

University of Cape Town

Department of Information Systems

Test – INF2011

*Instructions to Candidates*

* This test is out of 100 marks and you have three hours. Marks allocated to a question should be used as an indication of level of detail expected in the answer.

1. Please write your name and student number on the question paper and the exam answer books provided.
2. This exam contains two sections. You are required to answer all sections.

* *Answer these questions in the exam books provided. All questions in this section relate to the Dental Clinic case study attached to the back of this question paper.*
* You should use pencil to draw any diagrams. Use pen for other written answers.
* The duration of this test paper includes appropriate reading time

Important

Please ensure that this question paper and answer books are all handed in at the end of this test.

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| Student Name | Student Number |

*Fold the page over on this line and seal with the stickers supplied.*

SECTION A – SYSTEM DESIGN [50 MARKS]

# QUESTION 1: CLASS DESIGN AND PATTERNS (20)

* 1. What kind of relationship or association exists between the following classes?
     1. Patient records and household (2)
     2. Invoices and its various types of invoices (Household and Insurance)? (2)
  2. What is the purpose of GRASP in systems design? (2)
  3. Which of the two classes between *Patient records* and *Household* can be classified as the creator, and the information expert according to GRASP? Motivate your answer (4)
  4. Based on question 2, what is your comment of the following statement? (2)

we can instantiate Household object in the Patient records class

* 1. Design a detailed class diagram depicting the attributes aspect of Invoices and its various types of invoices (Household and Insurance) (8)

# QUESTION 2: SOFTWARE ARCHITECTURE DESIGN (20)

# A software architecture describes the subsystems and components of a software system and the relationships between them. To fully understand and document the subsystems and components of a software systems, designers use different views to show the relevant functional and non-functional properties of a software system.

* 1. What are the different views that designers use to show the relevant functional and non-functional properties of a software system? (5)
  2. Given the following Table:

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| Enterprise Architecture |
| Detailed Design |
| Software Reverse Engineering |
| software architecture |
| System Design |

* + 1. Which of the items in the Table involves the design of user interfaces, interactions, classes, and data storage?
    2. Which of the items in the Table analyzes a software system, either in whole or in part, to extract design and implementation information
    3. Which of the items in the Table involves choosing technologies and frameworks, setting standards, applying patterns?
    4. Which of the items in the Table involves meeting users’ requirements and determining high level structure of system
    5. Which of the items in the Table involves the alignment of IT architecture to Business Strategy and Structure, and IT?

# Architects use architectural models to reason about the system and its ability to deliver the required quality attributes or the non-functional requirements. Identify non-functional requirements that are cultural and political specific which architects need to consider (4)

# Which view would result in the output in Figure 1 and 2 motivate your answer? (6)

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**QUESTION 3: REPORTING AND CONTROL (10)**

# Sometimes, dentists like to see a list of the procedures they performed during a week or month, and they can request that report. Design a report as per specification’s in the case study (7)

# How should management regulate the distribution and use of printed reports? (3)

**SECTION B – IMPLEMENTATION [30 MARKS]**

*Answer these questions in the exam books provided. All questions in this section relate to the Quality Building Supply case study attached to the back of this question paper.*

# Question 1: [5 Marks]

You can assume that both a patient and a dental staff member are also of type Person.

Patients belonging to one household may be of different types. For example, there could be the *head*, the person that would receive the dedicated invoices. In addition to this, there would be the *spouse*, who would have specific rights regarding the medical scheme and the *child* dependents or sometimes there also could be an “*other*” type.

In the case of dental staff, types like *dentist*, *hygienist, xraytech* technician or *orthotech* ortodontic technicians may exist.

For sophisticated coding practices, enumeration could be used to define these types listed above.

1.1 Provide enum types for the dental staff class. (2)

1.2 Provide the statements that will give an array of strings to represent the dental staff types. (2)

1.3 Enumeration can be used to implement and exhibit the principal of \_\_ \_\_in object oriented programming, (1)

# Question 2: [7 Marks]

In the Dental Clinic system you can assume that all the patients are grouped per household for easy access as specialised invoices are only created for the head of each household. The Dental Clinic has several households for whom data is kept. Each object of type *Household* has a *collection of patients*, called *patients*. Each item in the patient collection will be of type *Patient* and will belong to that particular household. You can assume that a *PatientController* class exist that will manage all the information per household and thus also the information of all patients. A PatientController class will thus have a collection of Households.

Write a *GetAllPatients* method that will run through every item in the collection of households. For every Household in this collection the method will add the patients one by one to a single patient collection ClinicPatients. This collection will just contain all the patients irrespective of the household they are in. These patients can become the datasource of a listview control, listing all the patients of the clinic.

# Question 3: [3 Marks]

Write a default constructor for the *Patient* class that will set the patient type variable to the enum value head. It will also call a method *CalculateID* that will calculate and return an *patientID* for that particular patient. You can assume that the *CalculateID* method exists and is working correctly.

# Question 4: [7 Marks]

Write a look-up method for the *HouseHold* class to find and return a particular patient in that household given the *patientID* of that particular *Patient* object.

# Question 5: [4 Marks]

Assume that you as the developer, needs to design the interface or screen to capture a specific procedure for a patient during a visit to the clinic. For ease of use, you would like the user to rather select values from a dropdown box than typing the text on the screen.

5.1 Use the array of string given in question 1.2 and write a statement that will populate a combobox with the different types (categories) a dental staff member can take, by assigning the array to the datasource property of the combobox. (1)

5.2 Assume that a method, *FindDentalStaff*, to find all dental staff of a specific type, already exists. This method belongs to the *ClinicController* class that manages all dental staff. The method needs the dental staff type as a parameter and will return a collection of all dental staff members of that type. Use the *FindDentalStaff* method and give a statement that will assign the collection of dental staff members to each item in the item collection of the combobox. (3)

# Question 6: [4 Marks]

Patients often do not turn up for their appointments. When a patient makes an appointment well in advance, an appointment date is set. A week before the patient’s appointment, the system will automatically send a reminder to the particular patient as a reminder.

Assume a delegate function statement, *AppointmentEventHandler* to the Patient class exist:

*public delegate void* AppointmentEventHandler *(Patient sender);*

6.1 Declare an event, *AppointmentAlert* for this Eventhandler in the Patient class (publisher) (1)

6.2 Define a method for the *Patient* class, *CheckAppointmentDate* that will find the difference between the appointment date and today’s date. If the number of days is less or equal to 7 the virtual event method *OnCheckAppointmentDate* will be called where the event will be raised. (3)

You can assume that a function *int DaysBetween(DateTime date1, DateTime date2)* exist that can be called to return the number of days between date1 and date2. In this case date2 will be the appointment date and date1 today’s date (*DateTime.Today*)

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| Dental Clinic Case Study |

A clinic with three dentists and several dental hygienists needs a system to help administer patient records.

Each patient has a record with his or her name, date of birth, gender, date of first visit, and date of last visit. Patient records are grouped together under a household. A household has attributes such as name of head of household, address, and telephone number. Each household is also associated with an insurance carrier record. The insurance carrier record contains name of insurance company, address, billing contact person, and telephone number.

In the clinic, each dental staff person also has a record that tracks who works with a patient (dentist, dental hygienists, x-ray technicians). Because the system focuses on patient administration records, only minimal information is kept about each dental staff person, such as name, address, and telephone number. Information is maintained about each office visit, such as date, insurance copay amount (amount paid by the patient), paid code, and amount actually paid. Each visit is for a single patient, but, of course, a patient will have many office visits in the system. During each visit, more than one dental staff person may be involved in doing a procedure. For example, the x-ray technician, dentist, and dental hygienist may all be involved in a single visit. In fact, some dentists are specialists in such things as crown work, and even multiple dentists may be involved with a patient. For each *staff person* *does procedure in a visit* combination (many-to-many relationship), detailed information is kept about the procedure. This information includes the type of procedure, a description, the tooth involved, the copay amount, the total charge, the amount paid, and the amount the insurance company denied.

Finally, the system keeps track of invoices. There are two types of invoices: invoices to insurance companies and invoices to heads of household. Both types of invoices are fairly similar, listing each visit, the procedures involved, the patient copay amount, and the total due. Obviously, the totals for the insurance company are different from the patient amounts owed. Even though an invoice is a report (when printed), it also maintains some information such as date sent, total amount, amount already paid, amount due, and the total received, date received, and total denied (insurance companies do not always pay all they are billed).

The receptionist keeps track of the patient and head-of household information, and will enter this information in the system. The receptionist will also keep track of office visits by the patients. Patient information is also entered and maintained by the office business manager. In addition, the business manager maintains the information about the dental staff.

The business manager also prints the invoices. Patient invoices are printed monthly and sent to the head of household. Insurance invoices are printed weekly. When the invoices are printed, the business manager double checks a few invoices against information in the system to make sure it is being aggregated correctly. She also enters the payment information when it is received. Dental staffs are responsible for entering information about the dental procedures they perform. The business manager also prints an overdue invoice report that shows heads of household who are behind on their payment. Sometimes, dentists like to see a list of the procedures they performed during a week or month, and they can request that report.