United International University

Department of **C**omputer **S**cience and **E**ngineering

CSE 2233 - Theory of Computation, Term Final Exam, **Fall 2020**

Total Marks: **25**, Time: **1 hour 15 minutes**

Answer all the questions

1. Consider the following context-free language: **[2+3]**

   $L = \{w_1 a^{3n} b^{2n} c^m \mid w_1$ represents any binary string, m = length of string w_1 and n>=0$\}$

   a) Define context-free grammar (CFG) for the language L.

   b) Design a pushdown automaton (PDA) for the language L.

2. Consider the following context-free grammar, G_1: **[5]**

   V = { E, F, A, C }
   Σ = { +, - , (,), x, y, z, *, %, 0, 1 }
   R = {
   E → E + E | E - E | (E) | F,
   F → x | y | z | A,
   A → A * A | A % A | C,
   C → 0 | 1
   }
   Start variable = E

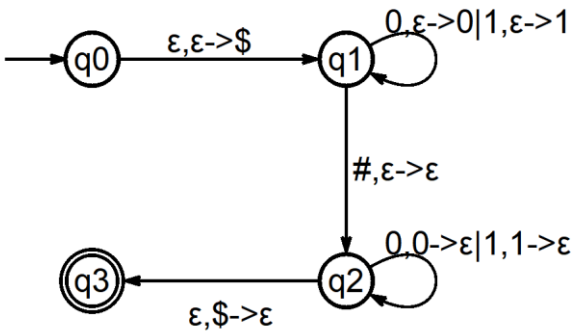
   Now using parse tree decide the ambiguity of this grammar G_1 for the string **(0%1*1) – z**

3. Convert the following context-free grammar into Chomsky Normal Form (show each step clearly): **[5]**

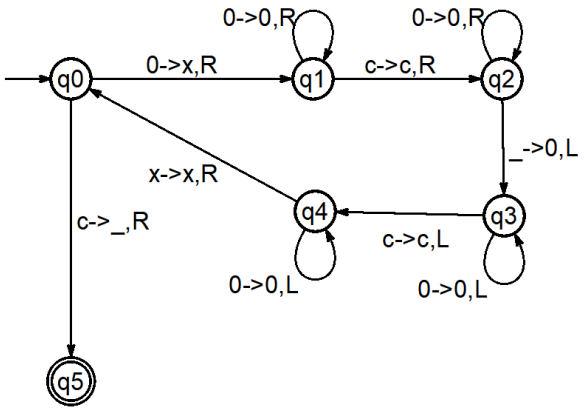
   V = { S, A }
   Σ = { 0, 1 }
   R = {
   S → 0S1 | A
   A → 1A0 | S | ε
   }
   Start variable = S

4. Show instantaneous description (show each step) for the following PDA and sample input **011#110**

   L = { w#w^R | *w* is any binary string and w^R is the reverse string of w } **[5]**



5. Consider the following state diagram of a Turing Machine: **[5]**



Now check the acceptability of string **00c0** for the above TM. (show each configuration strings step by step)