INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

**FACULTY OF SCIENCE AND TECHNOLOGY**

**END OF SEMESTER EXAMINATIONS - MAY 2024/2025**

**PROGRAMME: BSSE**

**YEAR/SEM: YEAR 3/SEMESTER 2**

**COURSE CODE: SWE3200**

**NAME: SOFTWARE EVOLUTION**

**DATE: 2025-08-04**

**TIME: 2:00-5:00PM**

**INSTRUCTIONS TO CANDIDATES:**

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

**DO NOT WRITE ANYTHING ON THE QUESTION PAPER**

# Section A Attempt All Questions

### Question 1:

You have been hired by a financial technology (fintech) company that uses old software systems to manage customers, handle transactions, and produce regulatory reports. These systems have been in place for more than 12 years. They are critical to the business but now break down often, cost a lot to maintain, and are hard to update. The company wants to switch to newer technologies like microservices, cloud computing, and faster deployment methods. You are in charge of helping with this modernization process.a)
i. What is meant by software evolution? (2 marks)
ii. What are Lehman's Laws of Software Evolution? (2 marks)
iii. Name four of Lehman's Laws that apply to this case. (4 marks)
iv. For each law you listed, explain how it relates to the fintech company's old systems. (4 marks)b)
i. What is software maintenance? (2 marks)
ii. List and explain four types of software maintenance. (4 marks)
iii. Give one example task for each type based on the fintech company's modernization. (4 marks)c)
i. What is software re-engineering, and how would you use it in this case? (3 marks)
ii. What is code refactoring, and why is it useful here? (2 marks)
iii. What is reverse engineering, and when would you apply it in the modernization process? (2 marks)
iv. Why is version control important when modernizing a system? (2 marks)
v. How can containerization (e.g., Docker) help in this modernization? (3 marks) d)
i. Mention two technical risks that could happen during modernization. (2 marks)
ii. Mention two organizational challenges that the company may face. (2 marks)
iii. Suggest one way to reduce each of the risks and challenges. (2 marks)

# Section B Choose any Three(3) Questions

### Question 1:

You are working on a school project with your team to build a simple web application. You decide to use **Git** for version control and **GitHub** to store your project online. Each team member is working on different parts of the project using different branches. Later, you plan to package the app using **Docker** and deploy it using **Kubernetes**.Answer the following questions: **a)** What is Git, and why is it useful in a group project like this? *(3 Marks)*
**b)** What is a Git branch, and why should team members use different branches for their tasks? *(3 Marks)*
**c)** What is a merge conflict in Git, and how can it be fixed in a simple way? *(3 Marks)*
**d)** What is the difference between GitHub, GitLab, and Bitbucket? Give one reason why GitHub is commonly used by students. *(4 Marks)*
**e)** What is Docker, and how does it help in running the web application the same way on every computer? *(4 Marks)*
**f)** What is Kubernetes, and why would it be helpful when the project grows and needs to run on many computers? *(3 Marks)*

### Question 2:

You have been hired by **TechRevamp Ltd**, a Ugandan software company that maintains a legacy inventory management system used across multiple districts. The system was developed over a decade ago and has become increasingly difficult to maintain due to poor documentation, frequent bugs, and growing customer demands for new features. The management has tasked your software engineering team with improving the codebase through re-engineering and refactoring practices without changing its core functionality.**Questions:** a) Describe **four key steps** you would follow during the **software re-engineering process** to improve the system's maintainability. *(4 marks)*
b) Identify **three common code smells** you are likely to encounter in such a legacy system and propose a

**suitable refactoring technique** for each. *(6 marks)*
c) Recommend one refactoring tool (e.g., IntelliJ IDEA, PyCharm, or VS Code) and explain **how it can assist in the refactoring process**, especially for identifying and correcting code smells. *(4 marks)*
d) Explain the role of **automated refactoring** and **static analysis tools** in improving code quality, giving one example of each. *(6 marks)*

## Question 3:

**Uganda Revenue Authority (URA)** is planning to implement a new tax management information system to streamline tax registration, filing, and payment processes across the country. The project team decides to use the **Joint Application Development (JAD)** approach to gather requirements and ensure user involvement from various departments including compliance, IT, customer service, and finance.**As a software engineering consultant**, you have been asked to facilitate the process using the JAD model.**Required:a)** Briefly explain the main purpose of using the JAD model in this system development context. (3 Marks)**b)** Identify and describe the roles of any **four key participants** involved in a JAD session for this project. (4 Marks)**c)** Draw a labeled diagram showing the **step-by-step process** of the JAD model, from project initiation to final approval. (6 Marks) **d)** Explain what happens in each step of the JAD process you have illustrated in part (c), linking each step to how it would be applied to the URA tax system project. (7 Marks)

## Question 4:

**Uganda Revenue Technology Authority (URTA)** has been using a legacy tax processing system developed in the early 2000s. The system has become increasingly difficult to maintain due to outdated technology, limited support, and the lack of proper documentation. With the need for digital transformation and improved service delivery, URTA is considering various modernization approaches to upgrade the system without disrupting critical tax services.**Questions:**
**(a)** Define what is meant by a legacy system and describe two *technical* and two *business* challenges URTA is likely facing with their current legacy tax system.
*(6 marks)***(b)** Explain how the following modernization strategies can be applied to URTA's system:
i. Reverse engineering
ii. Migration
iii. Encapsulation
*(6 marks)***(c)** Discuss how the lack of documentation and outdated technologies in URTA's system may affect the success of their modernization efforts.
*(4 marks)* **(d)** Suggest two key considerations URTA should keep in mind when planning for the modernization of mission-critical systems like tax processing platforms.
*(4 marks)*

## Question 5:

Uganda Revenue Systems Ltd (URSL), a government-affiliated agency, has been relying on a Java-based legacy system developed in the early 2000s to manage taxpayer registration and record-keeping. Over the years, the system has become increasingly difficult to maintain, lacks integration capabilities with modern applications, and contains complex legacy code that newer developers struggle to understand. As part of its digital transformation agenda, URSL has initiated a project to modernize the system using a phased strategy.
**Questions:(a)** Describe four key characteristics of legacy systems that may be applicable to the URSL system.
*(4 Marks)***(b)** Identify and explain three common issues developers may face when working with the legacy Java codebase.
*(6 Marks)***(c)** Discuss the following three strategies that can be used to modernize legacy systems like URSL's Java application. Include one advantage and one limitation for each:

- Reverse engineering
- Migration
- Encapsulation
  *(6 Marks)*

**(d)** Using a case study approach, outline a basic plan URSL could follow to modernize their legacy Java application. Your plan should include stakeholder involvement, technical approach, and risk mitigation.

*(4 Marks)*

## Question 6:

**Zimsoft Solutions Ltd**, a mid-sized software development firm in Uganda, developed a health management system for public hospitals five years ago using the Waterfall model. Recently, the Ministry of Health has requested the company to update the system to comply with new healthcare regulations, improve performance, and introduce new features for telemedicine integration. Zimsoft is now considering migrating to Agile or DevOps to handle ongoing updates more effectively.**Based on the scenario above, answer the following questions:**

**(a)** Identify and briefly explain the **four types of software maintenance**. For each type, provide one relevant example from the scenario.
*(8 Marks)***(b)** Differentiate between **software maintenance** and **software evolution**, using the case of Zimsoft Solutions to illustrate your points.
*(4 Marks)***(c)** Discuss how **software evolution** is handled differently in the **Waterfall, Agile, and DevOps models**, and explain which model would be most suitable for Zimsoft's future updates.
*(4 Marks)* **(d)** Identify **two technical** and **two organizational challenges** Zimsoft may face during the transition from Waterfall to Agile or DevOps, and suggest strategies to mitigate each.
*(4 Marks)*