

1 Boolean Algebra [12 points]

- (a) [6 points] Find the simplest sum-of-products representation of the following Boolean equation. Show your work step-by-step.

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

$$F = B.C + A$$

Explanation:

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

$$F = (0 + B.(\overline{A} + A) + \overline{A}.\overline{C} + B + B.(\overline{C} + C) + C.A + 0).C + A$$

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

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

$$F = (B.C + 0 + C.A) + A$$

$$F = B.C + A.(C + 1)$$

$$F = B.C + A$$

- (b) [6 points] Convert the following Boolean equation so that it contains only NAND operations. Show your work step-by-step.

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

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

Explanation:

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

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

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

$$F = \overline{\overline{A} \cdot \overline{B.C} \cdot \overline{\overline{A}.C}}$$

$$F = \overline{\overline{A} \cdot \overline{B.C} \cdot \overline{\overline{A}.C}}$$