

## 2003 Paper 7 Question 7

### Specification and Verification II

- (a) Describe the semantics of formulae in *linear temporal logic* (LTL) and *computation tree logic* (CTL). [2+2 marks]  
Illustrate your answer by contrasting the meanings of  $\mathbf{G} P$  in LTL with  $\mathbf{AG} P$  in CTL (where  $P$  is a property of states). [2+2 marks]
- (b) Give an LTL property that cannot be expressed in CTL. [2 marks]
- (c) Give a CTL property that cannot be expressed in LTL. [2 marks]
- (d) Describe briefly the kinds of properties that can be expressed using Sugar Extended Regular Expressions (SEREs), Foundation Language (FL) formulae and Optional Branching Extension (OBE) formulae of the *Sugar 2.0* property language. [4 marks]
- (e) Consider the property: “whenever a, b and c occur on successive cycles, then on the cycle that c occurs, d must occur also, followed on the next cycle by e” (where a, b, c, d and e are boolean expressions). Use this property to illustrate how SEREs can sometimes help specify properties more compactly than pure LTL. [4 marks]