Module Title: Energy Flows in Buildings: Part A	**Module Code: EV7106** **Level: 7** **Credit: 15** **ECTS credit: 7.5**	**Module Leader**: Frances Hill **Additional tutors:** Bryce Gilroy-Scott Jane Fisher Louise Halestrap Ruth Stevenson Tim Coleridge Alan Owen Siobhan Maderson

Pre-requisite: none	**Pre-cursor:** none
Co-requisite: none	**Excluded combinations** : none

Location of delivery: CAT/By distance learning

The main aims of the module are to enable students to;

Synthesise an understanding of the conceptual aspects and appreciate the complex nature of the inter relationships that exist between occupant comfort, energy flows in buildings and energy efficient building design.

Apply the above in practice and define how they relate to adaptation and sustainability in the built environment.

Develop a systematic, holistic, multidisciplinary and analytical approach to the critical appraisal of energy efficient design, heat flows, and provision of thermal comfort with respect to the demands of climate change adaptation and the principles of sustainability.

Main topics of study:

- Thermal comfort
- Heat transfers through building fabric, determination of U values
- Thermal mass
- Ventilation
- Impact of moisture on building fabric and occupant health
- Passive Cooling
- Passive approaches to sunlight and solar gain
- Natural lighting
- Solar resource
- Urban heat island effect
- Climate influences on design and future climate change considerations for this
- Quantification of building performance

Learning Outcomes for the module

At the end of this module, students will be able to:

Knowledge

1. Demonstrate a clear understanding of the principles of occupant comfort in the context of energy efficient design of the built environment under an adaptation and sustainability remit;

2. Illustrate a critical understanding of the general principles of heat transfers and ventilation in buildings in the context of the design of buildings under an adaptation and sustainability remit;

Thinking skills

3. Demonstrate skills in numerical analysis applied to energy flows in buildings;

Subject-based practical skills

4. Critically evaluate a building's design in terms of effectiveness in providing for occupant comfort, energy efficiency, wider environmental impacts, and resilience to climate change;

Skills for life and work (general skills)

5. Effectively communicate (written) to a wider audience.

Teaching/ learning methods/strategies used to enable the achievement of learning outcomes:

The factual content of the module is taught through lectures, seminars, practical workshop, presentations, and tutorials, and throughout this process an active exchange of views and opinions is encouraged. Both theoretical and practical aspects are covered. The summative coursework consists of a critique of paper from the field and a piece of numerical analysis that might typically include analysis of heat flows to and from a series of three or more rooms, through different elements of the fabric and by ventilation, with critical discussion of the implications.

There is formative learning element to the module to allow the students to receive critical feedback on their work without the pressure of marked assessment.

For distance-learning (DL) students, learning will be supported through Internet-based lectures (of the onsite lectures), situation related practical exercises, seminars and tutorials.

All students also have access to Moodle discussion boards and regular Skype surgeries, where they can meet with their peers and a tutor to discuss any academic issue.

Lectures onsite and through DL highlight key concepts, models and frameworks, and integrate additional resources (such as journal articles). They encourage deep learning through the use of self-assessment questions which encourage students to engage with the topic, to help students understand new topics and skills.

Assessment methods which enable students to demonstrate the learning outcomes for the module:	**Weighting:**	**Learning Outcomes demonstrated:**
1. Essay (2,000 words max.)	67%	1,2,4,5
2. Numerical analysis (1,000 words equivalent)	33%	3,4,5

Reading and resources for the module:

Core

McMullan, R., (2012) *Environmental Science in Building* 7th Edition, London: Palgrave Macmillan.

Recommended

Baker N. and Steemers K. (2002). *Daylight Design of Buildings*, James & James. 2013 edition, Abingdon: Earthscan.

Clements-Croombe D. (editor) (1997). *Naturally Ventilated Buildings: Buildings for the Senses, Economy and Society*. Abingdon: Spon Press.

Givoni B. (1976). *Man, Climate and Architecture*, London: Applied Science Publishers.

Harvey, L. D. D. (2010). *Energy Efficiency and the Demand for Energy Services*. Energy and the New Reality 1. London: Earthscan.(*)

Roaf, S. (2009) *Adapting buildings and cities for climate change : a 21st century survival guide.* 2nd ed. Oxford: Elsevier. (*)

Santamouris M. (2001). *Energy and Climate in the Urban Built Environment*. James and James (Science Publishers) Ltd. 2011 edition, Abingdon: Routledge.

Further relevant journals, websites and other relevant resources will be provided within reading materials that are made available for the module.

(*) Available as an e-book

Indicative learning and teaching time **(10 hrs per credit):**	**Activity**
1. Student/tutor interaction:	Lectures, seminar, tutorial, presentation, practical / demonstration 30 hours
2. Student learning time:	Seminar reading and preparation, Assignment preparation, Background reading, On-line research activities. 120 hours
Total hours (1 and 2):	 150 hours