# 2005 Paper 4 Question 3

**Data Structures and Algorithms**

(a) A closed hash table is one in which the overflow chains of key–value pairs are held within the table itself. Carefully describe how the closed hash table mechanism works for both insertion and lookup. [6 marks]

(b) Assume that the initial probe is $p_0 = \texttt{Hash1(key) mod } B$ and the secondary probes are $p_i, i = 1 \ldots B - 1$. Discuss the relative merits of the following schemes for choosing the secondary probes.

   (i)   $p_i = (p_0 + i) \texttt{ mod } B$

   (ii)  $p_i = (p_0 + 13 * i) \texttt{ mod } B$

   (iii) $p_i = (p_0 + 13 * i + 17 * i * i) \texttt{ mod } B$

   (iv) $p_i = (p_0 + \texttt{Hash2(key)} * i + 17 * i * i) \texttt{ mod } B$

You may assume that all the arithmetic is unsigned. [8 marks]

(c) Carefully describe a mechanism for deleting key–value pairs from a closed hash table. [6 marks]