

EGT3  
ENGINEERING TRIPOS PART IIB

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Monday 29 April 2024 2 to 3.40

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**Module 4M21**

**SOFTWARE ENGINEERING AND DESIGN**

*Answer not more than **three** questions.*

*All questions carry the same number of marks.*

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

**STATIONERY REQUIREMENTS**

Single-sided script paper

**SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM**

CUED approved calculator allowed

Engineering Data Book

**10 minutes reading time is allowed for this paper at the start of the exam.**

**You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.**

**You may not remove any stationery from the Examination Room.**

1 A customer support centre is introducing a new support system for operators. The system automatically analyses the customer call and presents a set number of response options to the operator on a visual display. The operator can choose among these options using a mouse. If the operator chooses a system-proposed option the customer is played a pre-recorded message. Alternatively, if no option is suitable, the operator can click a dedicated button to engage with the customer in a phone call.

- (a) Is this a task that can be modelled using the Hick-Hyman law? Explain your reasoning. [10%]
- (b) Draw a *function structure* diagram, indicating the overall function and the key subfunctions. [10%]
- (c) Use the system-centric and user-centric evaluation criteria in the types and levels of automation framework to critique the level of automation in the system. [30%]
- (d) Assume the system-proposed options are drawn from a fixed pool of 40 system-prepared responses. When one of these options is viable, it is presented at a fixed consistent location on the visual display. Explain when an operator is exhibiting skill-based, rule-based, or knowledge-based behaviour while using the system. [20%]
- (e) State three key requirements and briefly explain how each of these requirements can be verified. [30%]

2 A manufacturing firm has developed a new purchasing system in an attempt to reduce both cost and procurement time. The system is intended for use by its engineers, accountants and managers, who are all held responsible for any adverse consequences in procurement, such as delays in production. As the system is untested in the field, the staff are offered a choice between using the old established system and the new system during a transitional period.

- (a) Describe the difference between *utility* and *usability*. [10%]
- (b) Explain why usability is both relational and emergent. Briefly discuss how these phenomena relate to the new procurement system. [20%]
- (c) Give three reasons why the new system may struggle to be accepted by users, relating these reasons to practical acceptability, social acceptability, and non-use. [30%]
- (d) The design team is considering evaluating the new procurement system using a heuristic evaluation. Explain the qualities of the system that can and cannot be reliably assessed using such a method. [40%]

- 3 (a) Identify two types of UML diagrams that are frequently used to describe a system in software engineering. Explain why these diagrams are useful. [10%]
- (b) A company designed an AI driven image recognition smartphone application for art gallery audio tours. The main view of the application has a live image from the camera, the live viewfinder. When the user points the camera at the artwork and taps on the live viewfinder, the image is captured and the artwork is automatically identified by the AI image recognition engine. The application then passes a unique identifier of the artwork to the audio player that starts the corresponding recording.
- (i) Propose a software design for the system described above. Draw a sequence diagram to demonstrate the scenario of a gallery visitor using the application to listen to an audio description about one of the gallery's artworks. [30%]
- (ii) Draw the corresponding class diagram. [30%]
- (c) Customer feedback indicated that users frequently requested easy access to the most recent audio files played. The main view of the application was therefore updated to include a subview with recently played recordings. Extend the software design to introduce this additional functionality. Update the class and sequence diagrams to illustrate the extension. [30%]

- 4 (a) Describe the key concerns related to the introduction and use of new medical software. [25%]
- (b) Give an example of a medical software failure in the past that resulted in actual harm to patients. What were the key software failure causes? Describe the practices commonly adopted today to reduce the risk of this form of failure. [25%]
- (c) A startup team is developing software for a wireless heart rate monitor for newborn babies who need special assistance at birth.
- (i) Propose a suitable software development model for this project. Justify your answer. List the main stages in the development process and the key advantages of the proposed approach. [20%]
- (ii) Learning from the lessons in (b), identify practices that should be incorporated into your software development lifecycle to address the concerns described in (a). [30%]

**END OF PAPER**

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