UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

M.Eng.

Chemical Eng E875: Advanced Material Processes and Product Engineering

COURSE CODE   : **CENGE875**

UNIT VALUE   : **0.50**

DATE   : **13-MAY-02**

TIME   : **14.30**

TIME ALLOWED   : **3 hours**

*Answer FOUR QUESTIONS including **question 1** (PART A), ONE question from PART B and TWO questions from PART C.*
ALL questions carry a total of 25 MARKS each, distributed as shown [ ]

PART A

1. Develop a process model for supercritical extraction of a solid component (A) from a solid matrix in a column. Making reasonable assumptions solve the model equations for the concentration of the extracted solid A in the supercritical fluid phase and its concentration in the solid matrix.
   Draw qualitative diagrams of the profile of the first one along the column at various flows. Draw qualitative diagrams of the profile of the latter one along the column at various times.
   Is a tubular column a good equipment to measure the solubility of A? Why? If not, suggest a more suitable alternative and justify your answer.   [25]

PART B

2. a) Explain the principle of lithography, as well as the terms positive and negative resist.   [5]
      Draw a typical sensitivity curve and define the term "contrast" for both resist types.   [5]
      How does the contrast value affect the resolution? Explain why.   [3]

   b) Describe the general mechanisms involved in polymer decomposition.   [6]
      What is meant by the following terms in relation to chain-scission mechanisms:
      i) Intramolecular H-Transfer   [3]
      ii) Intermolecular H-Transfer   [3]
      Use reaction schemes in your answer

3. a) Derive an equation for the solubility, expressed as mole-fraction, of a solid compound in a supercritical fluid, as a function of the fugacity coefficient of this compound in the supercritical fluid. Making reasonable assumptions simplify this equation.   [13]

   b) Derive an equation describing the dependence of the average molar mass of the resist upon the radiation dose in lithography.   [7]
      Define the characteristic quantity G and explain how it can be estimated.   [5]

TURN OVER

PART C

4. a) Name the methods in product development projects commonly used for Raw Data Gathering. Comment on them.
Name and discuss the methods for documenting interactions with customers. [12]

   b) Name and discuss the step-by-step procedure for organising customer needs into a hierarchy. [13]

5. a) Name and discuss the phases of industrial design. [12]

   b) What are 'technology-driven products' and 'user-driven products'? Discuss their characteristics and give an example for each group. What is the role of industrial design for each group? [5]

   c) Name and discuss the five categories for assessing the quality of industrial design. [8]

6. a) Name and discuss the five principles of prototyping. [13]

   b) Explain and discuss the reasons the following products have been unsuccessful although they were very advanced technologically:
   - Monsanto's genetically modified food products
   - Motorola's Iridium mobile phone
   Explain and discuss the reasons for the success of the following products:
   - Philips's disposable fluorescent bulb
   - Swatch's watches [12]

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