University of Asia Pacific (UAP)

Department of Computer Science and Engineering (CSE)

Course Outline

Program:	B.Sc. in Computer Science and Engineering (CSE)
Course Title:	Design and Testing of VLSI
Course Code:	CSE 457
Semester:	Fall-2023
Level:	4th Year 2nd Semester
Credit Hour:	3.0
Name & Designation of Teacher:	Dr. Md. Moshiur Rahman, Associate Professor, Department of EEE
Office/Room:	Room No. 501, 5th Floor, Department of EEE.
Class Hours:	Sunday: 03.30pm -05.00pm, Tuesday: 03.30pm -05.00pm (A) Sunday: 12.30pm -02.00pm, Monday: 08.00am -09.30am (B)
Consultation Hours:	Monday: 09.30am-02.00pm, Thursday : 01:00 am - 02:00 pm
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Rationale:	This is an optional course that will help the students to understand the fabrication process, CMOS circuits and layout design of different logic devices.
Pre-requisite (if any):	CSE 209
Course Synopsis:	Fabrication process and CMOS circuit design of different logic devices. Layout design rules and physical design of simple logic circuits. Review of MOS transistor theory, NMOS and CMOS inverter. CMOS circuit characteristics and performance estimation.
Course Objectives:	The objectives of this course are to: **1.** Introduce with fabrication process of MOSFET and Logic circuits. **2.** Demonstrate CMOS circuits and Layout of different logic devices.

3. Interpret different memory and arithmetic devices and their design procedures.
4. Show the efficient, economic and precise design procedures of different logic devices.
5. Provide idea regarding CMOS circuit characteristics and performance estimation.

Course Outcomes (CO) and their mapping with Program outcomes (PO) and Teaching-Learning Assessment methods:

CO No.	CO Statements: Upon successful completion of the course, students should be able to:	POs (Appendix-1)	K (Appendix-2)	P (Appendix-3)	A (Appendix-4)	Bloom's taxonomy domain/level (Appendix-5)	Delivery methods and activities	Assessment Tools
CO1	Interpret the fabrication process of MOSFETs and construct the NMOS, PMOS and CMOS circuit and layout of basic logic gates and different logical devices.	PO(a)	K4	P1 P2 P3		Apply	Class lecture, design Practice and discussion	Written exam
CO2	Select the appropriate design parameters for efficient device development using NMOS, PMOS and CMOS.	PO(b)	K4	P1 P2 P3		Apply	Class lecture, design Practice and discussion	Written exam
CO3	Compare the performances of NMOS, PMOS and CMOS circuits by calculating output voltage, current, power, delay time etc.	PO(b)	K4	P1 P2 P3		Analyze	Class Lecture, discussion, & Problem solving	Written Exam.

Weighting COs with Assessment methods:

Assessment Type	% Weight	CO1	CO2	CO3
Final Exam	**50%**	16.67	16.67	16.67
Mid Term	**20%**	20		
Written Quiz	**30%**	10	10	10
Total	**100%**	46.67	26.67	26.67

Grading Policy: As per the approved grading policy of UAP (Appendix-6)

Course Content Outline and mapping with Cos

Weeks	Topics / Content	Course Outcome	Delivery methods and activities	Reading Materials
1	Introductory discussion on VLSI design and MOS characteristics, fabrication technology of CMOS transistor.	CO1	Class lecture and discussion	D.A. Pucknell
2-3	CMOS and NMOS circuit design process, stick/layout diagram of different logic gates and devices.	CO1	Class lecture, design Practice and discussion	D.A. Pucknell
4	NMOS & PMOS pass transistor, CMOS pass transistor, Implementation of logic circuits: multiplexer, adder, subtractor using NMOS, PMOS pass transistor & Transmission gate	CO1	Class lecture, design Practice and discussion	D.A. Pucknell
		Quiz-01		

5	Introduction on Verilog code, Design and implementation techniques of different logic circuits using Verilog code.	CO1	Class lecture and discussion	Class Lectures
6	Bus arbitration logic circuit, Parity generator circuit, and ALU.	CO1	Class lecture and discussion	D.A. Pucknell
Quiz-02				
7	PLA circuits	CO2	Class lecture and discussion	D.A. Pucknell
Midterm Exam				
8	Review of MOS transistor theory, threshold voltage, body effect, I-V equations and characteristics.	CO2	Class lecture and discussion	Linda E.M. Brackendury, Chapter – 2
9-10	NMOS Inverter: NMOS Inverter circuit with resistive, enhancement and depletion types load, power consumption, delay, aspect ratio calculation.	CO2	Class Lecture, discussion, & Problem solving	Linda E.M. Brackendury, Chapter – 2
Quiz-03				
11-12	CMOS inverter: Power consumption, delay, aspect ratio calculation, voltage transfer characteristics	CO3	Class Lecture, discussion, & Problem solving	Linda E.M. Brackendury,
13	Buffer chain design for high capacitive load, RC delay calculation for CMOS circuits.	CO3	Class Lecture, discussion, & Problem solving	Linda E.M. Brackendury,
Quiz-04				
14	Review & problem-solving	All COs	Discussion	
Final Exam				

Required Reference(s):

1. D.A. Pucknell & K. Eshraghian, Basic VLSI Design
2. Design of VLSI Systems – A Practical Introduction, Linda E.M. Brackenbury.
3. CMOS VLSI Design, N.H.E. Weste, D. Harris & A. Banerjee.

Recommended Reference(s):

1. Microelectronic Circuits, Sedra & Smith
2. CMOS Circuit Design, Layout and Simulation, R.J. Baker.

Special Instructions:

- Minimum 70% attendance is required to attend the semester final exam.
- There is no mark for class attendance. However, there is mark for class performance.
- There will be no make-up for quizzes and mid-term exam.
- No plagiarism would be allowed in assignments. Cases of copying one another in assignments or class tests would be dealt very strictly.
- Students must come to the class prepared for the course material covered in the previous class.
- Do not do anything which may disturb the class (such as passing irrelevant and negative comments etc.); you will be monitored, and disciplinary actions will be taken.

Prepared by	Checked by	Approved by
Dr. Md. Moshiur Rahman Associate Professor Department of EEE	Chair, PSAC Department of EEE	Head Department of EEE

<u>Appendix-1:</u> **BAETE specified Program Outcomes (PO) or Graduate Attributes for engineering programs**

PO / Graduate Attributes	Characteristics
PO(a)	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.
PO(b)	Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)
PO(c)	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
PO(d)	Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO(e)	Create, select and apply appropriate techniques, resources, and modern engineering and

	IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)
PO(f)	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
PO(g)	Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
PO(h)	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)
PO(i)	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PO(j)	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO(k)	Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO(l)	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Appendix-2: Knowledge Profile

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the Discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Appendix-3: Range of Complex Engineering Problem Solving

Attribute: Complex Engineering Problems have characteristic P1 and some or all of P2 to P7		
P1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
P2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues
P3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
P4	Familiarity of issues	Involve infrequently encountered issues
P5	Extent of applicable	Are outside problems encompassed by standards and codes of practice for

	codes	professional engineering
P6	Extent of stakeholder	involvement and conflicting requirements: Involve diverse groups of stakeholders with widely varying needs
P7	Interdependence	Are high level problems including many component parts or sub-problems

<u>Appendix-4:</u> Range of Complex Engineering Activities

Attribute: Complex engineering activities means activities or projects that have some or all of the following characteristics:		
A1	Range of resources	Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
A2	Level of interaction	Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
A3	Innovation	Involve creative use of engineering principles and research based knowledge in novel ways
A4	Consequences for society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
A5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches

<u>Appendix-5</u>

Bloom's Taxonomy (Taxonomy of Learning)

3 Domains

(1) **Cognitive (Knowledge)**	**(2)** **Psychomotor (Skill)**	**(3)** **Affective (Attitude)**
Remember	Imitation	Receiving
Understand	Manipulation	Responding
Apply	Precision	Valuing
Analyze	Articulation	Organization
Evaluate	Naturalization	Characterization
Create		