National University of Computer and Emerging Sciences
Islamabad Campus

Part A

Question 1   **[25 marks]**

Read the description below and do an architectural design:
Software for Conference Refereeing

Professional conferences are held in order to announce and discuss new results. The core activity of organizing a conference focuses on selecting the papers to be presented. Usually this is done by making an open invitation calling for papers to be submitted, circulating the submitted papers to a (geographically distributed) panel of reviewers, then selecting the best papers to appear on the conference program. A system to automate conference refereeing should do the following:

• The program committee announces "call for papers" by entering necessary conference information into the system. The program committee can add email addresses of potential authors or addresses from various mailing-lists into the system.

• Potential authors receive the call for papers by email from the system and decide to submit papers on their work. They write papers, and submit them using the system, where they add needed information as well as upload a PDF file of the paper. A given paper may have several authors, but there is only one corresponding author with one reply address. A notification is sent to the author after a successful submission has been made.

• The program committee consisting of several reviewers goes through a bidding process where they bid on the paper they want to review, and mark the papers they cannot review due to conflicts of interest. • The system will then distribute the papers among the reviewers in the program committee.

• The reviewers will review the papers and enter their comments and score for each paper into the system.

• The system will rank the papers according to their scores and give the program committee an opportunity to mark the papers that will be accepted.

• When the program committee has decided on the accepted/rejected papers, they can through the system notify all the authors of the papers whether the papers got accepted or rejected.

The Conference Refereeing system can be accessed through a web-browser on PCs, tablets or smart phones. The users can also access the system using an app for tablets and smart phones. Typical customers of the system will be organizers of business conferences, research conferences and military conferences. For the latter, it is important that the papers submitted to the conference that can contain classified information should not be accessible for people outside military organizations.

    a) Which architectural patterns/styles would be useful in this situation and provide the rationale why you have selected this pattern. [3]

        MVC - we may many concepts/classes, managerial classes. Managerial classes will be added into controller component and basic classes will be added into Model.

    b) Name the components of the system you would associate with each part of the chosen architectural patterns/styles? [8]
        Refer to Answer of part d below

    c) Draw the activity diagram of review process for Software for Conference Refereeing.[7]
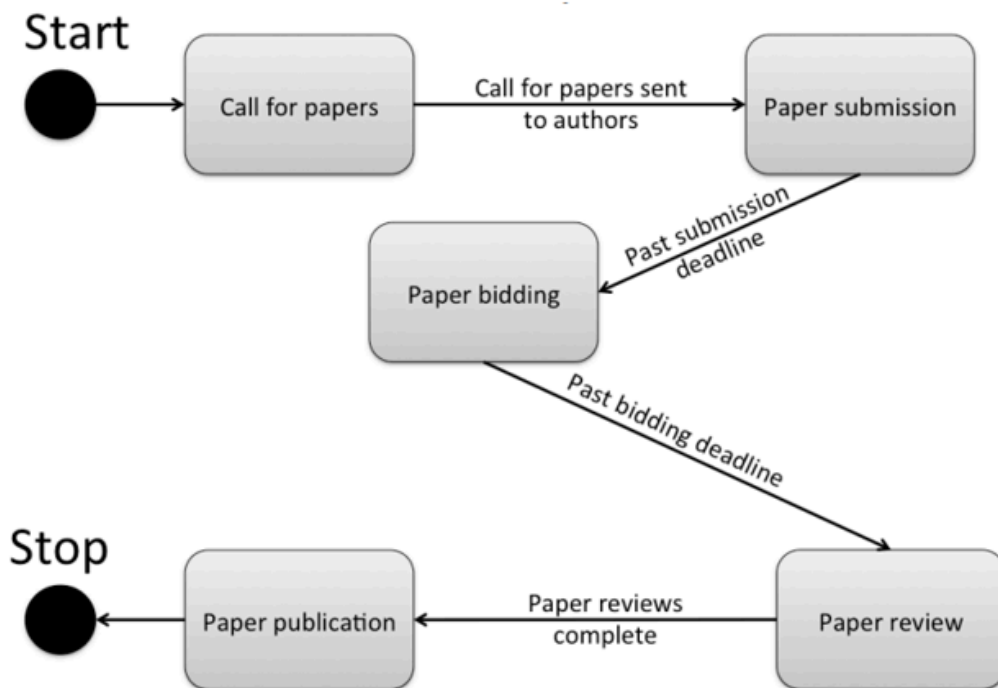
d) Draw a diagram that describes your system architecture.[7]
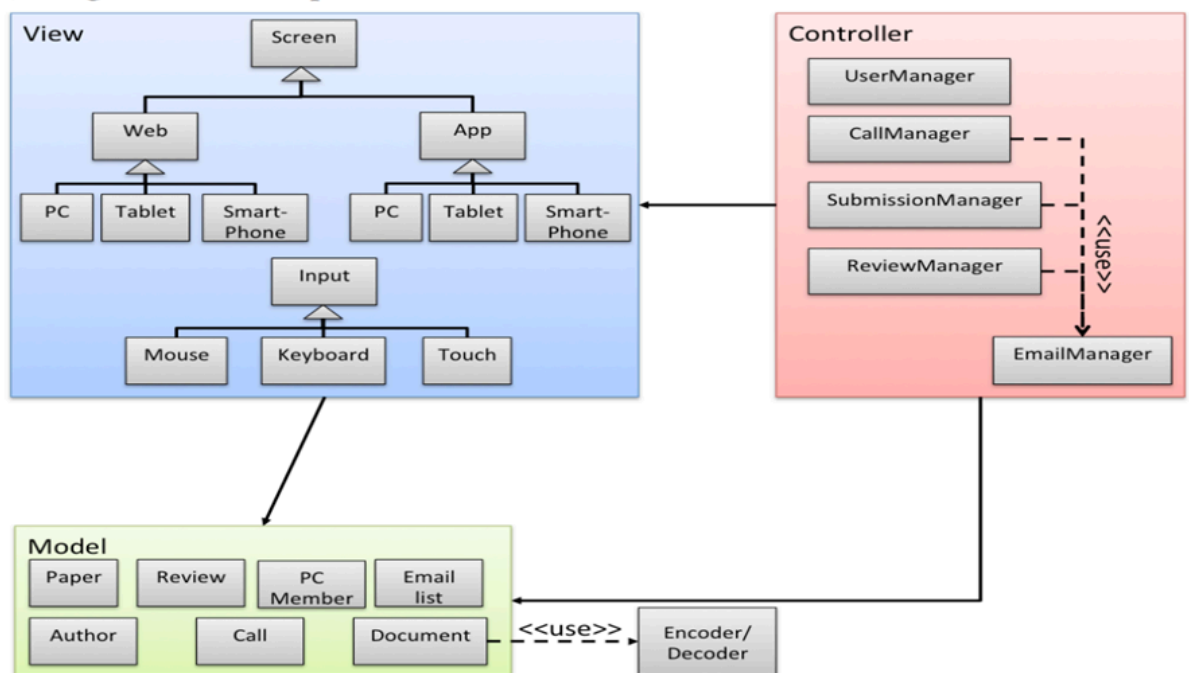
Question 2   [15 marks]

Read the following statements. Identify the single most specific or appropriate corresponding concept from the answer options. (Each statement does have exactly one corresponding answer.) Each option can be used more than once. [15 Marks]

Answer Bank

Maintainability	Spiral Development	Ethnography
Waterfall Development	Stakeholders	Regression Testing
Milestone	Requirement Validation	Requirement Elicitation
Software Metric	Xtreme Programming	Productivity
Unit Testing	Effort Estimation	Rapid Application Development
Scrum	Integration Testing	Iterative and incremental Development
Risk	Spiral Development	

Statements:

1. The database company Debacle has decided to adopt a process where they deliver prototypes every three months. Each prototype phase, they gather any changing requirements, identify risks and build mitigation plan, design and implement software that meet these new requirements, and deliver the next prototype.

2. The manager of the Sprightly Software Company decides to plan effort in two-week sprints, with daily stand-up meetings.

3. Meimei is the new manager of a mobile app development team and has decided to apply a different process for managing effort. They will first gather requirements from customers, then design and implement the app. Only after all of the app is developed, will they test functionality.

4. Visual Studio embeds a numerical computation for approximating the complexity of code

5. Your teammate, Walter Melon, never documents any of their code. When your new intern joins during the summer, you have to spend several hours with the intern walking through and explaining the code. If only Mr. Melon had considered _____ aspect of software and code, he could add comments and document the basic business logic for future use of code.

6. Taki is writing Virtual Reality software for Mitsuha. They agree upon a set of measurable outcomes for the software that will be delivered at the end of each year in their three-year contract.

7. The Fast University is considering revamping Flex access, representatives from human resources, academics, accounts, examination professors, and students are all gathered to provide input.

8. In practice, adding more people to a late project tends to make it later, informing our ability to plan with respect to this concept.

9. A pacemaker software that allowed attackers to kill patients by wirelessly disabling pacemakers. A company responsible for such software can considering adopting various processes to help account for this aspect of project delivery.

10. For each function Elliot has written, they have also written test cases to ensure each individual function works as intended.

11. After making major changes to the code base, Herman notices that previous issues that they had resolved are showing up again. They resolve these issues and add tests such that, in the future, these issues will not arise again without alerting the developer.

12. Hodaka is writing a weather prediction app that contains a web-based front-end, a payment system, and a back end for storing user data. He has written many tests for each individual component. However, the app fails when all the components are brought together. If only Hodaka had listened to his boss, Hina, and used this to validate the whole app.

13. Management asks developers to predict how long it will take to localize and fix the defect.

14. The team manager decided to have on site customer during the software development phase.

15. *A customer decides to have a software company representative onsite to comprehend and record their operations.*

Solution

1. Spiral Development

2. Scrum

3. WaterFall Development

4. Software Metric

5. Maintainability

6. Milestone

7. Stakeholders

8. Productivity

9. Risk

10. Unit Testing

11. Regression Testing

12. Integration Testing

13. Effort Estimation

14. Xtreme Programming

15. Ethnography

Question 3   **[20 marks]**

Read the Health portal in vacation resort case study carefully to answer part a, b, and c.
Health portal The Piedmont region is the public health provider for citizens living in the region. To improve the health services the region has developed a web portal, accessible via PC and Smartphone, to deliver a number of services both to citizens, analysis labs, and general practitioners. A citizen, to access any medical service from the public system, must first select a general practitioner. A general practitioner issues analysis requests, medicine requests, and so on. A citizen selects an analysis lab to perform an analysis, as requested by the general practitioner. To access any service an end user has to authenticate first. Authentication is performed via SPID, the authentication service for Italy. In principle, every Italian citizen should obtain a digital identity provided by SPID. This identity is used to access any service offered by the public administration. The service and the SPID interact to provide the authentication. A citizen accesses a service, the service redirects to the SPID, the citizen sends to the SPID service its social security number and password, receives an OTP (one time password) via SMS on her cellphone, introduces the OTP. If all is correct the user is authenticated and sent back to the service for a one session interaction. In this case the service is health portal for a session.

The portal can be used by a citizen to
· Upload health documents. A health document in pdf format can be of several types (ex lab analysis result, lab analysis request, medical report etc), has an issue date and a doctor who signs it.
· Browse or search health documents
· Open, read, download a health document
· Browse through available general practitioners, select a general practitioner
· Browse through available lab analysis, send a lab analysis request to the selected lab

In its turn a general practitioner can use the portal to
· Browse the list of citizens she takes care of
· Select a citizen
· Browse, select, read, download a health document belonging to the citizen
· Upload a lab analysis request for the citizen
· Finally, an analysis lab can use the portal to send the resulting lab analysis result to the concerned citizen

a. **Identify Stakeholders and draw a context-level diagram for Health Portal [4]**
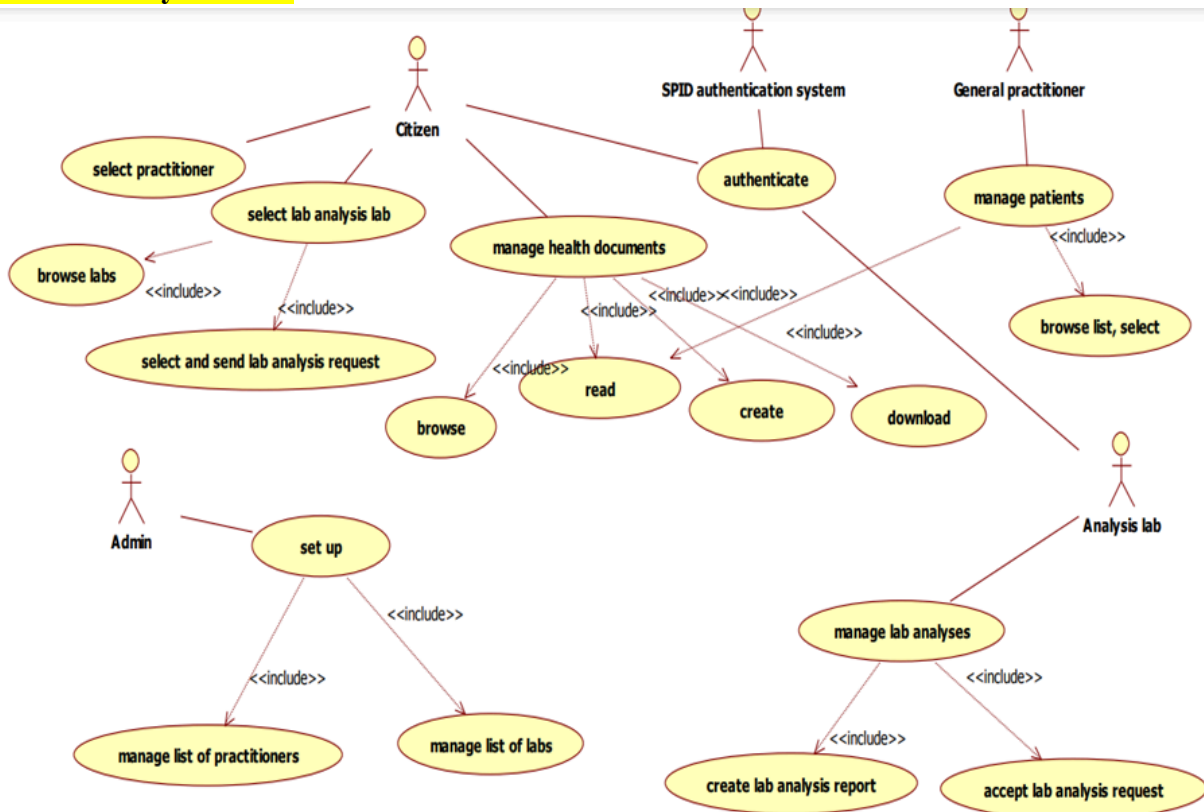   Stakeholders = +2
    Diagram = +2
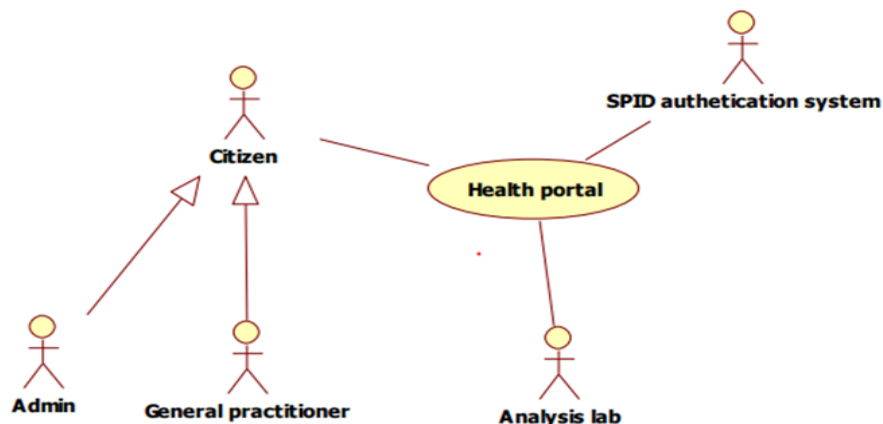
b. **List 4 functional requirements that you deem important for the application using natural language specification.[8]**

Below is set of Usecases- Functional requirements can be formulated from these usecases.
Rubrics:
FR should be written in Shall format and FR should be from below usecases:
WithOut shall keyword: -1

c. **List 4 non-functional requirements that you deem important for the application using natural language specification keeping in mind all the guidelines regarding NFRs. [8]**

Privacy: The data of Healthcare portal shall be secured using Advanced Encryption Standard (AES).
Efficiency: Response time of all functions shall be less than 5 seconds.
Usability: All users shall be able to use the system in less than 30 mins without training.
Interoperability: Health portal shall be accessible to notebooks, desktops, smartphones.

Rubrics:
1. NFR must be Verifiable using Metric.
2. Shall Statement
3. Belongs to NFRs.

Part B

Question 1   **[25 Marks]**

Fast UNIVERSITY wants to create a new student portal in which they are mainly focused on providing functionalities similar to FLEX. The system should contain basic functionalities for the content management system. After initial analysis, it is determined that the system will have five External inputs with one having Average complexity, one with high complexity, and the other three having low complexity. There will be six external outputs from which five have low complexity while the remaining have high complexity.

Students will be able to carry out a total of six external inquiries of which five have low complexity and one has high complexity. As the system interacts with HEC's system for verification of degree and student information, there is one high complexity External interface file. Also, the system will have four internal logical files with one having low complexity, two have average complexity, and one with high complexity.

Data communication and Online data entry have an average influence on the system while.
the transaction rate and performance have a strong influence. There are no other Influential factors.

Based on the above information provided, calculate the
1. **Unadjusted Functional Point (UFP)**

							Total
ILF	Low	1	x	7	7		42
	Average	2	x	10	20		
	High	1	x	15	15		
EIF	Low	0	x	5	0		10
	Average	0	x	7	0		
	High	1	x	10	10		
EI	Low	3	x	3	9		19
	Average	1	x	4	4		
	High	1	x	6	6		
EO	Low	5	x	4	20		27
	Average	0	x	5	0		
	High	1	x	7	7		
EQ	Low	5	x	3	15		21
	Average	0	x	4	0		
	High	1	x	6	6		
						UFP	119

2. **Total Degree of influence (TDI)**

14 or 16

3. **Value adjustment factor (VAF)**
     0.79 or 0.81

4. **Functional Point (FP)**
     94.01 or 96.39

5. **Let's assume that an organization covers an average of the 18-function points per month. How much man months (time) is required to complete this project? (Please round off the result e.g. 9.9 ≈ 10)**
     (5.22 or 5.335) 6 months

6. **If the average programmer is paid $5200 per month, what will be the total labor cost (Labor cost = time x cost per month)**
     31200

Question 2   **[40 Marks]**

You have to find the critical path using either PDM or ADM method.

For PDM:
You must demonstrate the proper steps for calculating ES, EF, LS, and LF. You can assume the starting time of independent activities to be zero. Redraw the table below on your answer sheet and fill it; otherwise, no marks will be awarded.

For ADM:
Show complete working by showing forward pass, backward pass, critical path and total duration require for the project.
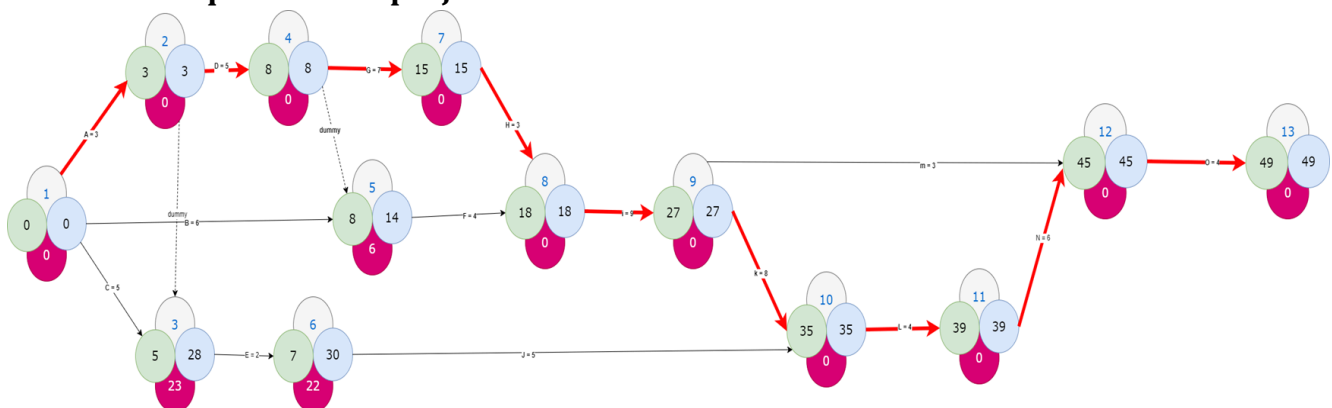
Critical path : A-D-G-H-I-K-L-N-O

No	Activity	Duration	Precedence	ES	EF	LS	LF
1	A	3	None	0	3	0	3
2	B	6	None	0	6	8	14
3	C	2	None	0	2	26	28
4	D	5	A	3	8	3	8
5	E	2	A,C	3	5	28	30
6	F	4	B,D	6	10	14	18
7	G	7	D	8	15	8	15
8	H	3	G	15	18	15	18
9	I	9	F,H	18	27	18	27

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10	J	5	E	5	10	30	35
11	K	8	I	27	35	27	35
12	L	4	J,K	35	39	35	39
13	M	3	I	27	30	42	45
14	N	6	L	39	45	39	45
15	O	4	M,N	45	49	45	49

Part C
NOTE: If not attempted on answer sheet, it is ,marked zero

Question 1: [5 marks]

For all of the following parts, write clear question number, part number and correct answer with reasoning. All answers without reasoning will be marked zero.

i. *Read the following description. "Customers of the garage can buy cars. Customers with a bad credit should pay an extra down payment". Which of the following diagrams represent this description?*
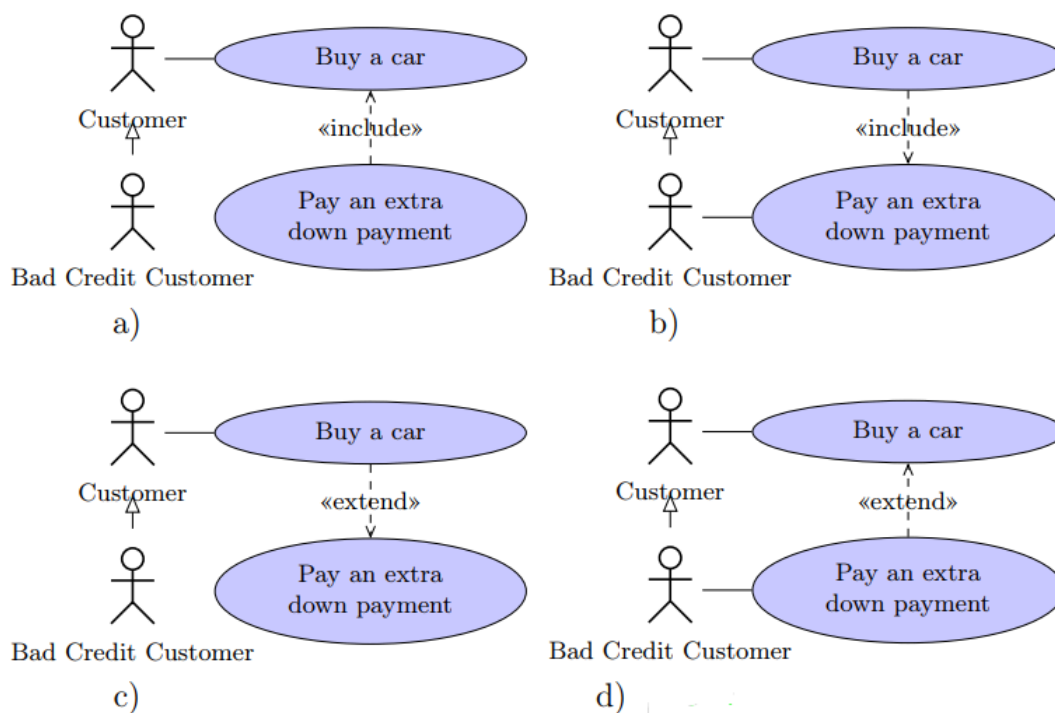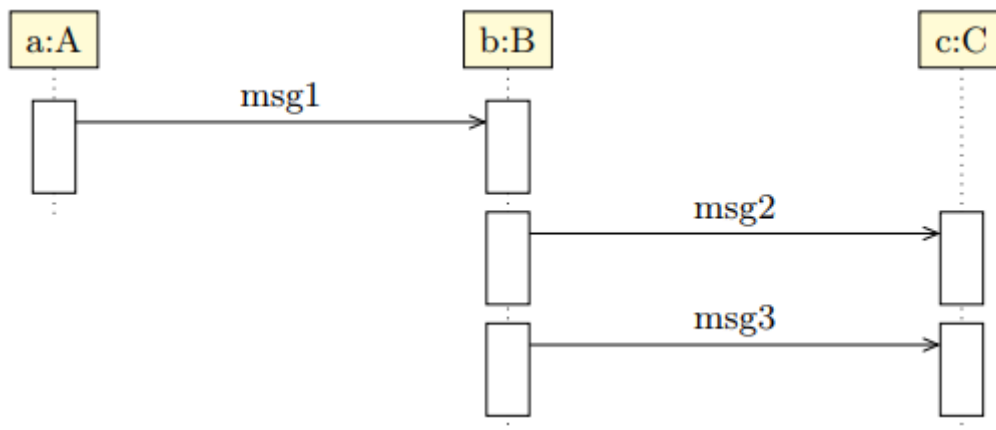

Answer D - without reason 1 mark else 2.5

ii. *Consider the following sequence diagram. Which of the following statement(s) are correct? (Multiple statements can be correct)*

a) Message msg1 is a synchronous message.
b) Message msg2 is received before msg3 has been sent.
c) Message msg2 is sent after msg1 has been received.
d) All statements are incorrect.

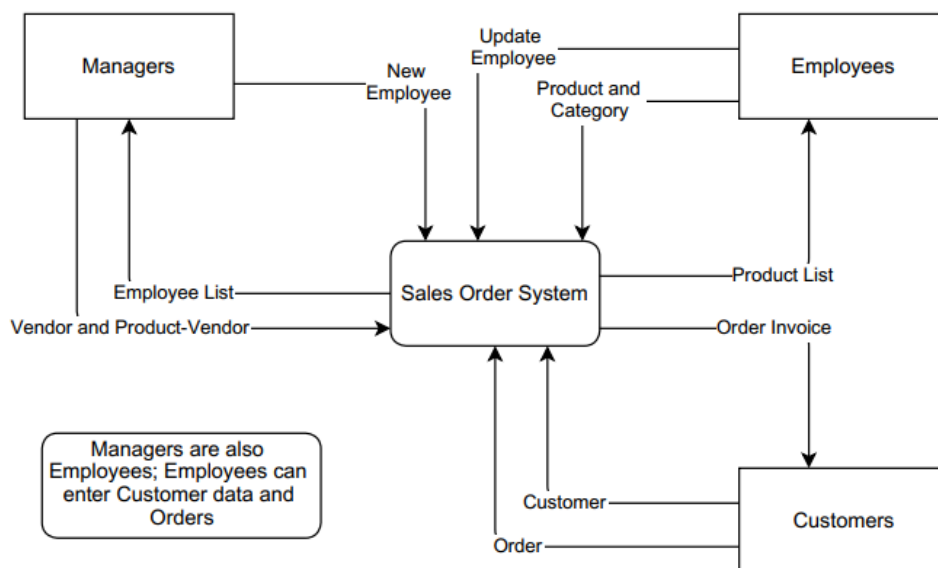Answer C - without reason 1 mark else 2.5

Question 2: **[30 marks]**

For all of the following parts, write clear question number, part number and correct answer with reasoning. All answers without reasoning will be marked zero.

i. *Consider the following context diagram:* **Please answer if the provided statement is correct or incorrect along with reasoning. 8 marks**

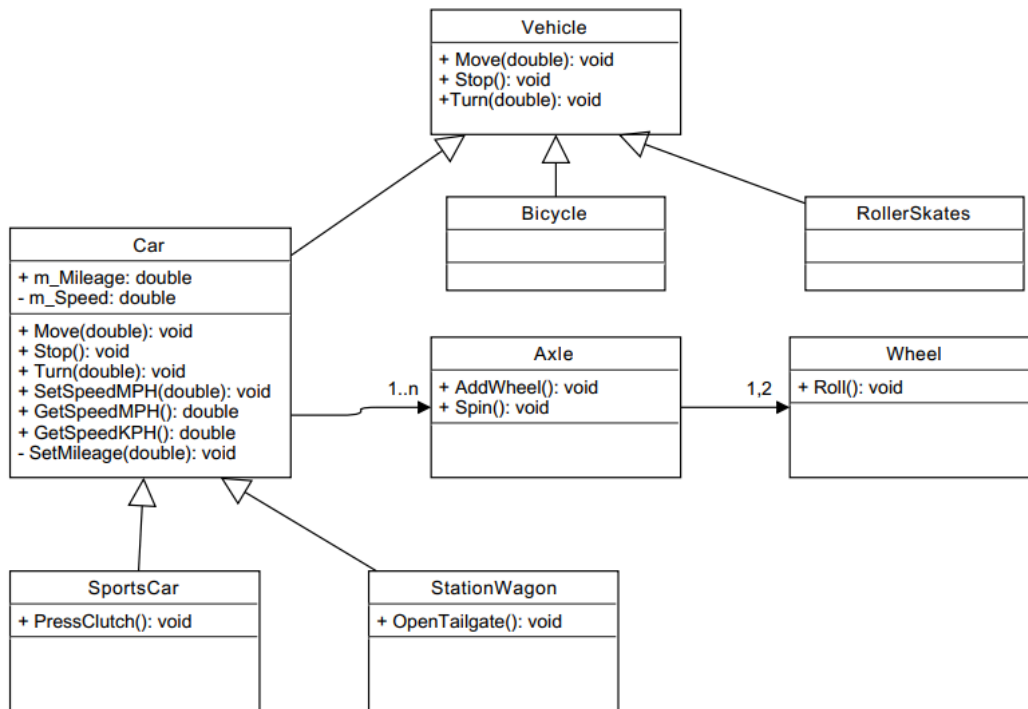| *Statement No.*	*Statement*

A	The context diagram is incomplete since it does not show where the data reside and how they flow. **Wrong**
B	The context diagram is incomplete because it is missing the cardinalities. **Wrong**
C	The context diagram is at the right level of detail, such that all the stakeholders can understand it. **True**
D	The managers, employees and customers can also be modelled using other symbols, other than boxes. **True**

true / false with no reasoning = 0 marks

ii. *Consider the following class diagram:* **Please answer if the provided statement is correct or incorrect along with reasoning.** *(4 marks)*

Statement No.	Statement
True	The class Vehicle does not contain any attributes.
False	The diagram contains a mistake: the direction of the five arrows with empty arrowheads pointing at Vehicle and Car should be reverse.
False	The objects of class StationWagon do not have any attributes.
False	SportsCar has a method called AddWheel().

true / false with no reasoning = 0 marks

iii. *Consider an online shop for books. Check if the following statements express functional or nonfunctional requirements. (5 marks).*
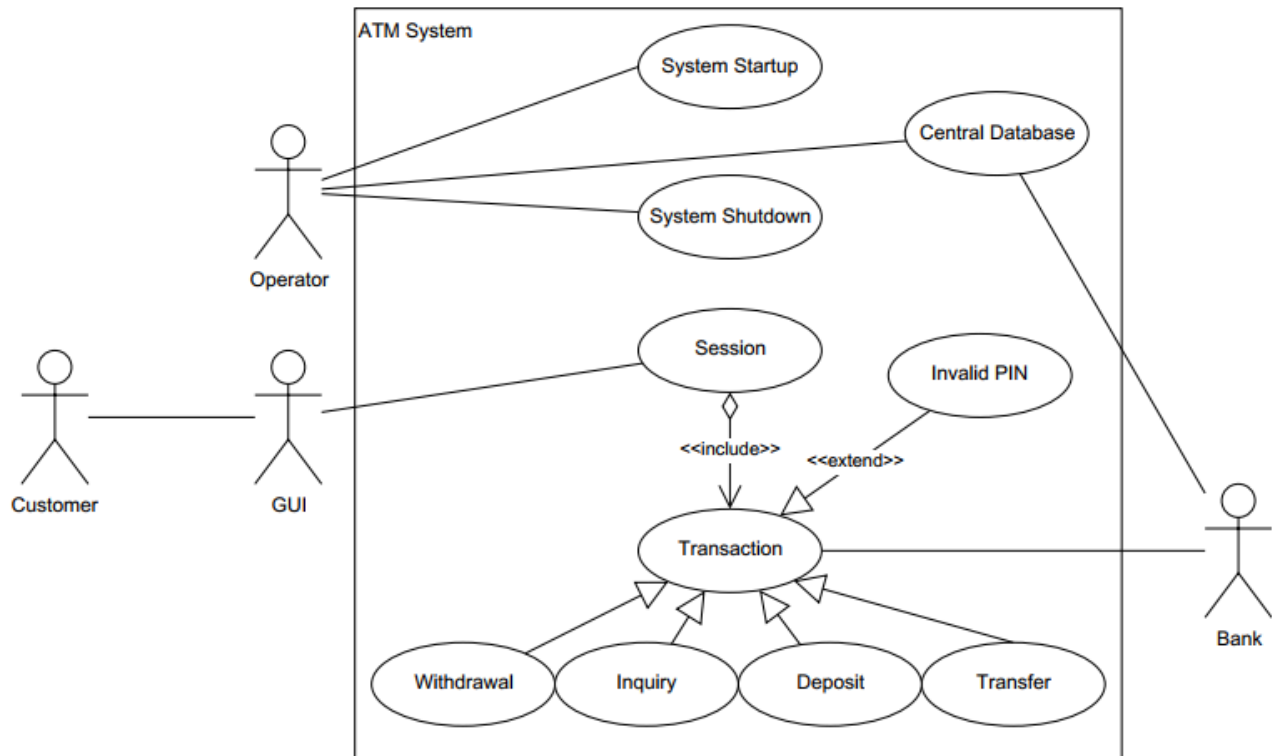
Statement No.	Statement
NFR	The system shall be available in English, German and French.
FR	The system shall allow the user to search for books by author and title.
FR	The system shall provide a list of all previously ordered books to the user.
NFR	The system shall support minimum 1000 transactions per hour.
NFR	The system shall be available to all users 24/7.

correct answer 1 else zero

iv. *Consider the following use case diagram.* **Please answer if the provided statement is correct or incorrect along with reasoning.** *(5 marks)*
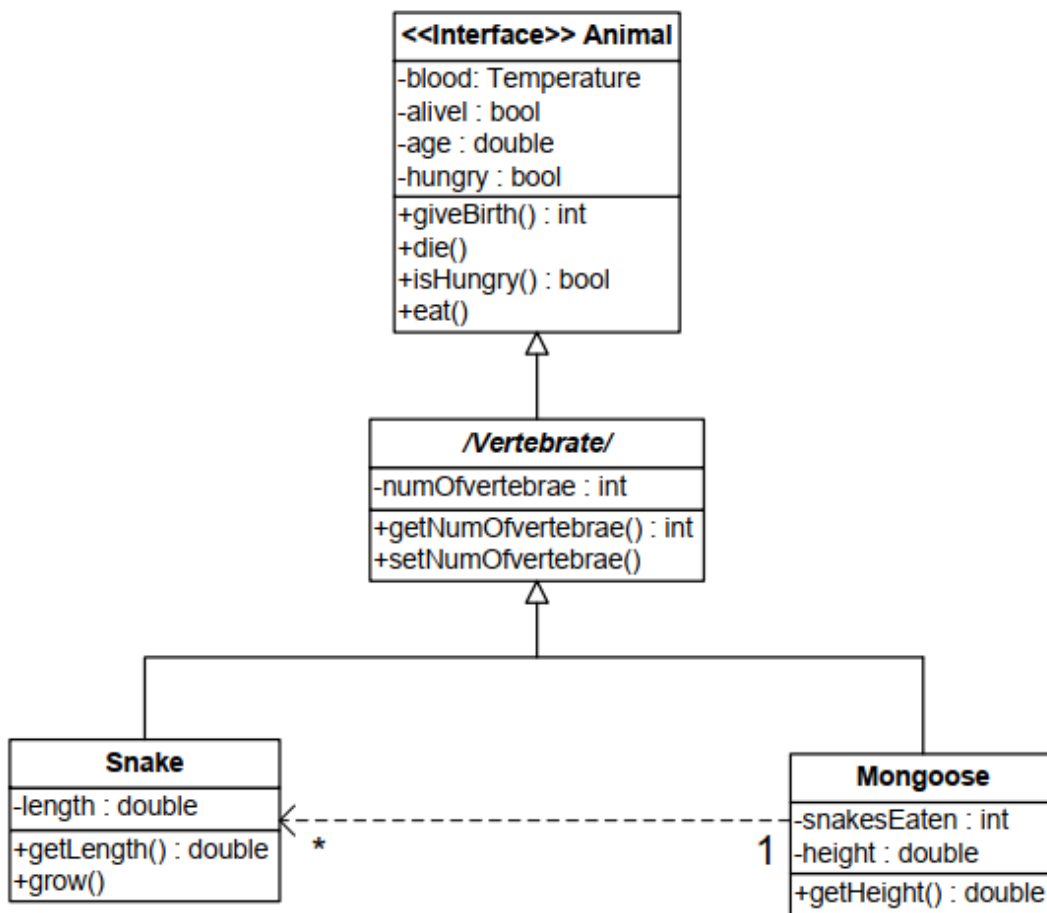

Statement No.	Statement
True	**The relation between Invalid PIN and Transaction does not conform to the UML standard.**
False	**The use case should clarify in what direction data is transferred to and from the Central Database.**
False	**The Central Database should be moved outside the ATM System box, but the connections should be kept.**
True	**The relation between the Customer and the GUI is not permitted in UML use case diagram syntax.**
False	**The relations connecting the Operator, GUI and Bank to the ATM System are missing the arrows.**

zero or 1 marks

v. *Please provide answers for the given class diagram with reasoning (8marks)*

Statement No.	Statement
A	What is the relationship between Vertebrate and Animal? **Vertebrate is a subclass of Animal.**
B	What is the relationship between Snake and Animal? **Snake is a subclass of Animal.**
C	What is the association type between Mongoose and Snake? **Dependency association.**
D	According to the class diagram, can 2 mongooses eat 1 snake? **No. The relationship between Mongoose and Snake is one-to-zero-or-more.**

2 or zero marks. All other answers other then solution are incorrect

Question 3: [25 marks]

a. Difference between possible and probable correctness. Also, provide an example. [5]
in possible random values are given to the system to check the possible correctness. e,g for age we tale 5 as random value, if true then possibly corrent
In probable we take some set of values based on carefully selected criteria e.g. in bva we take min +-1 and max +-1
if true then 2.5 for each with example else zero
b. The figure below shows a little C# code snippet. Do the following.

Write test cases (values) for the statement coverage and decision coverage. Also calculate the coverage percentage for each test case. Make sure to follow the guidelines for writing good test cases. (detailed test case is not required) [20]

```
1     declare Length as integer
2     declare i as integer
3     READ Length;
4     READ i;
5
6     WHILE (i <= 6) LOOP
7          IF (Length >= 100) THEN
8               Length = Length - 2;
9          ELSE
10              Length = i * Length;
11         END IF
12    i = i + 1;
13    END WHILE;
14    PRINT Leng
```

Solution
The purpose of a test case using any technique is to write a minimum number of test cases with no repetition. When the criteria for testing is achieved, we stop testing. Common mistakes were more than one test cases - zero marks
incorrect test cases zero marks.
Note that this code has a loop and for the value of length and i, this code will run until loop is exited,

```
10 marks statement coverage 10 marks decision coverage
```

Statement Coverage		
TCID	Test Value	Statement Coverage
1	i = 5 length = 100	100%

Decision Coverage		
TCID	Test Value	Decision Coverage
1	i = 5 length = 50	100%

Question 4: [20 marks]

Perform Equivalence class partitioning for the following requirements.
  1. *Identify all the classes. [10]*

  2. *Identify the number of test cases required for weak Equivalence class partitioning. [2.5]*

3. *Identify the number of test cases required for strong Equivalence class partitioning. [2.5]*

4. *Perform weak equivalence for the identified classes. [5]*

Salary Calculation Example

A program that takes three inputs: gender (male, female), age ([18-55]), salary ([1000-10000]) and output the total salary for one person.

$$Total\_salary = 10000 * factor,$$

where factor is given by the following age information.

Young (18-35 years) factor 75
Middle (36-45 years) factor 55
Old (46-55 years) factor 30
It has 3 inputs

Gender, Age, Salary

if classes are incorrect, the rest of the question is marked zero

Gender

Valid = {male, female}

Invalid = {Any other input}

Age

Valid = {18-35}

{36-45}

{46-55}

Invalid

{<18}

{>18}

Salary

Valid {1000 - 10000}

Invalid

{<1000}

{>10000}

Weak Equilience = 5 TC

Strong = 2*5*3 = 30 TC

5 TC are required written in tabular format by following all rules,.

Question 5:   **[20 marks]**

For the following program

1. *Draw Control Flow Graph [10]*

2. *Find the Cyclomatic Complexity. Please state the formula as well which is used to determine cyclomatic complexity. [5]*

3. *Write all identified paths. [5]*

Program to do binary search (Note: All code blocks have been numbered already. Use these to make the CFG).

Source Program:

```
int binsearch(int x, int v[], int n)
{
        int low, high, mid;
  1     low = 0;
        high = n - 1;
        while (low <= high)  2
        {
             3   mid = (low + high)/2;
                 if (x < v[mid])
                        high = mid - 1;   4
             5   else if (x > v[mid])
                        low = mid + 1;    6
             7   else return mid;
        }
        return -1;  8
} 9
```

If made correctly then 10 else zero. If cfg is incorrect, rest of the question is marked zero.

Source Program: CFG:

```
int binsearch(int x, int v[], int n)
{
        int low, high, mid;
   1    low = 0;
        high = n - 1;
        while (low <= high) | 2
        {
            mid = (low + high)/2;
        3   if (x < v[mid])
                high = mid - 1;  | 4
        5   else if (x > v[mid])
                low = mid + 1;   | 6
        7   else return mid;
        }
        return -1; | 8
} | 9
```
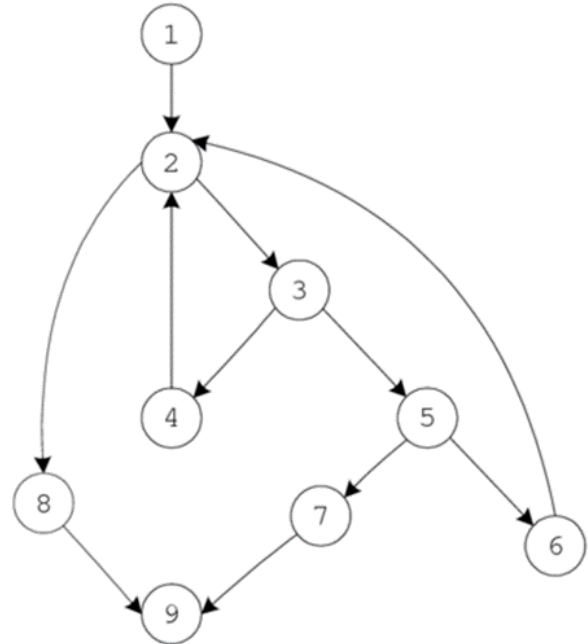

Any formula

CC = 4

Paths

1 2 3 4 5 7 9

1 2 3 4 2 8 9

1 2 8 9

1 2 3 4 5 6 2 8 9