Semantics of Programming Languages

Write short notes on four of the following five topics.

(a) The relationship between three forms of operational semantics of the Language of Commands (LC) given by

- an evaluation relation $\langle P, s \rangle \Downarrow \langle V, s' \rangle$
- a transition relation $\langle P, s \rangle \rightarrow \langle P', s' \rangle$
- a transition relation between the configurations $\langle c, r, s \rangle$ of the SMC-machine

(b) The notion of semantic equivalence of LC phrases and its congruence property.

(c) Call-by-name and call-by-value rules for evaluating function applications in the Language of Functions and Procedures (LFP) and the relationship between the evaluation relations for LFP based upon each of them.

(d) The notion of bisimilarity of two configurations in a labelled transition system.

(e) The rules defining the possible labelled transitions of parallel composition ($P_1 | P_2$) and restriction ($\nu c. P$) in the Language of Communicating Processes (LCP).

[5 marks each]