SSM INSTITUTE OF ENGINEERING AND TECHNOLOGY

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Dindigul – Palani Highway, Dindigul – 624 002

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VAC

On

Quantum dot Cellular Automata in Nanotechnology

SSM Institute of Engineering and Technology * DINDIGUL-624 002 *

Dr.D.SENTHIL KUMARAN, M.E., Ph.D., (MUS).,
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Dindigul – Palani Highway, Dindigul-624 002

Value added Course on"Qunatum dot Cellular Automata in Nanotechnology"

INDEX

HOD/ECE

Dr.S. KARTHIGAI LAKSHMI
Professor & Head
Department of ECE
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Dindigul-624 002

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SSM INSTITUTE OF ENGINEERING AND TECHNOLOGY,DINDIGUL

DEPARTMENT OF ECE

CIRCULAR Date: 07.09.19

This is kindly to inform that a Value added course on "**Quantum dot Cellular Automata in Nanotechnology**" for Final Year students has been arranged for their project work.

Schedule:

Class 1	**29.06.2019**
Class 2	**06.07.2019**
Class 3	**31.08.2019**
Class 4	**07.08.2019**
Class 5	**21.08.2019**

Faculty Incharge

1.Dr.S.Karthigai Lakshmi, Prof/ECE

2. M.Jeyalakshmi,AP/ECE

HOD (ECE)

Principal

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Value added Course on"QCA in Nanotechnology"

Date :29.06.2019 to 21.08.2019

Syllabus content

1. Introduction to Nanotechnology
2. Introduction to Quantum dot Cellular Automata
3. QCA Cells
4. QCA Logic gates
5. QCA Crossovers
6. QCA clock zones
7. Introduction to QCA software Version 2.0.3
8. Design of digital logic circuits using QCA software

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Value Added Course Summary 2019-2020

Course Name: Quantum dot Cellular Automata in Nanotechnology

Course Duration: 40 hours

Year Offered: 2019-2020

Course Instructors: Dr.S.Karthigai Lakshmi,HoD/ECE
Mrs.M.Jeyalakshmi,AP/ECE
SSMIET,Dindigul

Course Outcome:

On completion of the course, students will be able to identify different QCA devices and components and design and analyze QCA-based logic gates and circuits

Course Type: Self Framed

Assessment Mode

Attendance: 40 hours

Number of Participants: 10

Scheme of Exam: MCQ

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Course Co-ordinators

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Department of Electronics and Communication Engineering

Students Namelist

S.No	Register number	Name of the Student
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2	922116106068	Selvameenakshi. V
3	922116106069	Shankar. S
4	922116106074	Shobanapandi. S
5	922116106075	Shobiga. N
6	922116106080	Sipriya. R
7	922116106081	Siyamala. K.T.G
8	922116106041	Meenatchi Sundaram. P
9	922116106042	Muniyappan. C
10	922116106037	Loganathan. K. B

1.Dr.S.Karthigai Lakshmi

2.M.Jeyalakshmi

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Quantum-dot cells

Origin

Cellular automata are commonly implemented as software programs. However, in 1993, Lent et al. proposed a physical implementation of an automaton using quantum-dot cells. The automaton quickly gained popularity and it was first fabricated in 1997. Lent combined the discrete nature of both cellular automata and quantum mechanics, to create nano-scale devices capable of performing computation at very high switching speeds (order of Terahertz) and consuming extremely small amounts of electrical power.

Modern cells

Today, standard solid state QCA cell design considers the distance between quantum dots to be about 20 nm, and a distance between cells of about 60 nm. Just like any CA, Quantum (-dot) Cellular Automata are based on the simple interaction rules between cells placed on a grid. A QCA cell is constructed from four quantum dots arranged in a square pattern. These quantum dots are sites electrons can occupy by tunneling to them.

Cell design

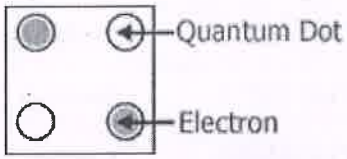


Fig:1 A simplified diagram of a four-dot QCA cell.

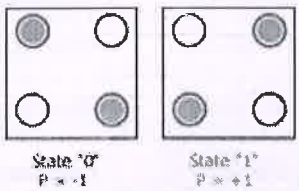


Figure 2 - The two possible states of a four-dot QCA cell.

Figure shows a simplified diagram of a quantum-dot cell.[1] If the cell is charged with two electrons, each free to tunnel to any site in the cell, these electrons will try to occupy the furthest possible site with respect to each other due to mutual electrostatic repulsion. Therefore, two distinguishable cell states exist. Figure 3 shows the two possible minimum energy states of a quantum-dot cell. The state of a cell is called its polarization, denoted as P. Although arbitrarily chosen, using cell polarization P = -1 to represent logic "0" and P = +1 to represent logic "1" has become standard practice.

QCA wire

Logic gates

Majority gate

Majority gate and inverter (NOT) gate are considered as the two most fundamental building blocks of QCA. Figure 5 shows a majority gate with three inputs and one output. In this structure, the electrical field effect of each input on the output is identical and additive, with the result that whichever input state ("binary 0" or "binary 1") is in the majority becomes the state of the output cell — hence the gate's name. For example, if inputs A and B exist in a "binary 0" state and input C exists in a "binary 1" state, the output will exist in a "binary 0" state since the combined electrical field effect of inputs A and B together is greater than that of input C alone.

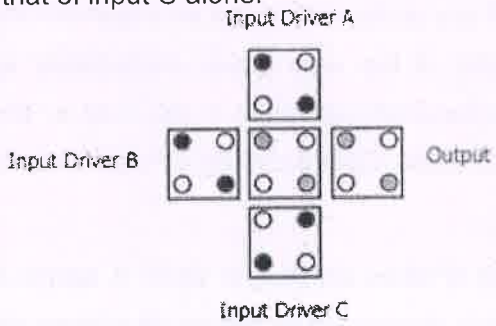


Figure 5 - QCA Majority Gate

Other gates

Other types of gates, namely AND gates and OR gates, can be constructed using a majority gate with fixed polarization on one of its inputs. A NOT gate, on the other hand, is fundamentally different from the majority gate, as shown in Figure 6. The key to this design is that the input is split and both resulting inputs impinge obliquely on the output. In contrast with an orthogonal placement, the electric field effect of this input structure forces a reversal of polarization in the output.

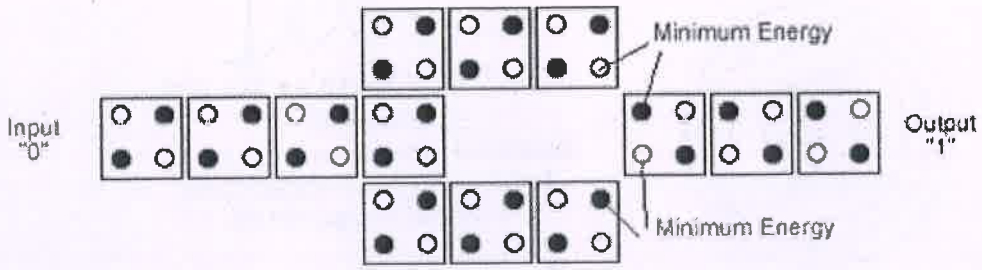
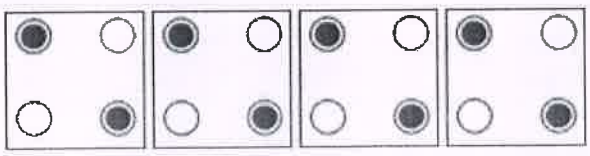


Figure 6 - Standard Implementation of a NOT gate. Note that the labeling of the input and output values follows a convention exactly opposite to that of the rest of this article.



A wire of quantum-dot cells. Note that the relative distances between cells and dots in a cell are not to scale (cells are much farther apart than dots within a cell).

Grid arrangements of quantum-dot cells behave in ways that allow for computation. The simplest practical cell arrangement is given by placing quantum-dot cells in series, to the side of each other. Figure 4 shows such an arrangement of four quantum-dot cells. The bounding boxes in the figure do not represent physical implementation, but are shown as means to identify individual cells.

If the polarization of any of the cells in the arrangement shown in figure 4 were to be changed (by a "driver cell"), the rest of the cells would immediately synchronize to the new polarization due to Coulombic interactions between them. In this way, a "wire" of quantum-dot cells can be made that transmits polarization state. Configurations of such wires can form a complete set of logic gates for computation.

There are two types of wires possible in QCA: A simple binary wire as shown in Figure 4 and an inverter chain, which is constituted by placing 45-degree inverted QCA cells side by side.

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Value added Course on"QCA in Nanotechnology"

Date :29.06.2019 to 21.08.2019

Attendance sheet

S.No.	Reg. No.	Name of the Student	Sign
1	922116106037	Loganathan.K.B	
2	922116106041	Meenatchi Sundaram.P	
3	922116106042	Muniyappan.C	
4	922116106067	Selvakumar G	
5	922116106068	Selvameenakshi V	
6	922116106069	Shankar S	
7	922116106074	Shobanapandi S	
8	922116106075	Shobiga N	
9	922116106080	Sipriya R	
10	922116106081	Siyamala K T G	

22/8/2019

Faculty Incharge

HOD/ECE

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Date :29.06.2019 to 21.08.2019

ASSESSMENT QUESTIONS

1. **QCA stands for** **(3 marks)**
   a)Qualitative Circuit Analysis
   b)Quantum dot cellular Automata

2. **Tick the types of crossovers present in QCA?** **(3 marks)**

   a) Cell crossover
   b) Coplanar crossover
   c) Multilayer crossover

3. **How many clock zones present in QCA?** **(3 marks)**
   a)2
   b)3
   c)4

4. **Does QCA meant to design circuits qualitatively?** **(3 marks)**

   a)Yes
   b)No

5. **QCA circuits are designed in** **(3 marks)**

   a)Microamps
   b)Nanoamps

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Name: Loganathan.K.B
Reg : 922116106037

Value added Course on"QCA in Nanotechnology"

Date :29.06.2019 to 21.08.2019

ASSESSMENT QUESTIONS

1. **QCA stands for** **(3 marks)**
   a)Qualitative Circuit Analysis
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15/15

V. Good

Signature of the Participant

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VAC on "QCAin Nanotechnology"

29/06/2019 To 21/08/2019

FEEDBACK FORM

Name of the Participant: Muniyappan . C

Year/Sem : IV - 7 Sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind		✓	
2	Whether your expectation gets satisfied		✓	
3	Whether the session was interactive		✓	
4	Knowledge gained from this VAC is	✓		
5	Was the VAC well organized	✓		

Comments on session:

Nill

C. Muniyappan

Signature of the Participant

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VAC on "QCAin Nanotechnology"

29/06/2019 To 21/08/2019

FEEDBACK FORM

Name of the Participant: Loganathan . K . B

Year/Sem : IV - 7 Sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind			
2	Whether your expectation gets satisfied			
3	Whether the session was interactive			
4	Knowledge gained from this VAC is			
5	Was the VAC well organized			

Comments on session:

Loganathan . K.B

Signature of the Participant

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29/06/2019 To 21/08/2019

FEEDBACK FORM

Name of the Participant: Sipriya. R

Year/Sem : IV - 7 sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind		✓	
2	Whether your expectation gets satisfied	✓		
3	Whether the session was interactive		✓	
4	Knowledge gained from this VAC is	✓		
5	Was the VAC well organized	✓		

Comments on session:

Good

Signature of the Participant

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FEEDBACK FORM

Name of the Participant: Shobiga. N

Year/Sem : IV - 7 sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind		✓	
2	Whether your expectation gets satisfied	✓		
3	Whether the session was interactive		✓	
4	Knowledge gained from this VAC is	✓		
5	Was the VAC well organized		✓	

Comments on session:

Nill

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FEEDBACK FORM

Name of the Participant: Meenatchi sundaram . P

Year/Sem : IV - 7 sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind		✓	
2	Whether your expectation gets satisfied	✓		
3	Whether the session was interactive		✓	
4	Knowledge gained from this VAC is	✓		
5	Was the VAC well organized			✓

Comments on session:

Informative

Signature of the Participant

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FEEDBACK FORM

Name of the Participant: Siyamala . K.T.G

Year/Sem : IV - 7 sem

S.No	Question	Excellent	Good	Satisfactory
1	Did the VAC enlighten your mind		✓	
2	Whether your expectation gets satisfied			✓
3	Whether the session was interactive		✓	
4	Knowledge gained from this VAC is	✓		
5	Was the VAC well organized		✓	

Comments on session:

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CERTIFICATE OF APPRECIATION

QCA 2019

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Sipriya.R

Who has sucessfully completed the valu added course in QCA in Nanotechnolofy from 29.06.2019 to 21.08.2019

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