Discrete Mathematics
Practice Questions

August 2025

1. Consider the set $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

   (a) Construct eight distinct subsets $T_1, \ldots, T_8$ of S, such that $1 \leq i \leq 8, |T_i \cap T_j| = 7$.

   (b) Construct nine distinct subsets $T_1, \ldots, T_9$ of S, such that, for any i of these subsets, the common intersection has cardinality $9 - i$.

2. Suppose the size of a finite set $|S|$ divides the size of its power set $\mathcal{P}(S)$. What are the possible values of $|S|$?

3. Can you express the propositional logic formula $p_1 \wedge p_2$, using only the connectives $\oplus$ and $\neg$. If so, give the expression and show how you derive it. If not, explain why it is not possible.