INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF SCIENCE AND TECHNOLOGY

END OF SEMESTER EXAMINATIONS - AUGUST 2025

PROGRAMME: BIT
YEAR/SEM: YEAR 3/SEMESTER 1
COURSE CODE: BIT3107
NAME: PRINCIPLES OF SOFTWARE ENGINEERING

DATE:
TIME:

INSTRUCTIONS TO CANDIDATES:

SECTION A

Attempt All Questions

Question 1:

SafeMeds Uganda Ltd is a local company that sells medicines to clinics and hospitals. They have started using computers to manage stock, record sales, communicate with customers, and protect their data. The company wants to understand more about different types of software they are using or should use.

Questions:

A. What is software? Give two examples of software that a company like SafeMeds might use.
(4 marks)

B. Explain the difference between **system software** and **application software**. Give one example of each that SafeMeds would need.
(6 marks)

C. What does system software do for a computer?

D. What does application software help the user to do?

E. What is **application software**? List and explain **three types** of application software that could help SafeMeds in daily business activities (e.g., sales, communication, report writing).
(6 marks)

F. What is **utility software**? Why is it important for the company?

(4 marks)

G. Mention and explain **two examples** of utility software that help in protecting or cleaning the system.

H. Define **backup software**.
(2 marks)

I. Why is it important for SafeMeds to back up its sales and patient data regularly?
(2 marks)

J. What is the difference between **custom-written software** and **off-the-shelf software**?
(4 marks)

K. Which one would be better for SafeMeds to track their unique medicine inventory? Give a reason for your answer.
(2 marks)

Software can be grouped into different categories. List and explain **four categories** of software with one example for each that could be used in the company.
(10 marks)

Question 2:

BrightWave High School received computers from a donor and wants to set up a computer lab for teaching and administration. The school

is looking for different types of software to help teachers, students, and staff work better and keep the computers safe.

Questions:

A. What is **application software**? Give three simple examples of application software that the school can use and explain how each would help in the school.
(6 marks)

B. What is **system software**?
(2 marks)

C. Name and describe **two functions** of system software that are important for running the school computers.
(4 marks)

D. What is **utility software**?
(2 marks)

E. List and describe **three types** of utility software that the school should install and explain how each helps keep the computers working well.
(6 marks)

F. The school wants to install some **custom-written software** and some **off-the-shelf software**.

I. What is custom-written software? Give one

advantage and one disadvantage.
(4 marks)

II. What is off-the-shelf software? Give one advantage and one disadvantage.
(4 marks)

III. Which type is better for keeping track of students' attendance and performance? Why?
(2 marks)

G.What is **backup software**?
(2 marks)

H.Why is it important for the school to back up students' records and teacher documents?
(3 marks)

I.Below is a list of different software. Put each one in its correct **category** (System Software, Application Software, Utility Software, or Programming Software) and explain your choice:

- Microsoft PowerPoint
- Windows 10
- Antivirus software
- Scratch programming tool
  (9 marks)

SECTION B

Choose any Three(3) Questions

Question 1:

DFCU Bank has initiated a project to develop a new **loan processing system** aimed at improving efficiency, ensuring regulatory compliance, and minimizing human error. Due to the strict documentation requirements, clear workflow, and minimal expected changes during development, the bank has chosen to adopt the **Waterfall Model** for this project.

Answer the following questions based on the scenario above:

(a) Explain why the Waterfall Model is an appropriate choice for this project. (4 marks)

(b) List and describe the five major stages of the Waterfall Model. (5 marks)

(c) For each of the five stages you mentioned in (b), briefly explain how they would be implemented in the context of the DFCU loan processing system. (10 marks)

(d) Mention one advantage and one limitation of using the Waterfall Model in such a banking project. (1 mark)

Question 2:

The Ministry of Health in Uganda plans to develop a **Digital Disease Surveillance** System to improve the reporting and monitoring of infectious diseases like malaria and cholera across all districts. The project requires a well-structured approach where each phase is completed before the next begins, with clear documentation and approval at every stage due to regulatory requirements and the involvement of multiple stakeholders such as health workers, district officers, and IT teams.

(a) Explain why the **Waterfall Model** would be an appropriate software development methodology for this project.
Give at least two reasons.
(4 marks)

(b) Identify and explain the **five main stages** of the **Waterfall Model** that would be followed in developing the Digital Disease Surveillance System.
(6 marks)

(c) For each stage identified in part (b), describe a specific **activity or task** that the development team would carry out for this health system.
(5 marks)

(d) Draw a labeled diagram of the **Waterfall Model**, showing all the main stages in order.
(5 marks)

Question 3:

Uganda Revenue Authority (URA) wants to quickly launch a **mobile tax filing app** to simplify the tax declaration process for small business owners and individual taxpayers. Given the urgency, they need to involve end-users from the beginning, develop prototypes rapidly, and gather feedback iteratively to ensure the system meets user needs within a short timeframe.

(a) Explain why the **Rapid Application Development (RAD)** model would be suitable for this project.
Mention at least two reasons related to project nature and objectives.
(4 marks)

(b) Identify and describe the **four major phases** of the RAD model that would be applied in developing the mobile tax filing app.
(6 marks)

(c) For each phase identified in part (b), provide a specific **activity or example** relevant to the URA project.
(4 marks)

(d) Discuss **two key advantages** and **two limitations** of using the RAD model in this scenario.
(4 marks)

(e) Illustrate the RAD model with a simple labeled diagram.
(2 marks)

Question 4:

The **Federal Inland Revenue Service (FIRS) of Nigeria** is planning to upgrade its **Taxpayer Registration System** to enhance service delivery and ensure accurate data management. To make sure that the upgraded system aligns with both user needs and business goals, the development team decides to apply the **Joint Application Development (JAD)** technique to gather system requirements collaboratively from key stakeholders, including tax officers, IT experts, and policy makers.

(a) Briefly explain what **Joint Application Development (JAD)** is and why it would be beneficial for FIRS in this situation.
(3 marks)

(b) Identify and describe any **three key roles** involved in a JAD session.
(3 marks)

(c) With reference to the FIRS scenario, describe **two specific activities** that would take place during a JAD session for the upgraded registration system.
(4 marks)

(d) Draw and label a **well-illustrated diagram** showing the **JAD process**, including major roles (e.g., facilitator, users, observers), session structure, and interaction flow.
You may use arrows, symbols, or swimlane-style visuals to represent collaboration and workflow.
(10 marks)

Question 5:

The **Central Bank of Nigeria (CBN)** intends to introduce a new **Mobile Banking App** to

enhance financial inclusion, particularly in rural areas. To ensure the system meets user expectations, the CBN's software development team chooses to use a **Prototyping Model**. The team will create several interactive versions of the mobile app to gather user feedback before building the final system.

(a) Explain what **software prototyping** is and state two reasons why it would be appropriate for this project.
(4 marks)

(b) Identify and describe the **four main stages** of the **Prototyping Model** in the context of the mobile banking app.
(4 marks)

(c) Explain any **two types of prototypes** (e.g., throwaway, evolutionary) and how each could be used in this scenario.
(4 marks)

(d) Draw and label a clear **diagram of the Prototyping Model**, showing all major stages and the feedback loop from users.
You may use arrows, boxes, or visual elements to show process flow and iteration.
(8 marks)

Question 6:

The **East African Health Integration Authority (EAHIA)** is developing a new **Regional Health Insurance Management System** to improve access to healthcare services across East African countries (Kenya, Uganda, Tanzania, Rwanda, Burundi, and South Sudan). The system will allow citizens to:

- Register for regional health insurance
- Access and track their insurance information
- Submit and manage claims
- Make cross-border mobile payments
- Integrate with existing national health systems in each country

Key project requirements include:

- Fast initial release for pilot testing
- User involvement across diverse countries and languages
- Flexibility to adapt to **policy changes and evolving user needs**
- Integration with **legacy hospital and insurance systems**
- Clear **compliance and documentation** for cross-border regulations

Task:

(a) From the following development models — Waterfall, RAD, JAD, Prototyping, Agile, Spiral — **select the most appropriate one** for the EAHIA project.
Clearly justify your choice using relevant aspects from the scenario.
(5 marks)

(b) Compare your selected model with **two other software development models**, explaining how each compares in terms of suitability for the EAHIA project.
(4 marks)

(c) Explain how **user participation** and **requirement flexibility** are managed in the methodology you selected. Provide two examples based on the project needs.
(3 marks)

(d) Draw a **well-labelled diagram** of the software development model you selected, clearly showing the phases and how feedback or iterations occur (if applicable).
Your diagram should visually show how the model supports the needs of a multi-country regional health insurance system.
(8 marks)

Question 7:

The **South Sudan National Health Information System Project** is being developed to digitize health services across the country. The system will allow registered users to:

- Register and log in securely
- Book hospital appointments online
- Access and download their medical records
- Submit national health insurance claims
- Chat with healthcare providers (doctors or nurses)
- Access support in English and local languages

The system must maintain **secure health records**, allow **hospital staff** to manage patient data, and enable **system administrators** to manage users, medical facilities, and insurance claims.

Task:

(a) Draw and label a Use Case Diagram for the proposed system.
Your diagram should include at least four major actors (e.g., Patient, Doctor, Hospital Staff, Administrator) and their interactions with the system's main functions.
Briefly explain the role of a use case diagram in system analysis.
(6 marks)

(b) Draw and label a Level 0 Data Flow Diagram (DFD) representing the main processes of the system (e.g., user registration, appointment booking, claims processing), external entities (e.g., Patient, Insurance Authority), and data stores (e.g., Patient Data, Appointment Records).
Also explain the importance of a DFD in system design.
(6 marks)

(c) Draw a simplified Entity Relationship Diagram (ERD) to represent the system's database.
Include at least four entities (e.g., Patient, Appointment, Doctor, InsuranceClaim), their key attributes, and relationships. Use correct notations such as primary keys and relationship cardinalities.
Briefly explain how an ERD helps in database design.
(6 marks)

(d) explain how these three diagrams (Use Case, DFD, and ERD) complement each other in the **systems development life cycle**.
(2 marks)

Question 8:

Uganda HealthPlus Services Ltd is a growing health-tech company based in Kampala. The company is developing a **Patient Management Information System (PMIS)** to serve clinics and hospitals across the country. As part of a software engineering team, you are responsible for ensuring that the database design and management align with **software engineering principles** such as modularity, maintainability, scalability, and data integrity.

The project must also follow software development best practices including requirements analysis, system design, testing, and maintenance. The system is expected to handle large volumes of patient data, ensure high availability, and enforce strict security protocols.

Answer the following questions :

(a) Explain **three reasons** why using a **Database Management System (DBMS)** supports core software engineering principles like modularity, maintainability, and reliability in large-scale systems like the PMIS.
(3 marks)

(b) As a software engineer, compare **Relational** and **Non-Relational** databases. Which would you recommend for Uganda Health Plus Services Ltd, and how does your recommendation support principles like scalability and consistency?
(4 marks)

(c) List and explain **four key features of database software** that support software engineering goals such as error handling, performance optimization, data validation, and ease of integration.
(4 marks)

(d) Draw a labeled diagram of a **three-tier architecture** (Presentation, Application, Database) for the Patient Management Information System. Explain how this architectural design supports **separation of concerns**, an essential software engineering principle.
(5 marks)

(e) Describe how **data integrity** and **data security** mechanisms in DBMS (e.g., constraints, roles, encryption) contribute to **quality attributes** in software engineering such as correctness, safety, and confidentiality. Provide relevant examples from the PMIS.
(4 marks)

Question 9:

NileTech Solutions, a mid-sized software development company in Uganda, is developing an educational tablet system for rural schools. The system must support different users such as teachers, students, and administrators. These users will interact with the tablet through a friendly user interface. The device must also be capable of running custom-developed educational programs written in a high-level language and compiled for performance. To meet these requirements, the system must be built with appropriate system software components, including a lightweight operating system, efficient compiler, and intuitive user interfaces.

Questions:

(a) Define system software and explain its role in the operation of the educational tablet.
(4 marks)

(b) Identify two main functions of an operating system that would be critical for the educational tablet and justify their importance.
(4 marks)

(c) The tablet must support a user-friendly interface. Describe the differences between **Command Line Interface (CLI)** and **Graphical User Interface (GUI)**. Which would be more suitable for primary school users and why?
(4 marks)

(d) The software development team is using a high-level language to build applications for the tablet.

- What is a compiler?
- Explain how it contributes to system performance and portability.
  (4 marks)

(e) Suggest two reasons why understanding the interaction between system software components is important in designing embedded systems like educational tablets.
(4 marks)

Question 10:

A South Sudan-based startup, **JubaTech Solutions**, is planning to build a web-based e-learning platform to support secondary schools in rural areas. The team is debating whether to adopt **Open-Source Software (OSS)** components, use **proprietary software**, or develop custom-built software from scratch. As the lead software engineer, you are tasked with advising management on the best approach for software acquisition and development.

(a) Define Open-Source Software and explain how it differs from proprietary and custom-built

software.
[4 marks]

(b) Discuss **three advantages** and **two disadvantages** of using Open-Source Software in the context of this project.
[6 marks]

(c) JubaTech is concerned about licensing issues. Explain the concept of **OSS licensing** and differentiate between **copyleft** (e.g., GPL) and **permissive** (e.g., MIT) licenses.
[4 marks]

(d) Propose a **hybrid strategy** that combines open-source, proprietary, and custom-developed components for the project. Justify your choices.
[6 marks]

Question 11:

A South Sudan-based startup, **NileMed Technologies**, is developing a mobile health application to help rural clinics track maternal and child health visits. The software must be user-friendly, secure, and functional in both online and offline environments. The development team is currently in the software engineering process and must go through the stages of design, implementation, testing, and validation to ensure the application meets its requirements.

Questions:

(a) Explain what key activities are involved in the *software design* stage for this mobile health application.
Include aspects such as architectural design, interface design, and data design.
(5 marks)

(b) Identify and describe two major challenges that might be encountered during the *implementation* stage, and suggest how the development team can address them.
(4 marks)

(c) Discuss the importance of *software testing* and outline the different levels of testing the NileMed application should undergo before deployment.
(6 marks)

(d) Define *software validation* and describe how it differs from software verification. Explain two methods that can be used to validate the NileMed mobile application.
(5 marks)

Question 12:

SmartTech Uganda Ltd is a growing software development company that specializes in building custom enterprise applications for clients in East Africa. As part of its digital transformation strategy, the company wants to integrate Artificial Intelligence (AI) technologies into its software engineering processes to enhance productivity, improve software quality, and deliver smarter solutions to its clients.

You are part of a strategic task force formed to explore how AI can be embedded in the company’s software engineering practices.

a) Define the term *Artificial Intelligence (AI)* and explain its relevance in modern software engineering. (4 marks)

b) Identify and describe **three areas** of the software development lifecycle where AI can be integrated. Give one real-world application or tool used in each. (6 marks)
c) Discuss the **benefits and potential risks** of integrating AI into software engineering processes. (4 marks)
d) Propose a roadmap or framework for integrating AI tools into SmartTech’s software development lifecycle, from requirements gathering to maintenance. Highlight any ethical or practical considerations. (6 marks)