1. (a) Convert the decimal integer 58 to binary, octal, and hexadecimal. (Show the computation.)

   \[
   \begin{array}{|c|c|}
   \hline
   & \text{GRADE} \\
   \hline
   1 & /20 \\
   2 & /20 \\
   3 & /20 \\
   4 & /20 \\
   5 & /20 \\
   \hline
   \text{SUM} & /100 \\
   \hline
   \end{array}
   \]

   Binary:
   Octal:
   Hex:

   (b) Perform each of the following additions directly in the specified bases:

   \[
   \begin{array}{lll}
   \text{Binary:} & \text{Octal:} & \text{Hex:} \\
   \text{Carry:} & & \\
   110010 & 761 & \text{CF9} \\
   +010111 & +673 & +\text{C7A} \\
   \hline
   \text{----------} & \text{-----} & \text{-----} \\
   \end{array}
   \]

   (c) Assuming 16-bit word size and 2’s complement number system, show the representation for the negative number \(-58\).
2. Using algebraic manipulations, obtain a simplified sum-of-products expression for each of the following functions.

(a) \( f = XY + XYZ + XZ \)

(b) \( f = (X + Y + Z)(X + Y + Z) \)
3. (a) Show the truth table for the following function.

\[ f = (X \oplus Y)(X + Z) \]

(b) Express the sum-of-minterms expression for the above function \( f \). (Write the expression in both algebraic form and decimal-notation form.)
4. (a) Use a map to find a simplified \textbf{sum-of-products} expression for:
\[ f(X, Y, Z) = \Sigma_m(0, 2, 4, 6, 7) \]

(b) Use a map to find a simplified \textbf{product-of-sums} expression for:
\[ f(W, X, Y, Z) = \Sigma_m(0, 3, 6, 7, 8, 11, 14, 15) + \Sigma_d(5, 13) \]
5. A comparator circuit has two integer inputs $X = (X_1, X_0)$ and $Y = (Y_1, Y_0)$. The inputs $X$ and $Y$ are unsigned integers in the range 0 to 3, and $X_0$ and $Y_0$ are the least significant bits of $X$ and $Y$. The circuit has a single output $G$ which will have a value of 1 whenever $X > Y$.

(a) Using a K-map, obtain a simplified sum-of-products expression for $G$.

(b) Draw the 2-level NAND circuit to implement $G$. Provide a brief explanation of the circuit.