

INDIAN STATISTICAL INSTITUTE

Mid Semester Examination

M.Tech CS

Computational Complexity

Date: 11 September 2025

Maximum Marks: 50

Duration: 2 hours

General comment. Answer as much as you can, but the maximum you can score is 50.

(Q1) Give a parsimonious reduction of SAT to 3SAT. [10]

(Q2) (40 Marks) Recollect the definition of **ZPP**, **RP**, **coRP** and **BPP**. Prove that

$$\mathbf{ZPP} = \mathbf{RP} \cap \mathbf{coRP}.$$

[10]

(Q3) (40 Marks) Prove that $\mathbf{IP} \subseteq \mathbf{PSPACE}$. [10]

(Q4) Construct (with a proof) a complete problem for the class coNP. [10]

(Q5) Suppose $L_1, L_2 \in NP$. Then is $L_1 \cup L_2 \in NP$? What about $L_1 \cap L_2$? [5]

(Q6) Show that $P \neq EXP$. [5]

(Q7) A language L is called unary if $L \subseteq 1^*$. Show that if a unary language is NP -complete, then $P = NP$. [10]