

Submission Deadline Dec 16, 23:55 pm. 5% per day late penalty will be applied. Maximum 5 day delay. This assignment assesses learning outcomes: 3,4,5

### Question 1

Are context-free languages closed under complement? Prove it or provide a counter example. (20 Marks)

Are co-Turing-recognizable languages closed under concatenation? Prove it or provide a counter example. (20 Marks)

(40 Marks Total)

### Question 2

Is the language  $A_{CFG} = \{\langle G \rangle \mid G \text{ is a CFG that only generates letter } a\}$  decidable? Prove your conclusion. (e.g.,  $S \rightarrow a|b$  is not valid and  $S \rightarrow a|aa$  is not valid.)

(30 Marks Total)

### Question 3

$T = \{\langle M \rangle \mid M \text{ is a TM and } \forall w \in L(M), |w| \leq 50 \text{ and } M \text{ accepts } w \text{ within 50 steps}\}$   
Is the language  $T$  decidable? Prove your conclusion.

(30 Marks Total)