Covid-19, psychrometry and environmental control systems – heating, cooling and air conditioning.

Learning Outcomes

Completion of the module is expected to:

LO1 – understand the processes underpinning human thermoregulation and the principles of human comfort, along with understanding the thermodynamics, heat transfer and mass transfer underpinning the maintenance and regulation of habitable environments

LO2 – undertake the heat transfer and psychometric calculations required to evaluate the performance of environmental conditioning equipment and processes

LO3 – undertake the initial sizing, design, and evaluation of an environmental control system

Syllabus

The module will teach the following:

1. Overview of human habitats and extreme environments.

2. Impacts of high and low temperatures on the body (hypothermia, heat exhaustion and stroke), metrics and maintaining comfort conditions, energy and environmental impact of comfort, comfort models and theories.

3. Human body and comfort, respiration, thermoregulation, heat exchange, comfort metrics, dry bulb temperature, mean radiant temperature, operative temperature, wet bulb temperature, moisture and relative humidity.
4. Environmental management and life support systems: vehicles, buildings, aircraft and spacecraft.

5. Review of heat transfer mechanisms – conduction, convection, and radiation (infrared heat exchange, solar heat gains).

6. Psychrometry, gas mixtures (partial pressures and properties) and two-phase systems, moisture, vapour pressures, dew point temperature, condensation and evaporation, enthalpy, psychrometric chart.

7. Heating and air conditioning processes, sensible heating and cooling, humidification, dehumidification, heat exchange and humidification technologies, depicting processes on psychrometric chart.

8. Air quality, common contaminants and impacts of exposure, ventilation and contaminant control approaches, air handling systems and analysis – fans, ducting, dampers.

9. Heating ventilation and air conditioning systems, convective heating and cooling, full air conditioning, radiant heating and cooling, energy efficiency.

10. Heating, ventilation and air conditioning design: heating and cooling loads, humidification and de-humidification loads, process design and sizing.

11. Environmental conditioning systems in buildings, road vehicles, trains, aircraft and spacecraft.

Assessment of Learning Outcomes

Criteria

The assessment for the module will be a combination of an exam (60%) and a design assignment (40%). For each of the Learning Outcomes the following criteria will be used to make judgements on student learning.

LO1 & LO2 – to assess their understanding of the material covered in the course, students will be required to do the following as part of an exam:

C1 – The ability to answer short questions to explain the principles of thermoregulation, human comfort, environmental conditioning and describe the components and systems required to undertake different environmental conditioning processes.

C2 – The ability to calculate heating, cooling, humidification, dehumidification and ventilation loads for a variety of situations in buildings, vehicles, air and spacecraft.

C3 – The ability to calculate and evaluate the performance of environmental conditioning systems.

LO3 – students will be expected to design a basic environmental conditioning system from first principles for a building, aircraft or spacecraft as part of an assignment. This will be submitted as a technical report and will be assessed based on:

C1 – clarity and structuring of the submission and understanding of the design task;

C2 – a technically competent design solution, evidence of a logical design process and technical evaluation of design outcome;

C3 – evidence of additional study beyond the material presented in class.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

Assessment of student performance within the module will be based on a combination of a design assignment and a class exam. The 90-minute exam will primarily assess the ability of the student to apply techniques introduced in class to basic technical problems in artificial environments and explain basic environmental conditioning concepts via a series of short questions. The design assignment will be used to gauge the student's understanding of the principles of artificial environments, environmental management processes and the design of environmental conditioning systems.

Multiple feedback mechanisms will be employed: the design assignment will be returned to students with comments on performance and understanding. Additionally, clear guidance will be provided in class as to what constitutes an acceptable level of performance in the assignment. The tutorial class will also be used to provide feedback on the development of a student's technical analysis skills. This will be achieved through direct observation of a student's efforts to tackle technical problems followed by appropriate mentoring. Additionally, peer-peer feedback will be employed in that students will be expected to present to their peers on how they set about tackling a tutorial problem.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

Examination				**Coursework**		**Practical**		**Project**	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	May	1.5 hrs	50%	1	50%				
LO1, LO2				LO2, LO3					

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submission deadlines (*academic weeks*): Week 10

Resit Assessment Procedures:
Submission of alternate ^^coursework(s) prior to commencement of the July/August exam diet.

^^Students must contact the module Registrar for details as soon as results confirm that a resit is required.

PLEASE NOTE:
Students must gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be reassessed prior to the July/August exam diet. This reassessment will consist of a coursework. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference**

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Date	Time	Room No
Announced in class		Check Myplace for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr A McLaren

Date of Last Modifications: 21/08/24

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME953**	**Module Title:**	**ENGINEERING ARTIFICIAL ENVIRONMENTS**

Brief Description of Assessment:

Design based coursework – set in week 7 and 1.5-hour examination at the end of the module.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item.

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Set	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Submit	Choose an item. Choose an item.	Exam