Please answer any TWO questions from the FOUR Questions provided

Use a SEPARATE answerbook for each SECTION.

This is a CLOSED book examination

The use of electronic calculators is NOT permitted
Section A

1. a) What are the characteristics of an agile process and model-driven software engineering that means that a model-driven approach can be used as an agile technology? [3 marks]

b) In model-driven software engineering, the phrase “everything is a model” is often used. Explain why this can be considered to be true. [3 marks]

c) Outline the four-levels of modelling defined by the OMG and compare the role of each level. With justification, indicate at which of these four-levels of modelling Platform Independent Models (PIMs) and Platform Specific Models (PSMs) occur? [4 mark]

d) The PIM meta-model below allows the definition of the domain model aspect of an application. Outline the two meta-models that would be required to support a Java bean PSM and relational database PSM version of this. [4 marks]

package domain {
    class Entity {
        property features : Feature[*];
    }
    abstract class Feature {
        attribute name : String;
    }
    class Attribute extends Feature {
        property type : DataType;
    }
    class Association extends Feature {
        property type : Entity;
    }
    class DataType {
        attribute name : String;
    }
}

e) Compare and contrast the transformations that would translate a domain PIM (conforming to the PIM meta-model in part d) into a Java Bean PSM or a relational database PSM that conform to the meta models that you outlined in part d. Your answer only needs to discuss the transformations and additional information that needs to be added, you are not required to show the transformations in any model-to-model (m2m) language. [6 marks]
2. a) In a model-driven approach, an input model is often captured using a Domain Specific Language (DSL). This will capture one or more of the following aspects of an application: domain model, flow-of-control, algorithm and user interface.

i) Describe by using examples, why a general purpose modelling language like UML is not used? [2 marks]

ii) For the user interface (UI) aspect of an application, what are the main elements that a model must be able to capture? [3 marks]

iii) A model can be captured using either a textual or graphical syntax, discusses the advantages and disadvantages of each and outline the circumstances under which you would recommend each. [5 marks]

b) Model-to-text (m2t) transformations are the final stage of generating implementations from models and are based on control structures, templates (design patterns) and placeholders.

i) State the main capabilities that the control elements of this must possess and compare and contrast how two different model-2-text (m2t) systems provide these. [6 marks]

ii) Outline with reasons, the abstraction-level relationship that exists between the input model and the templates. [2 marks]

iii) For the MOFscript template below show what is output when applied to the following input model. [2 marks]

**MOFScript:**

```plaintext
ddl.Database::main() {
    'CREATE DATABASE ' self.name
    self.tables->forEach(table) { table.output() }
}
ddl.Table::output() {
    'CREATE TABLE ' self.name '('
    self.elements->forEach(column:ddl.Column) between(',',) {
        column.output()
    }
    ')'
} Ddl.Column::output() { self.name ' ' self.type }
```

**Input model:**

```xml
<ddl>
    <Database name="xxx">
        <Table name="yyy">
            <Column name="zzzz" type="abc"/>
            <Column name="zzz" type="def"/>
        </Table>
    </Database>
</ddl>```

[PTO]
Section B

3. a) In each of the following scenarios, an agile team is breaking one of the four values from the Agile Manifesto. For each scenario, state which value is being disregarded and give a brief justification of your answer. (The text of the Agile Manifesto is given in Appendix A, for you to reference.)

i) A co-located team of 5 developers and 1 customer representative has been created to deliver a small but important addition to the customer organisation’s website. One of the developers recommends his preferred story management software. None of the other team members have used this tool before, so he proceeds to run several half-day training sessions on how to use it. During these training sessions, the customer representative catches up on e-mail and phone calls unconnected with the project.

ii) A member of a busy sales team is seconded to work with an agile team developing software for the sales staff. She works with the agile team for 2 days every week. Her absence is putting pressure on her sales team colleagues, and so she is keen to let them know that she is working hard for them while with the agile team. Because of this, she spends a part of each day with the developers writing a report on the decisions made and the achievements of each day, to show to her sales colleagues.

iii) An agile team is impressing its client by delivering useful software to a reliable release schedule. Half way through the current release, the client organisation receives news that it has won a very lucrative contract, for which it will require some additional functionality to be added to software the team is building. Rather than abandon the work they have done in the current release, in the customer’s absence, the team decides to finish the current release (requiring 3 more 1 week iterations) and then to start to look at how the new functionality can be brought in. [6 marks]
3) (Continued from previous page)

b) For each of the following, state whether it is or is not an acceptable way of writing this user story, according to common agile practice. Briefly justify your answer in each case.

i) In order to encourage more people to browse the catalogue, as a marketing campaign planner, I want to select which current discounts should be advertised prominently in our home page.

ii) Select which current discounts should be displayed prominently on the home page.

iii) As a marketing campaign planner, I want to select which current discounts should be displayed prominently on our home page.

iv) Fred, a marketing campaign planner, chooses the “20% off for orders over £100” discount on electronic goods, to be displayed at the top of the time-limited discounts area on the home page.

[2 marks]

c) An agile team has selected the following stories for its next release and has placed them in priority order (most important first, least important last):

i) Display selected discounts in a prominent area of the home page
ii) Cancel a discount
iii) Make changes to an existing discount
iv) Add a new discount
v) Remove a discount from display on the home page
vi) Select a discount for display in a prominent area of the home page

Roles have been omitted since all these stories relate to the role of marketing campaign planner. Business values have also been intentionally omitted, since this question is asking to you think about the business values for yourself.

Provide a rationale for this particular ordering of the stories, based on the business value that each might provide. For example, why has the customer decided that it is more important to be able to cancel (i.e., delete) discounts from the system than to be able to add new discounts? What are the negative consequences for the business of being able to do the latter but not the former?

Your answer should account for the relative position of all of the stories in this release plan. [6 marks]
3) (Continued from previous page)

d) Explain briefly what would be involved technically in implementing the stories from part c) in the order given. For example, amongst other questions, your answer should explain how we can write, test and (potentially deploy for use) code to display discounts on the home page, before you have written the code to create the discounts and to select them for display. [4 marks]

e) Write business values for any two of the stories from part c) of this question, apart from i) and vi). The business values you give should be consistent with your answer to part c).

[2 marks]
4. a) For each of the following lines of Java code, state whether it is production code, or test code, or whether it could be either.

i)  `assertEquals(0.0, distance, 1e-15);`

ii) `public String getName() { return this.appName; }`

iii) `Customer cust1 = new Customer("123456789", "Fred", "Smith", "22", "M1 1AA");`

iv) `double distance = 1 - ngram.match(s.toString(), t.toString());`

[2 marks]

b) The following actions all relate to the development of a suite of automated unit tests for some system. For each action, say whether the developer performing it is using a test-driven development style (TDD), a test-first development style (TFD) or a traditional style in which tests cases are written after the code they test has been implemented (TAD, for "test after development").

i) The developer uses the conditions of if-statements and loops in the method under test to design a set of contrasting unit tests for the method.

ii) The developer runs the test suite to decide whether to write some production code or some test code next.

iii) The developer is responsible for implementing a particular class from scratch. She starts by writing five test cases to help her understand the key parts of the class’s interface.

iv) The developer implements a method with a single statement:

```
return 0;
```

checks that the implemented tests now pass, and checks the code into the team’s repository.

[4 marks]
c) Design an acceptance test table for the following story, and populate it with four rows describing four contrasting acceptance tests:

As a special circumstances board member, I want to calculate the total mark for an individual student on a particular course unit, so that I can make better decisions about what compensation actions should be taken in respect of that student.

On the back of the index card bearing this story, the following notes have been written:

- Total mark is sum of weighted coursework mark and weighted exam mark.
- All coursework, exam and total marks must be given as percentages.
- Each course unit can choose its own weighting for each component (weights must add to 100).
- The student can be resitting any or all of the components. In this case, the maximum mark that can be counted for a resit component is 40. E.g. if mark for coursework is 55, then only count as 40 if resit.

Take care to indicate clearly which of your columns are inputs and which are outputs.

Note: this test can be encoded without a fixture table. However, marks will not be deducted for including a fixture table, provided the meaning of the tables taken together is correct. [6 marks]

d) Write a JUnit test case (or, for almost full marks, a close pseudocode equivalent) for any one of the examples given in your answer to question c), from which you can elicit some of the classes and methods needed to implement this application in a test-first manner. (Note: you should not give the implementation of any of the application classes/methods in your answer – you should write the test case referring to them as though they have already been implemented, and you are using them like an API. Candidates will not be penalised for minor syntactic errors in Java code.) [4 marks]
4) (Continued from previous page)

e) You are a member of an agile team who is contracting for work from a client organisation you have not worked for before. At present, your team’s is the leading bid for the work, but there is one stumbling block. The client insists that the majority of the testing work on the project be carried out by an independent test group, employed by them from another favoured contractor, and is unwilling to resource your team for this part of the work.

State the problems that the client’s insistence on this approach to testing will cause for your team. Suggest a compromise position that might keep the client happy, while allowing your team to function according to its usual testing practices.

Make clear any assumptions you make about your team (e.g., methodology used, agile practices used) or the client (e.g., awareness of agile practices, mission criticality of software to be built), in your answer.

[4 marks]
APPENDIX A: The Agile Manifesto

This appendix contains the text of the Agile Manifesto (agilemanifesto.org), for reference when answering question 3, part a).

The Agile Manifesto (2001)

“We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

1. Individuals and interactions over processes and tools.
2. Working software over comprehensive documentation.
3. Customer collaboration over contract negotiation.
4. Responding to change over following a plan.

That is, while there is value in the items on the right, we value the items on the left more.

END OF EXAMINATION