

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn Examinations 2012

Module Title: Climate Change Energy and Sustainability (CA)

Module Code: INTR 6006

School: Applied Physics and Instrumentation
School of Mechanical and Process Engineering

Programme Title(s): BEng (Hons) Sustainable Energy
BSc (Hons) in Environmental Science & Sustainable Technology

Programmes Code(s): ESENT_8_Y1
SESST_8_Y1

External Examiner(s): Mr Paul Kenny, Mr Conor Buckley
Internal Examiner(s): Chris Gibbons

Instructions: Answer three questions

Duration: 2 Hours

Sitting: Autumn 2012

Requirements for this examination:

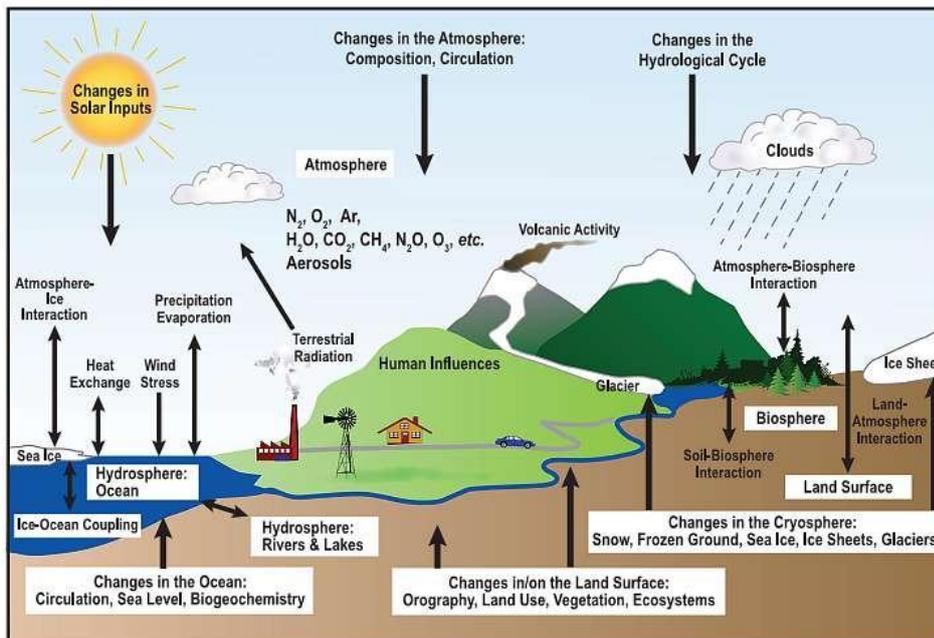
Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination. If in doubt please contact an Invigilator.

Q1 Climate Modelling

The figure below shows a general overview of factors that need to be considered in climate modelling. One key component of climate modelling is the energy balance of the atmosphere and oceans.

Provide a detailed explanation of the importance of the hydrological (water) cycle in the thermal heat balance of the atmosphere, use suitable sketches to assist in your answer. Ensure to cover all aspects of the cycle include precipitation rates, evaporation rates, cloud, and water vapour.

(25 marks)



Q2 Heat Exchange Balance

The equation for a basic model of the heat exchange between the Earth, the Sun, and the atmosphere, taking the atmosphere as a reference point, is as follows:-

$$-(1 - a_a - t_a + a_s t_a) S/4 - c (T_s - T_a) - \sigma T_s^4 (1 - t_a - a_a) + 2 \sigma T_a^4 = 0$$

- (a) Sketch the processes using a suitable energy flow diagram to show each of the energy paths and relate each part of the diagram to the appropriate part of the equation given above. Briefly explain each process. (15 marks)
- (b) Explain the meaning of the following five terms used in the equation;-

- (i) a_a
- (ii) S
- (iii) σ
- (iv) T_a
- (v) t_a

(10 marks)

Q3 Climate Change

- (a) Use a suitable diagram to illustrate the process of radiation capture from the Earth by the Green House Effect. Your answer should include the wavelength (long or short) of the radiation for each process, and an explanation of the effect and type of gases described as GHGs. (greenhouse gases) (10 marks)
- (b) Explain how a variation of the atmospheric concentration of GHGs such as CO₂ can potentially cause a change in the rate of radiation capture (5 marks)
- (c) Explain how a change in the rate of radiation capture could lead to increase in atmospheric temperatures (5 marks)
- (d) Briefly describe one means that has been proposed to lower the future concentrations of CO₂ in the atmosphere (5 marks)

Q4 Energy Sources

A flat plate solar thermal collector is one of the devices that are used to harness the thermal energy of the sun. The design of these panels must take into consideration the thermal heat transfer processes and the optimum material properties of the key components.

- (a) Draw a suitable diagram to indicate all the heat transfer processes which occur when the panel is collecting solar thermal energy. (10 marks)
- (b) Write an expression for the overall energy balance on the panel. (5 marks)
- (c) Sketch the internal construction of a flat plate panel and clearly identify each component and explain its function. (5 marks)
- (d) Outline the points that would need to be considered if you were to compare flat plate solar water collectors with evacuated tube solar water collectors, and hence outline which system is best suited to use in Ireland. (5 marks)