Ans. to the Q no. 1

Product backlog for the user stories are broken down into task as follows:

User story 1: As a user I want to log in Securely So that I can access my account.

Tasks:

① Design the login page (UI/UX design)
② Implement the front end of the logic page
③ create and integrate user authentication APIs
④ configure database for storing and validating user
⑤ Implement password encryption and security measures
⑥ conduct unit testing for login functionality
⑦ perform integration testing with the database.
⑧ Write automated test case for security validation

User story 2: As a user, I want to search for product by category to find items easily.

Tasks:

① Design the search page and category filters

② Implement the front end of search page.
③ create backend APIs for fetching products by category.
④ Integrate the API with front end.
⑤ optimized the database queries for efficient product search.
⑥ Implement validation for search input.
⑦ conduct unit testing for search input functionality.
⑧ perform usability testing to ensure ease of use.

→ Prioritization of user stories in sprint planning

During sprint planning, the development team and product owner collaborate to prioritize user stories based on:

① Value of the customer
② Technical Feasibility.

Sprint prioritization order:

(I) User stories 1 (Login functionality): High priority due to its criticality.

(II) User story 2 (Search functionality)

Tracking process using a Scrum board.

A Scrum board is divided into three column: To Do, In progress, and Done.

To DO: All tasks from the product backlog that are selected from the sprint.

In progress: Task activity being worked on by team member

Done: completed tasks that meet the Defination of Done:

Main point

(I) product backlog
(II) Sprint prioritization
(III) Scrum board.

Ans. to the Q no. 2

How does the methodology address Risk management and Adaptability.

1. Spiral Methodology:

Risk Management:- Spiral focuses heavily on risk Analysis. Each phase starts with identifying and Mitigating risk. High Risk components are addressed early.

Adaptability:- The iterative nature allows for refinment and changes after each cycle, ensuring the product evolves as risks and requirements become clearer.

Key Advantage: Best for project with high uncertainty, as it emphasizes risk reduction through repeated evaluation.

2. Agile Methodology:

Risk Management: Agile minimizes risks by delivering working software in short iterations. Feedback after each iteration ensure potential

risks are identified and resolved early.

Adaptability:- Agile is high adaptable because it embraces change allowing the client to update requirements frequently.

Key Advantage: Suited for projects with evolving requirments as it ensures continous client collaboration and quick responses to change.

3. Extreme programming (XP)

Risk management: XP manage risks through practices like pair programming, continous integration and frequent releases. It reduces the likelihood of defects and ensures equality at every step.

Adaptability: XP is high adaptive due to its focus on customer collaboration and delivering small increments of functional software. Changes can be integrated at any stage.

Key Advantage: Works best in projects requiring frequent delivery of small functional components with envolving requirments.

Most suitable ~~project~~ Methodology for this project is Agile methodology because;

(i) It embraces change, allowing the team to adjust to envolving client needs.

(ii) Regular feedback and short iterations reduces the risk of delivering a product that doesn't need meet expectations.

(iii) continous collaboration ensures alignment with client priorities, making it cost-effective and manageable.

Horever, If the risks are too high and require in-depth analysis, the spiral methodology could be an alternative due to its strong focus on risk management.

Ans. to the Q no. 3

comparison of Development models:

1. Waterfall model

Key features:

→ Sequential and linear process (Requirement → Design → development → Testing → Deployment).

→ Works best for projects with well-defined and stable requirements.

Strengths:

→ Predictable and easy to manage

→ Suitable for project with strict timelines and clear deliverables.

Weakness

→ Not flexible for evolving requirments

→ High risk if errors are found late in the process

2. Agile model:

Key features:

→ Iterative and incremental development with regular customer feedback.

→ Divides work into short sprints or iterations

Strengths:

→ Highly adaptable to changing requirments.

→ Encourage close collaboration with the customer

Weakness:
→ Requires continous involvement from the customer
→ Less suited for project with strict deadlines and fixed requirments.

3. Extreme Programming (XP):

key features:
→ Focuses on frequent release continous testing and customer collaboration.
→ Emphasizes practices like pair programming test driven development and small functional updates.

Strengths:
→ Excellent for projects with evolving requirments.
→ Reduces technical risk through frequent testing and updates.

Weakness:
→ Require high level of discipline and collaboration
→ Less structured than waterfall or spiral for well defined projects.

4. Spiral model:

key features:
→ combine iterative development with risk and

analysis at every phase.
→ Focuses on identifying and mitigating risk early
Strength:
→ Handle high risk project effectively
→ Allow refinement of requirements over time.
Weakness:
→ can be more expensive and more complex to implement
→ Requires expertise in risk analysis.

Analysis of project A and project B:

1. project A (well-defined requirements strict deadline):
Best methodology: waterfall model
Reasoning:
→ clear and stable requirements align with waterfall's structured Approach.
→ The sequential process ensures each phase is completed on time, meeting the strict deadline.
→ predictability and a fixed timeline are crucial and waterfall excels at delivering such projects.
→ Agaile or xp's flexibility ~~are~~ is unnecessary when requirement are well-defined.
→ The iterative process may be waste time that is critical for a strict deadline.

project B (Envolving requirment, uncertain timeline)
Best methodology: Agile or xp

Reasoning:

→ Agile's iterative approach is perfect for handling evolving requirments.

→ continous customer feedback ensures the project product evolves to meet changing needs.

→ xp is also a strong choice for its focus on frequent release and adaptability.

→ Waterfall is rigid and does not handle changing requirments effectively so that it is not suitable.

→ Spiral is suitable for high risk projects but may be unnecessary complex for evolving requirments with continous feedback so it is not use.

Ans. to the Q. no. 4

principle of software engineering ethics:

Software engineering ethics are guidelines that ensure professional act responsibly and prioritize public welfare, quality and integrity in their work. Key principles includes:

Public interest:

Software engineers should prioritize the well being and safety of the public above personal or organizational interests.

Quality of work

Delivering high-quality reliable and maintainable software is an ethical responsibility.

Honesty and integrity:

Engineers must provide accurate information about the capabilities, risks and limitations of software.

confidentiality:

protecting sensitive data and respecting the privacy of users is critical.

Competence:
Engineers should work only within their areas of expertise and continously improve their skills.

Fairness:
Avoid discrimination and treat all clients ~~colleagues~~ colleagues, and user fairly.

Issues Related to professional Responsibility:

Accountability:
Engineers are responsible for the software they design, including its social, legal, and technical impacts.

conflicts of Interest:
Ethical dilemmas may arises when personal interest conflicts with profession duty.

Security and privacy concerns:
Engineers must ensure that software protects user data and prevents unauthorized access.

Failure and Risk management:
Ignoring potential risks or delivering defective software could harm users or organizations.

Respecting Intellectual property:
Using third party software or ideas without proper acknowledgment is unethical.

Role of ACM/IEEE code of Ethics
The ACM/IEEE code ethics provides a framework for ethical decision-making in software engineering. It emphasizes the following.
1. Act in the public Interest.
2. Avoid Harm.
3. Be honest and transparent
4. Respect privacy and confidentiality.
5. provide free treatment.
6. Maintain competence.
7. Support Ethical Standards.

How the code guides Ethical decision-making.
1. public safety concerns
2. privacy violations
3. Reporting Defects
4. Intellectual property issues.

Ans. to the Q. no. 5

Functional Requirements

Functional Requirements describe what the system should do, focusing on the features and capabilities that support its primary purpose.

Flight Search and Reservation:

users should be able to search for available flights based on criteria like destination, date and time.

User Registration and Authentication

The system must allow users to create accounts, log in securely, and manage their profiles.

contribution: Improves security by ensuring that only authorized users can access their bookings.

payment processing

The system should support secure payment options (credit/debit cards, digital wallets) for ticket purchases.

contribution: provides a seamless booking process and ensures final financial transaction

are secure.

Ticket management:

User should be able to view, modify or cancel their reservations.

contribution: Keeps user informed, improving the user experience and reliability of the system.

Non functional Requirment

Non-functional requirments describe how the system should perform and focus on quality attributes such as performance, reliability and maintainability.

1. System performance

The system must be handle upto 10,000 concurrent users without significant delays.

contribution: Ensures smooth performance during peak usage times, improving user satisfaction.

2. Availability and uptime:

The system must be available 99.9% of the time, with minimal down time for maintenance

contribution: Ensures reliability and builds user trust in the system.

3. Data Security

All user data, including payment information must be encrypted and comply with industry

Standards.

Contribution: Protects Sensitive user information ensuring security and compliance.

4. Scalability

The system should be scalable to accommodate increasing numbers of users and flights.

Contribution: prepares the system for future growth ensuring long-term usability and cost effectiveness.

5. Usability

The interface should be intuitive, with clear navigation and minimal learning curve for new users.

Contribution: Enhances the user experience, ensuring that even ~~a~~ non-~~technical~~ non-technical users can use the system effectively.

Ans. to the q.no. 6

The V-model is a software development approach where testing is planned alongside development. It connects every development activity to a maching testing activity, making it easier to find and fix errors early. The 'V' shapes shows the relationship between development and testing phases.

Phases of the V- model

1. Requirment phase:

What happend?
Gather what the system should do
Testing activity: Acceptance Testing
checks if the final product meets user needs and works as expected.

2. System design phase:

what happend?
Define how the system will Work including its structure and components.

Testing activity:
Tests the entire system to ensure it meets the original requirments.

3. High level design phase: (HLD)

What happend?

Break the system into modules and define how they interact.

Testing activity: Integration Testing

Ensures that different parts of the system works together correctly.

4. Low level design phase (LLD)

What happend?

Define the details of each module, such as logic and Algorithms.

Testing Activity: unit testing

Checks if individual parts (modules) of the system work properly.

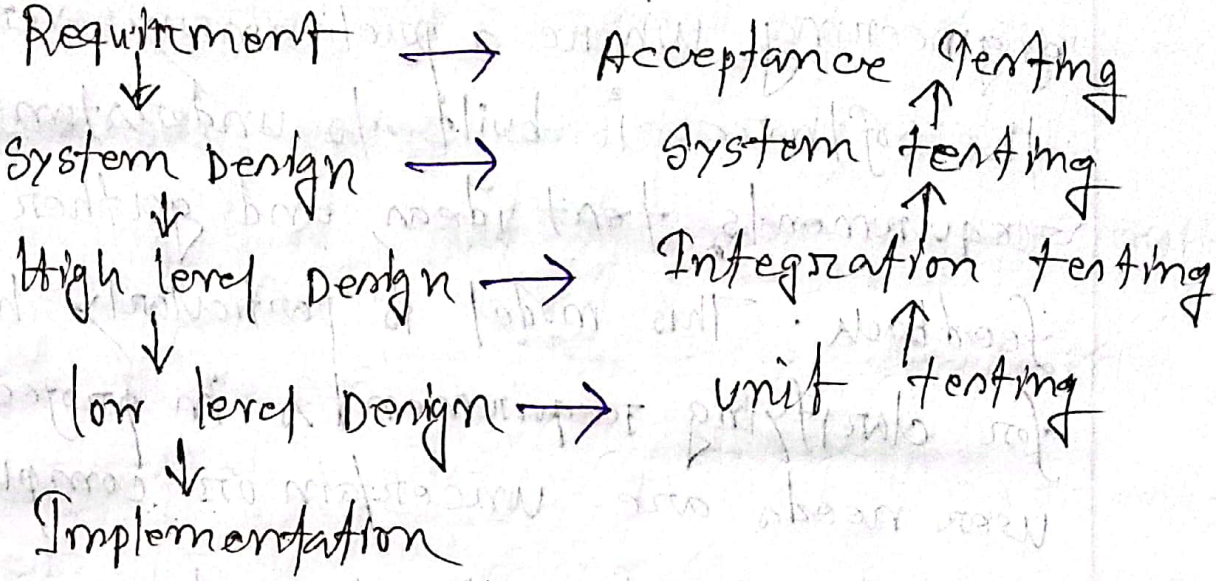
5. Implementation phase:

What happens?

Write the actual code of the system based on the design.

Test activity: code Reviews / static Testing

Diagram of V-model



→ The left side of the 'V' is for development.

→ The right side the 'V' is for testing.

→ Both side are connected : each development phase has a matching testing phase.

Benefits of V-model

(I) Early Testing
(II) clear plan
(III) Quality Assurance
(IV) well-Documented.

Ans. to the Q.no. 2

Prototype development is a process in software engineering where a preliminary version of the software is built to understand requirements, test ideas, and gather user feedback. This model is particularly helpful for clarifying requirements in projects where user needs are uncertain or complex.

Phase in prototype Development.

1. Requirement Gathering and Analysis:
→ understand the initial high-level requirements of the system.
→ focus on feature that are unclear or need validation through user interaction.

2. Quick design
→ create a simple and preliminary design for the prototype.
→ The design includes the ~~not~~ core design ~~for the~~ features that need testing or demonstration.

3. prototype building.

→ Develop the prototype based on the given design.

→ Use basic coding and tools to create a working model that demonstrates functionality, user interface or workflows.

4. User Evaluation

→ Present the prototype to stakeholders or end-users for feedback.

→ Identify gaps, areas for improvement or additional requirements.

5. Refinment of Requirments

→ Based on user feedback, refine the system requirments.

→ Repeat the process iteratively until the requirment are well-understood.

6. Development of the final product.

Once the requirments are clear and finalized, move on the actual system design and development.

How prototype Refine software Requirments

Visual Representation: The prototype provides a tangible way for stackholders to see how the system will work, helping them articulate their needs better.

Feedback integration: feedback from users helps identify gaps in requirments or any missing functionality.

Requirments validation: Ensures that the initial requirements align with user expectations and business goals.

Benefit of ~~using~~ using prototype model.

(I) Improve user feedback
(II) Risk Reduction
(III) Iterative development
(IV) Better communication.

Improve user feed back:

→ prototype gives users to an early version of the system to interact with.

→ user can identify usability issues or suggest enhancements before the final product is

built.

Risk Reduction

→ Identify potential design flaws or misunderstandings early, reducing costly change later.

→ Helps avoid building unnecessary features by refining requirements iteratively.

Iterative Development:

→ prototypes are updated multiple times based on feedback, leading to gradual improvement.

→ Allows the development team to focus on features that add the most value.

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Ans. to the q. no. 8

The process improvement cycle in software engineering is a continous cycle of assessing, improving and monitoring the processes used to develop software. The goal is to enhance the efficiency, effectiveness and quality of the software development process over time. It involves the use of systematic method to identify areas of improvement, make changes, and evaluate the outcomes to ensure better software development practices.

Key stage of the process improvement cycle.

1. process Assessment: first the current development process is reviewed to see what's working well and what needs improvement.
2. Goal Setting: After identifying area for improvement, specific goals are set. for example, reducing bugs or speeding up development time.
3. Implementation of improvements: changes or improvements are made to the process.

This could include adopting new tools, changing workflows, or improving communication.

4. Measurement and Monitoring: After the improvements, it important to measure how well they are working.

5. Review and Evaluation: The final step is to review the results. If the goals were achieved, the improvements are kept, If not, more changes are made, and the cycle continue.

commonly used process matrics.

(I) Defect density
(II) cycle time
(III) Velocity
(IV) customer Satisfaction
(V) code churun

How metrics help to Improving Software processes

(I) spot problems Early.
(II) Track Improvement.
(III) make Informed decisions.
(IV) Maintain quality.

Ans. to the Q. no. 9

The SEI CMM is a framework that helps organization improve their software dev development processes over time. It helps assess where an organization is in its software development journey and provides a roadmap for improvement. The model has five levels, each representing a different stage of growth in an organization's processes.

The five level of SEI ~~model~~ CMM

1. Level 1 : unpredictable (initial)
2. Level 2 : Managed (Repeatable processes)
3. Level 3 : Defined (Standardized processes)
4. Level 4 : Quantitatively managed (using data to manage processes)
5. Level 5 : optimizing (continous improvement)

How the level helps :

Level 1 : organizes the processes.

Level 2 : Improves predictability and control

Level 3 : Increase consistency and efficiency.

Level 4 : make decisions based on data

and measurement.

Level 5: focus on continuous improvement and staying competitive.

By moving through these levels, an organization gradually improves its software development practices, making processes more efficient and predictable, and ensuring better quality software in the long run.

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Ans to the Q. no. 10

Agile is a method of software development that allows focuses on flexibility, teamwork, and customer feedback. The goal is to deliver small parts of the software quickly, get feedback from users, and improve the software step by step.

core principle of Agile:

1. customer collaboration: Agile values talking to the customer often to make sure the software meets their needs.
2. Responding to changes: Agile encourage adapting to change.
3. people over process: Agile believes that the team work skills and communication are more important than strict processes.
4. working software over process documentation
5. Simplicity
6. Self organized teams.
7. Frequent delivery
8. continous Improvement.

How Agile works in different Environment

1. Startups.
2. Large Enterprises.
3. Software maintenance.
4. customer facing projects.

Benefic of Agile

1. Faster delivery
2. Better customer satisfaction
3. Flexibility
4. High quality
5. Better collaboration and Teamwork.

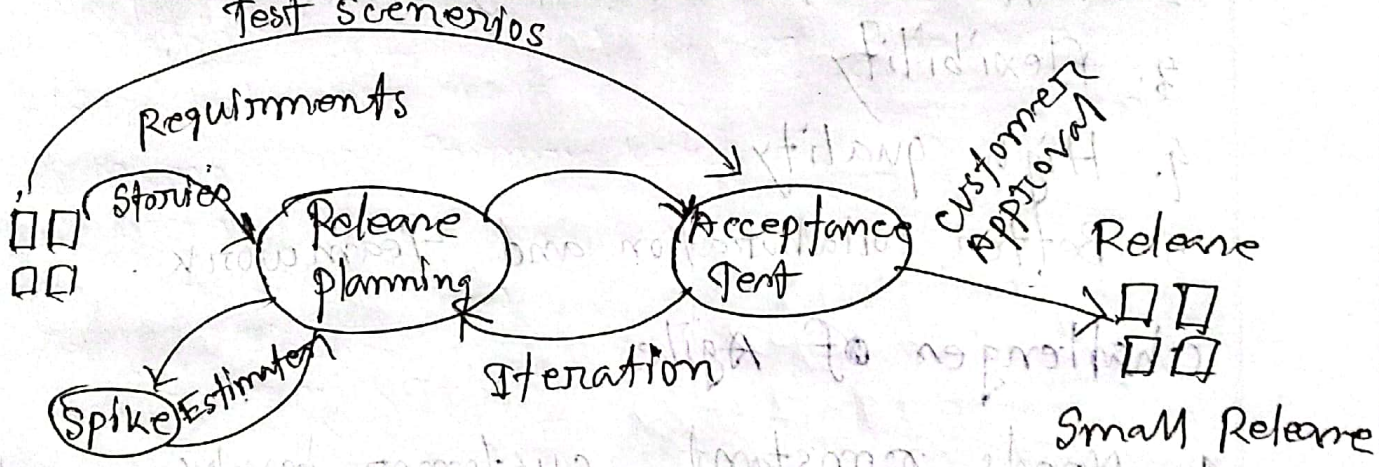
Challenges of Agile

1. Needs constant customer involvement
2. Scaling issues.
3. Resistance to change.
4. Relies on team Expertise.
5. Scope creep.

Ans. to the Q. no. 11

Extreme programming (XP) is a software development methodology designed for flexibility, high-quality software, and customer satisfaction. Its release cycle is iterative and emphasizes frequent release of small, & function software increments.

Release cycle of extreme programming



1. Exploration phase:
→ collaborate with the customer to define user stor
→ prioritize the stories based on value and feasibility
2. planning phase
→ create a release plan for multiple iteration
→ Select high priority user stories for first iteratio
3. iteration cycle.
(i) Design (ii) coding (iii) Testing (iv) Review

4. Release:
→ Delivery the working product to the customer after a few iteration (every 1-3 weeks)
→ collect customer feedback for future development

5. Maintenance
→ Address bug and issues based on user feedback
→ plan additional iteration if required.

Influential programming practice in XP.

Extreme programming includes several key practices that contributes to the success of the software development process.

1. Test-driven development (TDD)
→ Write automated tests before writting the code
→ Ensures code meets requirements and reduces bug
2. pair programming
3. Continous Integration
4. Simple design
5. collective code ownership
6. Frequent Releases.
7. on-site customer
8. Refactoring.

Ans. to the Q.no. 12

Entity Relationship Diagram (ERD) for a Library Management System

Entity and Attributes

1. Book

Attributes:

(I) Book_ID (primary key)

(II) Title (III) Author (IV) ISBN (V) Genre

2. Member

Attributes:

(I) Member_ID (primary key)

(II) Name

(III) contact_details

3. Borrowing Activity

Attributes:

(I) Borrow_ID (primary key)

(II) Borrow_Date

(III) Return_Due_Date

(IV) Return_Status

(V) Fine

4. overdue catalog

Attributes:

(P) overdue_ID (primary key)

(W) Borrow_ID (foreign key)

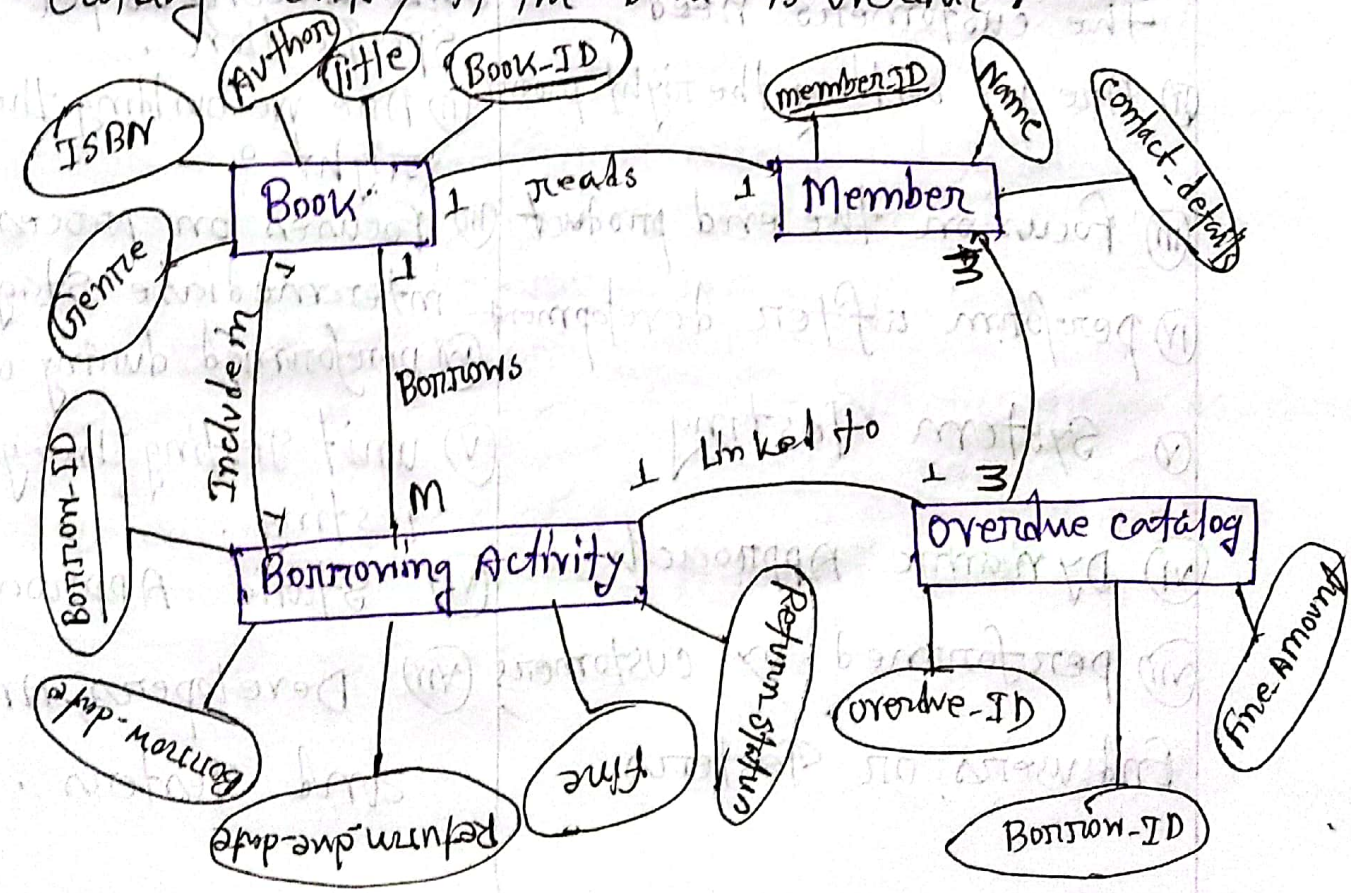
(W) fine_Amount

Relationships:

→ Member (1) → Borrows → Borrowing Activity (M)
one member can have multiple borrowing activities

→ Book (1) → Include in → Borrowing Activity (1)
one book is tied to one borrowing activity at a time

→ Borrowing Activity (1) → Linked to → overdue catelog (1)
one Borrowing Activity can result in one overdue catalog entry if the book is overdue.



Ans. to the Q. no. 13

Testing in software engineering is the process of evaluation of a software application or system to ensure it meets the specified requirments, functions correctly and is free from defects. The goal of testing is identify bugs, ensure the software perform as expected, and verify that it meets user needs.

Difference between Validation and Verification

Validation	Verification
(i) Ensures the product meets the customer's need	(i) Ensures the product is built correctly as per specification.
(ii) Are we building the right product	(ii) Are we building the product right ?
(iii) focus on the end product	(iii) Focuses on processes an intermediate stage.
(iv) perform after development	(iv) performed during developm
(v) System Testing	(v) unit Testing, Integration Testing.
(vi) Dynamic Approach	(vi) Static Approach
(vii) performed by customers End users, or Testers	(vii) Developers, Analysts and Testers.

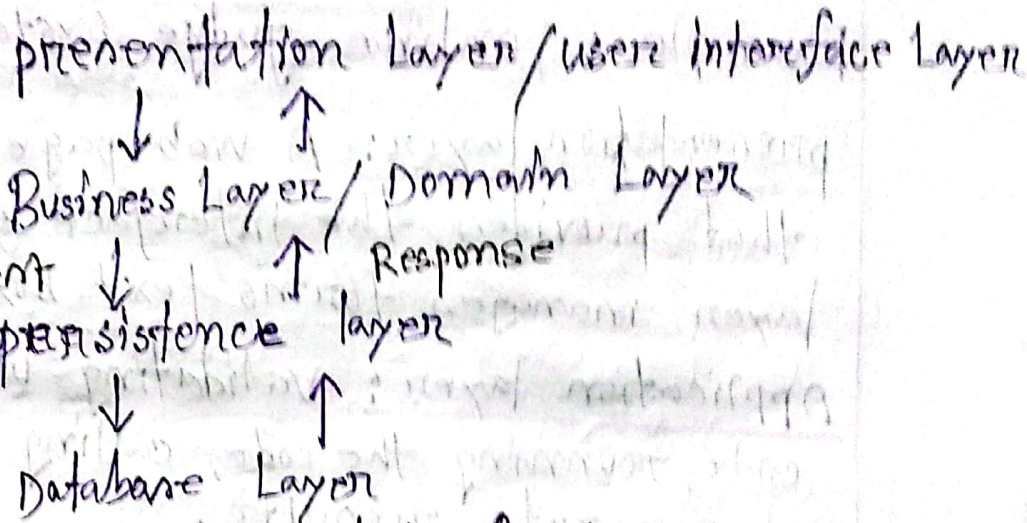
Ans to the Q. no. 14

Layered Architecture model:

The Layered Architecture model is a software design pattern that separates the systems responsibilities into different layers.

→ organized the system into layers with related functionality associated with each layer.

→ A layer provides services to the layers above it



presentation Layer / user interface Layer:

→ Responsible for handling all user interface and browser communication logic.

Business Layer / Domain Layer:

→ Responsible for executing specific business rules associated with the request

→ We can put the method models and logic that is specific to business problem that we are trying to solve.

Persistence layer:

→ It contains the code to access the database layer

→ It is the set of code to maintain manipulate the database like SQL statements, connection details.

Database Layer:

→ This is the layer where all the data is stored
→ It is the underlying database technology like SQL server.

Example: online judge system.

presentation layer: A web page or mobile App that provides the interface for users. This layer manages forms text boxes, buttons, etc.

Application layer: Validating user-submitted code, running the code, calling services to generate results.

Business layer: Managing the execution process of a piece of code, like running C++ code or executing python code correctly.

Database layer: Registration data, grading information, code archives, etc.

Ans. to the Q.no. 15

Data flow diagram Hospital management system is used to create an overview of Hospital management without going in too much detail.

→ context level (0 level) DFD of Hospital management system : The 0 level DFD for hospital management system despicts the overview of whole hospital management system. It is supposed to be an abstract view of overall system.

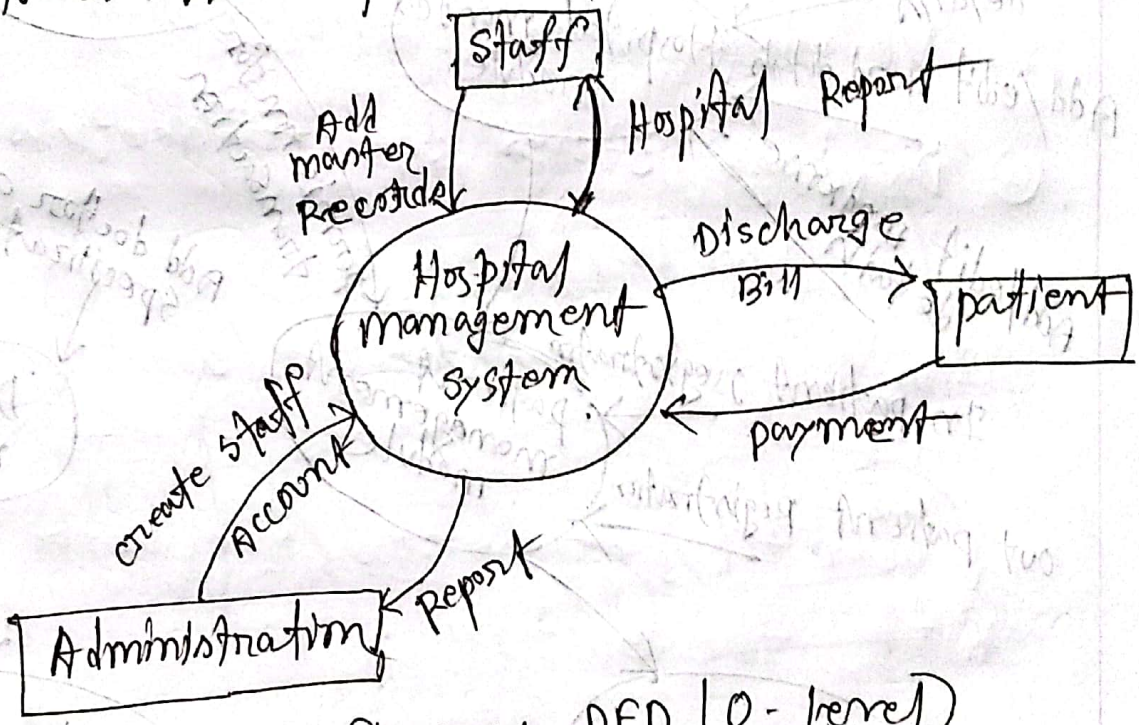
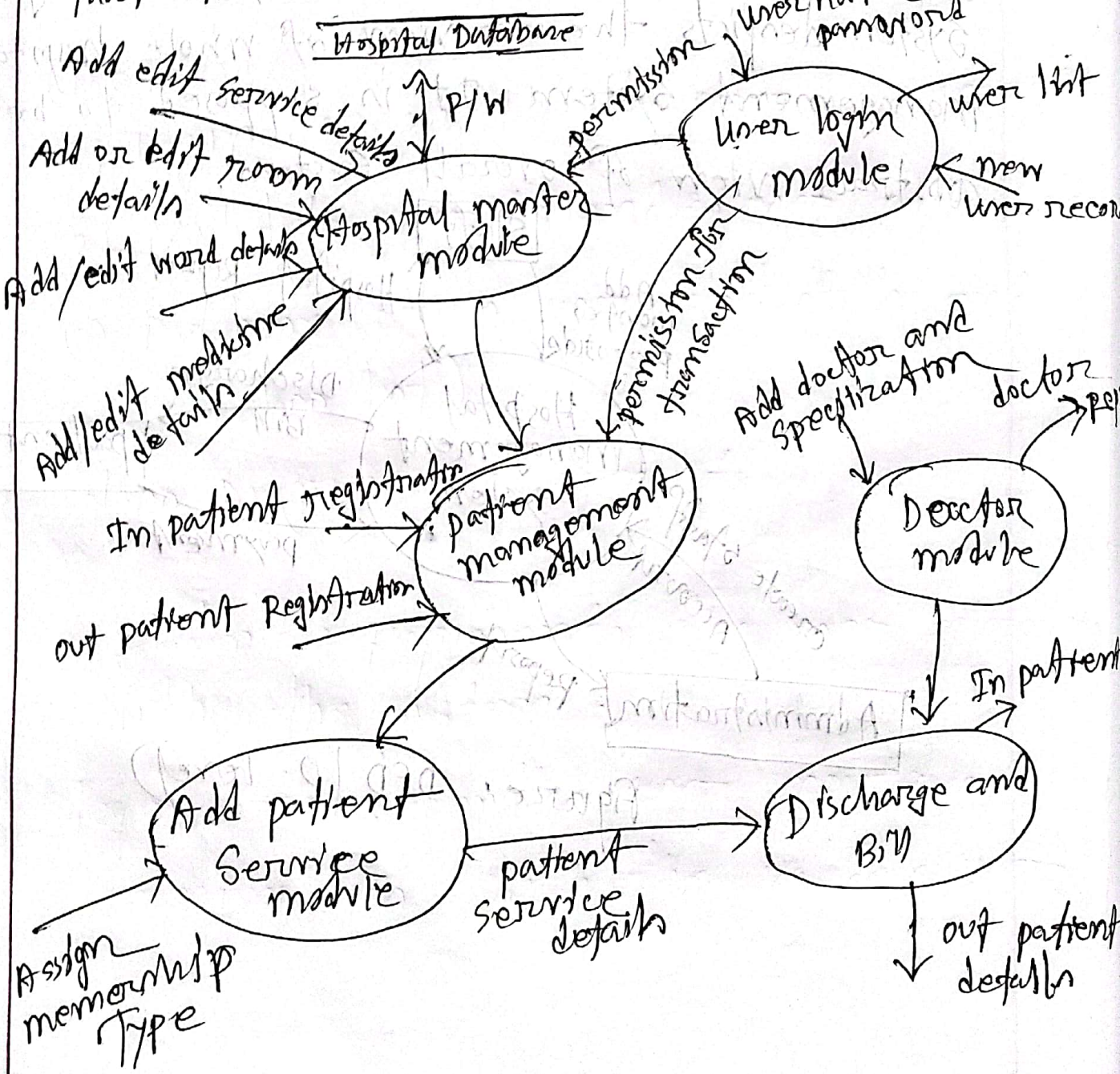


figure : DFD (0 - level)

First level Data Flow Diagram (level-1 DFD) Or Hospital management system.

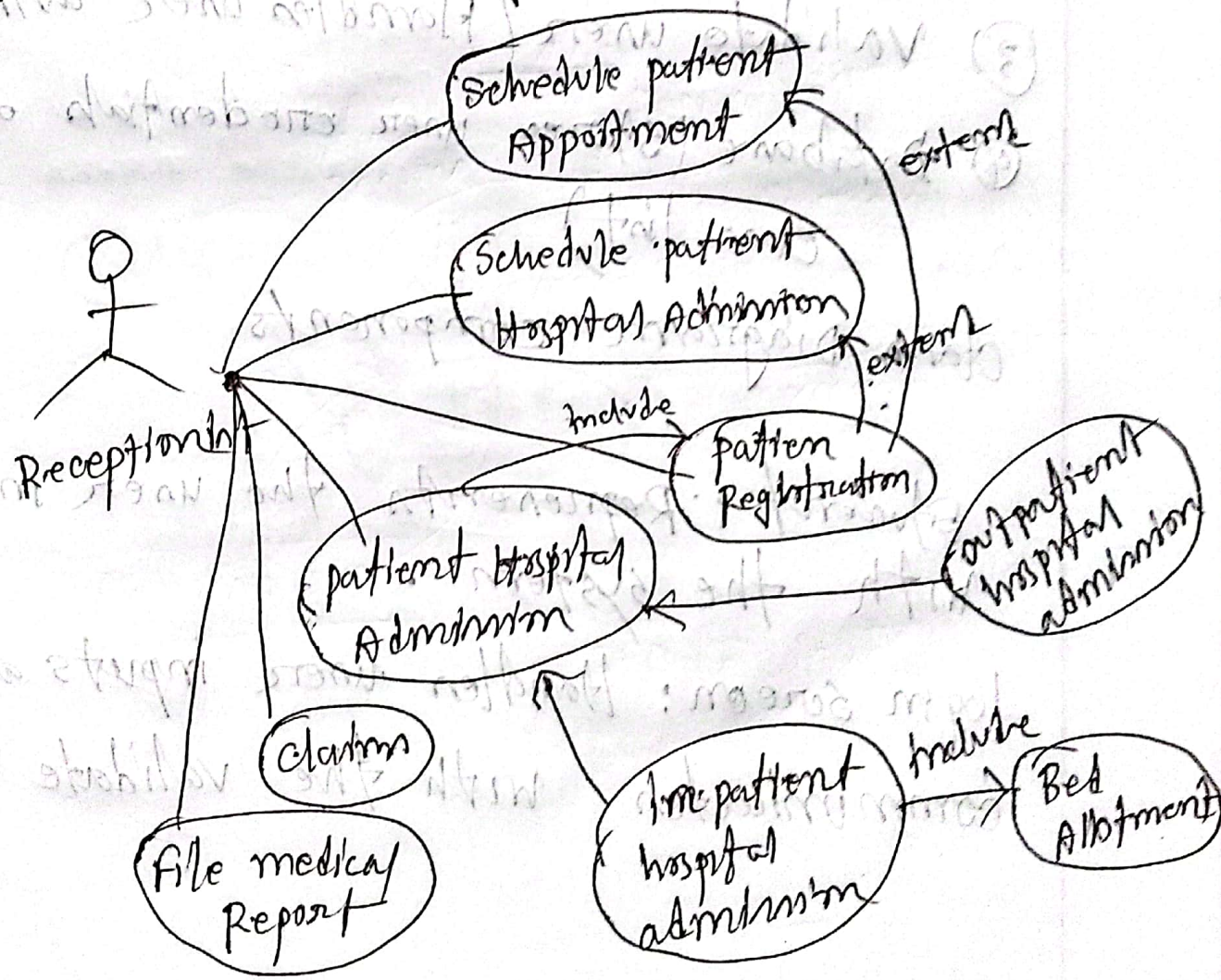
The first level DFD (1st level) of Hospital management shows more details of processing Level-1 DFD list all the major sub processes that makes the entire system.



The important process to be carried out are:

(i) User and login
(ii) Hospital Master
(iii) patient registration
(iv) Doctor module
(v) Add patient service
(vi) Discharge billing

UML use case diagram:



Ans to the Q no 26

Based on the uml sequence diagram, we can derive a uml class diagram by identifying the key entities and their relationship. The main entities involved in this scenario are:

1. Student (Actor)
2. Login Screen (Handles user login interface)
3. Validate user (Handles user authentication)
4. Database (Stores user credentials and class list)

class Diagram components

Student : Represents the user interacting with the system.

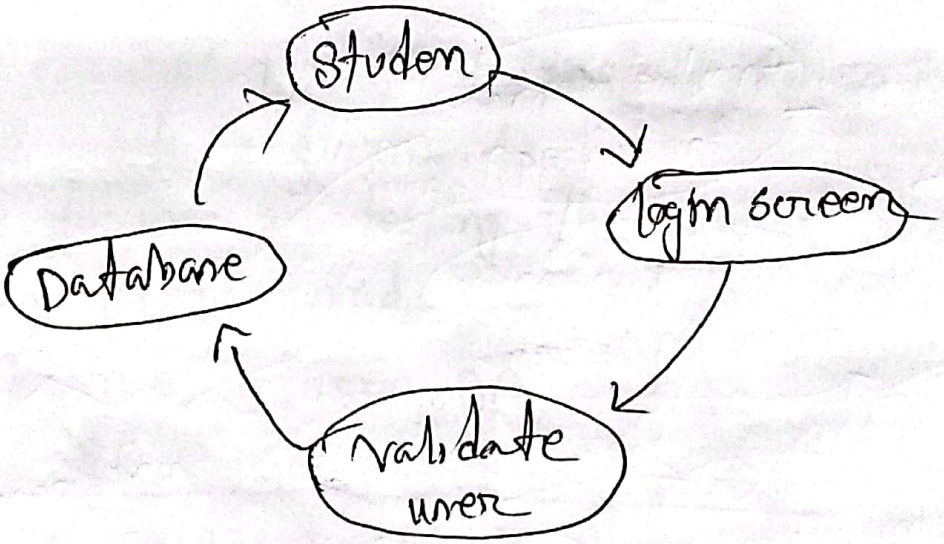
Login screen : Handles user inputs and communicates with the validate user

class.

Validate user: process login credentials and interacts with database.

Database: Stores user credentials are class with information.

class diagram relationship:



Ans. to the Q. no. 12

Quality assurance (QA)

→ QA is about improving processes to prevent problems.
→ It ensures that the way software is developed is efficient and ~~product~~ produces high-quality results.
→ QA focuses on planning, setting rules, and following best practices to avoid mistakes.

Quality control (QC)

→ QC is about checking the product to find any mistakes or problems.
→ It ensures the final product works as expected and meets requirements.
→ QC focuses on testing the product and fixing any issues found.

Difference between QA and QC

QA	QC
(i) Focus on processes	(i) Focus on product
(ii) Nature proactive	(ii) Nature Reactive
(iii) Prevent problem before they happen	(iii) Find and fix problem in the product.
(iv) Responsible for entire organization	(iv) Responsible for Testers and developers.

Impediments to QA and QC

challenges in QA

(i) Inconsistent process Adherence.
(ii) Lack of skilled professionals.
(iii) Time and Resource constraints
(iv) Resistance to change.

challenges in QC

(i) Inadequate test coverage
(ii) complex defect Detection
(iii) Poor Requirement clarity.
(iv) Tools and Resource Limitations.

→ QA and QC are complementary.
→ QA makes sure that processes are right to prevent problems.
→ QC checks the product to find and fix problems
→ Both are important and work together to ensure high-quality software.

Ans. to the Q:no. 18

No, the goal of Quality Assurance (QA) is much more than finding bugs. It ensures that the processes used to build software are correct, efficient and lead to high-quality products. Finding and fixing bugs early is part of QA, but the main focus is to prevent defects and ensure the software meets user needs.

Role of QA in Each SDLC phase

1. Requirement Analysis phase:
→ QA ensures that requirements are clear and testable
→ QA identifies any unclear or missing details in the requirements
→ This prevents problems later due to misunderstood requirements.

2. Design phase:
→ QA reviews the system design to ensure it meets requirements.
→ It checks for any potential problems in the design before development starts.
→ This helps avoid major changes during development

3. Development phase:
→ QA ensures that developers follow coding Standards.
→ QA helps with unit testing and identifies errors in the code early.
→ This reduces the changes of bugs during testing.

4. Testing phase:
→ QA runs different types of tests like functional integration and system tests.
→ Bugs found during testing are reported and fixed.
→ This ensures the of software works as intended and meets user requirements.

5. Deployment phase:
→ QA checks the software is ready for release by running final tests.
→ QA ensures the development process is smooth and error-free
→ This helps deliver reliable software to users.

6. maintance phase:
→ QA monitors the software for issues after release
→ QA ensures any update or changes are properly tested before going live.

Ans. to the Q.no.19

The Rapid Application and development (RAD) model is a software development methodology that emphasizes speed and flexibility. It focuses on quickly development prototypes and delivering functional components in short cycles. RAD aims to meet changing user needs and delivery quality software faster.

Key phases of RAD model.

1. Requirements planning
2. User design
3. construction
4. cutover.

principle of RAD model

① User involvement
② Iterative development
③ prototyping
④ component Range Reuse.

Advantage of RAD model

① Faster delivery
② Flexibility
③ High user Satisfaction
④ Reduced Risk
⑤ Better quality.

How RAD Supports Faster Delivery and matntains Quality.

(I) prototyping
(II) Iterative process
(III) user feedback
(IV) Reusable components.
(V) parallel Development..

Ans. to the q. no. 20

Lets break the problem into two parts

(i) Analyzing a simple code with decisions and designing test cases.

(ii) Implementing a Junit test class to test these decisions.

Simple code with decisions (if, else, and while)

```
public class DecisionExample {
    public static String process(int x, int y)
        if (y<0){
            return "y is zero";
        }
    else{
        StringBuilder result = new StringBuilder();
        for (int i=1; i<=x; i++){
            if (i%y==0){
            result.append(i).append(" ");
        }
    }
    return result.toString().trim();
    }
}
}
```

Table for test case

Decision	x input	y input	Expected output
y==0	5	0	"y is zero"
x==0	0	3	"x is zero"
for loop does not run	0	2	"" (empty string)
i%y==0	4	2	"2 4"
i%y!=0	4	3	"3"

Junit test codes

```
import org.junit.Test;
import static org.junit.Assert.*;
public class DecisionExampleTest {
    // Test case for y==0
    @Test
    public void testIsZero() {
    assertEquals("y is zero", DecisionExample.process(5,0
    }
// Test code for x==0
    @Test
    public void testXIsZero() {
```

```
assertEqual("x is zero", DecisionExample.process(0,3));
    }
// Test case where the loop doesnot run.
    @Test
    public void testLoopDoesnotRun(){
    assertEquals("", DecisionExample.process(0,2));
    }
// Test case where number divisible by y are printed
    @Test
    public void testNumberDivisibleByY(){
      assertEquals("2 4", DecisionExample.process(4,2));
    }
//Test case where number not divisible by y
    @Test
    public void testNumbersNotDivisibleByY(){
      assertEquals("3", DecisionExample.process(4,3));
    }
}
```

Ans. to the Q. no. 21

production code Example

```
public class utility {
  // method for division
public static double divide (int numerator, int denominator
 {
   if (denominator == 0){
throw new IllegalArgumentException ("Denominator can
                                    not be zero");
   }
  return (double) numerator/denominator;
}
// method for reverse a string
 public static string reverseString (String input){
      if (input == null){
  throw new nullPointerException ("Input string cannot be
                                    null");
   }
  return new StringBuilder (input).reverse().toString()
}
```

JUnit 4 test class

Here's how we can write test case using JUnit 4 applying exceptions, a setup function and timeout rule.

```
import org.junit.Before;
import org.junit.Rule;
import org.junit.Test;
import org.junit.rules.ExpectedException;
import org.junit.rules.Timeout;
import org.junit.Assert.*;

public class UtilityTest {
    // Rule for timeout
    @Rule
    public Timeout globalTimeout = Timeout.millis(10
// Rule for exception testing
    @Rule
public ExpectedException thrown = ExpectedException.n
// setup function to initialize reusable test da
// Test for divide method
    @Test
    public void testDivide() {
        assertEquals(2.5, utility.divide(5,2), 0.01);
    }
```

```
// Test for divide exception
@Test
public void testDivideException() {
thrown.expect(IllegalArgumentException.class);
thrown.expectMessage("Denominator cannot be zero");
    utility.divide(10,0);
}
// Test for ReverseString() method.
  @Test
  public void testReverseString() {
     assertEquals("cba", Utility.reverseString("abc"));
  }
// Test for reverse string exception
   @Test (expected = NullPointerException.class)
    public void testReverseStringException() {
      utility.reverseString(null); }
// Timeout test example
   @Test
   public void testLongRunningProcess() {
          int result=0;
        for(int i=0; i<100000; i++){
              result+=i; }
             assertTrue(result>0);
        } }
```