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

Software Design using Patterns

Date: Monday 16th January 2012
Time: 09:45 - 11:45

Please answer Question 1 and two other questions

The questions are based on the online assessment software case study used throughout the course. You should use your knowledge of the domain to make reasonable assumptions as necessary. If in doubt, state those assumptions. For full marks your answers should be concise as well as accurate.

This is a CLOSED book examination
The use of electronic calculators is NOT permitted
Question 1
This question is **COMPULSORY**

a): Explain the notion of a **design pattern**, and why design patterns are important in object-oriented software development. (4 marks)

b) Suggest ways in which the **Observer** design pattern could be used in the software, particularly in the implementation of the Take Exam use case. (4 marks)

c) One of the very earliest design decisions in the real project was to use the Composite design pattern in the core data structures of the application such as Question and Answer. Explain why. (4 marks)

d) Draw a UML diagram to illustrate the Composite pattern as applied to Question and related classes, showing one important operation. (6 marks)

e) Suggest how two other GoF design patterns might be used in implementing the Take Exam use case. (2 marks)

Question 2

a) State four key principles of Agile software development. (4 marks)

b) Give one example of how each principle is reflected in agile practices. (4 marks)

c). Briefly explain the relationship between the Unified Process and Agile development. (2 marks)

d) Do Agile UP and Scrum project teams differ significantly in the way they interact with stakeholders? (2 marks)

e). State two similarities, and two differences, between **use cases** and **user stories**. (4 marks)

f) You are tasked with introduction of the agile UP into a large organisation that produces computer software for its internal needs. What arguments would you use to persuade non-technical senior and middle management that this is a good move for the organisation? (4 marks)
Question 3

a). Explain, using an example from the exam software, how a domain class diagram can be used to gather useful information from stakeholders. Your answer should take into account the different kinds of skills which different stakeholders have. 

(5 marks)

b). In the UK many professional bodies (e.g. the National Institute of Advanced Plumbers, the Royal Society of Double Accountants) conduct nationwide paper-based examinations for thousands of students at a time, conducted at test centres across the country. Some important aspects of the process are as follows:

“Exam papers are prepared, and sent to the organisation’s central administration facility, where they are copied and sent out to all the test centres by courier. All the students sit the exam at the same time. Once the test has been taken the students’ exam papers are copied at the test centre, and copies are sent to two markers who mark independently. Both copies of each paper are then sent to a third, senior, marker who resolves discrepancies between the marks, and in doing so also checks the performance of the other markers. Finally all the papers, and the marks, are returned to central admin, who then inform the students of their results. At all stages of the process, rigorous procedures are in place to ensure that the right people get the right pieces of paper.”

Draw a class diagram to represent the significant domain classes suggested by this description and their important relationships and attributes. 

(7 marks)

c) If we were to replace this paper system by an electronic one, to what extent would these domain classes correspond to design classes?

(4 marks)

d). Suggest ways in which the process described above could be improved in the software implementation.

(4 marks)
Question 4

a) Briefly explain the role of GRASP patterns in object-oriented software development. (3 marks)

b) Explain the GRASP principles of Polymorphism and Protected Variations, and how they are related, using examples from the exam software. (6 marks)

c) Briefly explain the GRASP principle of Indirection, and how it relates to Polymorphism and Protected Variations. (3 marks)

d) We have a tool, implemented as a Java applet, which monitors exams in progress by accessing information from the server every few seconds. It contains a table with a row for each student, showing the status of the student, for instance how much time they have left, and when their work was last backed up. The invigilator has various display options, such as showing only student currently working, or ordering the table based on any of the columns.

Explain the notion of a Controller, and the different types of controller, using the monitoring tool as an example. Suggest what sort of controller, if any, would be most appropriate here. (5 marks)

e) How might other GRASP patterns be applied in the design of the monitoring tool? (3 marks)
Question 5

a) Explain why design patterns are a tool for communication. Your answer should state who is doing the communicating and should include two specific examples of design patterns. (4 marks)

b). Explain the idea of a Proxy, and give two different examples of proxies which could be used in the exam software. (3 marks)

c) Briefly explain how the Visitor design pattern works. (4 marks)

d) Under what circumstances is it appropriate to use the Visitor pattern? (2 marks)

e) Briefly explain the idea behind the Flyweight pattern. (2 marks)

f). How are the Proxy, Visitor, and Flyweight patterns related to GRASP principles? Name five different GRASP principles in your answer. (5 marks)

[END OF EXAMINATION]