SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF CSE - IoT

COURSE NAME:19EC306 / DIGITAL CIRCUITS

II YEAR/III SEMESTER

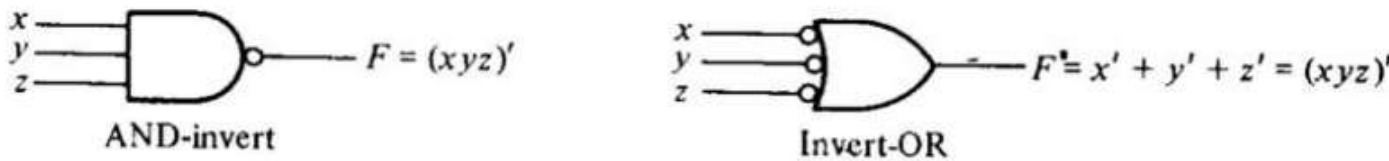
UNIT:1- MINIMIZATION TECHNIQUES AND LOGIC GATES

TOPIC:NOR IMPLEMENTATION

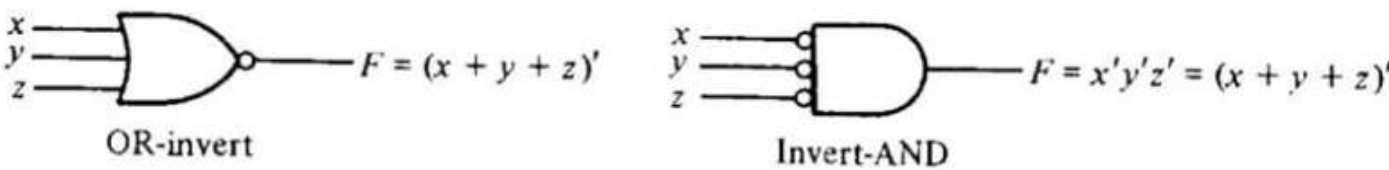
NAND & NOR IMPLEMENTATION

- Digital circuits are more frequently constructed with NAND or NOR gates than with AND and OR gates.
  - easier to fabricate with electronic components.
  - They are the basic gates used in all IC.
- Rules and procedures have been developed for the conversion from Boolean functions given in terms of AND,OR, and NOT into equivalent NAND or NOR logic diagrams.

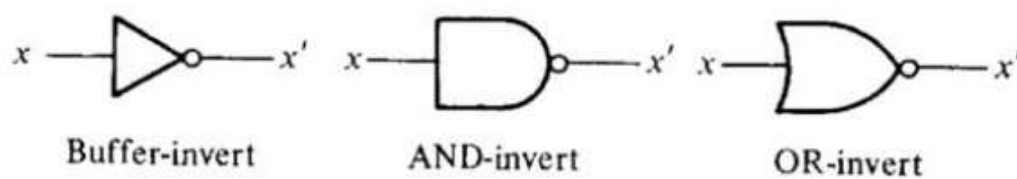
NAND & NOR IMPLEMENTATION



(a) Two graphic symbols for NAND gate.



(b) Two graphic symbols for NOR gate.

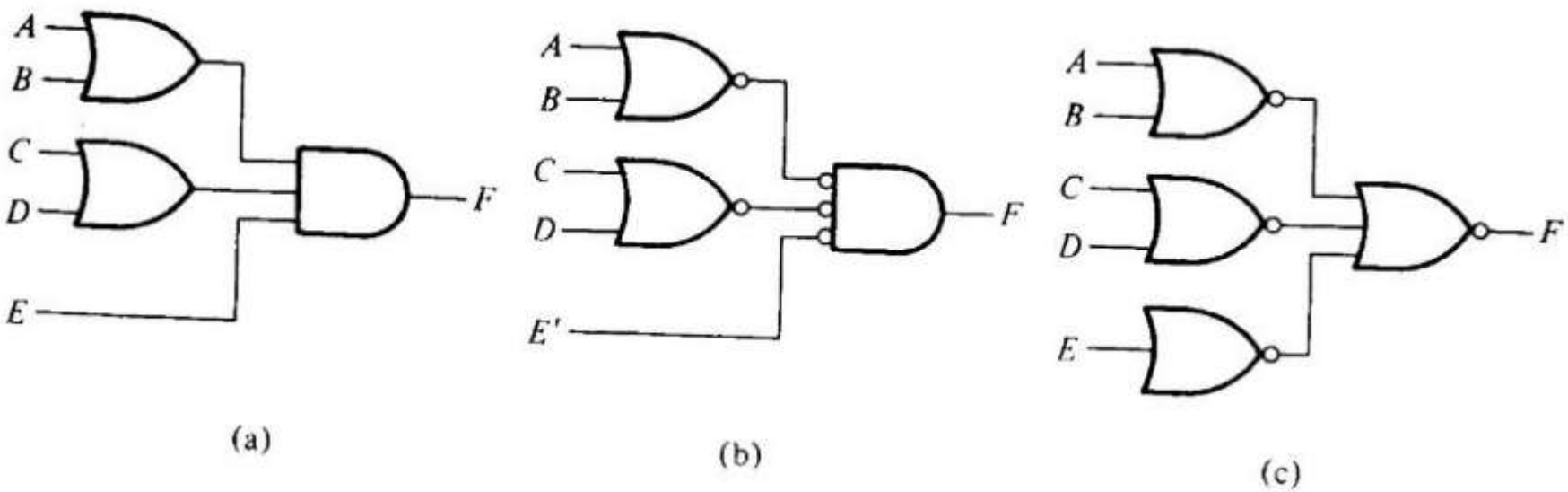


(c) Three graphic symbols for inverter.

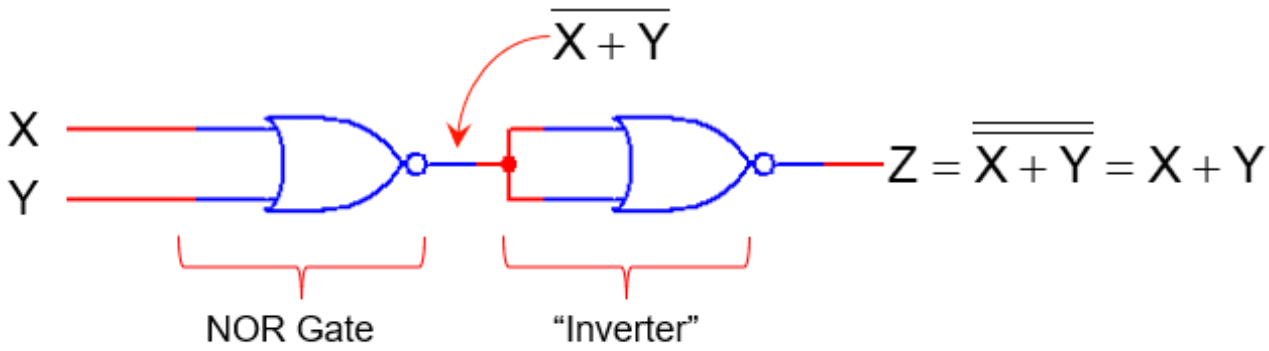
NOR IMPLEMENTATION

- The NOR function is the dual of the NAND function.
  - All procedures and rules for NOR logic are the dual of the corresponding procedures and rules developed for NAND ligic.
- implementation of a Boolean function with NOR gates requires that the function be simplified in product of sums form.
  - To obtain the simplified product of sums from a map , it is necessary to combine 0's in the map and then complement the function.

Three ways to implement $F = (A + B)(C + D)E$



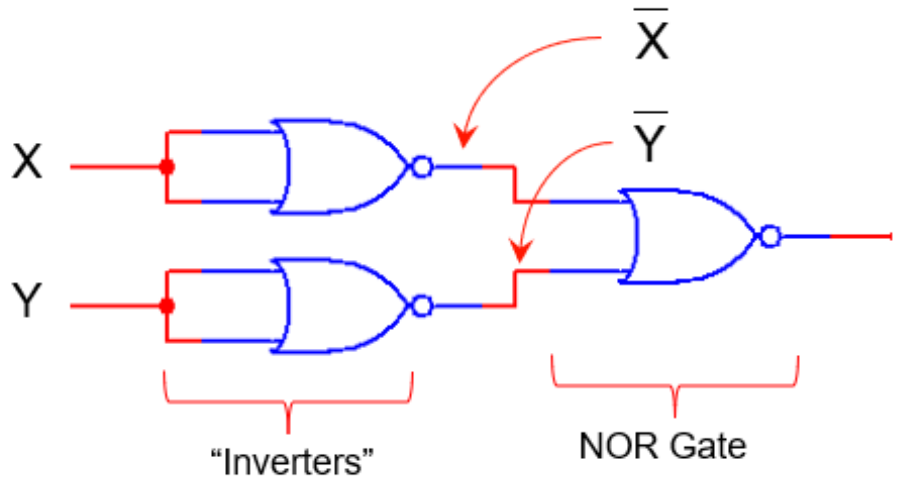
NOR as an OR GATE



X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

Equivalent to OR Gate

NOR as an AND GATE

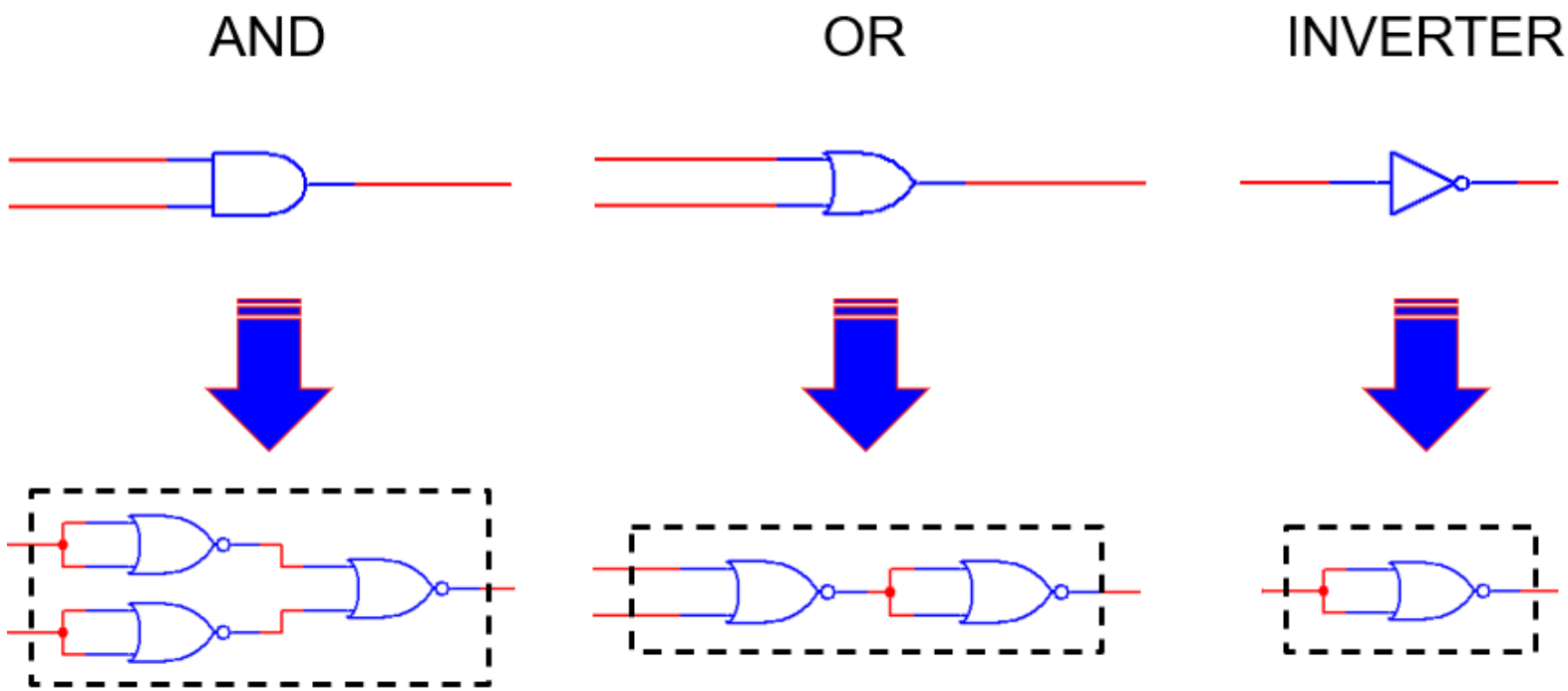


$$Z = \overline{\overline{X} + \overline{Y}} = \overline{\overline{X}}\,\overline{\overline{Y}} = X\,Y$$

X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

Equivalent to AND Gate

NOR GATE EQUIVALENT OF AOI GATES

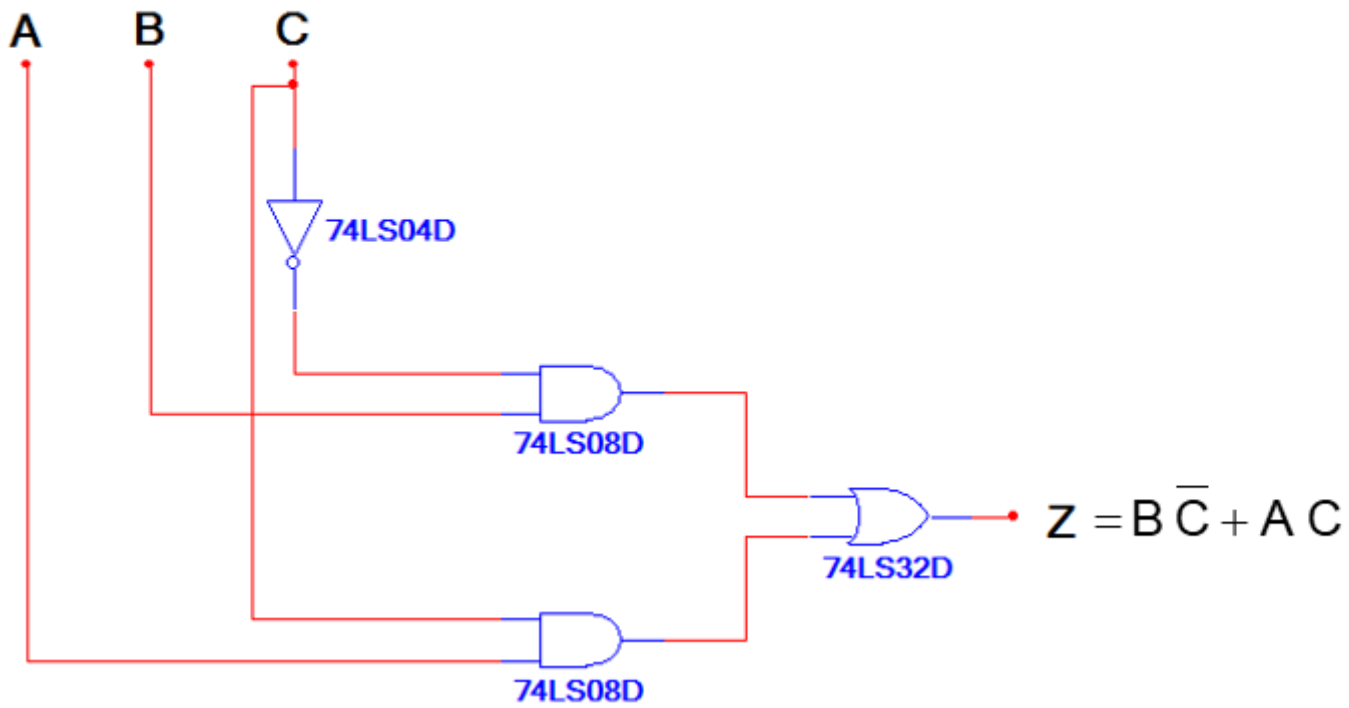


Process for NOR implementation

1. If starting from a logic expression, implement the design with AOI logic.
2. In the AOI implementation, identify and replace every AND,OR, and INVERTER gate with its NOR equivalent.
3. Redraw the circuit.
4. Identify and eliminate any double inversions. (i.e. back-to-back inverters)
5. Redraw the final circuit.

Example

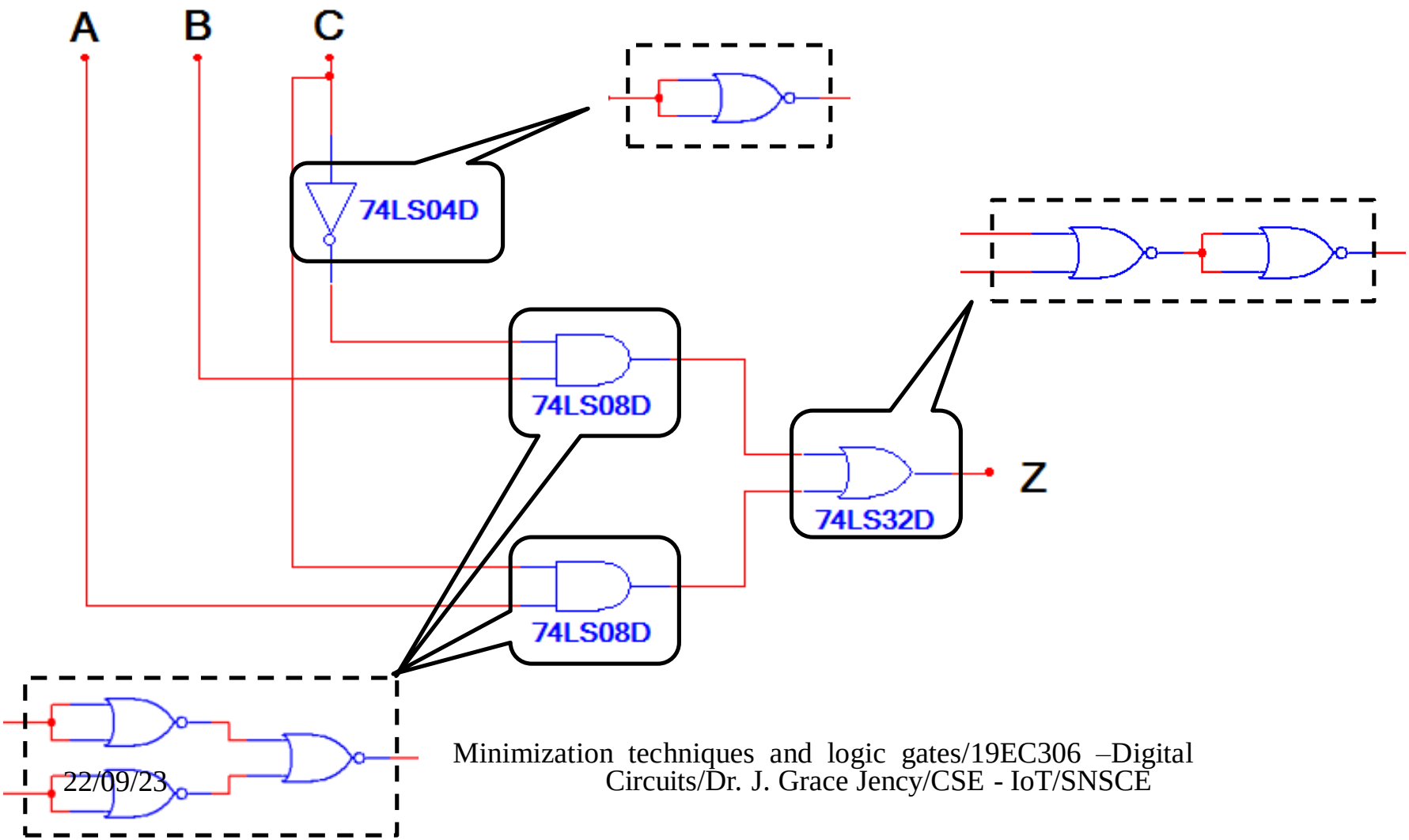
Design a NOR Logic Circuit that is equivalent to the AOI circuit shown below.



NOR Implementation

Solution – Step 2

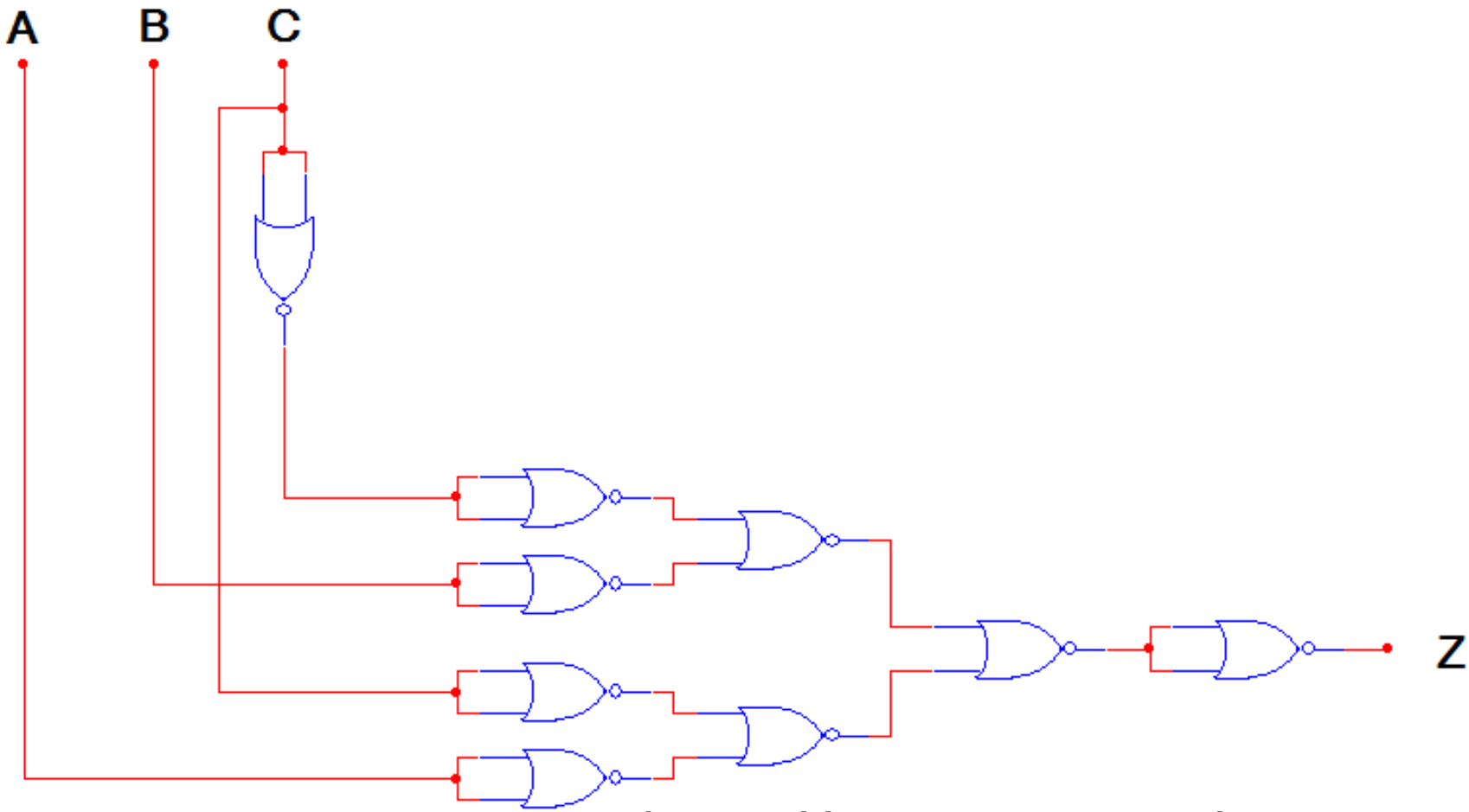
Identify and replace every AND,OR, and INVERTER gate with its NAND equivalent.



NOR Implementation

Solution – Step 3

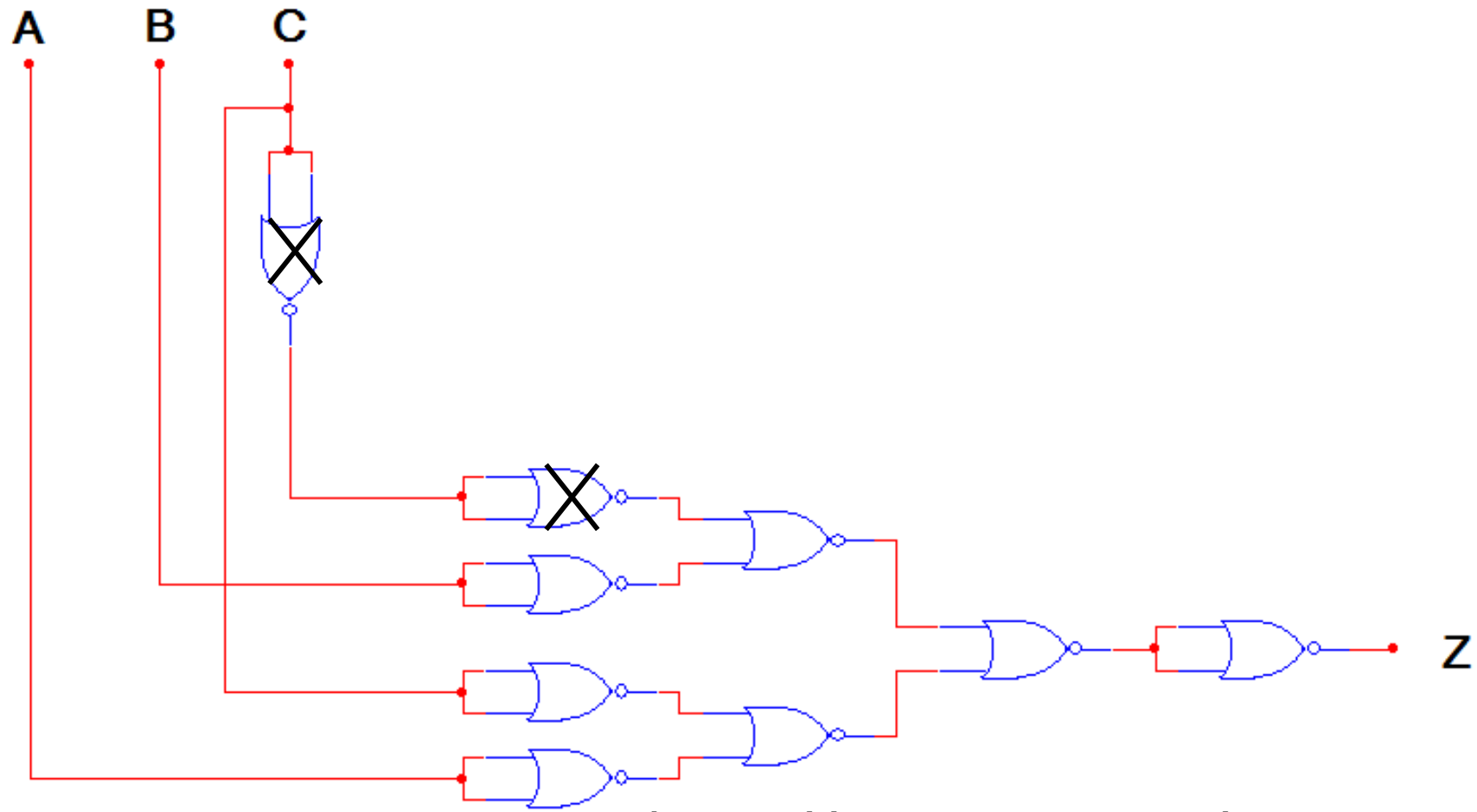
Redraw Circuit.



NOR Implementation

Solution – Step 4

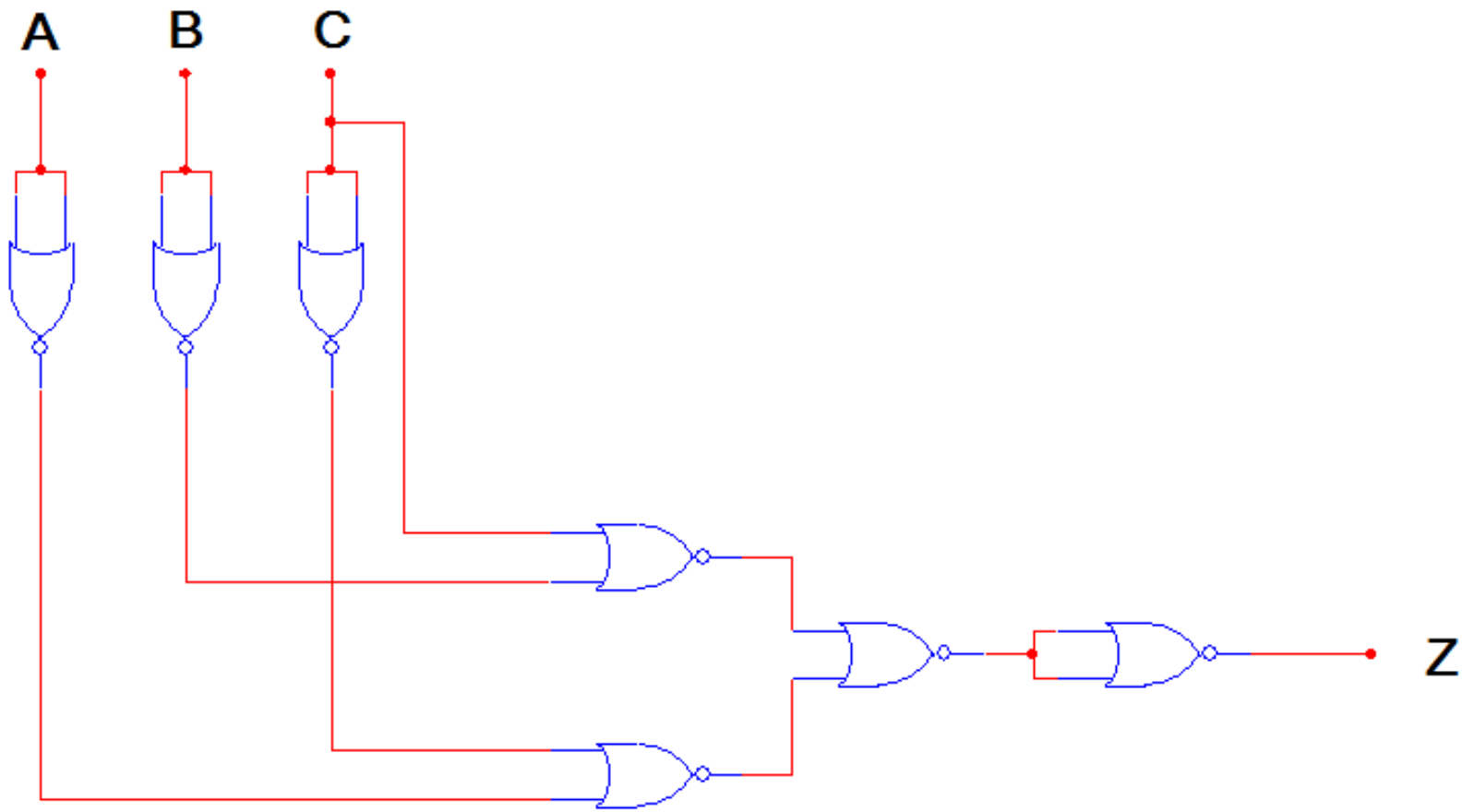
Identify and eliminate any double inversions.



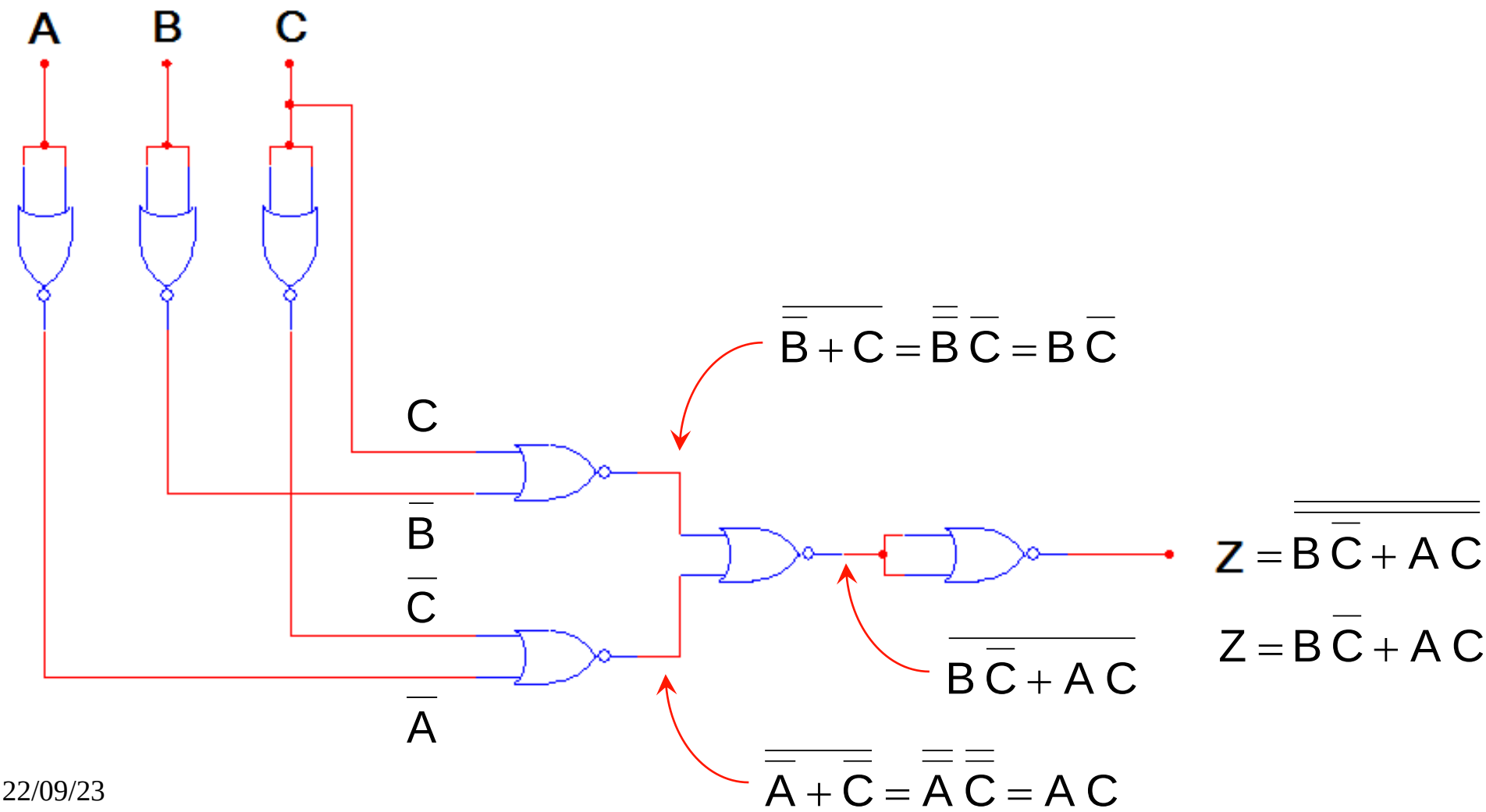
NOR Implementation

Solution – Step 5

Redraw Circuit.



Proof of Equivalence




Thank you