National University of Computer & Emerging Sciences, Karachi
Spring-2021CS-Department
Mid Term-II
23rd of April 2021, 09:45a.m– 10:45a.m

Course Code: CS301	Course Name: Theory of Automata
Instructor Names: Mr. Shahzad, Shaharbano, Bakhtawar, Musawar	
Student Roll No:	Section No:

Instructions:

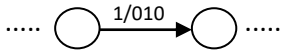
- Return the question paper.
- Read each question completely before answering it. There are **5 questions and 2 pages**.
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- Start each question in a new sheet.

Time: 60 minutes. **Max Marks:** 50 points

Question 1A (5 Points):

The circuit of a simple 3-bit Up/Down counter gives a maximum count of zero (000) to seven (111) and back to zero again. The 3-Bit counter advances upward in sequence (0,1,2,3,4,5,6,7) or downwards in reverse sequence (7,6,5,4,3,2,1,0). Design a mealy machine for the 3-bit Up/Down counter, which produce the upward and downward sequence in between 000 and 111. The input and output alphbet of this machine are ∑={0, 1} and Δ ={0,1}. Some of the random input/output transitions on some states are as follows:

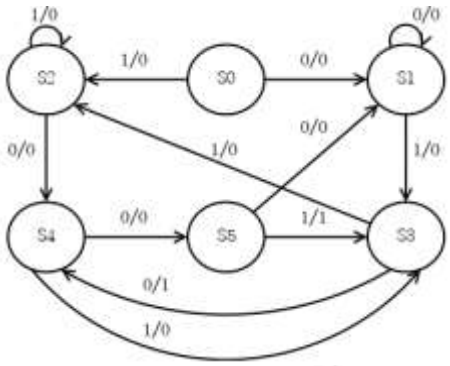
[Note: Mealy & Moore machines are capable to produce strings by reading 1 input symbol e.g. following intermediate transition represents that, by reading 1, 010 will be produced as output.]



Current State	Current Output	Input	New Output
q3	010	1	011
q3	010	0	001
q5	100	1	101
q5	100	0	011

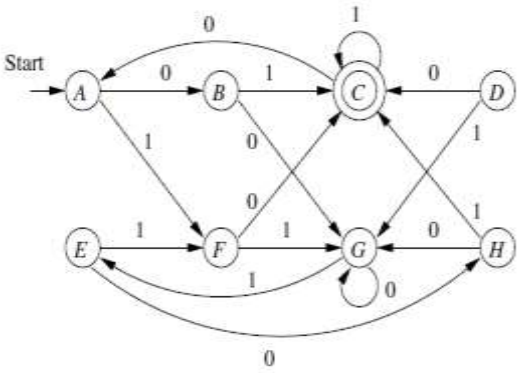
Question 1B (5 points):

Convert the given Mealy machine into equivalent More Machine:



Question 2 (10 points):

Find the minimal DFA of the following:



Question 3 (5+5 points):

Common misunderstanding test in Pumping Lemma

Assume you are a TA of CS301, and you are grading the **Bilal** and **Amjad** provided answers:

Part A.

"Is the language
L = {w | w is a binary string with at least as many 1's as 0's} regular?

Prove your answer using pumping lemma"

Bilal, has submitted following answer:

> I will prove that L is not regular, using the pumping lemma.
> i. Let p is a pumping length
> ii. Let w = 01^p , so that w ∈ L and |w| ≥ p.
> iii. Let w = xyz, with x = Ɛ, y = 0, and z = 1^p , so that |xy| ≤ p and |y| > 0.
> iv. Then $xy^{p+1}z$ is not in L.

Identify the single incorrect line in Bilal's proof and explain what he did wrong.

[NOTE: do not list small mistakes, typos, etc.; explain the major logical error which invalidates Bilal's proof**]**

Part B.

"Show that where the language L={0^{2n} | n≥0} is regular or not regular"

Prove your answer using pumping lemma"

Amjad has submitted the following answer:

> i. Let p is pumping length
> ii. Let's take s=0^{2p}
> iii. Let s=ϵ00^{2p-1} (i.e., x=ϵ, y=0, z=0^{2p-1}). This satisfies |y|>0 and |xy| ≤ p.
> iv. But, taking i=0, we get xy^iz = ϵ$0^0 0^{2p-1}$ = 0^{2p-1}, which isn't in L because its length is odd. So the language isn't regular.

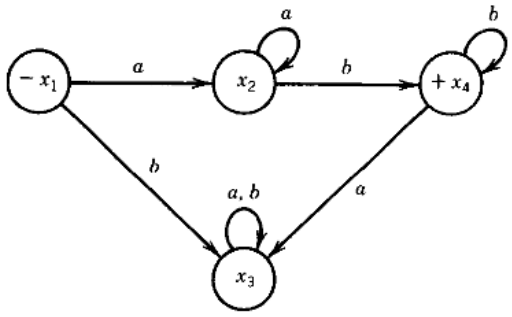
Identify the single incorrect line in Amjad's proof, and explain what he did wrong.

[NOTE: explain the major logical error which invalidates Amjad's proof**]**

Question 4(10 points):

Find closure of the given below FA:

$$\mathbf{r = aa^*bb^*}$$



Question 5 (4+4+2 points):

Write CFG of the following languages:

a. $L1$ = {$a^n b^m$,(n+m) is divisible by 2}
b. $L2$ = {$a^n b^{n-3}$: $n \geq 3$}
c. $L3$ = {$a^m b^n c^p$ | m>n>p }

BEST OF LUCK!