Course Code: CIT308

Course Title: Formal Methods, Automata and Software Development

Course Credit: 3 units

Time Allowed: 3 hours

Instruction: Answer **Question One (1)** and any other **Three (3)** Questions

Question 1: 25 marks
1 (a)   Define formal methods in the context of software engineering. (2 marks)
1 (b)   Explain why software quality is important in an organization. Provide three specific reasons. (3 marks)
1 (c)   List and briefly describe three characteristics of high-quality software. (6 marks)
1 (d)   Outline any five (5) typical software development phases. (5 marks)
1 (e)   Discuss the role of formal methods in software development. How do they contribute to the overall development process? (5 marks)
1 (f)   List any three (3) outputs of the software design process and their significance for the implementation phase. (4 marks)

Question 2: 15 marks
2 (a)   Describe how formal methods can be applied during the development phase of software creation. (5 marks)
2 (b)   List and briefly explain three automated techniques used in formal method verification. (6 marks)
2 (c)   Discuss the benefits of using formal methods in software development. Provide at least four points. (4 marks)

Question 3: 15 marks
3 (a)   List and briefly explain three important considerations when dealing with a formal system. (6 marks)
3 (b)   Discuss the challenges of introducing formal methods into existing systems. How can these challenges be addressed? (6 marks)
3 (c)   Explain the concept of abstract interpretation in automated proof techniques. (3 marks)

Question 4: 15 marks
4 (a)   Define formal methods and explain their primary purpose in software development. (4 marks)
4 (b)   Describe three advantages and two disadvantages of using formal methods in software engineering. (5 marks)
4 (c)   Explain the concept of integrity levels in relation to formal methods. Provide an example of a system for each integrity level. (6 marks)

Question 5: 15 marks
5 (a)   Outline and briefly describe the four stages of formal methods. (8 marks)
5 (b)   Discuss how formal methods can be applied to any two (2) stages of the Software Development Life Cycle (SDLC). (2 marks)
5 (c)   Define a proposition in the context of formal methods. Provide two examples of valid propositions and two examples of statements that are not propositions. (5 marks)

Question 6: 15 marks
6 (a)   Explain the concept of a truth table. (5 marks)
6 (b)   Construct a truth table for the following compound proposition: $(p \land q) \lor \neg r$ (8 marks)
6 (c)   Define tautology and consistency in propositional logic. Provide an example of each.
(2 marks)