1. Prove the following Boolean equations.
   (a) $x + y.x = x$
   (b) $x + \bar{x}.y = x + y$
   (c) $x + (y.z) = (x + y).(x + z)$
   (d) $\bar{u} = (\bar{c}.(w + r))$ is equivalent to $\bar{u} = c + \bar{w} \bar{r}$

2. Consider the Karnaugh map given in Figure 1. Write down the Boolean expression associated to this map.

   ![Karnaugh Map](image)

   Figure 1: Karnaugh map associated to exercise 2.

3. Implement the following equation $S = A.B.C + B.\bar{D}$ using only two-inputs NOR logical gates.

4. The attached document (HW6_data74ls151.pdf) contains the characteristics of the 74LS151 chip used in Lab. 12.

   (a) From the truth table provided in this sheet, prove that the sequence used for D0-D7 switch in the lab is proper for generating prime number (here prime means 2,3,5,7).
(b) Write down which combination of A0, A1, A2 yield a prime number.

5. In Lesson 12 handout, a slide on Karnaugh map presents a possible way of generating the month number (1 to 12) corresponding to Jan to Dec.

(a) We seek to generate the month numbers by using four inputs. Why four?

(b) Retrieve the Karnaugh map shown. Knowing that to each valid month number (that is an integer between 1 and 12) we associate either T or F depending on the number of days in the month (T=31 days and F=not 31 days).

(c) Write down the expression associated to this map (carefully explain how you come to this expression since the solution is given).