National University

of Computer and Emerging Sciences Chiniot -Faisalabad Campus

EE1005 – Digital Logic Design
Quiz# 4
SOLUTION MANUAL

Total Marks: 20

Q: In a simple copy machine, a stop signal, S, is to be generated to stop the machine operation and energize an indicator light whenever either of the following conditions exists: (1) there is no paper in the paper feeder tray; or (2) the two microswitches in the paper path are activated, indicating a jam in the paper path. The presence of paper in the feeder tray is indicated by a HIGH at logic signal P. Each of the microswitches produces a logic signal (Q and R) that goes HIGH whenever paper is passing over the switch to activate it. Design the logic circuit to produce a HIGH at output signal S for the stated conditions, and implement it using two input NAND gates only. **(10 marks)**

Marking Criteria: Note: Incase Truth table is wrong, the question will be marked as 0.

Correct Truth Table = 5 marks

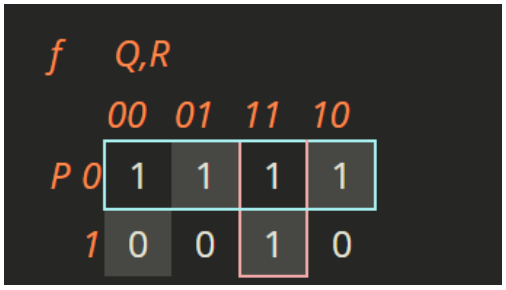
Correct k-map = 3 marks

Correct Circuit = 2 marks

Solution:

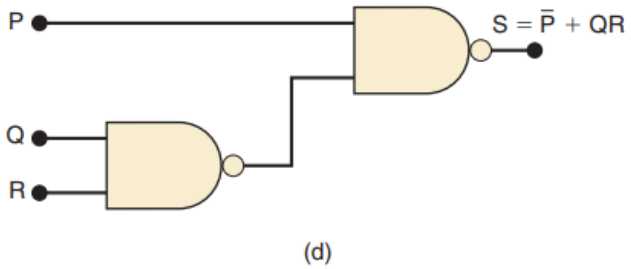
The truth table is shown below, The S output will be a logic 1 whenever P = 0 because this indicates no paper in the feeder tray. S will also be a 1 for the two cases where Q and R are both 1, indicating a paper jam. As the table shows, there are five different input conditions that produce a HIGH output

P	Q	R	S	
0	0	0	1	$\overline{P}\,\overline{Q}\,\overline{R}$
0	0	1	1	$\overline{P}\,\overline{Q}R$
0	1	0	1	$\overline{P}Q\overline{R}$
0	1	1	1	$\overline{P}QR$
1	0	0	0	
1	0	1	0	
1	1	0	0	
1	1	1	1	PQR



$$S = P' + QR$$

Circuit Diagram:



(d)

Q2: An analog-to-digital converter is monitoring the DC voltage (VB) of a 12-V storage battery on an orbiting spaceship. The converter's output is a four-bit binary number, ABCD, corresponding to the battery voltage in steps of 1 V, with A as the MSB. The converter's binary outputs are fed to a logic circuit that is to produce a HIGH output if the binary value is greater than 6; that is, the battery voltage is greater than 6 V. Design this logic circuit. **(10 marks)**

Marking Criteria: Note: Incase Truth table is wrong, the question will be marked as 0.
Correct Truth Table = 5 marks
Correct k-map = 3 marks
Correct Circuit = 2 marks

Solution:

For each case in the truth table, we have indicated the decimal equivalent of the binary number represented by the ABCD combination. The output z is set equal to 1 for all those cases where the binary number is greater than 0110 (6). For all other cases, z is set equal to 0. Using k-map we can obtain the equation as followed:

	A	B	C	D	z	
(0)	0	0	0	0	0	
(1)	0	0	0	1	0	
(2)	0	0	1	0	0	
(3)	0	0	1	1	0	
(4)	0	1	0	0	0	
(5)	0	1	0	1	0	
(6)	0	1	1	0	0	
(7)	0	1	1	1	1	$\rightarrow \bar{A}BCD$
(8)	1	0	0	0	1	$\rightarrow A\bar{B}\bar{C}\bar{D}$
(9)	1	0	0	1	1	$\rightarrow A\bar{B}\bar{C}D$
(10)	1	0	1	0	1	$\rightarrow A\bar{B}C\bar{D}$
(11)	1	0	1	1	1	$\rightarrow A\bar{B}CD$
(12)	1	1	0	0	1	$\rightarrow AB\bar{C}\bar{D}$
(13)	1	1	0	1	1	$\rightarrow AB\bar{C}D$
(14)	1	1	1	0	1	$\rightarrow ABC\bar{D}$
(15)	1	1	1	1	1	$\rightarrow ABCD$

$$Z(A,B,C,D) = BCD + A$$

Circuit Diagram: