UNIVERSITY OF MORATUWA

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BSc Engineering Honours Degree
Semester 4 Examination: 2023

CS3023: SOFTWARE ENGINEERING

Time allowed: 2 Hours July 2023

ADDITIONAL MATERIAL: *None*

INSTRUCTIONS TO CANDIDATES:

1. This paper consists of **3** questions in 3 pages.
2. Answer all **3** questions.
3. Start answering each of the 3 main questions on a new page.
4. The maximum attainable mark for each question is given in brackets.
5. This examination accounts for 60% of the module assessment.
6. This is a close-book examination.

   NB: It is an offence to be in possession of unauthorised material during the examination.
7. Only calculators approved and labelled by the Faculty of Engineering are permitted.
8. Assume reasonable values for any data not given in or with the examination paper. Clearly state such assumptions made on the script.
9. In case of any doubt as to the interpretation of the wording of a question, make suitable assumptions and clearly state them on the script.
10. This paper should be answered only in English.

Question 1 (30 marks)

(i) Define the job role of a software engineer in the current state of the industry. Your answer must consider the software industry practices, nature of the work and any other relevant factor of importance.

[5 marks]

(ii) Software process models help us to manage the software lifecycle. Critically examine the future of software process models and their importance.

[5 marks]

(iii) Describe one advantage and a disadvantage of using standard APIs, Frameworks and Platforms as the basis for your system design. Your answer must only consider the factors related to system architecture. Marks will not be given for other explanations.

[5 marks]

(iv) Describe the xUML based generative system development process. You must clearly explain the three model types we use with a suitable example system.

[9 marks]

(v) Describe the following:

a. System Test.
b. Algorithmic Cost Models
c. Risk Severity [3 x 2 marks]

Question 2 (40 marks)

Sri Lanka Foreign Employment Bureau (SL-FEB) has started a software system development project that aims to automate the processes of registration of employment seeking Sri Lankan citizens and the prospective employers from around the world. Once completed the system can match the employer requirements against skills and qualifications of the registrants seeking foreign employment. It is also expected to monitor the foreign worker remittance of the registered workers at SL-FEB and recommend for benefits such as tax exemptions and import permits (vehicle).

You have been recruited as a lead software engineer for the project by the competent software development company that is developing the solution.

(i) Identify five key stakeholders of this system. Briefly justify your answer.

[5 marks]

(ii) Draw Five use case diagrams each for the identified stakeholder. Text descriptions are not required.

[5 marks]

(iii) State and describe three (3) functional and non-functional requirements for the system.

[6 marks]

(iv) Draw a suitable UML Activity diagram for the employee registration process. State your assumptions.

[4 marks]

(v) Briefly describe the Architecture at large of the proposed system using suitable illustrations.

[5 marks]

(vi) Prepare complete architecture diagrams using the following perspectives for the proposed system with sufficient finer level details.

a. Software component level breakdown using a class diagram

[5 marks]

b. Software component level interactions using sequence diagrams

[6 marks]

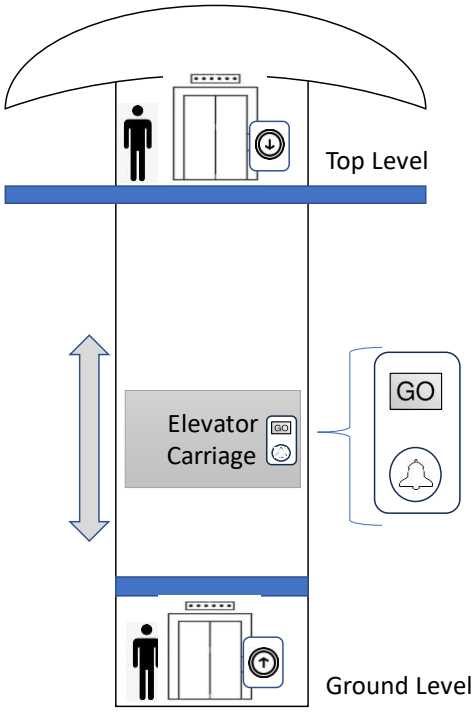
c. High-level structure using a package diagram

[4 marks]

Question 3 (30 marks)

The tourist attraction *Portabella Tower* has an elevator to transport visitors between the Ground Level and the viewing deck at the Top Level. Both the Top and Ground levels have a button to request the elevator. The elevator carriage door automatically opens after reaching a level and stays open. Inside the carriage there is a GO button which needs to be pressed for the elevator to start moving towards the other level. The carriage automatically closes its door when GO is pressed and moves only when the door is completely closed.

The elevator motor has two modes: one to lift the carriage and the other to lower the carriage. Limit switches are used to identify whether the carriage door is closed and whether the carriage is at the top or ground level.



(i) Developing graphical models of systems is common in modern software systems development projects. List three (3) uses of such models. For each use, state how accurate the model should be and why. [6 marks]

(ii) Briefly explain what a behavioral model of a system is. [3 marks]

(iii) Develop a behavioral model for the above-described elevator control system.

a. List the states of the system with brief descriptions of them. [3 marks]

b. List the stimuli of the system with brief descriptions of them. [3 marks]

c. Draw a state machine model for the elevator control system. [3 marks]

(iv) Considering that the elevator carriage movement was shown as a single super state in the above model, expand it in a separate state machine diagram to show movement in up and down directions. [3 marks]

(v) Differentiate between soft real-time and hard real-time systems with the aid of suitable examples. [3 marks]

(vi) You are designing the embedded software which switches a Data Centre from mains power (i.e. from CEB) to generator power when a power failure occurs. This switching should take place within 45 milliseconds to avoid damaging IT equipment. There are 3 major time-consuming steps involved. They are: S1) identifying a power failure by monitoring drops in supply voltage; S2) running a process to switch off mains power and start generators; S3) the time needed for the generators to become operational. There is a voltage checking process which runs every 3ms. (If there is a significant drop in voltage between readings and this is sustained for 3 readings, then it is assumed that there is a power failure.) The generators take 20ms to become operational (S3). Calculate the worst-case execution time for the switching process (S2). You must show how you arrived at the solution. [6 marks]

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