Department of Information and Communication Technology
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Tutorial 02

Boolean Logic

Part A: Simplify using Laws of Boolean Algebra

1. ABC+ABC′ +AB′C+A′BC
2. AB+A′ C+AB`C+BC
3. ABC+ABC′+A′B′C+AB′C
4. ABC+A′BC+AB′C′+ABC′
5. (A+B)(A+C)+A′BC
6. (AB+A′C)+(A+B)C
7. AB` + A(B + C)` + B(B + C)`
8. [AB`( C + BD) + A` B`]C
9. A`BC + AB`C` + A `B` C` + AB`C + ABC

Part B: Map the following expressions to a K-map and simplify. *(Note: Convert to Standard SOP before mapping to a K-map)*

1. A`B`CD + A`BC`D`+ ABC`D + ABC`D`+ A`B`C`D+ ABCD+ AB`CD`
2. A`+AB`+ABC`
3. B`C`+AB` + ABC` + AB’CD` +A`B`C`D + AB`CD
4. F(A,B,C) = ∑(0,1,2,4,5,6)
5. F(A,B,C,D) = ∑ (0,1,5,7,8,9,11,13) + ∑d(2,3)

Part C: Construct Simple Logic Circuits

1. A room has three sensors:
   A (Motion Sensor) – Detects if someone is in the room (1 = person detected, 0 = no one).
   B (Daylight Sensor) – Detects if there is enough sunlight (1 = bright, 0 = dark).
   C (Manual Switch) – Allows manual control (1 = ON, 0 = OFF).

Requirement:
The light should turn ON (Output = 1) if either:
   Motion is detected AND it's dark.
   The manual switch is turned ON.

2. A car has three sensors:
   A (Seatbelt Sensor) – 1 if the seatbelt is not fastened.
   B (Ignition Sensor) – 1 if the ignition is ON.
   C (Weight Sensor) – 1 if a person is seated.

   Requirement:
   The warning alarm (Output = 1) should activate if:

   A person is seated AND the ignition is ON AND the seatbelt is not fastened.

3. A farm uses a system to control a water pump based on three conditions:
   A (Soil Moisture Sensor) – 1 if the soil is dry.
   B (Rain Sensor) – 1 if it is raining.
   C (Manual Switch) – 1 if the pump is turned on manually.

   Requirement:
   The pump should turn ON if:
   The soil is dry AND it is not raining.
   The manual switch is ON.