

UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

M. Sc.

ESGE4: Building Solar Design

COURSE CODE : **ENVSGE04**

DATE : **15-MAY-02**

TIME : **14.30**

TIME ALLOWED : **2 hours**

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UNIVERSITY OF LONDON

MSc DEGREE IN SCIENCE in BUILT ENVIRONMENT 2002

for Internal Students of University College London

Module ENVS GE 04: BUILDING SOLAR DESIGN

Answer TWO questions only. Answer all parts of the questions chosen.

1. (a) Explain briefly the concept behind “building bioclimatic design”. (3 marks)
 - (b) Explain the term “climatic envelope”, illustrating your answer with a rough sketch of a psychrometric chart showing the approximate envelope for London. (3 marks)
 - (c) Sketch the climatic envelopes for i) a typical hot dry climate and ii) a typical warm humid climate, explaining why the envelopes have the form they have. Where on the earth’s surface might these types of climate be found? (10 marks)
 - (d) Discuss the range of options that are available to cool passively domestic buildings in i) a hot dry climate and ii) a warm humid climate. Explain why these options can be effective in improving indoor thermal comfort, and what influence they should have on the layout and construction of the dwellings, illustrating your answer where appropriate. (24 marks)
 - (e) List, then briefly discuss any factors, other than climate, that you feel may have a bearing on how domestic buildings are currently laid out and constructed in hot dry and warm humid climates in the developing world. (10 marks)
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2. You have been appointed as the energy consultant to a large architectural practice, which has been commissioned to design a “solar” housing estate of 200 dwellings on a green-field site on the outskirts of London. The idea is that the houses should use as little winter heating energy as possible. They should also, of course, not overheat in summer. The partners have asked you to brief the design team on the range of options available to achieve these aims.
 - (a) As part of the briefing process, write a short report highlighting the major issues that need to be considered by the design team to achieve the project aims. In your report, which should be illustrated where appropriate, you should refer to real examples of both good and bad practice to illustrate the points you want to make. (35 marks)
 - (b) End your report by highlighting the **FOUR** or **FIVE** design issues, which you consider to be the most critical in achieving the project aims, explaining why these particular issues are so crucial. (15 marks)

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3. (a) In the context of window glazing, explain briefly the meaning of i) reflectance, ii) transmittance and iii) absorptance. Explain the meaning of the “secondary heat gain component” in relation to heat transfer through windows. (10 marks)
- (b) Explain in what way low-emittance spectrally-selective coatings, such as tin oxide or silver based coatings, reduce the U-value of glazing systems. (5 marks)
- (c) For a building in a heating dominated climate, discuss what you consider to be the ideal performance of glazing to minimise heating energy consumption. Describe how current glazing technology is being used to try to achieve this ideal performance. (10 marks)
- (d) For a building in a cooling dominated climate, discuss what you consider to be the ideal performance of glazing to minimise cooling energy consumption. Describe how current glazing technology is being used to try to achieve this ideal performance. (10 marks)
- (e) There is currently considerable research into evacuated glazing. Explain the concept, and why low U-values can be achieved with this type of glazing. What are the disadvantages? (5 marks)
- (f) There is also much research currently into electrochromic glazing. Explain very briefly what electrochromic glazing is, and discuss what might be the benefits and drawbacks of using this type of glazing in an office building in the UK. (10 marks)
4. (a) Explain why 1 m^2 of horizontal surface in the UK receives about one tenth of the power (when averaged over a year) of the solar constant. (5 marks)
- (b) Either water or air can be used as the heat transfer fluid in a flat plate solar collector. Explain the advantages and disadvantages of each and the applications for which each type is most suitable. (10 marks)
- (c) Detail **FIVE** different methods of reducing the heat loss from a flat plate solar absorber, listing how each method works and the advantages and disadvantages of each. (10 marks)
- (d) A solar water heating salesperson has offered you 10 m^2 of solar hot water collector, plus storage, for £10,000. The salesperson says that these will provide 80% of your space and water heating requirements. Given the information in part (a) of this question and the following information, calculate the simple payback period of the solar collector and comment on the salesperson’s offer. (25 marks)

solar constant: 1.3 kW/m^2

seasonal efficiency of solar collector: 50%

seasonal efficiency of gas heating system being replaced by solar system: 80%

cost of gas: 2.0 p/kWh

annual space and water heating cost: £500

END OF PAPER