

Theory of Computation

Midterm Examination

210072

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Problem 1 (20 points) Let L be

$\{\langle M_1 \rangle; \langle M_2 \rangle \mid \text{the outputs of } M_1 \text{ and } M_2 \text{ are the same for all inputs}\}$.

Show that L is not recursively enumerable.

Problem 2 (20 points) Determine whether the following Boolean formula is a tautology:

$$(x_1 \vee x_2 \vee x_3) \wedge (\neg x_3 \vee \neg x_4 \vee \neg x_5) \Rightarrow (x_1 \vee x_2 \vee \neg x_4 \vee \neg x_5).$$

Problem 3 (20 points) Show that $n^{\frac{1}{n}} = O(1)$ as $n \rightarrow \infty$.

Problem 4 (20 points) Let L_1 and L_2 be two non-recursive languages. Determine (i.e. prove or disprove) whether the following claims are true or false.

- a. $L_1 \cup L_2$ cannot be recursive.
- b. $L_1 \cap L_2$ may be recursive.