National University of Computer and Emerging Sciences, Lahore Campus				
	Course:	Theory of Automata	Course Code:	CS 301
	Program:	BS (CS)	Semester:	Fall 2019
	Duration:	60 minutes	Total Marks:	40
	Paper Date:	9 November, 2019	Weight:	
	Section:	-	Page(s)	2
	Exam:	Midterm 2		

Student Name: _____ **Roll Number:** _____

Instruction/Notes	1. Solve in the space provided. Extra sheets will **NOT** be marked. 2. One A4 handwritten help sheet is allowed in the exam. 3. Make a reasonable assumption in case of ambiguity. Good luck!

PROBLEM 1 **(Marks: 10)**

Write a context free grammar for the following language and clearly indicate the start symbol.

L = $\{0^n 1^m \mid m \neq n, m \geq 0, n \geq 0\}$

PROBLEM 2 **(Marks: 10)**

Construct a **deterministic PDA** to accept the following language. Show its state transition diagram.

L = $\{0^i 1^j 2^k \mid i \geq 0, j \geq 0, i \geq 0, j = i + k\}$

PROBLEM 3 **(Marks: 10)**

Show the transition diagram of a **single tape deterministic Turing machine** to decide the following:

L = {x#y | x and y have the same number of zeros and x ∈{0,1}* and y∈{0,1}* }

PROBLEM 4 **(Marks: 5+5)**

1. Prove that the following is an ambiguous grammar using right most derivations:
   S -> S0S | 0SS | 0

2. Remove unit productions from the following grammar and write the final grammar. S is the start symbol.

   S -> AB
   A -> C
   B -> D
   C -> C0 | D
   D -> 0 | 1 | AB