BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

SYSTEMS ANALYSIS & DESIGN

Monday 26th September 2016 – Morning

Answer **any** FOUR questions out of SIX. All questions carry equal marks
Time: TWO hours

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 **NOT** allowed in this examination

Section A

General Comments

Questions 2 and 3 were answered by more than half the candidates, possibly because they required written answers rather than knowledge of a particular diagram notation. However, there was a tendency for candidates to write everything they knew about the topics rather than directly answering the questions. Answers should be focussed on the question to make sure time is not wasted in the examination.
In general candidates seem to learn theory that they can reproduce in the examination but are less able to apply the theory in practice.

Question Number 1

Learning Outcomes:

2. Discuss various approaches to systems analysis and design and explain their strengths and weaknesses.
3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
6. Provide suitable documentation for systems analysis and design activities.

Question

The question is based on this case study:

Smith's Second Hand Bookshop

John Smith owns a second hand book shop on the High Street of a busy town. The book shop buys and sells second hand books, but also has a small private library of rare books which he loans to local people. He has to keep a careful record of each loan and return. Before anyone can borrow any books they must register with the book shop and pay a deposit. The deposit is repaid when a person wishes to cease membership of the library if all the borrowed books have been returned in good condition.

When someone offers a book for sale John searches his catalogue of books to see if he already has a copy either in the library or for sale. If so he checks how much he paid for the copy or copies he already has. If he has several copies of the book already he may decline to buy the book, or offer a reduced price. If John doesn't already have a copy of the book he will offer to buy it, paying a reasonable price depending on its condition and rarity.

John has realised that the supply of second hand books locally has diminished and has decided to set up a web site where people can offer their books to John to buy. He realises that the seller of a book would have to input the condition of a book as well as the title and publication date. The web application would have to decide what price to offer by retrieving the purchase and selling price of any previous copies of the book. If the potential seller agrees to the price a transaction number would be displayed for the seller to include when sending the book. John will send a cheque to the seller when the book is received. If the application could not calculate a price John would like an e-mail notification so he can value the book himself.

Question One

A1

a) Produce a top level data flow diagram for the current system of the scenario above.

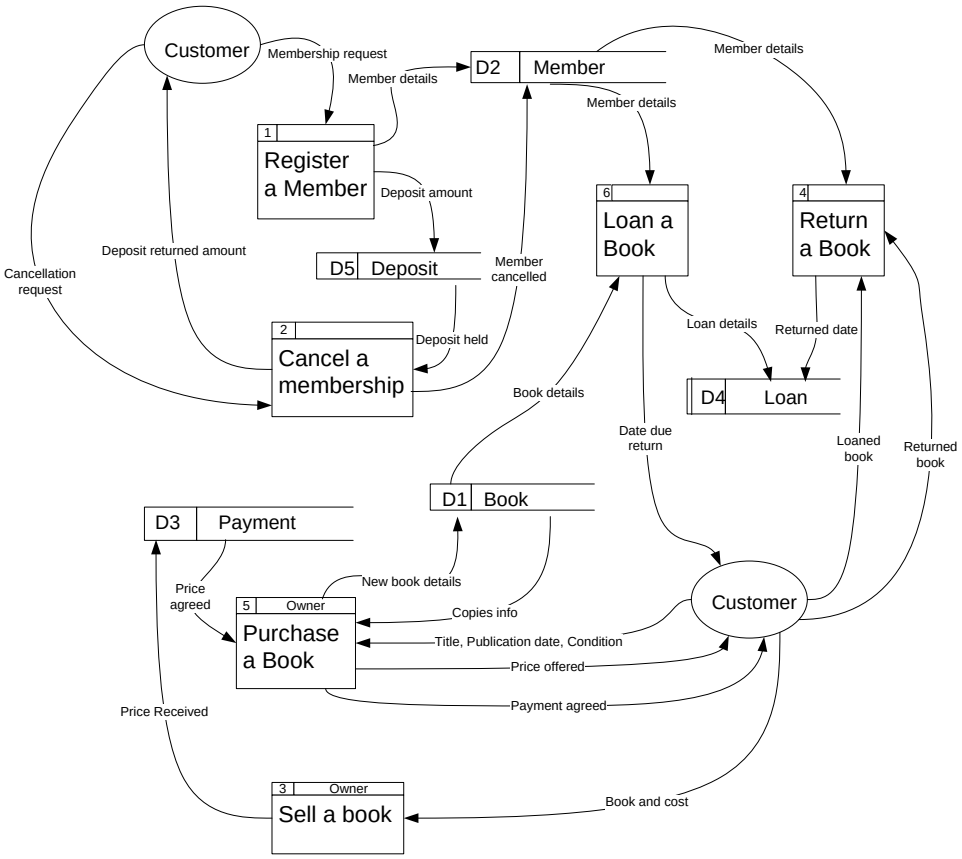
17 marks

b) Compare the use of a data flow model with an activity diagram for modelling business processes. Your comparison should include an explanation of both notations. There is no need to model the scenario again.

8 marks

Answer Pointers/Model answer

a) The DFD should contain the key processes (Issue Loan, Register Borrower, Return Loan, Terminate Membership, Search Catalogue, Add Book for Sale) and data stores (Loans, Registered Users, Catalogue) and dataflows (loan request and so on). With appropriate relationships between these.
An example of a possible DFD is shown below:



b) For each correct comparison 1 or 2 marks

for example

a. Activities v processes,

b. DFD shows information flow, external entities, data stores;

c. Activity diagram shows sequence, alternative paths.

The symbols should be presented. The point should be made that the DFD follows the flow of data through the system whilst the activity diagram models the sequence of activities with a greater emphasis on workflow and decision-making.

Examiners' Guidance Notes

This question was attempted by 48% of candidates, most of whom obtained a pass mark for the question. The average mark for this being 14/25. Most answers for part (a) were quite good with only a few candidates failing to produce a suitable diagram. The majority of candidates made the mistake of representing some dataflows as processes and a substantial minority represented some datastores as processes. But this should not be interpreted as harsh criticism. In Part (b) many candidates failed to provide any notation for activity diagrams, a few confused these with statecharts but the majority were able to explain the difference between the two types of diagram.

Question Number 2
Learning Outcomes:

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

A2

This question is based on the required new system for the case study above.

a) Produce a system use case description for the normal scenario of the use case 'Offer a book for sale' which can be used by a potential seller.

10 marks

b) Explain what an alternative scenario is, and why it may occur.

5 marks

c) Write the alternative scenarios for the use case description in part a.

10 marks

Answer Pointers/Model answer

The question is asking candidates to propose a Use Case Realisation. This would normally be done as a textual description of the dialogue that would unfold between the user and the system during a straightforward execution of the Use Case (i.e when nothing goes wrong). This is sometimes referred to as the "happy path" through the Use Case. Part b) refers to the situation where a step in the "happy path" may fail and an alternative route has to be identified. Part c) then asks for specific examples of this from the case study.

The use case might have taken the form:

Actor = 'Book Seller' or similar

1. The Book Seller enters the title of the book, the publication date and the condition
2. The system checks that the book is already in the catalogue
3. The system calculates the price of the book
4. The system requests acceptance of the price
5. The Book Seller accepts the price
6. The system displays a transaction number
7. The use case ends

Examples of alternative scenarios include:

In step 2 the book is not in the catalogue

1. The system requests a contact phone number or e-mail
2. The Book Seller enters the details
3. The system issues an e-mail to the shop owner

In step 5 the Book Seller rejects the price

1. The system displays a rejection message
2. The use case ends

Examiners' Guidance Notes

Only 30% of candidates attempted this question, and the majority of them achieved a pass mark for their answer. The average mark for this question was 12/25. Only a few candidates represented the logic of the Use Case as a dialogue between system and user. Most candidate simply described the logic of the Use Case in text or in an activity diagram. A few presented a version of a Use Case Model in which each step in the Use Case being analysed was presented as a separate Use Case – this was not really appropriate since the steps were too simple to be represented as a Use Case.

Question Number 3

Learning Outcomes:

1. Describe different life cycle models and explain the contribution of the systems analysis and design within them.
6. Provide suitable documentation for systems analysis and design activities.

Question

A3

a) Explain when in the life cycle a requirements document would be produced, and describe the contents of a requirements document.

18 marks

b) Explain the difference between a functional and non-functional requirement.

7 marks

Answer Pointers/Model answer

a) A requirements document would be produced in the requirements analysis phase of the SDLC but it would be a working document to be updated throughout the project. 3 marks

Example Contents:

- Background information and the purpose of the project
- The stakeholders and the users of the product
- Definition of project scope

- Constraints
- Facts and assumptions
- Functional and data requirements
- Non functional requirements
- Issues

Up to 3 marks for each suitable heading with explanation - maximum 15

b) Functional requirement is what the system must do, the processing it must carry out and the data it must hold or update. A non-functional requirement describes how well the system must perform the functional requirements.
Non-functional requirements may refer to a particular functional requirement or the system as a whole.

The question is asking candidates to show that they appreciate the need to specify the objectives of a development project in a document that describes the current and proposed system in terms of functional and non-functional requirements. Some reference should be made to the role of Use Cases in this as well as prototype interfaces and so on.

Examiners' Guidance Notes

This was the most popular question in section A with nearly 68% of candidates attempting it. The majority of candidates achieved a pass mark for their answer with an average mark of 14/25. Most candidates were able to explain the role of the requirements document and the main sections in the report but few commented on the role of Use Case Models or navigation models.

SECTION B

General Comments

Questions 4 and 5 were much more popular than Question 6. The best results were achieved for Question 4, followed by Question 5 results. The Question 6 results were substantially worse.

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

This question refers to the case study described above. John Smith owns a second hand book shop and a small private library of rare books. The table below shows an example of a list of rare books which were on loan.

Book code: S127	Book title: Origin of Species	Book details: Oxford Press, 1899	Seller name: A Brown	Seller tel. no.: 02087654321
	Loan code: L2010/23	Loan details: 2 weeks	Borrower name: P Palmer	Borrower address: 12 Elm Rd, SW12
	Loan code: L2010/27	Loan details: 1 week	Borrower name: A Green	Borrower address: 1 Prince Rd, SE8
	.....	.....	.....	....
Book code: P287	Book title: Pride and Prejudice	Book details: Webster's , 1902	Seller name: G Holmes	Seller tel no: 02071234567
	Loan code: L2010/12	Loan details: 2 weeks	Borrower name: P Daniels	Borrower address: 45 Elm Rd, SW12
	....	.....	....	....
Book code: A123	Book title: The Art of Italy	Book details: Pergamon Press, 1912	Seller name: A Blake	Seller tel .no: 02085674321
	Loan code: L2011/5	Loan details: 1 week	Borrower name: S Short	Borrower address: 11 Eton Square, SW1
	.....	.....	.....	.....

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

18 marks

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

7 marks

Answer Pointers/Model answer

a) The steps of normalisation are shown below:

UNF	1NF	2NF	3NF	Relations
Book code Book title Book details Seller name Seller tel. no. Loan code Loan details Borrower name Borrower address	<u>Book code</u> Book title Book details Seller name Seller tel. no. <u>Book code</u> <u>Loan code</u> Loan details Borrower name Borrower address	<u>Book code</u> Book title Book details Seller name Seller tel. no. <u>Book code</u> <u>Loan code</u> <u>Loan code</u> Loan details Borrower name Borrower address	<u>Book code</u> Book title Book details Seller name* <u>Seller name</u> Seller tel. no. <u>Book code</u> <u>Loan code</u> <u>Loan code</u> Loan details Borrower name* <u>Borrower name</u> Borrower address	Book Seller Loan/Book Loan Borrower

For correct 1NF with explanation (remove repeating groups) **5 marks**

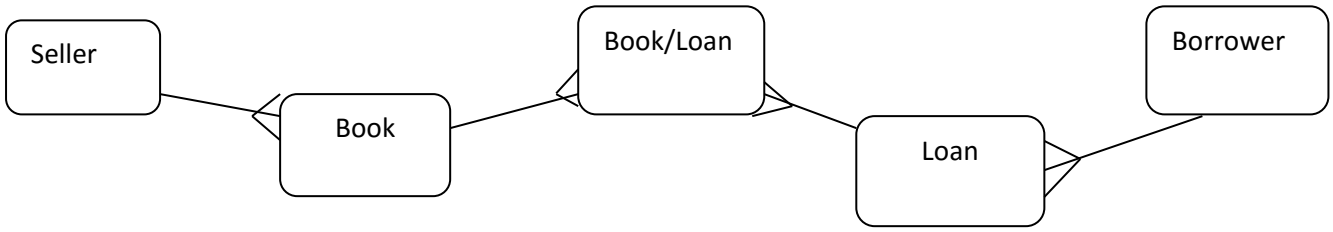
For correct 2NF with explanation (remove part key dependencies) **5 marks**

For correct 3NF with explanation (remove non-key dependencies) **5 marks**

For correct relations **3 marks**

Question 4a - 18 marks

b)



For correct relationships and their relationships **5 marks**

For correct entities **2 marks**

Question 4b – 7 marks

Examiners' Guidance Notes

Nearly 100% of candidates attempted this question and the majority of them achieved a pass mark for their answers. Many answers for part (a) were good and the majority of candidates were able to practically demonstrate the normalisation process. Some candidates however did not provide proper explanations and did not specify foreign keys. Part (b) was answered generally well. Some candidates had problems with relationships (with cardinalities of relationships in particular).

Question Number 5

Learning outcomes:

2. Discuss various approaches to systems analysis and design and explain their strengths and weaknesses.
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 book shop and the small library owned by John Smith described above:
"John Smith plans to introduce two types of loans: long loans (for books to be taken out) and short loans (for books to be read on premises in a small reading room). The following data should be stored about each long loan: *Loan code, Borrower no., Loan date, Return date, Book condition on return*. The attributes of each short loan are: Loan code, *Borrower No,* Loan date, *Loan time, Return time, Book condition on return.*
An object of class Book consists of an Introduction, a number of Chapters, an Index"

Explain the following relationships between classes using examples from John Smith's 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) Discuss two similarities and two differences between class diagrams and entity relationship diagrams. Your discussion must not concentrate on notation!

10 marks

Answer Pointers/Model answer

a) Explanation of association **2 marks**
Example of association (e.g. between Book and Seller). A relevant fragment of a class diagram should be drawn. **3 marks**

Explanation of aggregation **2 marks**
Example of aggregation (e.g. object of class Book 'consists' of Introduction, iteration of Chapter, Index) . A relevant fragment of a class diagram should be drawn. **3 marks**

Explanation of inheritance/generalization **2 marks**
Example of inheritance/generalization (e.g. Loan – superclass with two subclasses: Long loan and Short loan). A relevant fragment of a class diagram should be drawn. **3 marks**

Question 5a – 15 marks

b) 2 similarities and 2 differences should be briefly discussed.
For reasonable similarities **5 marks**
For reasonable differences **5 marks**
For example:
Similarities:

- Both diagrams show the structure of data in the system i.e. 'things' (entities, objects) about which data should be stored
- Both diagrams show the relationships between these 'things'

Differences:

- In Class Diagrams there are 3 types of relationships: associations, aggregations and inheritance while in ERDs relationships correspond to associations
- Classes of course are semantically 'richer' than entities – as they encapsulate both the attributes and operations (entities encapsulate attributes only)

Question 5b – 10 marks

Examiners' Guidance Notes

This question was attempted by appr. 85% of candidates. Part (a) was answered reasonably well. Some candidates however were unable to give proper and correct examples of relationships between classes (many candidates did not draw relevant fragments of a class diagram). A small number of candidates also had problems with definitions/explanations of relationships between classes (associations in particular). Some candidates answered part (b) reasonably well, but many did not clearly distinguish between similarities and differences.

Question Number 6

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) 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)

(i) Give a brief explanation of the role sequence diagrams play in systems modelling with the emphasis on designing the interaction between the user and the system.

6 marks

(ii) Produce a sequence diagram for the use case 'Return a book' in the book shop and the small library system described above. A brief description of this use case is given below.
"The corresponding *Book code* and *Borrower number* are entered by a Librarian. The system retrieves the relevant loan and updates all affected objects. Next the librarian enters the book's *Condition on return* and if the condition got worse then the corresponding book record is updated and a fine is recorded against the loan. Otherwise the loan is deleted."

13 marks

Answer Pointers/Model answer

a) Proper and brief explanation of the meaning of object interaction and collaboration. For example – Object interaction defines the message passing between objects within the context of a collaboration to achieve a particular behaviour e.g. to achieve the realisation of a use case. **2 marks**
At least two similarities should be identified.
Possible similarities are: Both model interactions between objects. Both show actors, objects and messages for relevant use cases. **2 marks**
At least two differences should be identified.
Possible differences are: In a communication diagram an interaction between objects is drawn on what is essentially a fragment of a class diagram (so the emphasis is on the structure), while a sequence diagram shows an interaction between objects arranged in a time sequence (so the emphasis is on the time sequence). **2 marks**

Question 6a – 6 marks

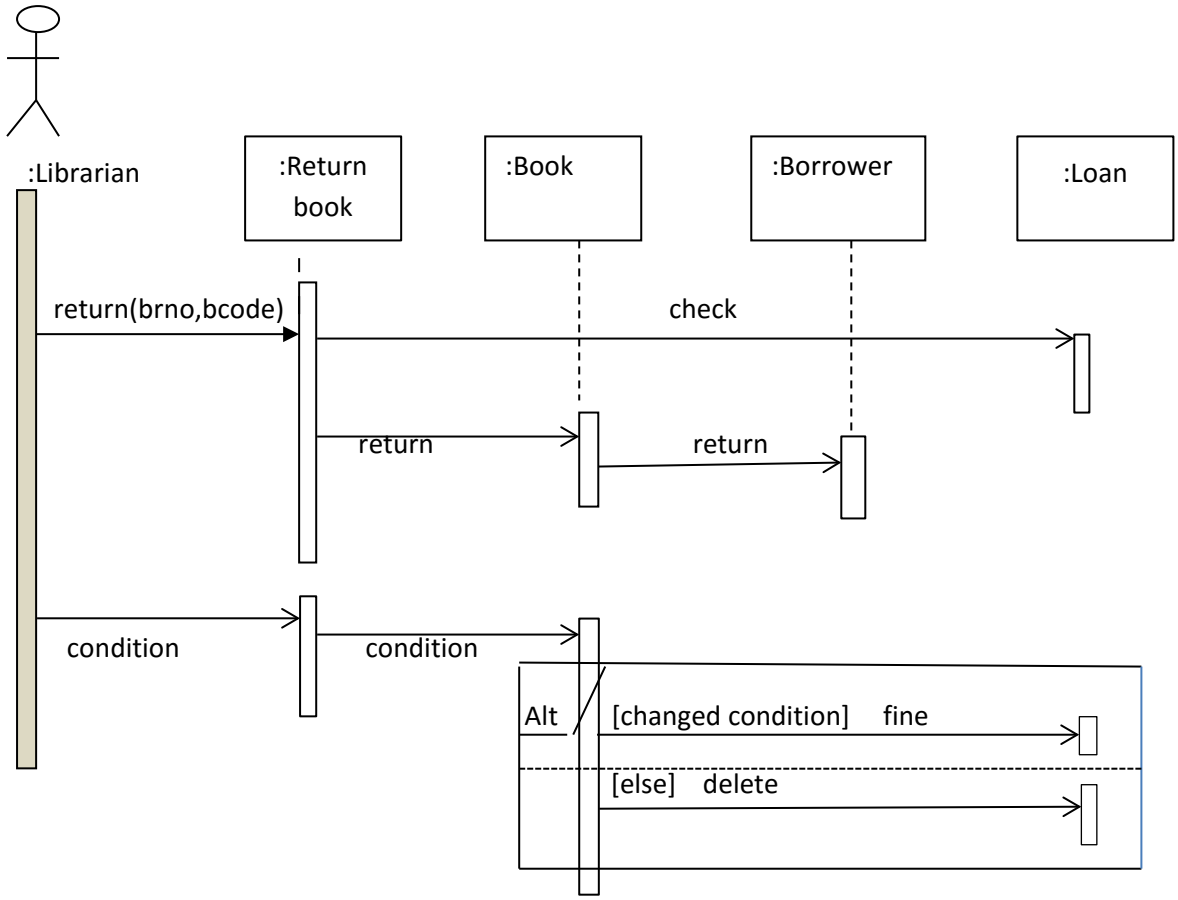
b)

(i) Sequence diagrams are used to model :

- interactions between objects (during the realisation of a use case), and
- interactions between the user and the system ('represented' by e.g. the boundary object)

Sequence diagrams can be used as Analysis technique (more general 'model' of interactions) or as a Design technique (more detailed 'model' of interactions). When modelling user-system interactions they focus on messages exchanged between the user and the system/the boundary object.

Question 6bi – 6 marks



(ii) The sequence diagram should have the following elements:

Actor – Librarian **2 marks**

Classes/Objects: Borrower (updated), Loan (updated and possibly deleted), Book (updated), possible User Interface **5 marks**

Right messages/operations **4 marks**

Branching (to show two alternative execution pathways) **2 marks**

Question 6bii) maximum 13 marks

An example of the sequence diagram is given above.

Examiners' Guidance Notes

Only a small number of candidates (appr. 30%) attempted this question, and the results are worse than the results of questions 4 and 5. In part a) many candidates were unable to provide proper explanations of object interaction and collaboration, but some identified proper similarities and differences between sequence and communication diagrams. The answers for b)(i) were adequate. In part b)(ii) only a few candidates produced sufficient sequence diagrams. Many candidates were unable to specify correct objects/classes 'participating' in this use case and specified incorrect objects such as e.g. System, Data base, etc.