Two hours - on line

The exam will be taken on line. This is the paper format, which will be available as a backup and to be handed out to students for reference immediately AFTER the examination starts

Please do NOT use the exam paper to write your answers

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Component-based Software Development

Date: Monday 17th January 2011
Time: 14:00 - 16:00

Please answer Question 1 in Section A and any TWO questions from Section B

Use a SEPARATE answerbook for EACH Section

For full marks your answers should be concise as well as accurate. Marks will be awarded for reasoning and method as well as being correct.

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text.

[PTO]
Section A

1. a) One of the goals of object-oriented programming is software reuse in large-scale software development. Has it achieved this goal? Explain why or why not.
   (2 marks)

b) ‘A component is just any building block, like a Lego brick or a jigsaw piece.’ Discuss.
   (2 marks)

c) Define and explain what a component model is. Illustrate your answer with an example.
   (4 marks)

d) Explain how an object (as in object-oriented programming) can be used as a component. Discuss the merits and demerits of using objects as components. Illustrate your answer with reference to specific component models.
   (4 marks)

e) Explain what an architectural unit (as in an architecture description language) is, and explain how it can be used as a component. Discuss the merits and demerits of using architectural units as components. Illustrate your answer with reference to specific component models.
   (4 marks)

f) Explain what an encapsulated component is. Discuss the merits and demerits of encapsulated components. Illustrate your answer with reference to specific component models.
   (4 marks)
2. a) Explain the desirable characteristics of a component-based software development life cycle. (4 marks)

b) Explain why components should have a separate life cycle from the system life cycle, and how these two life cycles should be linked up. (2 marks)

c) Briefly describe the phases of the idealised component life cycle. (2 marks)

d) In terms of the idealised component life cycle, explain how well each of the following meet the necessary criteria, and illustrate your answer with suitable component models:

   i) component models based on objects (4 marks)
   ii) component models based on architectural units (4 marks)
   iii) component models based on encapsulated components (4 marks)
3. a) Briefly explain the X-MAN component model. (5 marks)

b) Consider a coin-operated vending machine that makes and sells cups of tea and coffee, with or without milk, and with or without sugar. To buy a drink, the customer inserts one coin and selects the drink. The machine contains dispensers for tea, coffee, milk and sugar, and uses them to make the drink the customer has selected. All drinks are the same price, and the machine does not give change. The machine does validate the coin inserted and will reject any fake coins. If the right coin is inserted, then the selected drink will be made and dispensed. Assume that the machine serves one size of the drinks and that its stock is infinite.

Suppose you want to use the X-MAN component model to build a system for this machine.

i) Identify suitable atomic components, and explain what each one does. (4 marks)

ii) Identify suitable composition connectors for composing the atomic components, and apply them to these atomic components. Explain each of your compositions, and show why together they deliver the functionality of the vending machine. Draw a diagram of the system to help with your explanation. (6 marks)

iii) Discuss the significance of composition in two phases (design phase and deployment phase) for this example. (5 marks)
4. a) Briefly explain the key elements of EJB, and how they work together. (5 marks)

b) Consider the vending machine in Question 3. Outline an EJB implementation for the vending machine.
   i) Identify clearly the beans and any client applications involved. (4 marks)
   ii) Explain how the whole EJB system works as a vending machine.
       Draw a diagram to help with your explanation. (6 marks)
   iii) Suppose the parts of the vending machines are to be developed independently by a component developer. Discuss how suitable EJB would be for developing these components, and for developing the vending machine using these components. (5 marks)
5. a) Briefly explain what an architecture description language is, and how it can be used to define a component-based system. (5 marks)
b) Explain what components are in UML2.0. (2 marks)
c) Explain how components are composed in UML2.0. (2 marks)
d) For the vending machine in Question 3, outline how you would use UML2.0 to build a system. Carefully explain the components you would use, and how you would compose them. (8 marks)
e) How does composition in UML2.0 compare with composition in X-MAN and EJB? (3 marks)