UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

B.Eng. *M.Eng.* *M.Sc.*

Chemical Eng E853: Process Engineering

COURSE CODE	:	**CENGE853**
UNIT VALUE	:	**0.50**
DATE	:	**13-MAY-02**
TIME	:	**14.30**
TIME ALLOWED	:	**2 hours**

02-C0185-3-90

TURN OVER

*Answer **Question 1** and **THREE** other questions from the rest of the paper.*
***Question 1** should be answered in a separate answer book.*
ALL questions carry a total of 25 marks each, distributed as shown [ ]

1. a) What is a runaway exothermic reaction and give example of one? [5]

b) What are the essential features in the control strategy of a batch chemical reaction? Describe each feature and the problems that may be encountered. [15]

c) List some of the essential data required to be known by the design engineer to ensure a safe process. [5]

2. a) Answer *True* or *False* on the following: [5]

i) A dummy activity always has zero duration.

ii) The critical path represents the maximum duration needed to complete the project.

iii) Completion of critical activities can be delayed without delaying the entire project.

iv) A network may include more than one critical path.

v) A non-critical activity cannot have zero total float.

b) A construction project involves the activities listed in the following table:

Activities	Duration (Days)	Prerequisites	Number of Workers Required
A	5	None	1
B	3	None	1
C	8	A	2
D	7	A, B	1
E	7	None	0
F	4	C, D, E	1
G	5	F	0
H	12	None	1
I	3	G, H	2

i) Draw the activity-on-node diagram for the above project. [3]

ii) What is the earliest completion time for the above project provided that a sufficient number of workers is available during the project? Which activities lie on the critical path? [8]

iii) Based on the activities' earliest starting times, draw the time chart of all the activities involved in the project (Gantt chart), and the utilisation profile of the workers over the duration of the project. [6]

iv) What effect would a 2-day delay in activity D have on the overall project completion time? [3]

TURN OVER

3. A product C is to be made from reactants A and B in accordance with the following reaction:

$$A+B \rightarrow C$$

The product reacts with reactant B to form an unwanted product D:

$$C+B \rightarrow D$$

a) Describe briefly the Douglas hierarchical approach to process design, clearly identifying the hierarchy. [5]

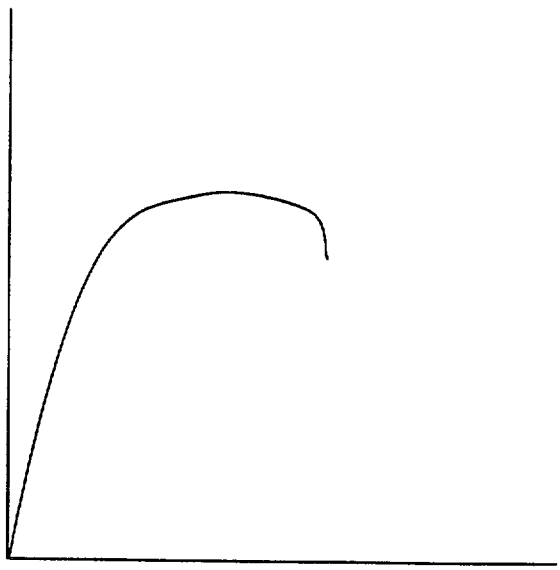
b) Suggest five possible process options for the process described above by considering a reactor and a separation block, showing the designations of the components A, B, C and D as products, recycles and waste streams. For each option selected, state the circumstances under which it may be economically viable. [10]

c) Suppose that component B is a gas with a very low boiling point. Also, components A, C and D are easily separated by distillation and it may be assumed that the normal boiling point of component A is less than that of component C which, in turn, is less than that of component D. Which of the suggested process options given in part b) is most appropriate and why? What would the separation section look like? [8]

d) If the reaction to form D were reversible instead of irreversible, as shown above, how would you modify the process flowsheet given in part c)? [2]

TURN OVER

4. a) On the figure below resulting from a tensile test define the axes and SI units of measurement and then locate the key features of importance for determining the mechanical properties of a material under such a test. [10]



Question 4: Figure

b) With the aid of simple sketches describe the changes in the above figure that might be expected to accompany a rise in operating temperature and explain your reasoning. [5]

c) Stainless steel predominates in its use in the biological industries. Why is this the case? [10]

TURN OVER

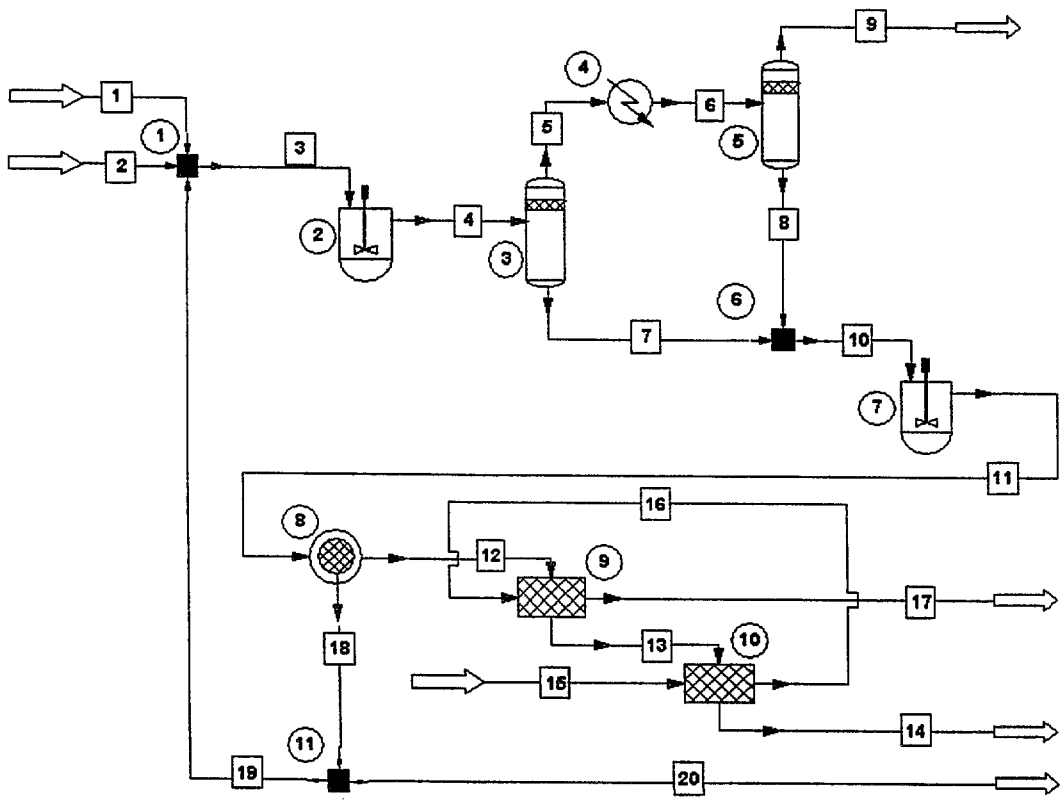
5. Discuss *briefly* **TWO** of the following:

i) how computers can aid the execution of large process design projects [12½]

ii) recycles and recycle convergence in process simulation [12½]

iii) the importance of good thermodynamic data [12½]

6. Draw up a *signal flowgraph* and a *stream precursors list* for the process flowsheet shown in the figure below, where the stream numbers are shown in boxes and unit numbers in circles. [7]



Question 6: Process flowsheet

Starting from this *signal flowgraph* and using *non-essential* and *essential stream node reduction*, determine graphically a *minimum tear set*. [15]

What is the computation order, in terms of **unit** numbers, required to solve this process flowsheet using a *sequential - modular* type approach? Indicate clearly any iteration loops in your computation order? [3]

END OF PAPER