Concurrent and Distributed Systems

For a transaction model based on objects and object operation time-stamps:

(a) (i) Define how conflict may be specified in terms of object operation semantics.

(ii) Give an example of conflicting operations.

(iii) Give an example of non-conflicting operations that would be defined as conflicting under read–write semantics. [3 marks]

(b) Define the necessary and sufficient condition for two transactions to be serialisable. Give an example of a non-serialisable execution of a pair of transactions. [3 marks]

(c) Define the necessary and sufficient condition for any number of transactions to be serialisable. [1 mark]

(d) Discuss how the following methods of providing concurrency control in database systems enforce the properties defined above.

(i) Strict two-phase locking. [4 marks]

(ii) Strict timestamp ordering. [4 marks]

(iii) Optimistic concurrency control. [5 marks]