



**FACULTY OF SCIENCE**

**Academy of Computer Science and Software Engineering**

<b>Module</b>	<b>IFM3A10 / IFM03A3</b> Informatics 3A – Introduction to Software Engineering
<b>Campus</b>	APK
<b>Exam</b>	June 2014

<b>Date</b>	13 June 2014	<b>Time</b>	08:30
<b>Assessor</b>	Mr F F Blauw (Theory) Mr D A Coulter (UML)		
<b>External Moderator</b>	Dr L Futchter (NMMU)		
<b>Duration</b>	180 minutes	<b>Marks</b>	150

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**The question paper consists of 7 pages**

**Instructions:**

- Answer all questions.
  - Please write neatly and legibly.
  - Do not write in pencil.
  - Ensure that all diagrams are neatly drawn.
  - Unless otherwise stated, diagrams do not constitute complete answers.
  - Calculators may not be used.
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## **SECTION A – THEORY**

### **QUESTION 1**

- 1.1. What is **software**? (2)
- 1.2. What are the key challenges facing software engineering? (2)
- 1.3. What are the four (4) fundamental software development activities? (2)
- 1.4. You have been employed to develop client management software for Help-U-Dress Clothing. During the development process you realise that you will have to put a lot of security in place to ensure that the clients' information stays safe. However, Help-U-Dress Clothing does not want to incur the additional cost of maintaining high level of security in their new systems.  
  
What should you do? Should you continue as is, or refuse to develop the system? Briefly discuss the ethical implications of either case. (4)

**[10]**

### **QUESTION 2**

Requirements engineering is the process of establishing the services that the customer requires from a system and the constraints under which it operates and is developed.

- 2.1. There are several ways/notations of writing system requirements specifications. Briefly discuss two (2) ways and mention in which circumstances each might be used. (4)
- 2.2. Discuss two (2) problems with domain requirements. (2)
- 2.3. After the requirements have been elicited, there is a chance that they might be incorrect. Briefly discuss two (2) techniques that can be used to validate the requirements. (4)

**[10]**

### **QUESTION 3**

GeneZe Software has hired you as a software engineer. You have been assigned to design a stock management system for Pharox Foods, a national distributor of phoenix related meat products.

Pharox Foods would like to be involved throughout the development process and get more feedback from the developers. In the past they found it difficult to judge the project progress from just software design documents. It should be noted that due to the agreement between GeneZe Software and Pharox Foods the entire system will be developed on-site i.e. at Pharox Foods' business premises. It is also a requirement that the entire system be developed entirely from scratch i.e. all parts of the system must be developed by GeneZe Software.

With the aid of diagram(s) to help your written discussion, select and discuss a software process model that should be used to develop the stock management. **[10]**

**QUESTION 4**

Extreme Programming (XP) is perhaps the best known and most widely used of the agile methods. As such, GeneZe Software has decided that they will change their development cycle to allow for XP. One drawback, according to GeneZe Software, is that XP might result in the less experienced (fresh from university) development falling behind.

- 4.1. Name and discuss one aspect of XP that will allow experience to be carried over to younger developers. (4)
- 4.2. Managing software developed using agile techniques work differently. Briefly discuss, using a diagram to assist, the agile project management process. (6)

**[10]****QUESTION 5**

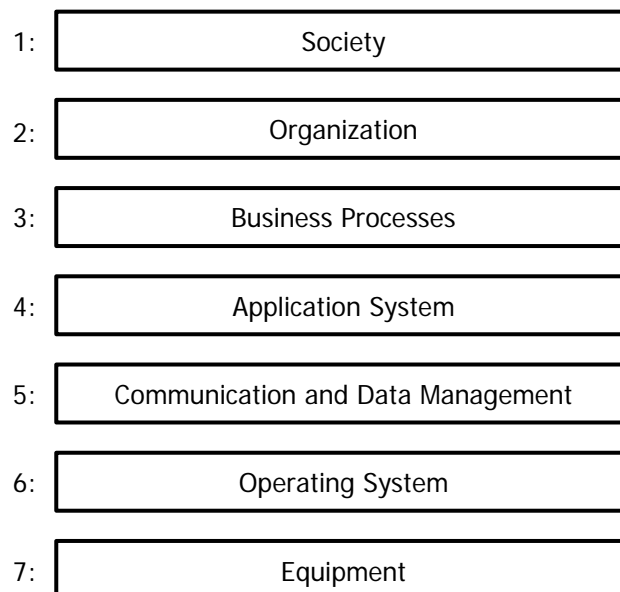
You have been hired by Centitri web development to implement a web application that must provide a user with multiple ways to view and interact with data. The requirements for the interaction and presentation of data are likely to change in the future.

Keep in mind that the design process for identifying the sub-systems making up a system and the framework for sub-system control and communication is architectural design.

- 5.1. Which **architectural design pattern** would you recommend for the above project? With the aid of a diagram, describe the pattern you recommend. (5)
- 5.2. Briefly compare the **advantages** and **disadvantages** of your recommended pattern. (2)
- 5.3. Briefly describe the **difference** between **architectural design patterns** and **application architectures**. (3)

**[10]****QUESTION 6**

Given the **socio-technical systems stack** below, answer the questions that follow.



- 6.1. What is understood by the term “socio-technical system”? (2)

PTO

- 6.2. Software engineering is only concerned with some of the layers in the socio-technical stack. Which layers are they? (1)
- 6.3. Briefly describe the organizational impact a socio-technical system may have on an organizational environment. (3)
- 6.4. What are emergent system properties? Briefly describe these properties and discuss two examples. (4)

**[10]**

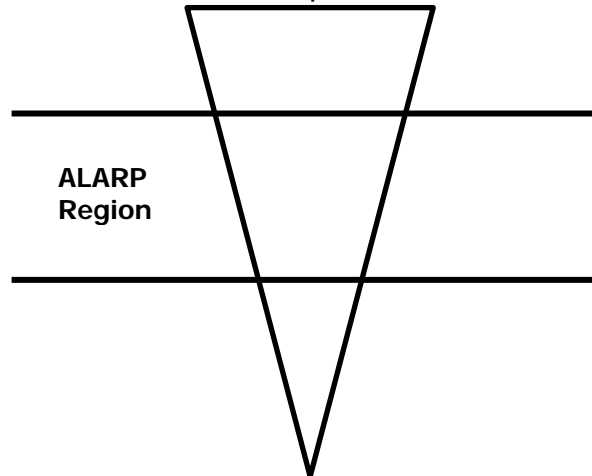
### **QUESTION 7**

- 7.1. It may not always be possible to develop a system that is absolutely dependable. Explain how some factor(s) may impact the development of a dependable system. You may use diagrams to aid in your discussion. (4)
- 7.2. When determining the balance between availability and reliability of a system, which do you believe should carry more weight? Motivate your answer. (2)
- 7.3. In terms of reliability, briefly discuss one possible means for a system to fail. HINT: Make use of terms linked to reliability. (4)

**[10]**

### **QUESTION 8**

Given the **risk triangle** below, answer the questions that follow.



- 8.1. Define the three regions of the risk triangle. Particularly give attention to the ALARP region. (6)
- 8.2. Briefly explain what is meant by a “risk-driven requirements specification.” (4)

**[10]**

**QUESTION 9**

Software engineering has been more focused on original development but it is now recognised that to achieve better software, more quickly and at lower cost, a design process that is based on systematic software reuse is required.

- 9.1. Discuss three (3) key factors that you should consider when planning to reuse software. (6)
- 9.2. Give three (3) circumstances where you might recommend against software reuse. (3)
- 9.3. In general, would you recommend that software reuse should be considered as a worthwhile means of procuring a new system? Motivate your answer. (1)

**[10]****QUESTION 10**

The components in a distributed system may be implemented in different programming languages and may execute on completely different types of processor. Models of data, information representation and protocols for communication may all be different.

Oyore Industries specialises in developing image processing applications that are used to detect the level of inebriation of a person before they are allowed to use heavy machinery or drive home from a restaurant. The application requires a lot of intensive computer processing and hence makes use of the GPU of a computer. The company would now like their customers to be able to use their application online by making use of a web-browser in order for the company to keep track of certain statistics regarding the application. Off-the-shelf software will be made available for the customers. Customers must install the software on their personal computers if they wish to make use of the service. The company would like to start off by making the application available to a small number of customers.

- 10.1. Recommend a client-server architecture that they can use. (1)
- 10.2. Provide the definition for the architecture you recommended. (2)
- 10.3. Justify why you recommended the architecture. (2)
- 10.4. Draw a diagram showing the structure of the chosen architecture. (4)
- 10.5. What is the main disadvantage of the architecture you recommended? (1)

**[10]****Section A Total: [100]**

## **SECTION B – PRACTICAL**

### **QUESTION 11**

Create a **UML Use-Case Diagram** to model the following:

The Oracular-Schism system allows for high dimensional data sets to be visualised using inexpensive commodity virtual reality glasses. The core functionality of the system can be summarised as follows:

- There are three main roles played by users of the system namely: data-capturer, data-modeller and administrator. The system has three distinct privilege levels. Everything that can be done by a data-capturer can be done by a data-modeller. The administrator is a super-user with access to all system functionality.
- The data-capturer is capable of adding raw data to the system. Since the data is governed by the POPI act every time data is added to the system it is automatically secured.
- The data-modeller is capable of reducing the dimensionality of data-sets in the system using any of the three following techniques: Growing Neural Gas, Self-organising maps or IsoMaps.
- The data-modeller may also visualise the data using either a VR Display or a 2D screen depending on the output device selected.
- The administrator is capable of managing users as well directly accessing the raw data in the data-sets.

**[10]**

### **QUESTION 12**

Create a **UML Activity Diagram** to model the following:

The Bootstrap Aggregating (Bagging) system is an ensemble learning technique which attempts to combine weak classifiers together into a single strong classifier system. The pseudo-code for the algorithm (for combining three classifiers) suitable for running on an Infrastructure-As-A-Service cloud framework (with each parallel computation in its own machine instance and aggregation occurring on the user's computer) is presented below:

```

Input: Data set D, Base Learning Algorithm L
Process:
for t = 1 ... 3 in parallel on cloud do
begin
    Db = GenerateBootStrapDistribution (D)
    hypothesisSet(T) = L(D, Db)
end
StrongClassifier = Aggregate(Vote(hypothesisSet))
  
```

**[10]**

**QUESTION 13**

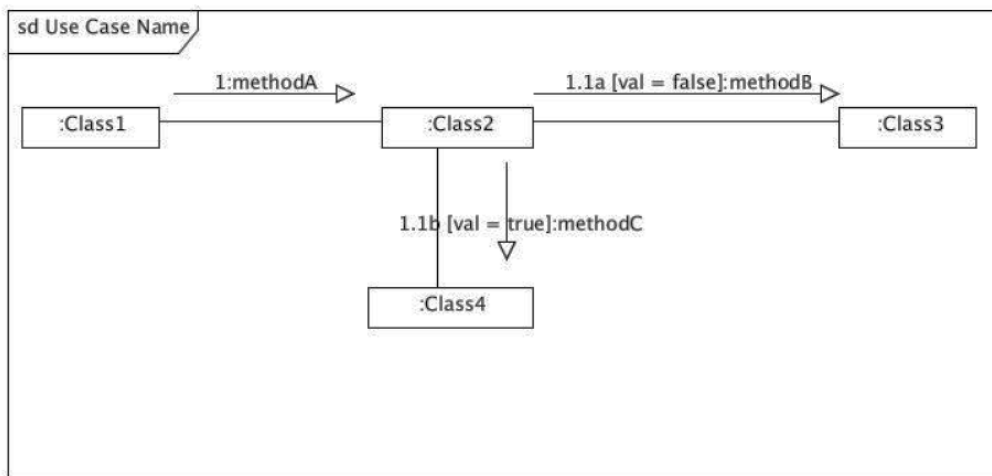
Create a **UML Class Diagram** to model the following:

A simple calculator stores a single value and is capable of the basic arithmetic operations. A student has a single calculator which is used to answer questions asked of the student by a lecturer. The student keeps the calculator. Students and lecturers are both kinds of university people and as such have names and surnames which are known to everybody as well as a password to the campus network which is kept hidden for security reasons.

[10]

**QUESTION 14**

Write a **minimal code example** in any object oriented programming language which implements the following UML Communication Diagram:



[10]

**QUESTION 15**

Create a **UML Deployment Diagram** to model the following:

The InfosSystem follows a typical 3-tier architecture:

- The presentation layer occurs on the client's web-browser and is implemented as a single-page web application which is dynamically updated via Asynchronous JavaScript and XML (AJAX). The only files transmitted to the user are index.html, ui.js and style.css. Everything else is dynamically retrieved via XML Remote Procedure Calls (XML-RPC) and the Document Object Model (DOM) of the website updated directly.
- The application layer is run on a Microsoft Internet Information Services (IIS) server with its core functionality encapsulated within two .NET class libraries namely: BusinessLogic.dll and Reporting.dll
- The data layer consists of an open source Firebird relational database management system with the following two databases: clients.fb and products.fb

[10]

**Section B Total: [50]**

— END OF EXAM —

**Grand Total: [150]**