Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page. The exam has 10 questions with equal weight. Some questions have multiple parts. Point totals are given in the margin.

Name: Answer Key

1.	10
2.	10
3.	10
4.	10
5.	10
6.	10
7.	10
8.	10
9.	10
10.	10
Total	100

No notes or books may be used on the exam. If you have any questions, please raise your hand and I will try to answer them.

2 1. (a) Reuse is an important quality of software because it . . .

i. improves reliability.
ii. adds redundancy.
iii. reduces costs through amortization.
iv. prevents errors.

Answer: (iii)

2 (b) The main difference between object-oriented analysis and structured analysis is that . . .

i. object-oriented analysis ignores operations on the data.
ii. object-oriented analysis considers data and operations separately.
iii. structured analysis considers data and operations separately.
iv. object-oriented analysis takes a functional view of the world.

Answer: (iii)

2 (c) The best team for generating innovative solutions is . . .

i. a loosely structured team.
ii. a chief programmer team.
iii. a highly structured team.
iv. a team with only rational extroverts.

Answer: (i)

2 (d) The cost of fixing an error in the waterfall model . . .

i. decreases as we progress from phase to phase.
ii. stays constant as we progress from phase to phase.
iii. increases as we progress from phase to phase.
iv. has no relation to the individual phases.

Answer: (iii)

2 (e) The three different levels of design reviews are . . .

i. customer, system, and program.
ii. preliminary, functional, and system.
iii. preliminary, critical, and program.
iv. customer, functional, and program.

Answer: (iii)

5 2. (a) What is the difference between the incremental and iterative process models?

Answer: In the incremental model, the product is delivered in stages with each stage adding new functionality to an existing base system. Each component delivered is complete. In the iterative model, the entire product is initially delivered with all components, but with many components having limited functionality (e.g., inefficient, simplistic). Each successive release completes functionality of one or more components.

5 (b) What is an evolutionary process model? What are three evolutionary models?

Answer: An evolutionary process model is simply a model that can adapt to changes in requirements as the product is built and released across multiple generations. Evolutionary models include the iterative, incremental, and spiral models.

2 3. (a) What is the difference between a requirements definition and a specification?

Answer: A requirements definition is written at a level the customer can understand, and a requirements specification is written at a level a system designer can understand and use.

2 (b) What is the difference between validation and verification?

Answer: Validation checks if the right product was built, and verification checks if the product was built right.

2 (c) What is functional requirement?

Answer: A functional requirement describes an interaction between the system and its environment.

2 (d) What is nonfunctional requirement?

Answer: A nonfunctional requirement (constraint) describes a restriction on the system.

2 (e) What is the difference between a requirement and a design decision?

Answer: A requirement addresses what the system must do. A design decision addresses how a requirement will be met by the system.

2 4. (a) What is a software architecture?

Answer: A software architecture describes the overall (high-level) structure of the system.

2 (b) What are the four types of architectural frameworks?

Answer:

- functional
- procedural
- object-oriented
- logical

2 (c) How is an architecture different from a design?

Answer: A software architecture describes the high-level structure of the system and may not match the actual design, which typically provides more details.

2 (d) What is the purpose of architectural styles?

Answer: The purpose of architectural styles is to convey a general impression of the overall form and structure of the system.

2 (e) What are the “three C’s” of architectural styles?

Answer:

- components
- connectors
- constraints

2 5. (a) What is the difference between a blackboard and a repository?

Answer: a blackboard has an active data store (data store in control), a repository has a passive data store (clients in control)

2 (b) What is the primary advantage of using an event-based architecture?

Answer: low coupling (do not have to know name of component in order to communicate with it), and therefore it is easy to add new components

2 (c) What is a mediator and what purpose does it serve?

Answer: a separate component that maintains a relationship between two or more other components

2 (d) Is a pipe-and-filter architecture efficient in general? Explain.

Answer: no, because all data must be copied from one filter to the next; yes, because each filter can be executed in parallel, increasing concurrency (either answer is acceptable provided an explanation is given)

2 (e) What design concept does a layered architecture demonstrate particularly well?

Answer: abstraction

2 6. (a) What is abstraction?

Answer: Abstraction is the rendering of lower-level details temporarily invisible to upper levels in order to facilitate the understanding and design of complex systems.

2 (b) What is modularity?

Answer: Modularity is the principle or method of decomposing a system into independent components that can be independently managed. Modularity makes systems easier to understand because it is usually easier to reason about several smaller problems than one large problem.

2 (c) What is coupling?

Answer: Coupling is a measurement of how much a module is tied to or dependent upon other modules. Low coupling indicates that a proposed change to one module will be less likely to impact the rest of the system.

2 (d) What is cohesion?

Answer: Cohesion is the degree to which a module does a single, well-defined, well-executed task. High cohesion helps reuse and understanding since all parts of a task are located in a single location.

2 (e) What is encapsulation?

Answer: Encapsulation is the bringing together of data and code and accessing the data structures using a well-defined interface.

2 7. (a) What is an object?

Answer: An object is an instance of a class.

2 (b) What is a class?

Answer: A class is a data type that holds attributes and the operations on those attributes.

2 (c) What is a method?

Answer: A method is an operation invoked on an object.

2 (d) What is inheritance?

Answer: Inheritance is the mechanism by which a child class can extend the operations and attributes of a parent class. The child class inherits (has access to) all operations and attributes of the parent class, and therefore the child class behaves like the parent class.

2 (e) What is polymorphism?

Answer: Polymorphism is a mechanism by which an object of a derived class can be used in place of an object of a parent class but with the operations of the derived class invoked rather than those of the parent class.

10 8. A library contains publications that it stores and loans to borrowers. There are many different types of publications including magazines, books, and journals. Each publication has a status such as reserved, on-shelf, on-loan, or overdue. A borrower may borrow a publication for a certain amount of time based on her status. A borrower may be a student, faculty, or staff member. A borrow also may have a balance if a loaned publication is overdue. The chief staff member is the head librarian. Other staff members include student workers and a research librarian. Draw a UML structural model class view to represent the library, its resources, the borrowers, the staff, and their relationships. You do *not* have to show the attributes, the methods of each class, or the cardinality of the relationships. You need only show the classes and their relationships.

Answer: Example classes and subclasses include:

- library
- publication
  - magazine
  - book
  - journal
- borrower
  - student
  - faculty
  - staff
- staff member
  - head librarian
  - student worker
  - research librarian

Example relationships include:

- library has publications
- staff members work at the library (library employs staff members)
- borrower borrows publications

Note that status and balance should be attributes, and not classes.

10 9. What is a man-month? Why is the concept of a man-month a typical myth in software engineering projects? Under what circumstances would the concept not be a myth?

Answer: A man-month is the amount of work one person can accomplish in a month. This concept is a myth because software engineering is not like manufacturing in which production output scales (more or less) linearly with increased production resources. Communication and training of new personnel take time away from existing developers on a project leading to the saying that "adding people to an already late project just makes it later". If new people could be brought on board that were already trained and could work more or less independently, then the concept would be more truthful.

10 10. Why does Brooks say "plan to throw one away; you will anyway"? What is he talking about? What process model is being discussed?

Answer: His argument is that it is impossible to get the requirements right the first time you build a system, no matter how hard you try. Therefore, the first system you build will never be exactly what the customer wanted. His question is whether you should deliver that first system to the customer or whether you should instead build a prototype to show to the customer for feedback. Therefore, he is advocating the prototyping process model.