

MID SEMESTER EXAMINATION

CS 564

Full marks – 70

25th February, 2024

Instructions

1. *There are more questions than you can possibly answer in the time allotted to you. Attempt as many as you can while presenting cohesive, comprehensible, and legible proofs.*
 2. *All questions carry equal marks.*
 3. *State clearly any assumptions that you may have to make.*
 4. *No clarifications will be provided during the examination.*
 5. **DON'T PANIC.**
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1. Prove that the *diagonal language* is uncomputable.
2. Prove that the *halting problem* is NP-hard.
3. Prove that

$$3SAT \leq_p \text{INDEPENDENT SET.}$$

4. Prove that the following language is NP-complete:

$\{ \Psi \mid \Psi \text{ is a Boolean formula with at least two satisfying assignments} \}.$

5. (a) Prove that any language containing finitely many strings is in P. You can assume that the language is non-empty.

(b) Prove that if languages L_1 and L_2 are in NP, then so is the language $L_1 \cup L_2$.

6. Prove that 2SAT is in P.

7. Prove that $3\text{SAT} \leq_p \text{VERTEX COVER}$.