

Name _____ Student No. _____

Tutorial: MP202 _____ UC144 _____ UC52 _____

AIDS ALLOWED: One page (two sides) of handwritten notes

Answer ALL questions on test paper. Use backs of sheets for additional space.

Total Marks: 60

REMINDER: You get 20% of any question or subquestion if you state “I do not know how to answer this question”. You get 10% of any question which you just leave blank.

1. Consider the following 3-bin packing decision problem *3BPD*.

Input instance: A set of N items each described by a positive integer a_i , $1 \leq i \leq N$, and a positive integer B which is the bound on the size of a “bin”.

Output: Yes if and only if the items can be partitioned into 3 subsets S_1, S_2, S_3 such that $\sum_{i \in S_j} a_i \leq B$ for $1 \leq j \leq 3$; that is, the items are placed into 3 bins so that the bin capacity is not exceeded.

Show that *3BPD* is *NP – complete*.

[20 points]

2. Let $FINITE = \{ \langle M \rangle \mid \mathcal{L}(M) \text{ is a finite set} \}$. Show that neither $FINITE$ nor \overline{FINITE} is semi-decidable. [20 points]

3. Consider the language $L = \{ \langle M_1, M_2 \rangle \mid \exists x \text{ such that } x \in \mathcal{L}(M_1) \cap \mathcal{L}(M_2) \}$. Show that L is semi-decidable but not decidable. [20 points]