Exam Guide

Dear Students,

These are some of the questions for the guide to assist you in preparing for the exam. However, you are also required to spend too much in the following chapter: Requirements, System models, software design (all UML diagrams) and software testing because there are several questions asked in final exam which are not included in this Guide.

Question 1
A university intends to build a **Student Academic Performance Prediction System** using machine learning. The requirements are well understood initially, but the ML model needs continuous refinement based on new data and user feedback. The university wants frequent demonstrations of progress every two weeks.
Which software process model is MOST suitable for this project?
A. Waterfall Model
B. Spiral Model
C. Agile Scrum
D. V-Model

Question 2
A national health agency plans to develop a **COVID-19 outbreak prediction system** with high security and data integrity requirements. Early phases must focus on identifying risks such as accuracy, privacy, and model failures.
Which process model best suits this scenario?
A. Spiral Model
B. Iterative Model
C. RAD Model
D. Prototyping Model

Question 3
A company develops an **online banking system**. The QA team checks whether each module complies with design documents, while a separate validation team ensures that customers' realistic scenarios (e.g., login, funds transfer) work correctly.
Which statements describe these activities?
A. Verification = "Are we building the right product?"
B. Validation = "Does the system meet the specifications?"
C. Verification = Comparison with design; Validation = Comparison with user needs
D. Verification includes beta testing by users

Question 4
AUCA plans to develop a Smart Campus Attendance System (SCAS) that uses RFID student cards, mobile facial recognition, and cloud-based analytics to automate attendance tracking for lectures, laboratories, and examination halls. The system must

integrate with the university's existing Learning Management System (LMS) and Enterprise Resource Planning (ERP) system.

The university hires Initiative Tech Solutions (ITS) Ltd as an external software development company, to design and implement SCAS within nine months.

During the requirements phase, students request real-time notifications whenever their attendance is recorded. Lecturers want a dashboard that displays attendance trends and automatically submits attendance to the registration office. The registration office requires strict security to prevent impersonation or attendance fraud. The head of ICT emphasizes that the system must support 10,000 concurrent users and must continue functioning even if one server fails.

During a project review meeting, the development team reports delays due to frequent requirement changes, unclear acceptance criteria, and difficulties integrating Radio Frequency Identifier (RFID) data with the facial recognition module. From the above scenario, answer the following questions:

1. **Which of the following best describes the non-functional requirement in the scenario?**
a. Students requesting real-time attendance notifications.
b. Lecturers wanting an attendance dashboard.
c. Support for 10,000 concurrent users and server failure tolerance.
d. Automatic submission of attendance to the exam office.

2. **The difficulty integrating RFID data with facial recognition is primarily a challenge in which software engineering activity?**
a. Requirements elicitation.
b. System integration and testing.
c. Project risk monitoring.
d. Feasibility study.

3. **Frequent requirement changes from stakeholders indicate that the project would benefit most from which development model?**
a. Waterfall Model
b. V-Model
c. Agile (e.g., Scrum)
d. Spiral Model

4. **The exam office's request for strict security is best captured as which type of requirement?**
a. Functional requirement
b. Architectural requirement
c. Performance requirement
d. Non-functional requirement

5. **The need for the system to keep running even if one server fails reflects:**
a. Availability requirement
b. Portability requirement
c. Maintainability requirement
d. Usability requirement

6. **Lack of clear acceptance criteria will most negatively affect which of the following?**
a. Design validation
b. User acceptance testing

c. System architecture modeling
d. Code refactoring
7. Which risk category best matches the delays caused by unclear requirements and frequent changes?
a. Technology risk
b. People risk
c. Requirements risk
d. External risk
8. Which UML diagram would be most appropriate to show interactions between RFID readers, the facial recognition module, and the attendance server?
a. Use-case diagram
b. Activity diagram
c. Sequence diagram
d. Class diagram
9. The registration office requests strict controls to prevent impersonation or attendance fraud. Which quality attribute is emphasized?
a. Reliability
b. Usability
c. Security
d. Accessibility
10. When the system is deployed, which testing technique should be used to ensure that it can handle 10,000 concurrent users?
a. Regression testing
b. Load testing
c. Alpha testing
d. Unit testing

Question 5

The AUCA plans to digitize its entire Gishushu campus operations by developing a Smart Campus Management System (SCMS**)**. The system must integrate student registration, course management, hostel allocation, smart ID card access, automatic attendance tracking using RFID, digital payment for cafeteria services, and a campus-wide notification service. Students will register online, receive a digital ID, view allocated courses, and check their attendance. Lecturers will manage course materials, submit attendance, and issue assessments. Administrators will oversee student records, fees, staff profiles, and campus resources.
The system must interact with external services such as mobile money APIs, biometric scanners, and the national student verification database. Different user roles—students, lecturers, administrators, and support staff—must be authenticated differently. Data consistency and real-time synchronization are required across departments. The system must support high availability and offline-to-online syncing when network connectivity is poor.
Task:
Design the system using UML. Provide the following UML diagrams:
    1. Use-Case Diagram showing all actors and major use cases
    2. Class Diagram with attributes, methods, and relationships

3. Sequence Diagram for "Student Course Registration" and "Biometric Attendance"
4. Activity Diagram for the "Hostel Allocation Process"
5. Deployment Diagram showing servers, databases, and external systems

Question 6

A University Teaching Hospital-Kigali (CHUK) wants a digital Telemedicine Platform allowing patients in rural areas to consult doctors remotely. Patients book appointments using a mobile app, describe symptoms, and upload medical documents. Doctors review patient history, conduct video consultations, prescribe medications, and request lab tests. The system automatically sends electronic prescriptions to partner pharmacies and receives lab test results from accredited laboratories.

The platform should integrate Artificial Intelligent (AI)-based symptom checking, secure payment processing, and an emergency alert button that immediately shares GPS location with the nearest ambulance service. Patient data must be encrypted in transit and at rest. Nurses, doctors, pharmacists, system administrators, and lab technicians each have different access rights. The system must log all activities for auditing and comply with health data privacy laws.

Task:
Develop UML diagrams including:
- Use-Case Diagram
- Class Diagram
- Sequence Diagram for "Video Consultation"
- Activity Diagram for "Lab Test Request and Result Handling"
- State Machine Diagram for "Patient Appointment Lifecycle"
- Deployment Diagram for mobile app, cloud servers, and third-party systems

Question 7

A startup plans to build a large-scale **multi-vendor e-commerce marketplace** where sellers can register, upload products, manage orders, and monitor sales analytics. Buyers browse products, add items to their cart, pay using multiple gateways, track orders in real time, and communicate with sellers via integrated chat. The system must support dynamic discounting, product recommendations, and an Artificial Intelligent (AI) fraud detection module.

Orders must pass through several stages: placed, confirmed, packed, shipped, delivered, or returned. Logistics partners update delivery status through APIs. Administrators handle dispute resolutions, refunds, and platform-wide configurations. Sellers have dashboards for revenue analytics and stock forecasting.

Task:
Develop the required UML diagrams:
1. Use-Case Diagram showing administrators, sellers, buyers, and logistics partners
2. Class Diagram detailing product, order, payment, cart, and seller modules
3. Sequence Diagrams for "Order Placement" and "Refund Process"
4. Activity Diagram for "Seller Product Upload Workflow"
5. Component Diagram for system architecture
6. Deployment Diagram showing cloud infrastructure

Question 8

A transportation authority wants to implement a real-time ticketing and fleet management system for buses across the city. Passengers should pay using smart cards, QR codes, mobile money, or NFC. Bus drivers authenticate at the start of a shift, check route

assignments, and monitor passenger count. Each bus is equipped with GPS to provide real-time location tracking, speed monitoring, and breakdown reporting.

Inspectors must verify tickets using handheld devices. The system should detect route violations, over-speeding, and unauthorized halts. A central control center monitors all buses and generates operational reports. Integration with weather forecasts and city-wide traffic systems is required for route optimization.

Task:

Design the UML diagrams:
1. Use-Case Diagram
2. Class Diagram
3. Sequence Diagram for "Passenger Ticket Validation"
4. Activity Diagram for "Bus Breakdown Handling"
5. State Machine Diagram for "Bus Operational States"
6. Deployment Diagram for onboard devices, cloud servers, and control center systems

Question 9

A cooperative of farmers from Nyagatare wants to automate irrigation across large farmlands using IoT sensors, drones, and cloud analytics. Soil moisture sensors, rainfall detectors, and temperature monitors send data to the cloud. The system recommends irrigation cycles and can automatically activate water pumps based on predefined thresholds. Farmers access the system through mobile apps to monitor farm conditions, manage irrigation schedules, and receive alerts for anomalies. The system must support multi-farm management, role-based access, remote pump control, drought prediction analytics, and maintenance scheduling for sensors and equipment.

Task:

a. Use-Case Diagram

b. Class Diagram representing sensors, actuators, analytics engine, and user modules

c. Sequence Diagram for "Automatic Irrigation Triggering"

d. Activity Diagram for "Sensor Maintenance Workflow"

e. Deployment Diagram showing IoT gateways, cloud servers, and mobile clients

Question 10

Nyereka Tech as one of startup operating in Rwanda is creating embedded software for smart thermostats that communicate with a mobile app. The software must be energy-efficient, secure, and compatible with multiple Internet of Things (IoT) devices.

a. Identify the challenges in using a traditional software process model versus an iterative or agile model for embedded systems.

b. Suggest a hybrid software process model and justify your selection.

c. Describe how requirements elicitation would work when both hardware and software constraints exist.

Question 11

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thresholds. Farmers access the system through mobile apps to monitor farm conditions, manage irrigation schedules, and receive alerts for anomalies.

The system must support multi-farm management, role-based access, remote pump control, drought prediction analytics, and maintenance scheduling for sensors and equipment.

Task:

Create the following UML diagrams:

1. Use-Case Diagram
2. Class Diagram representing sensors, actuators, analytics engine, and user modules
3. Sequence Diagram for "Automatic Irrigation Triggering"
4. Activity Diagram for "Sensor Maintenance Workflow"
5. Deployment Diagram showing IoT gateways, cloud servers, and mobile clients

Question 12

A health management system is being developed to record patient data, schedule appointments, and generate reports for hospital administrators. During V&V meetings, the project manager emphasizes the need to ensure the system meets both the design specifications and user expectations.

a. Explain the difference between verification and validation using examples from this system.

b. Describe two activities for verification and two for validation that should be performed during the SDLC.

c. Discuss the consequences of skipping validation in this scenario.

Question 13

Bank of Kigali wants a comprehensive loan management system where customers submit applications online, upload supporting documents, and track loan status. Loan officers verify information, credit analysts evaluate credit scores, and managers approve or reject applications. The system must automatically detect fraudulent submissions using machine learning and cross-check documents with national ID and employment databases.

The system also manages repayment schedules, penalty calculations, loan restructuring, and early settlement. Notification services must alert customers of approvals, rejections, due dates, or missed payments.

Task:

Provide UML diagrams:

1. Use-Case Diagram
2. Class Diagram
3. Sequence Diagram for "Loan Application Evaluation"
4. Activity Diagram for "Fraud Detection Workflow"
5. State Machine Diagram for "Loan Lifecycle"
6. Deployment Diagram for bank data center infrastructure

Question 14

The Adventist University of Central Africa is a Seventh-day Adventist institution of higher learning near two campuses in Kigali, Rwanda. It is a part of the Seventh day Adventist education system, the world's second largest Christian school system. It has a philosophy to operate on the basis of the Seventh-day Adventist worldview:" God is the Creator and Sustainer of the universe and the source of true knowledge. The entrance of sin caused man's alienation from God, therefore the restoration of the relation between man and his God is the main aim of Adventist Christian Education that leads students to

discover and understand the truth through critical thinking. The University was founded in 1978. The official opening took place on 15 October 1984 and the university had its definitive operating license via the law n0 0056/05 of 3rd February 1988, granting AUCA the legal personality as a nonprofit making association. This university is the largest Adventist University serving the French speaking parts of Africa. In 2015, it had about 4,000 students. Its mission is to provide Christ-centered quality-education founded on holistic approach that prepares people for the service of this life and the life to come. The vision of the AUCA is to be a center of excellence in undergraduate and graduate programs. Quality shall be the hallmark of all its undertakings, including research and service delivery to its students, faculty, staff and the community at large.

AUCA is seeking an enhanced solution that automates Library Management System. You are hired as a System developer/Analyst (SD/A) to develop a new Library Management System. Proposed system will help to maintain all records of the library such as several available books in the library, the number of issued books or returning a book, etc. It also helps to maintain a database of all issue books and available in the library. So, teachers and students can check the online available book in the mobile application and also check the status of the book as available in the library, borrowed, and reserved. You are responsible for managing the project including analysis and designing stage of the new system. Being a System Analyst, you are suggested to use modern software development model in developing the library Management System   Features to be included in your proposed project are:

1. Simple and easy to use.

2. Highly Secure, Scalable & Reliable.

3. Save Time for manual work for data entry.

4. Manage Multiple Library.

5. Cost-Effective

Also consider feasibility study and non-functional requirements after discussion with your development team.

Task:

As a part of your responsibility, you are required **to prepare a report** that describes different software development cycles. Your report must include the following:

1. Description of predictive and adaptive software development models considering at least two iterative and two sequential models.
2. The risks involved in each of the models and how the risk can be mitigated /managed in each model by taking a reference of the spiral model. Once you have prepared the report you are required to produce documentation.
3. Describe with an example why a particular life cycle model is selected for a development environment. You may consider a different development environment with different business logics, platform, etc., and the applicability of the particular software development model over the development environment.
4. Assess the merits of applying the waterfall model to a large software development project with appropriate evidenced researched work with reference to the current context.

All the best