Atal Bihari Vajpayee Indian Institute of Information Technology & Management, Gwalior

IT404: Software Engineering

Major Examination (Session 2023–24)

Maximum Time: 3 Hours **Max Marks: 70**

Note: Answer all questions. Show calculations and draw diagrams wherever required.

1. (a) Compare Waterfall and Agile process models — list at least four differences with practical implications. (8 Marks)
   (b) In which situations would you still prefer Waterfall over Agile? Give two use-cases. (4 Marks)

2. (a) Draw a UML class diagram for a simplified Library Management System containing classes: Book, Member, Loan, Librarian. Show attributes and key relationships (association, multiplicity). (8 Marks)
   (b) Provide two sequence diagram interactions: (i) Issue Book (ii) Return Book — brief notes on messages exchanged. (4 Marks)

3. **(COCOMO Numerical)** A proposed project is estimated at 50 KLOC (thousand lines of code). Using the basic COCOMO model for an organic project: Effort (person-months) = 2.4 * (KLOC)$^{1.05}$. (a) Compute the estimated effort. (6 Marks)
   (b) If average productivity per person is 6 PM/month, estimate required team size (round up). (4 Marks)

4. (a) Explain software design principles: SOLID (briefly describe each letter). (8 Marks)
   (b) How does modular design improve maintainability? Give two reasons. (4 Marks)

5. (a) Discuss test case design using boundary value analysis and equivalence partitioning with an example (choose a simple input domain). (6 Marks)
   (b) Explain the difference between white-box and black-box testing and give one technique for each. (4 Marks)

6. **Case Study:** (14 Marks)
   A mid-size e-commerce company plans a major refactor of its monolithic checkout service into microservices to improve scalability and release velocity. They expect high seasonal traffic spikes and require strong consistency for payment processing. Propose a migration plan outlining: - Key microservices you would extract (list at least 4) and their responsibilities. - Data management strategy (how to handle consistency for payments vs eventual consistency for inventory). - Deployment strategy (CI/CD, blue-green or canary? why). - Observability and rollback plan in case of failures. Provide a high-level diagram and justify your choices.

7. Write short notes on any three (each 4 Marks — total 12 Marks): (i) Continuous Integration vs Continuous Deployment (CI vs CD) (ii) Technical debt — identification and remediation strategies (iii) Software metrics: Defect Density and Mean Time To Repair (MTTR) — how they influence quality decisions (iv) Security in SDLC: threat modeling basics and where to integrate security checks