

[This question paper contains **8** printed pages.]

Your Roll No.:

Sr. No. of Question Paper : **15064**

Unique Paper Code : 2932812402

Name of the Paper : Software Engineering

Name of the Course : B. Tech. CSE

Semester : IV

Duration: 3 Hours

Maximum Marks: 90

Instructions for Candidates

1. Write your Roll No. on the top immediately upon receipt of this question paper.
2. Attempt **five** questions in all, including **question no. 1**, which is **compulsory**.
3. Non-programmable scientific calculator is allowed.
4. **All** questions carry equal marks.

Questions

- 1.(a)** A medical startup is developing a high-stakes, robotic surgical assistant. Identify which one of the Waterfall, Spiral, and V&V models is most suitable for this project. Justify your choice by writing one specific advantage of the chosen model and one major limitation of each of the other two models in this specific context.
- 1.(b)** During development, a team working in Scrum model, encounters a major technical roadblock: the DatabaseSync feature is significantly more complex than the initial requirements suggested, making the current Sprint goal unattainable. How does a traditional model and an Agile model differ in their approach to handling such a technical discovery?

- 1.(c)** You are designing a Weather Monitoring System where a *Sensor Data Component* must communicate with a *User Dashboard Component* via an API. To ensure the system is maintainable and scalable, you must apply standard interface design principles. Identify whether Synchronous or Asynchronous communication is better suited for a scenario where the sensor sends updates every second. Justify your choice based on system performance.
- 1.(d)** A Smart Cafeteria system allows Students to order meals. The system must also interface with an external Bank API to process payments and allow a Kitchen Staff member to update the menu. For the "Order Meal" use case, write a single User Story in the format "As a ..., I want... so that...".
- 1.(e)** You are tasked with testing a new AI-driven Recommendation Engine. Between Black-box and White-box testing, which strategy is more appropriate for validating the final recommendations of this engine? Justify, in under two lines, your choice.
- 1.(f)** During the development of a high-performance database engine, your engineering team identifies a critical technical risk: the third-party compression library you planned to use may not meet the required data throughput speeds under heavy load. How the team would go about if it implements Risk Mitigation strategy.

(3 × 6 = 18)

- 2.(a)** An aerospace company is commissioned to develop a Flight Control System for a new commercial aircraft. The project is characterized by extremely high complexity, zero tolerance for failure, and requirements that are 100% fixed by international aviation authorities before development begins. However, the related hardware is being developed simultaneously with the software and may experience slight delays.
- I. How does the Waterfall model's lack of overlapping phases complicate the problem due to simultaneous development of hardware and software?
 - II. How can the team adapt the pure Waterfall approach such that the stringent requirements, integration of hardware and software, and the development restrictions are met?

(3+6=9)

2.(b) You are the Lead Architect for a startup developing an Autonomous Drone Delivery System for medical supplies in a crowded urban environment. The project is currently in the initial phase, and your team is struggling with scope creep and conflicting stakeholder demands.

- I. Provide three examples for Functional requirements.
- II. Identify two major Requirements Engineering challenges likely to occur in this urban drone scenario. For one of the challenges, propose a technical strategy (*hint: fail-safe mode*) you would implement during the design phase to prevent a catastrophic failure.

(3+6=9)

3.(a) You are tasked with modeling a Digital Healthcare Management System. The system must handle Patients and Doctors.

- All *Users* (both Patients and Doctors) have a Name and an ID.
- *Patients* track their Medical History, while *Doctors* have a specific Specialization.
- A *Doctor* can treat multiple *Patients*, and a *Patient* can be assigned to multiple *Doctors* (for consultations).
- The system must support operations such as $K; @ = \langle MD = HHGAFLE = FLir$ and $MH < 9L = 0 = ; GJ < ir$.

Draw a complete Class Diagram for this scenario ensuring correct notation for attributes, operations, and relationships. (9)

3.(b) A rapidly growing fintech startup is moving from a localized e-Wallet to a high-scale

International Payment platform. The system must handle:

- Real-time currency conversion.
- Independent scaling for the Transaction Engine vs. the Customer Support Chat.
- Strict security layers to protect sensitive banking data.
- A cross-platform interface - mobile and web - that fetches data from a central database.

- I. Select the most appropriate architecture - Layered or Microservices - for this specific scenario. Justify, in under two lines, why this choice is superior to the other regarding scalability and independent deployment.
- II. Even within your chosen architecture, how does the Client-Server model still play a role in how users interact with the platform. (3+6=9)

4.(a) You are the Project Manager for a high-budget mobile banking application. The project is behind schedule and the Testing Phase has just begun. You have a fixed remaining budget and a non-negotiable launch date in three weeks. Your Lead Quality Assurance (QA) suggests two options:

- A: Exhaustive manual testing of every single UI element and edge case.
- B: Developing an automated Regression Suite for core transaction logic and performing targeted Unit Testing on new features.

- I. Choose between options A and B. Justify your choice based on the Return on Investment (RoI).
- II. Propose a strategy to prioritize which modules to test first - based on Value and Risk - if the remaining three weeks are not enough to cover the entire system.

(3+6=9)

- 4.(b)** You are investigating a critical module of an Automated Braking System (ABS). The following code snippet determines if the emergency brakes should be engaged based on the distance to an obstacle and the current speed:

```
HM: DA; String evaluateBrakeSystem(<GM:D= distance, <GM:D= speed) {
```

```
    A> (distance < 10) {
```

```
        A> (speed > 50) {
```

```
            J=LMJF "EMERGENCY_STOP";
```

```
        } =DK= {
```

```
            J=LMJF "FULL_BRAKE";
```

```
        }
```

```
    } =DK= A> (distance >= 10 && distance <= 50) {
```

```
        J=LMJF "DECELERATE";
```

```
    }
```

```
    J=LMJF "MAINTAIN_SPEED";
```

```
}
```

Draw a Control Flow Graph (CFG) and list all the independent paths through the function. (9)

- 5.(a) You are a Quality Assurance Lead evaluating two different modules of a project. You have collected the following product metrics:

Metric	Baseline	Module A
Cyclomatic Complexity $V(G)$	8	42
Lines of Code	500	2500
Comment Density (comments/KLoC)	0.80	0.15
Defect Density (errors/KLoC)	0.4	5.80

- I. What does the metric $V(G)$ indicate?
- II. How does the combination of comment density and defect density impact the maintainability of Module A?
- III. Should Module A be accepted or should it be refactored? If you recommend it be *accepted*, provide a technical justification for why its current metrics are acceptable. If you recommend it be *refactored*, give one risk to the project's long-term quality that would occur if the module were deployed in its current state.

(1+2+6=9)

- 5.(b)** A company has been successfully running its payroll software for five years. The Lead Engineer argues that even if there are no bugs to fix, the team must still invest in software evolution. Give two reasons why this software system must undergo evolution. (9)

- 6.(a)** You are the Project Manager for a high-priority automated Logistics System. The client has provided a rough set of requirements. Your team is now in the Planning phase. You must decide between two estimation techniques - Process-Based Estimation and Empirical Estimation Models.

- I. Compare Process-Based Estimation with Empirical Estimation Models. (Just give three points each for comparison.)
- II. Suppose your team is using a recently launched technology stack with no historical data, which method would you choose?

(3+6=9)

6.(b) Suppose you have an idea for a software-based solution for a problem in your local community.

- I. Describe the project idea in under two lines.
- II. Identify one major Technical Risk and one major Financial Risk that could lead to project failure.
- III. Based on the complexity of your project, which estimation technique - Process-Based, Empirical, or LOC-based - would you use to determine the budget and timeline? Justify your choice based on how it helps to minimize financial risk.

(1+2+6=9)

(300)