1 Boolean Logic Circuits [20 points]

(a) [10 points] Using Boolean algebra, find the simplest Boolean algebra equation for the following min-terms:
$\sum(1111, 1110, 1000, 1001, 1011, 1010, 0000)$. Show your work step-by-step.

$F = (\overline{B}.\overline{C}.\overline{D}) + (A.(C + \overline{B}))$

Explanation:
$F = (A.B.C.D) + (A.B.C.\overline{D}) + (A.\overline{B}.\overline{C}.\overline{D}) + (A.\overline{B}.\overline{C}.D) + (A.\overline{B}.C.D) + (A.\overline{B}.C.\overline{D}) + (\overline{A}.\overline{B}.\overline{C}.\overline{D})$

$F = (\overline{B}.\overline{C}.\overline{D}).(A+\overline{A})+(A.C).(B.D+B.\overline{D}+\overline{B}.D+\overline{B}.\overline{D})+(A.\overline{B}).(\overline{C}.D+\overline{C}.\overline{D}+C.D+C.\overline{D})$

$F = (\overline{B}.\overline{C}.\overline{D}) + (A.C) + (A.\overline{B})$

$F = (\overline{B}.\overline{C}.\overline{D}) + (A.(C + \overline{B}))$

(b) [10 points] Convert the following Boolean equation so that it only contains NOR operations. Show your work step-by-step.

$F = \overline{A} + \overline{(B.C + \overline{A.C})}$

$F = (\overline{(\overline{A + A} + \overline{(B.C + \overline{A.C})})}) + (\overline{(\overline{A + A} + \overline{(B.C + \overline{A.C})})})$
$B.C = \overline{\overline{B + B} + \overline{C + C}}$
$\overline{A.C} = \overline{A + A} + \overline{\overline{C + C} + \overline{C + C}}$

Explanation:
$F = (\overline{\overline{(\overline{A} + \overline{(B.C + \overline{A.C})})}})$
$F = (\overline{(\overline{A} + \overline{(B.C + \overline{A.C})})}) + (\overline{(\overline{A} + \overline{(B.C + \overline{A.C})})})$
$F = (\overline{(\overline{A + A} + \overline{(B.C + \overline{A.C})})}) + (\overline{(\overline{A + A} + \overline{(B.C + \overline{A.C})})})$
$B.C = \overline{\overline{B + B} + \overline{C + C}}$
$\overline{A.C} = \overline{A + A} + \overline{\overline{C + C} + \overline{C + C}}$