

**BCS THE CHARTERED INSTITUTE FOR IT  
BCS HIGHER EDUCATION QUALIFICATIONS  
BCS Level 5 Diploma in IT**

**September 2013**

**EXAMINERS' REPORT**

**Systems Analysis and Design**

**Section A**

**General Comments**

Candidates in general can reproduce theoretical learning but are less skilful at applying the theory. Questions asking for comparisons or recommendations are often answered by just writing as much as possible about the topic in a general way rather than specifically answering the question. For questions asking for comparisons, disadvantages, advantages or recommendations, most marks are gained by making relevant points not by writing at length.

It is pleasing to see that more candidates than in previous years are knowledgeable about the non-traditional techniques of analysis and design, such as iterative and incremental development (including Agile).

**Question Number 1**

Learning Outcomes:

3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
4. Use appropriate methods and techniques to produce an analysis of a given scenario
6. Provide suitable documentation for systems analysis and design activities.

**Question**

- a) Produce a context diagram of the health centre system described above.

**6 marks**

- b) Produce a **logical** top level data flow diagram of the health centre system.

**19 marks**

**Answer Pointers/Model answer**

- a) Context diagram:

Correct external entities (Doctor, Patient and Receptionist) 3

Correct scope/boundary (to only include the patient registration, appointments and consultation outcome) 3

**6 marks**

- b) For good representation of scenario:

Top level DFD:

Correct data stores 3

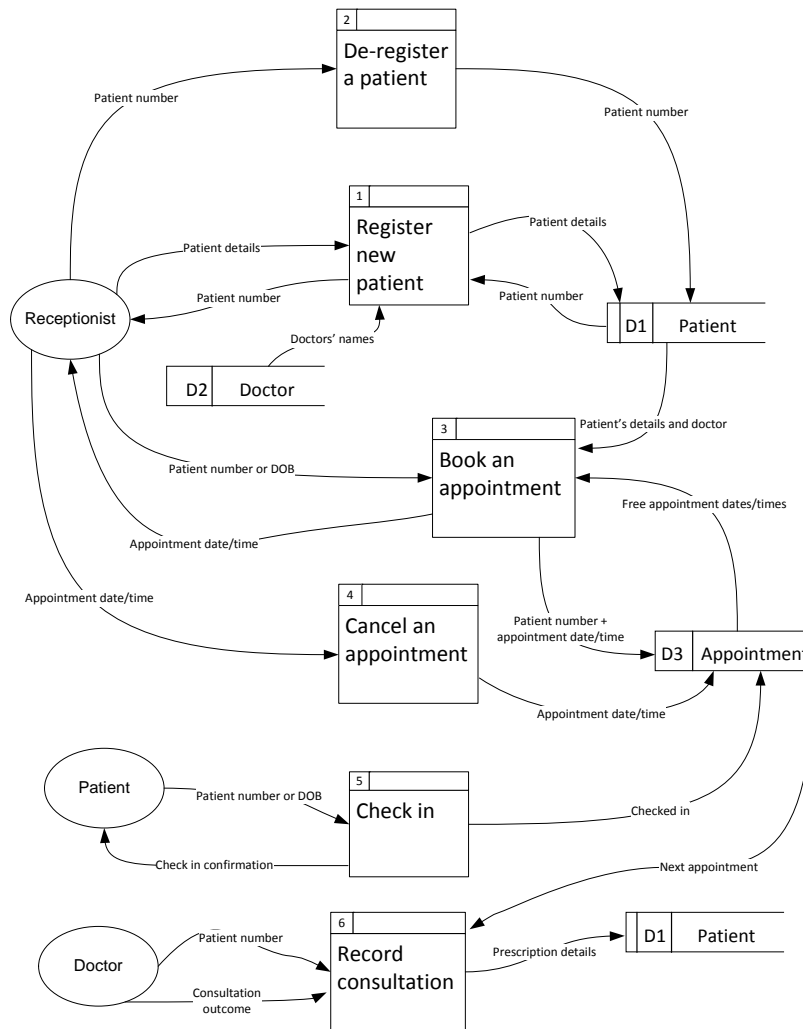
Correct processes 6

Consistency with context diagram 3

Correct notation 5

Completeness 2

See sample solution below.



## Question 1 - 25 marks

**Examiners' Guidance Notes**

- a) It seemed as if some candidates produced the top level DFD first, then drew the context diagram. Although this meant the dataflows had good consistency between the 2 diagrams, it also lead to too much detail in the dataflows on the context diagram. Some candidates did not produce a context diagram even though they produced a good top level DFD.
- b) A re-occurring error with data flow diagrams each year is that many candidates either do not name data flows or label them as actions e.g. update accounts. Candidates should be clear that data flows are flows of information and should be labelled as such e.g. amount paid.

Very few candidates produced a **logical** DFD. A logical DFD assumes all human activity is outside the system boundary. In this case study that means that the patients only interact with the system through the special check-in terminal. Otherwise the receptionist acts as an intermediary between the patient and the system. The processes inside the system boundary are logical, therefore they do not have a role or location associated with them.

## Question Number 2

Learning Outcomes:

1. Describe different life cycle models and explain the contribution of the systems analysis and design within them.
2. Discuss various approaches to systems analysis and design and explain their strengths and weaknesses.

### Question

a) Explain the difference between a waterfall and an iterative/incremental System Development Life Cycle. Illustrate your answer with diagrams. **15 marks**

b) Which approach would you recommend for developing the system for a Health Centre similar to the one described in the case study above? Justify your recommendation.

**10 marks**

### Answer Pointers/Model answer

- a) The waterfall model is standard although the phases may be named slightly differently. There are a number of iterative and incremental life cycle models and any of these can be accepted as long as the difference between iteration and increments is clear.
- |                                |                  |
|--------------------------------|------------------|
| For each diagram:              | max 5 marks each |
| For explanation of differences | max 5 marks      |

**15 marks**

- b) Waterfall is appropriate when requirements are known and fixed at the start of project, all requirements must be delivered, and for safety critical systems. It could be argued that all requirements are known and must be delivered for the health centre. The solution is unlikely to be required by a fixed date. (However this is not a safety critical system so that can't be used as justification)

Iterative and incremental are suitable when requirements are unclear or likely to change, or timescales are short. Although the Health Centre requirements seem to be clear there could be requirements that change. The Health centre system could be developed in increments such as appointment booking and checking in, registering and de-registering patients, and recording the outcome of consultations.

Either development approach is acceptable as long as it has been justified.

2 marks for each valid point **max 10 marks**

**Question 2 - 25 marks**

### Examiners' Guidance Notes

- a) Most candidates attempting this question produced acceptable waterfall diagrams. However, fewer candidates were able to produce iterative or incremental diagrams despite providing a textual description. Various representations of iterative and incremental life cycles could have been used, for example: the DSDM (and Atern) framework, the unified software development process framework, or the spiral model. Few candidates actually explained the difference between the two approaches. Most answers just described the two approaches separately.
- b) This part of the question was mostly answered well, along the lines of the marking criteria shown above.

### Question Number 3

Learning Outcomes:

3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.

#### Question

- a) A company has decided to purchase 'off the shelf' (OTS) software to handle the financial aspects of its business. Describe at least 10 general criteria that should be used to decide which OTS software applications are suitable for the company.

**19 marks**

- b) If no OTS software can be found that exactly matches the required criteria, what other options does the company have to obtain suitable software?

**6 marks**

#### Answer Pointers/Model answer

- a) Does s/w meet functional requirements?

Does s/w meet non-functional requirements?

- Personalisation
- Portability
- Maintainability
- Usability
- Reliability
- Efficiency (time to produce results)

Is it within cost constraints?

Cost of purchase

Cost of deployment

On going costs such as support costs

Reputation of vendor

Quality of documentation provided

2 marks for each main criterion + up to 2 for each sub-criterion **max 19 marks**

- b) Change the business processes to fit the s/w application

Modify the s/w to better fit the business – either in-house or by consultants

Build bespoke system – either in-house or outsourced

**6 marks**

**Question 3 - 25 marks**

#### Examiners' Guidance Notes

- a) Only about a third of candidates attempted this question. Of these a small number made the mistake of basing their answer on the case study, and listed the requirements for the Health Centre system. Candidates need to read the questions carefully. Although most candidates listed suitable criteria there was a tendency to redundantly duplicate some of the criteria in the answers.
- b) Most answers identified one or two options, very few candidates identified all three options.

## General comments – Part B

Most candidates attempting Question 4 gave reasonable and satisfactory answers to parts a) and b). Question 5 caused some problems. Question 6 was answered satisfactorily by few candidates only.

### Question Number 4

Learning outcomes:

5. Use appropriate methods and techniques to produce a design for a given scenario
6. Provide suitable documentation for systems analysis and design activities

### Question

- a) This question refers to the case study described above relating to a local health centre. The table below shows an example of a list of appointments arranged with doctors.

<b>Doctor no.: 1</b>	<b>Doctor name:</b> Smith J	<b>Doctor room no.:</b> G5			
		<b>Appointment date:</b> 2/9/12	<b>Appointment time:</b> 10.20	<b>Patient No.:</b> 217	<b>Patient name:</b> Jones J
		<b>Appointment date:</b> 3/9/12	<b>Appointment time:</b> 9.40	<b>Patient No.:</b> 357	<b>Patient name:</b> Patel J
		.....	.....	....	.....
<b>Doctor no.: 3</b>	<b>Doctor name:</b> Mills D	<b>Doctor room no.:</b> G2			
		<b>Appointment date:</b> 3/9/12	<b>Appointment time:</b> 13.40	<b>Patient No.:</b> 87	<b>Patient name:</b> Brown G
		.....	....	....	
<b>Doctor no.:4</b>	<b>Doctor name:</b> Fitzgerald J	<b>Doctor room no.:</b> G3			
		<b>Appointment date:</b> 2/9/12	<b>Appointment time:</b> 11.20	<b>Patient No.:</b> 412	<b>Patient name:</b> Wilson P
		.....	.....	....	.....
		.....	.....	.....	.....

Normalise the table to produce a set of relations in the Third Normal Form. You must show all of your working explaining each step.

(14 marks)

- b) Draw an entity relationship diagram (ERD) based on the relations produced in part a).

(6 marks)

- c) Give a brief explanation of denormalisation in database design.

(5 marks)

### Answer pointers/Model answer

a) The steps of normalisation are shown below:

b)

UNF	1NF	2NF	3NF	Relations
Doctor no. Doctor name Doctor room no.	<u>Doctor no.</u> Doctor name Doctor room no	<u>Doctor no.</u> Doctor name Doctor room no	<u>Doctor no.</u> Doctor name Doctor room no	Doctor
Appointment date Appointment time Patient No. Patient name	<u>Doctor no.</u> <u>Appointment date</u> <u>Appointment time</u> Patient No. Patient name	<u>Doctor no.</u> <u>Appointment date</u> <u>Appointment time</u> Patient No. Patient name	<u>Doctor no.</u> <u>Appointment date</u> <u>Appointment time</u> Patient No.*	Appointment
			<u>Patient No.</u> Patient name	Patient

For correct 1NF with explanation (remove repeating groups)

**4 marks**

For correct 2NF with explanation (remove part key dependencies)

**3 marks**

For correct 3NF with explanation (remove non-key dependencies)

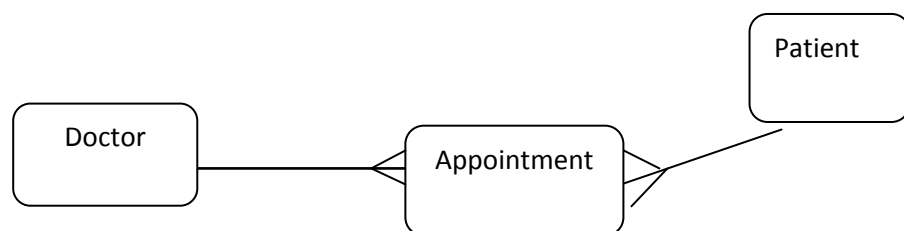
**4 marks**

For correct relations

**3 marks**

### Question 4a - 14 marks

b)



For correct relationships and their multiplicities

**4 marks**

For correct entities

**2 marks**

### Question 4b – 6 marks

- c) A relational normalised database imposes a heavy access load over physical storage of data even if it is well tuned for high performance. Denormalisation is the process of attempting to optimise the read performance of a database by adding redundant data

or by grouping data. In some cases, denormalisation is a means of addressing performance in relational databases.

#### **Question 4c – 5 marks**

#### **Examiners' Guidance Notes**

93% of candidates answered this question.

- a) A substantial number of candidates provided a full and correct explanation of each step and identified correct relations/tables. 2NF caused however some problems.
- b) Most candidates answered this part reasonably well. A few candidates had problems with relationships and their multiplicities.
- c) Only a small number of candidates answered this part satisfactorily.

#### **Question Number 5**

Learning outcomes:

- 3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
- 5. Use appropriate methods and techniques to produce a design for a given scenario
- 6. Provide suitable documentation for systems analysis and design activities

#### **Question**

- a) Consider the following extra information about the local health centre system described above:  
"There are two types of doctors: full time doctors and visiting doctors. The following data should be stored for both types of doctors: Doctor no., Doctor name, Doctor tel. no., Doctor room no. For visiting doctors additional attributes are: Next visit date, Next visit duration. An object of class Prescription consists of a Header, a number prescription lines, a doctor's signature"

Explain the following relationships between classes using examples from the local health centre system to illustrate your answers:

- i) Association,
- ii) Aggregation or Composition, and
- iii) Generalisation/Inheritance.

The examples should show relevant fragments of a class diagram.

(15 marks)

- b) Explain briefly how you would map an inheritance hierarchy in a class diagram to relational database tables. Consider three possible approaches.

(10 marks)

### Answer pointers/Model answer

- a) Explanation of association **2 marks**  
Example of association (e.g. between Patient and Appointment) **3 marks**
- Explanation of aggregation **2 marks**  
Example of aggregation (e.g. object of class Prescription 'consists' of Header, iteration of prescription lines, signature) **3 marks**
- Explanation of inheritance/generalization **2 marks**  
Example of inheritance/generalization (e.g. Doctor – superclass with two subclasses: Full Time and Visiting) **3 marks**
- Question 5a – 15 marks**

- c) There are three approaches to mapping:
- Only the superclass is implemented as a table. Attributes of subclasses become attributes of the superclass table and have null values when they are not used. This approach is in particular useful when subclasses differ from their superclass more in behaviour (operations) than in attributes.
  - Only the subclasses are implemented as tables. The attributes of the superclass are kept in the subclass tables. This works if the superclass is *abstract* (i.e. there are no instances of it).
  - All the classes (both the subclasses and the superclass) are implemented as separate tables. To retrieve the data for a subclass, both its own table and the table of its superclass must be accessed.

**Question 5b – 10 marks**

### Examiners' Guidance Notes

Just under 90% of candidates answered this question.

- a) This part was generally answered well, but some candidates provided completely wrong answers. Many candidates were unable to properly identify and explain aggregation (or composition).
- b) Many candidates produced reasonable explanation of the three mapping approaches.

### Question Number 6

Learning outcomes:

5. Use appropriate methods and techniques to produce a design for a given scenario
6. Provide suitable documentation for systems analysis and design activities

### Question

- a) Give a brief explanation of object interaction and collaboration in object-oriented systems.
- Discuss the similarities and differences between sequence and communication/collaboration diagrams.

(6 marks)



- b) Produce a sequence diagram for the use case 'Check in' in the local health centre system described above. A brief description of this use case is given below.

"The patient enters his/her date of birth. The system searches patient and appointment details. The name, appointment details (date, time), and the doctor's details (name, room no.) are displayed for patients with a matching date of birth and an appointment on that day".

(13 marks)

- c) Provide a brief explanation of the following characteristics/attributes of a good software design: Efficiency, Flexibility, Reusability.

(6 marks)

### **Answer pointers/Model answer**

- a) Proper and brief explanation of the meaning of object interaction and collaboration.

**2 marks**

At least two similarities should be identified.

**2 marks**

At least two differences should be identified.

**2 marks**

**Question 6a – 6 marks**

- b) The sequence diagram should have the following elements:

Actor – Patient

**2 marks**

Classes/Objects: Appointment, Patient, Doctor

**6 marks**

Right messages/operations

**5 marks**

**Question 6b – 13 marks**

- c) Explanations of characteristics

**(2marks \* 3)**

**Question 6c -6 marks**

### **Examiners' Guidance Notes**

This question caused more problems than questions 4 and 5. Less than 45% of candidates attempted this question.

- a) Some candidates managed to provide a reasonable answer.  
b) Only a small number of candidates answered this part satisfactorily. All other candidates specified wrong (or insufficient) classes/objects and messages.  
c) This part also caused problems. Only a small number of candidates properly explained all three characteristics.