

May 2013

98-Comp-A6
Software Engineering

3 Hours Duration

Notes:

1. If doubt exists as to the interpretation of a question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.
2. No calculators permitted. This is a closed book exam.
3. Answer any five of the nine questions.
4. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
5. All questions have equal weight.

Question 1. *The Software Development Process.*

- (a) List the stages of the software development life cycle and briefly describe each stage.
- (b) Contrast and compare these stages to the stages of purchasing and owning a piece of equipment, such as a car or a refrigerator. In particular, contrast the life cycle costs of owning the equipment with that of software. How are they similar and how are they different? Justify your answer.

Question 2. *Software Design.*

- (a) Discuss the differences between object-oriented and function-oriented design.
- (b) Sketch an *function-oriented* design of the following system:

A gas station is to be set up for fully automated operation. A driver inputs his or her credit card into the pump, the card is verified by communication with a credit card company computer and a fuel limit is established. If the card is invalid, it is returned by the pump with no fuel to be dispensed. The driver may then take the fuel required and on completion of delivery (i.e., when either the fuel limit is reached or the pump hose is returned to its holster), the driver's credit card is debited with the cost of the fuel taken..

Question 3. *Object-oriented Design.*

A software system is to be developed to hold details of newspaper and magazine deliveries in a small town. In addition to recording which households take newspapers and magazines, the system includes billing details and details of customer vacations, when newspapers are not delivered. For each delivery person, the system prints a daily list of which newspapers and magazines are to be delivered to which households. The system is also able to produce summary information showing how many copies of each newspaper were sold each day in the week. Bills for each customer can be printed at the end of the month and delivered with the first delivery each month.

Using an object-oriented approach, derive a design for the system outlined above. Make reasonable assumptions about the system when deriving the design. Identify the objects that might exist in this system and the behavior that is associated with each object.

Question 4. *Software Reuse and Portability.*

- (a) In an object-oriented programming language, *information-hiding* and *inheritance* can be used to adapt software components for reuse. Describe information-hiding and inheritance, and the pros and cons of using each to support code reuse.
- (b) You have been assigned the task of implementing a calendar and clock which gives time and date information. This has to operate on a range of computers from 8-bit micros to 64-bit special purpose processors. Design and implement an abstract data type for representing the calendar and clock that can be readily ported from machine to machine.

Question 5. *Software Testing.*

- (a) Explain why testing can only detect the presence of errors but not their absence.
- (b) Explain why it is not necessary for a program to be completely free of defects before it is delivered to its customers. To what extent can testing be used to validate that the program is fit for its purpose.
- (c) Discuss the differences between functional and structural testing and suggest how they may be used together in the defect testing process.

Question 6. *Critical Software Development.*

- (a) Describe the three complementary approaches to developing dependable software.
- (b) Describe four software engineering techniques that can lead to fault-free software.
- (c) Illustrate how the techniques you describe in part (b) above can be used in the design of a software-controlled insulin delivery system that works by using micro-sensors embedded in the patient to measure some blood parameter that is proportional to sugar level and then control a pump to dispense the necessary amounts of insulin via a permanently attached needle.

Question 7. *Configuration Management.*

Configuration management is the management of system change. When a system is maintained, the role of the configuration management team is to ensure that changes are incorporated in a controlled way.

A common problem with system building occurs when physical file names are incorporated in system code and the file structure implied in these names differs from that of the target machine. Write a set of programmer's guidelines that help avoid this and other system building problems that you can think of.

Question 8. *Software Reliability.*

Suggest appropriate reliability metrics for the following classes of software systems. Give reasons for your choice of metric. Suggest also approximate acceptable values of the system reliability.

- (a) A system that monitors patients in a hospital intensive care unit.
- (b) A word processor.
- (c) An automated vending machine control system.
- (d) A system to control braking in a car.
- (e) A management report generator.

Question 9. *Real-Time Software Systems.*

- (a) Define real-time software systems.
- (b) What is the difference between “soft” real-time systems and “hard” real-time systems?
- (c) Draw a state machine model of the control software for the following system.

A telephone answering machine that records incoming messages and displays the number of accepted messages on a LED display. The system should allow the telephone owner to dial in, type a sequence of numbers (identified as tones) and have the recorded messages replayed over the phone.