Worksheet 3

Objective:

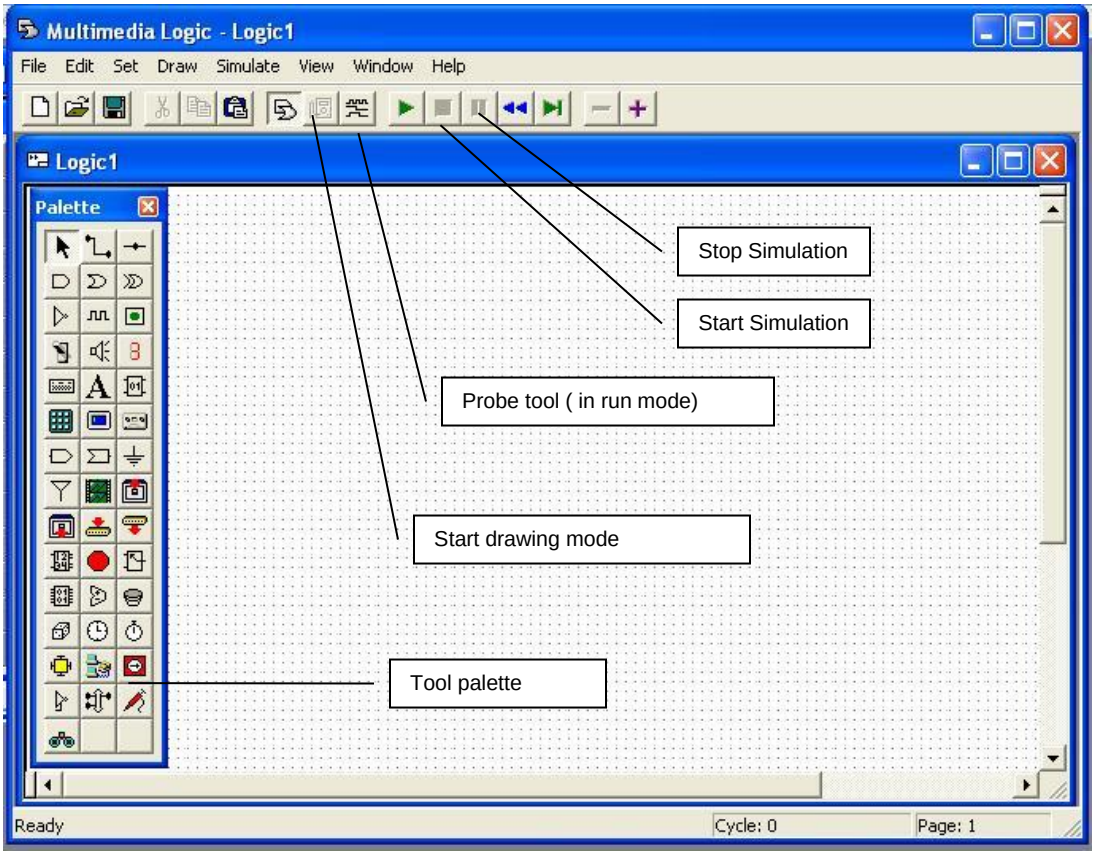
(1) To be familiar with the basic drawing capabilities, how to save/open a file and run the simulator of the 'Multimedia Logic' (MM Logic) software

(2) To understand the behavior of Basic Logic gates (AND, OR, NOT, NOR, NAND) using MM Logic

1) Introduction to Multimedia Logic

a) What is Multimedia Logic?

MultiMedia Logic is a powerful software which can be used to simulate digital logic circuits. It is a freeware produced by Softronics, Inc. It has facilities to connect directly to a computer's real devices (e.g. Keyboard, Screen, Serial Ports) including MultiMedia ones (e.g. PC speaker) and use them in logic implementations. This software can be used effectively to experiment and learn digital logic. In ICS lab sessions you will use MultiMedia Logic Version 1.3 to understand the logic circuits learned in lectures and tutorials. Following is the opening screen of MML. Ver 1.3



Worksheet 3

Important tools are

Arrow (1, 1): used to select and move/delete objects. To delete select and hit the (del) key. Double clicking on a selected item will bring up a *context sensitive menu* for it.

Wiring Tool (1, 2): used to wire objects. Wire *right to left* (←).

AND, OR, XOR gates on row 2. Three or Four input and/or NAND, NOR and NXOR versions available via *context sensitive menu* (see Arrow tool).

NOT (inverter) Gate (3, 1)

LED (light) (3, 3): Circuits terminate in lights. Red, yellow, and green versions thru *context sensitive menu*.

Switch (4, 1): circuits begin with switches. Toggle and push button versions thru *context sensitive menu.*

Text Tool (5, 2): used to label diagrams

a) Modes of Operation of MML

The Multimedia Logic Simulator can be used in several different modes of operation.

- **Ready** mode – ready to start drawing or start simulator.
- **Drawing** mode – devices can be added, deleted, moved, wired and modified.
- **Running** mode – devices can be operated, heard, and seen.
- **Pause** mode – examine circuits by stepping through them one cycle at a time.

b) Drawing of Devices (control, input, output) , nodes and wiring

To draw any device, click the respective tool in the palette and click the drawing canvas. Nodes also can be drawn in the same way. Use wire tool to connect devices. Nodes may be useful to arrange the circuits nicely.

Use pointer tool to select any device drawn on the canvas. Then they can be moved, copied or deleted. Wires cannot be moved separately but by moving the devices the connected wires will also move.

To draw a circuit

1. Position switches on left, LED's on right, gates in middle. Circuits flow *left to right*. (→)
2. Wire components *right to left* beginning from LEDs on Right back to switches on Left
3. To change component attributes, select and right click on component to bring up context sensitive menu.

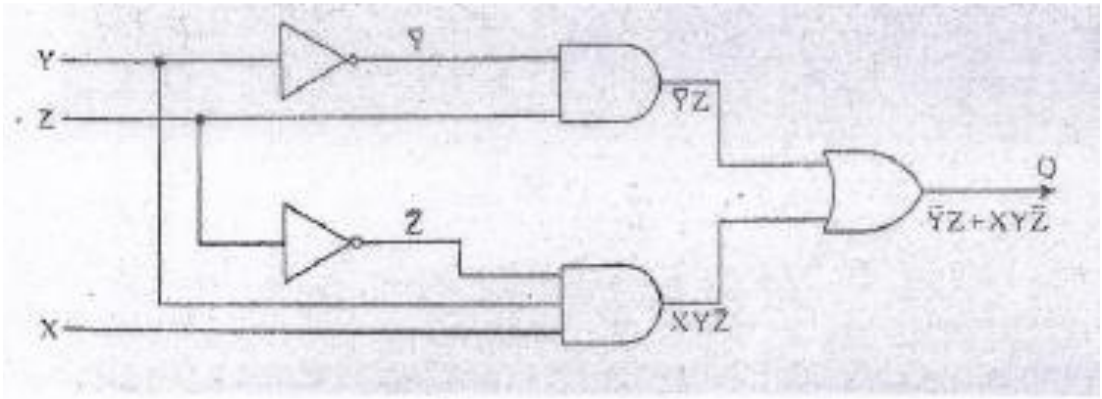
c) Save file / Run the Simulation

Circuits implemented have to be saved before you run the simulation. The file extension is .lgi. There can be more than one circuit in a single .lgi file. (Note: there are few limitations when simulating some advanced circuits, when they are drawn in a single file.)

Use 'Run' button to run the simulator. Then change the input and observe the output. Probe tool can be used to check the state of a node at any time while in run mode. Refer (b) above for other useful modes.

2) Draw circuit diagram and observe the output.

a) Draw the following circuit diagrams using MM Logic.



Save file as ex1.lgi.

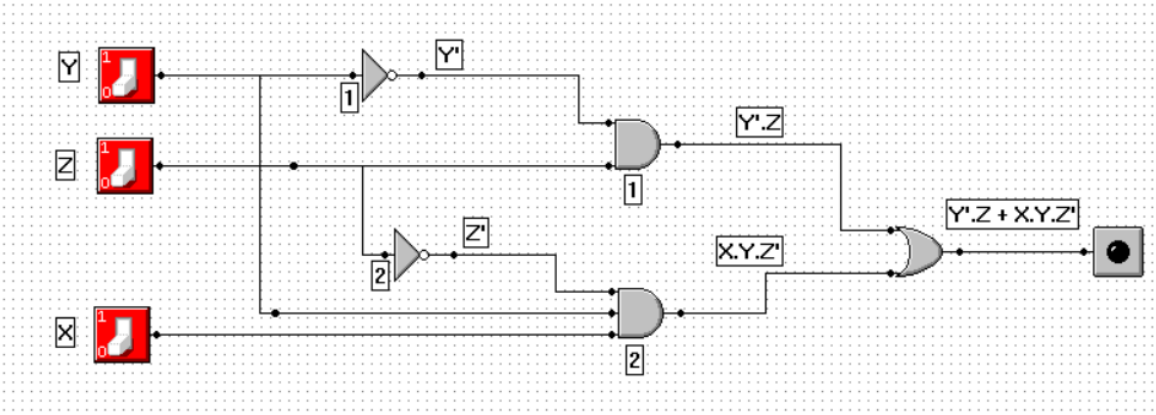
The following components are needed to build the circuits:

- 03 Switches
- 01 LED, which act at the visual representation of the output
- 02 AND Gate
- 01 OR Gate
- 02 Inverters

Worksheet 3

To build the circuit:

- Connect Switch Y to Inverter 1; then connect Inverter 1 to AND Gate 1.
- Connect Switch Z to AND Gate 1.
- Connect Switch Z to Inverter 2; then connect Inverter 2 to AND Gate 2.
- Connect Switch Y to AND Gate 2.
- Connect Switch X to AND Gate 2.
- Next, AND Gate 1 and AND Gate 2 will be connected to OR Gate, which later connected to LED.



b) For the circuit diagram above, Set the input values to different combinations to observe the output and fill the truth table below.

X	Y	Z	Y`	Z`	Y`Z	XYZ`	F=Y`Z+XYZ`
0	0	0	1	1	0	0	
0	0	1	1	0	1	0	
0	1	0	0	1	0	0	
0	1	1	0	0	0	0	
1	0	0	1	1	0	0	
1	0	1	1	0	1	0	
1	1	0	0	1	0	1	
1	1	1	0	0	0	0	

Worksheet 3

3)

$$F = A'B'C' + A'BC' + AB'C' + ABC'$$

a) Draw the circuit diagram for the above function in MML.

b) Obtain the truth table of each function by observing the output.

A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

c) Simplify the above Sum of Product-SOP expression using Boolean algebra and obtain the simplified answer.

d) Draw the simplified circuit diagram in MML.

4) A Digital Logic Circuit (DLC) is needed to identify the **Prime** numbers between integers 0-7. If those binary inputs represent a prime number the circuit should produce the HIGH (1) as the output of F, otherwise the output should be LOW (0).

Worksheet 3

a) Derive the truth table for the above-mentioned circuit.

In Dec	A	B	C	Output
0	0	0	0	0
1	0	0	1	0
2	0	1	0	1
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	1

b) Write the Boolean expression for the output F in Sum-of-Product –SOP form.

$$F = A'BC' + A'BC + AB'C + ABC$$

c) Draw the circuit diagram for the above SOP in MML.

d) Simplify F you wrote in part (b) using Boolean algebra.

e) Draw a circuit diagram for the simplified expression in part d) using Basic Logic gates.