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.

Marking Scheme

1. (a) 10 marks; (b) 5 marks; (c) 5 marks.
2. (a) 10 marks; (b) 10 marks.
3. 20 marks.
4. (a) 10 marks; (b) 10 marks.
5. (a) 5 marks; (b) 5 marks; (c) 5 marks; (d) 5 marks.
6. (a) 5 marks; (b) 5 marks; (c) 10 marks.
7. (a) 10 marks; (b) 10 marks.
8. (a) 5 marks; (b) 5 marks; (c) 5 marks; (d) 5 marks
9. (a) 10 marks; (b) 5 marks; (c) 5 marks.

Question 1. *The Software Development Process.*

(a) List the stages of the software development life cycle and briefly describe each stage.

(b) In percentage of total effort, how much effort does each stage require on average in industry? Explain your answer.

(c) Contrast and compare these stages to the stages of building and owing a house. Comment on how good the analogy is between the software development process and the processes of building and owning the house.

Question 2. *Software Design.*

(a) Discuss the differences between object-oriented and function-oriented design.

(b) Sketch an *object-oriented* design of the following system:

> A cruise control system for a car that maintains a constant speed set by the driver. The system should adjust the car controls depending on measured road speed.

Question 3. *Software Design.*

A software system is to be developed for a microprocessor-based *Insulin Delivery System* (IDS) in a hospital. The system works by using a micro-sensor embedded in the patient to measure blood parameters that are proportional the sugar level. These parameters are then sent to a pump controller. This controller computes the sugar level, judges how much insulin is required and sends signals to a miniaturized pump to deliver the insulin via a permanently attached needle.

Using a *function-oriented* approach, derive a design for the HSS described above. Make reasonable assumption and clearly state them.

Question 4. *Software testing.*

(a) Discuss the differences between functional and structural testing and suggest how they may be used together in the defect testing process.

(b) Design a testing strategy for the microprocessor-based Insulin Delivery System described in **Question 3** above.

Question 5. *Formal Methods.*

(a) Explain what is meant by "formal methods" in Software Engineering.

(b) What are the advantages of formal methods to software engineers?

(c) What is the difference between algebraic and model-based approaches to formal specification?

(d) An abstract data type representing a stack has the following operations associated with it:

New:	Bring a stack into existence
Push:	Add an element to the top of the stack
Top:	Evaluate the element at the top of the stack
Retract:	Remove the top element from the stack and return the modified stack
Empty:	True if there are no elements on the stack

Define this abstract data type using an algebraic specification.

Question 6. *Distributed Software Systems.*

(a) Explain why distributed systems are inherently more scalable than centralized systems. What are the likely limits on the scalability of distributed systems?

(b) What is the difference between a fat-client and a thin-client approach to client-server systems development?

(c) Using a distributed object approach, propose an architecture for a national theatre booking system where users can check seat availability and book seats at a group of theatres. The system should support ticket returns so that people may return their tickets for the last-minute resale to other customers.

Question 7. *Software Cost Estimation.*

(a) Describe the COCOMO model for estimating the cost of software projects. Why is this model particularly useful?

(b) Consider an embedded system that to control an experiment that is to be launched into space. The system must be very reliable and is subject to strict weight limits. Use the COCOMO model to estimate the cost of the project taking into account the cost of the hardware, the development platform, and software development. Make reasonable assumptions.

Question 8. *Software Maintenance.*

(a) Explain why a software system that is used in a real-world environment must change or become progressively less useful.

(b) Describe three types of software maintenance, substantiating each type with an example.

(c) Explain the rationale underlying Lehman's Laws. Describe 3 of the laws in details, and explain under what circumstances might the laws break down?

(d) Do software engineers have a professional responsibility to produce code that can be readily evolved, even if their employer does not explicitly request this? Justify your answer.

Question 9. *Software Development Environments.*

(a) Define a Software Development Environment (SDE).

(b) Describe the major classes of SDE's, citing examples of each class when possible.

(c) Can Unix be considered an SDE according to your definition? Justify your answer.