Question#01 **[40 Marks]**

Choose one of the given options for every question.

1. Who is the father of Software Engineering?
   a) Margaret Hamilton
   b) Watts S. Humphrey
   c) Alan Turing
   d) Boris Beizer
2. What is Software Engineering?
   a) Designing a software
   b) Testing a software
   c) Application of engineering principles to the design a software
   d) None of the above
3. What are the features of Software Code?
   a) Simplicity
   b) Accessibility
   c) Modularity
   d) All of the above
4. Define Agile scrum methodology.
   a) project management that emphasizes incremental progress
   b) project management that emphasizes decremental progress
   c) project management that emphasizes neutral progress
   d) project management that emphasizes no progress
5. The activity that distributes estimated effort across the planned project duration by allocating the effort to specific software developing tasks is _____
   a) Project scheduling
   b) Detailed schedule
   c) Macroscopic schedule
   d) None of the mentioned

6. Who proposed the spiral model?
   a) Barry Boehm
   b) Pressman
   c) Royce
   d) IBM
7. _____ suits the Manifesto for Agile Software Development.
   a) Customer collaboration
   b) Individuals and interactions
   c) Working software
   d) All of the mentioned
8. Regardless of application area, project size, or complexity, software development work may be divided into three generic phases: the_____ phase, which focuses on *what*, the_____ phase, which focuses on *how*, and the_____ phase, which focuses on *change*.
   i. support
   ii. development
   iii. definition
   a) iii, ii, i
   b) iii, i, ii
   c) i, ii, iii
   d) ii, i, iii
9. Which of the following is not project management goal?
   a) Keeping overall costs within budget
   b) Delivering the software to the customer at the agreed time
   c) Maintaining a happy and well-functioning development team
   d) Avoiding customer complaints
10. Which of the following is/are main parameters that you should use when computing the costs of a software development project?
    a) travel and training costs
    b) hardware and software costs
    c) effort costs (the costs of paying software engineers and managers)
    d) all of the mentioned
11. Architectural design is a creative process satisfying only functional-requirements of a system.
    a) True
    b) False
12. The UML was designed for describing _____
    a) object-oriented systems
    b) architectural design
    c) SRS
    d) Both object-oriented systems and Architectural design
13. At Conceptual level Class diagrams should include
    a) operations only
    b) attributes only
    c) both operations and attributes
    d) none of the mentioned
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    a) operations only
    b) attributes only
    c) both operations and attributes
    d) none of the mentioned

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15. Select the statement true for activity diagrams.
    a) They can be used to discover parallel activities
    b) They are used to depict workflow for a particular business activity
    c) Activity diagram do not tell who does what and are difficult to trace back to object models
    d) All of the mentioned
16. Which of the following are the valid relationships in Use Case Diagrams
    a) Generalization
    b) Include
    c) Extend
    d) All of the mentioned
17. Which diagram in UML emphasizes the time-ordering of messages?
    a) Activity
    b) Sequence
    c) Collaboration
    d) Class
18. Which of the following term is best defined by the statement:"a structural relationship that specifies that objects of one thing are connected to objects of another"?
    a) Association
    b) Aggregation
    c) Realization
    d) Generalization
19. Which of the following UML diagrams has a static view?
    a) Collaboration
    b) Use case
    c) State chart
    d) Activity
20. Software Testing with real data in real environment is known as
    a) alpha testing
    b) beta testing
    c) regression testing
    d) none of the mentioned
21. Beta Testing is done by
    a) Developers
    b) Testers
    c) Users
    d) All of the mentioned
22. By collecting _____ during software testing, it is possible to develop meaningful guidelines to halt the testing process.
    a) Failure intensity
    b) Testing time
    c) Metrics
    d) All of the mentioned
23. In which testing level the focus is on customer usage?
    a) Alpha Testing
    b) Beta Testing
    c) Validation Testing
    d) Both Alpha and Beta
24. Which of the following is non-functional testing?
    a) Black box testing
    b) Performance testing

c) Unit testing
d) None of the mentioned

25. Unit testing is done by
a) Users
b) Developers
c) Customers
d) None of the mentioned

26. Which of the following is NOT a key aspect of project management?
a) Risk management
b) Quality management
c) Time management
d) Code optimization

27. Refactoring is used to:
a) Add new features to the software
b) Optimize the performance of software
c) Improve the internal structure of the software without changing its external behavior
d) Correct software bugs

28. What is the primary purpose of a sequence diagram?
a) To define the structure of a system
b) To illustrate the dynamic behavior of a system
c) To model the data flow in a system
d) To outline the deployment of components in a system

29. Which diagram is used to show interactions between a system and its environment?
a) Use case diagram
b) Class diagram
c) Sequence diagram
d) Activity diagram

30. What is a user story in Agile methodology?
a) A detailed technical document
b) A high-level description of a feature from the end-user perspective
c) A list of tasks for the development team
d) A project management tool

31. What is the primary purpose of software architecture?
a) To provide detailed design specifications
b) To describe the high-level structure of a software system
c) To outline the programming languages to be used
d) To document the user interface design

32. Which of the following is NOT typically a concern of software architecture?
a) System organization
b) Performance optimization
c) Data structure selection
d) Communication between components

33. In a layered architecture, what is the primary function of the business logic layer?
a) To manage user interface interactions
b) To handle the core functionality and business rules of the system
c) To manage data storage and retrieval
d) To ensure network connectivity

34. Which of the following best describes a client-server architecture?
a) A system where components are organized in layers with each layer providing services to the one above it

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b) A distributed system model where a server provides services to multiple client machines
c) A system where components are organized in a pipeline, each processing a stream of data
d) A system where each service is independent and communicates via message passing

35. Which architectural pattern is often used in data processing applications where the same processing steps are applied to multiple data streams?
a) Layered architecture
b) Client-server architecture
c) Pipe and filter architecture
d) Microservices architecture

36. In a repository architecture, which component is responsible for managing data storage?
a) Data repository
b) Client
c) Server
d) Filter

37. Which type of architecture is particularly well-suited for developing systems that must handle complex user interfaces and user interactions?
a) Layered architecture
b) Model-View-Controller (MVC) architecture
c) Microservices architecture
d) Client-server architecture

38. In a Model-View-Controller (MVC) architecture, what is the primary responsibility of the Controller?
a) To manage the data and business logic
b) To handle user input and interactions
c) To render the user interface
d) To store application data

39. Which of the following is a disadvantage of a monolithic architecture?
a) Easier to scale horizontally
b) Greater ease of understanding the system structure
c) Difficult to isolate services for independent deployment
d) Simplified communication between components

40. What is an architectural view?
a) A detailed algorithmic description of a software function
b) A representation of one aspect of the architecture
c) The final implementation of the architecture
d) A testing strategy for the software architecture

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Fundamentals of Software Engineering (CS2004)

Final Exam

Total Time (Min): 130
Total Marks: 60
Total Questions: 4

Date: June 01 2024
Course Instructor(s)
Ms. Ansa Liaqat

22L-7556 Roll No
BDS-4A Section
Student Signature

Do not write anything on the question paper except the information required above.

Instructions:

1. Read the question carefully, understand the question, and then attempt your answers in the provided answer booklet.
2. Verify that you have **Four (4)** printed page of the question paper including this page. There are **Four (4)** questions.

CLO#5: Design architecture of a software system by choosing the most appropriate architecture styles

Question2: **[15 Marks]**

Mobile Robotics System

This case study explores a mobile robotics system for applications such as space exploration, hazardous waste disposal, and underwater exploration. It controls manned and semi-manned vehicles using advanced software to interact with external sensors and actuators, ensuring real-time responsiveness and managing motion and path planning under unpredictable conditions.

Application Scenarios

1. Space Exploration: Robots autonomously navigate extraterrestrial terrains, collect samples, and avoid obstacles.
2. Hazardous Waste Disposal: Robots handle toxic materials with precise control and robust safety mechanisms.
3. Underwater Exploration: Robots operate under water, dealing with pressure, limited visibility, and dynamic currents.

Software Requirements

The software must:

Integrate External Sensors and Actuators: Process data from sensors (e.g., cameras, LIDAR) to control movements.

Ensure Real-Time Responsiveness: React quickly to environmental changes and commands.

Acquire Sensor Inputs, Control Motion, and Plan Paths: Continuously gather data, adjust movements, and strategize based on current and predicted scenarios.

Design Considerations

1. Accommodate Deliberate and Reactive Behavior: Balance pre-planned actions with the ability to react to unforeseen events.
   - Example: A Mars rover follows a set route but detours around newly discovered obstacles.
2. Allow for Uncertainty: Operate effectively with incomplete or contradictory sensor information.
   - Example: An underwater robot maps surroundings despite fluctuating sonar readings.
3. Account for Dangers: Maintain safety and high performance under adverse conditions.
   - Example: A robot in a nuclear waste site operates safely despite radiation exposure.
4. Give Design Flexibility: Support frequent experimentation and reconfiguration.
   - Example: Modular software allows easy updates to sensors or control algorithms.

To Do: Sketch an appropriate software architecture and explain how you would assign key functionalities to the components.

CLO#6: Learn to test the software system

Question 3: **[8+6+6=20 Marks]**

Estimating the Environmental Quality Index (EQI)

An environmental application estimates the Environmental Quality Index (EQI) of a country by considering its Greenhouse Gas Emissions (GGE) in million metric tons (0.0 – 500.0, 500.0+), its Renewable Energy Usage (REU) as a percentage (0.0 – 25.0, 25.1 – 75.0, 75.1 – 100.0), its Air Quality Index (AQI) (good, poor), and its Population Density (PD) (very low, low, medium, high, very high). The EQI estimation module of this application uses the estimates shown in the table below.

Table 1: EQI Estimation

GGE Range (million metric tons)	REU Range (%)	AQI	PD	EQI Estimate
0.0 – 500.0	0.0 – 25.0	Good	Very Low	Very High Quality
0.0 – 500.0	0.0 – 25.0	Good	Low	High Quality
0.0 – 500.0	0.0 – 25.0	Good	Medium	Moderate Quality
0.0 – 500.0	0.0 – 25.0	Good	High	Low Quality
0.0 – 500.0	0.0 – 25.0	Good	Very High	Very Low Quality
0.0 – 500.0	0.0 – 25.0	Poor	Any	Low Quality
0.0 – 500.0	25.1 – 75.0	Good	Any	Moderate Quality
0.0 – 500.0	25.1 – 75.0	Poor	Any	Low Quality
0.0 – 500.0	75.1 – 100.0	Any	Any	High Quality
500.0+	Any	Any	Any	Very Low Quality

Use ECP and BVA to fill out the following three tables for black-box testing of the above module.

ECs and BVA for Black-Box Testing:

Variable	Valid ECs	Representing values	Invalid ECs	Representing values for invalid ECs
GGE				
REU				
AQI				
PD				

Test Cases:

For Valid ECs:

Test case no.	GGE	REU	AQI	PD	Test case results (EQI)
1					
2					
3					
4					
5					
6					

For Boundary Values:

Test case no.	GGE	REU	AQI	PD	Test case results (EQI)
7					
8					
9					
10					
11					
12					

Question 4: **[10+3+2=15 Marks]**

For the following program:

1. Draw Control Flow Graph
2. Find the Cyclomatic Complexity. Please state all formulas as well which is used the determine the cyclomatic complexity.
3. Write all identified paths.

Program to do binary search (Note: All code block has 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]
```

CLO#3: Learn to model the requirements of software system

Question5: **[10 Marks]**

Consider the following simplified description of a university where professors teach seminars in which students can enroll. A professor has a name, address, phone number, email address, and salary. A student has also a name, etc., but no salary (sorry). A student, however, has an average mark (of the final marks of his or her seminars). A seminar has a name and a number. When a student is enrolled in a seminar, the marks for this enrollment are recorded and the current average as well as the final mark (if there is one) can be obtained from the enrollment. From a student one can obtain a list of seminars he or she is enrolled in. Professors teach seminars. Each seminar has at least one and at most three teachers. There are two types of seminars: bachelor and master. From a bachelor seminar student cannot withdraw. From a master seminar they can. Draw a class diagram for this university. Visibility modifiers (public, private, etc.) are not required.