

**COL703: Logic for Computer Science**

Tue 16 Nov 2021

**Major Exam**

09:30-12:00

Max marks 80

**Instructions:**

1. Download each question at the appropriate time.
2. Write your name and entry number in the designated space on top.
3. Scan the page with your completed answer.
4. Upload it on Gradescope 2101-COL703 page within the given time. *Make sure the first page with your name, entry no and signature is also the first page of your uploaded file*
5. Email submissions after the closing of the portal will not be evaluated (You get a 0).
6. Uploads without the first page details (including signature) may be awarded 0 marks.
7. *Do not forget to sign the honour statement below.* You need to sign it only once for the entire exam.

**I abide by the Honour code that I have signed on my admission to IIT Delhi. I have neither given any help to anybody nor received any help from anybody or any site on the internet in solving the question(s) in this paper.**

**Signature:****Date:**

**1. COL703: Major-Q1 09:30-09:50, late submission accepted till 09:55, 1+2+4+4 = 11 marks**

Let  $e = cspy_1y_0d_3d_2d_1d_0$  be your login id and  $n = 10(p + 10(y_1 + 10(y_0 + 10(d_3 + 10(d_2 + 10d_1 + d_0))))))$  be a decimal number formed by the digits of your login id and let  $r = n\%8$  (i.e. the value of  $n$  modulo 8).

$r$	$p_1$	$p_2$	$p_3$	$\phi(p_1, p_2, p_3)$
0.	0	0	0	0
1.	0	0	1	1
2.	0	1	0	1
3.	0	1	1	0
4.	1	0	0	1
5.	1	0	1	0
6.	1	1	0	0
7.	1	1	1	1

Now consider the rows  $r$  and  $(r + 1)\%8$  of the following truth table.

- What is the value of  $r$  for your login id?
- Encode the rows  $r$  and  $(r + 1)\%8$  as provability statements of propositional logic.
- Prove the statement simulating the row  $r$  in the system  $\mathcal{H}_0$ .
- Prove the statement simulating  $(r + 1)\%8$  in the system  $\mathcal{H}_0$ .

**Caution.**

- You are not allowed to express  $\phi(p_1, p_2, p_3)$  or rows  $r$  and  $(r + 1)\%8$  in any logically equivalent form.
- If you get the value of  $r$  wrong, your answers to the other parts will not be evaluated.
- You may use any of the axioms or derived rules upto and including those used in the completeness of  $\mathcal{H}_0$  but no rules of derived operators are allowed.