

### CSC 360 Mid-Term Exam 1

*This exam carries 20% of course grade*

Time Limit: 75 minutes

NAME: \_\_\_\_\_

1. (2 points, (1 point each))

(a). State whether the following functions  $f : N \rightarrow N$  (which map from set of Natural numbers  $N$  to set of natural numbers  $N$ ) are (i). **one-to-one** or **many-to-one**; (ii). **into** or **onto**; and (iii). **partial** or **total**.

$$f(n) = n \% 5$$

( $n \% 5$  returns the remainder when divided by 5)

(b). State whether the following binary relation  $P$  between Natural numbers is (i) Reflexive; (ii). Symmetric; (iii). Transitive.

$$[x, y] \in P \text{ if } x \% y == 0$$

(x and y are related if x is evenly divisible by y).

2. (3 points)

Give a regular expression that represents the described set.  
**The set of strings over  $\{a, b, c\}$  which does not contain the substring ac.**

3. (3 points). Give a regular expression that represents the described set. The set of strings over  $\{a, b, c\}$  which do not begin with 'bb' and which do end with 'cc'.
4. (3 points) Construct a Context Free grammar over  $\{a, b, c\}$  whose language is  $\{a^n b^{2n} c^m \mid n > 0, m > 0\}$ .
5. (3 points). Construct a Context Free grammar over  $\{a, b, \}$  whose language is  $\{a^m b^n \mid 0 \leq n \leq m \leq 3n\}$ . (i.e., number of a's is at least as many as b's but no more than 3 times the count of b's)

6. (3 points) Give a grammar for a regular language which generates strings over  $\{a, b\}$  with at least two a's.

7. (3 points). Let  $G$  be the grammar

$$S \rightarrow abSc \mid A$$

$$A \rightarrow cAd \mid cd$$

What is  $L(G)$  Give your answer in set notation  $\{\dots\}$ .