

**BCS THE CHARTERED INSTITUTE FOR IT**

BCS HIGHER EDUCATION QUALIFICATIONS  
BCS Level 6 Professional Graduate Diploma in IT

**SYSTEM DESIGN METHODS**

Thursday 31<sup>st</sup> March 2016 - Afternoon  
Time: THREE hours

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

**Answer any Section A questions you attempt in Answer Book A  
Answer any Section B questions you attempt in Answer Book B**

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are <b>NOT</b> allowed in this examination.
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**Section A**  
**Answer Section A questions in Answer Book A**

**Question 1**

1. a) Compare and contrast the data modelling capabilities provided by class diagrams and entity relationship diagrams. **(9 marks)**
- b) Compare and contrast the process modelling capabilities provided by use case diagrams and data flow diagrams. **(8 marks)**
- c) Compare and contrast the software architecture design capabilities provided by UML deployment diagrams and component diagrams. **(8 marks)**

**Answer pointers**

- 1.a) The following (or suitable alternatives) would be expected:

Class diagrams can model different types of relationships between data entities e.g. association (one to one and one to many), as well as generalisation and aggregation. **(3 marks)**

Entity relationship diagrams can model the relationship between data entities in terms of being one to one, one to many, optional, exclusive or recursive. **(3 marks)**

Class diagrams and entity relationship diagrams can both model the data entities required for a system. **(3 marks)**

1.b) The following (or suitable alternatives) would be expected:

Use case diagrams can model the processes (use cases) involved with different user (actor) interactions with the system.

**(3 marks)**

Data flow diagrams can model the decomposition of processes, and how data flows between processes.

**(3 marks)**

Use case diagrams and data flow diagrams both model system's functionality.

**(2 marks)**

1.c) The following (or suitable alternatives) would be expected:

Deployment diagrams can be used to model the different software components of a system and the hardware on which the software components are deployed.

**(4 marks)**

A component diagram depicts how software components are connected to form larger components and software systems.

**(4 marks)**

### **Examiner's Guidance Notes**

Part (a): Candidate provided on the whole adequate answers. Most candidates were able to mention the main features of both diagrams but had some difficulties with explicit comparing and contrasting the data modelling capabilities.

Part (b): Candidate provided on the whole adequate answers. Most candidates were able to mention the main features of both diagrams but had some difficulties with explicit comparing and contrasting the process modelling capabilities.

Part (c): Candidate provided on the whole insufficient answers. This part caused more problems than parts a) and b).

### **Question 2**

a)

A Rich Picture is one of the main modelling techniques used in Soft Systems Methodology (SSM). Rich Pictures are particularly useful as a way of understanding the problem situation at the beginning of the project. They focus on various 'soft' facts/aspects of the problem situation which are not represented by 'hard' modelling techniques such as structured techniques, object-oriented techniques, etc.

Which 'soft' facts/aspects can be represented in Rich Pictures?

**(10 marks)**

b)

(i) The *Rapid* method (see **Appendix**) specifies the development process, but it does not force a method 'user' (i.e. developer) to use a prescribed set of systems modelling techniques. Assume that you are required to use the *Rapid* method in your project. Your task is to decide which Unified Modelling Language (UML) techniques you would use in the different stages of the method. Briefly justify your decisions.

**(12 marks)**

(ii) Which UML technique is suitable for modelling system dynamics? Briefly justify your answer.

**(3 marks)**

### **Answer pointers**

2.a) Rich Pictures focus on subjective 'facts'/aspects. The following aspects should be mentioned:

- points of view
- prejudices
- potential conflicts of interests
- 'political' issues
- worries of individuals
- external interested parties
- major concerns

At least 5 'facts' should be briefly discussed. (2 marks for each) **(10 marks)**

2.b) (i)

Feasibility study: Possibly 'outline' Use Case Diagram and 'high level' Class Diagram.

Business analysis: Use Case Diagram, Class diagram, possibly Activity diagrams (to model business processes).

Build usability and functional prototype: Use Case Diagram (updated), Class Diagram (updated/expanded), Interaction Diagrams, possibly State Diagrams

Refine prototype: Component and Deployment Diagrams. **(12 marks)**

2.b)(ii)

State charts/machines are suitable for modelling system dynamics i.e. for showing how entities/objects change over time.

The state of the entities/objects needs to be specified in order to ensure that they are processed correctly.

**(3 marks)**

### **Examiner's Guidance Notes**

Part (a): Only a few candidates provided adequate answers. The evidence shows that many candidates discussed irrelevant and incorrect aspects of Rich Pictures.

Part (b) (i), (ii): generally reasonable answers. Many candidates were able to 'allocate' proper modelling techniques to proper stages, but only a small number of candidates provided sufficient explanations.

### Question 3

- a) Discuss how a systems development methodology might be used for systems maintenance within an organisation. **(10 marks)**
- b) The *Rapid* method (see **Appendix**) is suitable for projects and applications/systems which have certain characteristics related to users, functional and non-functional requirements, complexity and time constraints. Suggest five such characteristics and justify your suggestions. Additionally, state types of applications which are not suitable for this method. **(15 marks)**

### Answer pointers

- 3.a) The following (or suitable alternatives) would be expected:

All the systems development methodology techniques could be used for each given systems maintenance project. However, this could be unnecessary and time consuming. **(5 marks)**

Just the relevant systems development methodology techniques could be used for each given systems maintenance project. This could ensure that the project is undertaken in a thorough manner without unnecessary activities. **(5 marks)**

- 3.b) The Rapid method can be used when the system has the following characteristics:

- is interactive i.e. users interact with ‘system functions’
- has clearly defined user groups
- is not computationally complex
- is time-constrained
- has requirements that can be prioritised
- has requirements that are unclear or subject to frequent change **(10 marks)**

Examples of unsuitable applications: complex real time applications, ‘fabrication’ of components (for reuse), applications/systems which do not have characteristics discussed above. **(5 marks)**

### Examiner’s Guidance Notes

Part 3 (a): The evidence shows that this part caused candidates problems. Many answers were irrelevant e.g. software life cycle models, stages of agile development methods, etc. were discussed instead. Some candidates discussed various systems modelling techniques with no reference to maintenance.

Part 3 (b): generally reasonable answers. Many candidates were able to identify proper characteristics.

## Part B

### Question 4

4. a) Your organization is implementing an agile systems development approach having previously used a waterfall based systems development approach. Discuss the likely impact of this upon systems developers and users in the organization. **(10 marks)**
- b) Every organization that wants to introduce a RAD/Agile method has an existing culture and accepted working practices. Therefore the introduction of the new method (e.g. *Rapid* method – see **Appendix**) must be carefully planned and managed to achieve a successful outcome. Suggest a plan of action for introducing *Rapid* method. Your plan should include 5 'actions'. **(15 marks)**

### Answer pointers

4. a) Systems developers would be involved in the development of frequent prototypes using the agile method, which would not be used in a traditional waterfall based approach. **(5 marks)**

Users would be involved in frequent meetings with systems developers, and would provide frequent feedback on prototypes, which would not be used in a traditional waterfall based approach. **(5 marks)**

4. b) Five (or more) actions should be specified. The actions are as follows:
- The reasons for introducing Rapid must be understood and the business case for Rapid should be developed – to justify its use.
  - Philosophy and concepts of Rapid should be communicated to all concerned (initial training courses, etc.)
  - The current development practices and procedures should be examined and compared with the Rapid approach
  - Using the same comparison, the areas that will need to be changed should be identified
  - Gain support and commitment for all the activities in the plan
  - The first suitable project should be identified
  - The project team should be trained (technical courses)
  - The development environment should be set up

**(15 marks)**

### Examiner's Guidance Notes

Most candidates answered part (a) reasonably well and discussed the impact upon developers and users.

Most candidates answered part (b) reasonably well and appropriately discussed the actions required to implement an agile approach.

### Question 5

5. a) Discuss how software tools used for systems development can support systems maintenance activities. **(10 marks)**
- b) Explain the difference between validation and verification (V&V) in software projects. Suggest various V&V activities and techniques suitable for different stages of the Rapid method process (see Appendix at end of paper). Your answer should include a brief justification of your 'allocation' of V&V activities/techniques to the Rapid stages. **(15 marks)**

#### Answer pointers

5. a) The following (or suitable alternatives) would be expected:

Diagramming tools could be used to update relevant design diagrams to document the amendments to the design of the system required for a given systems maintenance project. **(4 marks)**

Debugging tools could be used to help test code amendments made during a systems maintenance project. **(3 marks)**

Programming tools could be used to code the amendments required for a given systems maintenance project. **(3 marks)**

5. b) Validation and verification are checking activities.  
Validation is intended to show that a software does what the user requires.  
Verification is intended to show that the software meets its specification.

Validation: A set of activities that ensure that the phase product which has been delivered is traceable to customer/user requirements i.e. it satisfies customer/user requirements.

Verification: A set of activities that ensure that a product emerging from any phase of the development process meets its specification. **(4 marks)**

Feasibility study: e.g. Reviews/inspections of the Feasibility report and (possibly) Feasibility prototype testing

Business analysis: Reviews/inspections of all documentary products

Build usability and functional prototype: Reviews/inspections of all documentary products e.g. system models, Prototype testing and reviews.

Refine prototype: Reviews/inspections of all documentary products, Prototype testing and reviews, Integration testing, System testing, User acceptance testing.

Deliver prototype: Reviews/inspections of all documentary products, Integration and system testing, Operational acceptance testing.

**(11 marks)**

### **Examiner's Guidance Notes**

Part (a) was generally answered well with most candidates appropriately discussing the use of tools for software development for maintenance activities. Part (b) was generally answered reasonably well, however the evidence shows a small number of candidates appeared unaware of the actual validation and verification activities and techniques.