Register Number:……..

KUMARAGURU
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B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Fifth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U18EEE0005:VLSI Design

COURSE OUTCOMES

CO1: Recollect and study the fundamentals of electronic devices and circuits.
CO2: Understand the principle and working of MOS and CMOS device
CO3: Apply the fundamentals of digital circuits and CMOS technology to develop different design techniques
CO4: Design various digital modules and systems using different CMOS design techniques
CO5: Analyze the different CMOS digital modules for performance parameters such as gate size and power.
CO6: Understand the concepts of programmable devices for custom design

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. CO1 [K_2]

List I	List II
A. Type of transistor used in the pull-up network of CMOS circuits	i. Faster switching speed
B. Transistor with higher electron mobility	ii. Requires negative gate voltage to turn ON
C. Transistor used in the pull-down network of CMOS circuits	iii. PMOS
D. Transistor that turns on with positive gate voltage	iv. NMOS

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	iv	ii

2. Identify the process parameters that affects the threshold voltage (Vth) of a MOS transistor. CO2 [K_3]

a) Oxide thickness (Tox) b) Channel length (L)

c) Gate capacitance (Cg) d) Electron mobility (μn)

3. Interpret the statements that are true about pass transistor logic CO3 [K_2]

A) Pass transistor logic reduces the number of transistors required compared to CMOS logic

B) Pass transistors can degrade signal levels due to threshold voltage drop

C) Both PMOS and NMOS transistors are equally used in pass transistor logic

D) Pass transistor logic circuits consume more static power than CMOS circuits

a) 1,3 b) 1,4

c) 1,2 d) 2,3

4. Give the factor that primarily contributes to dynamic power dissipation in CMOS circuits. CO5 [K_1]

a) Leakage current in the off state b) Charging and discharging of capacitive loads

c) Short-circuit current during switching d) Subthreshold leakage during standby operation

5. Assertion (A): Setup time violations can lead to incorrect data being latched in a sequential circuit. CO4 [K_2]
Reason (R): A setup time violation occurs when the data input is not stable for a required minimum time before the clock edge.

a) Both A and R are true, and R is the correct explanation of A. b) Both A and R are true, but R is not the correct explanation of A.

c) A is true but R is false d) A is false but R is true

6. The commonly used technique to reduce power consumption in low-power memory circuits. CO5 [K_2]

a) Increased supply voltage b) Dynamic voltage scaling

c) Using static random-access memory (SRAM) exclusively d) Eliminating read and write operations

7. Arrange the following steps in the correct order for a 4-bit ripple carry adder when adding two 4-bit binary numbers A and B. CO4 [K_2]

1. Calculate the sum bits using the XOR operation.
2. Propagate the carry to the next stage using the AND operation.
3. Initialize the carry-in for the least significant bit (LSB).
4. Calculate the carry-out for each bit position.
5. Output the final sum and carry-out after the last stage.

a) 2-3-4-1-5 b) 5-1-3-2-4

c) 3-1-2-4-5 d) 4-1-5-3-2

8. Infer the primary function of a barrel shifter in digital circuits. CO4 [K_2]

a) To perform addition and subtraction operations
b) To rotate or shift data bits left or right in a single clock cycle
c) To store data temporarily during computation
d) To convert analog signals to digital form

9. Assertion (A): Full custom design allows for maximum optimization of circuit performance and area. CO6 [K2]

Reason (R): Semi-custom design methodologies provide a faster design cycle and lower initial costs compared to full custom design.

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

10. Identify the statement that is true regarding FPGAs. CO6 [K2]

a) FPGAs are programmable only once after manufacturing.
b) FPGAs consist of a fixed hardware architecture with no ability to configure logic functions.
c) FPGAs can be reprogrammed multiple times to implement different functions or applications.
d) FPGAs are primarily used for applications that require high-speed processing with fixed logic.

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. List the regions of operation for an N-MOSFET with its voltage levels. CO1 [K1]
12. Justify the reason for using PMOS as pull-up network. CO2 [K2]
13. Implement AND gate using pass transistor logic. CO3 [K2]
14. Recall Elmore's Constant. CO3 [K2]
15. Define propagation delay. CO5 [K1]
16. List the performance parameters of digital circuits. CO5 [K1]
17. List any two data path circuits. CO4 [K1]
18. State the purpose of ALU. CO4 [K1]
19. List any two importance of FPGA CO6 [K1]
20. Recall standard cell design. CO6 [K1]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 350 words)

21.	a)	Construct the stick diagram of NAND gate realized using static CMOS logic.	7	CO2	[K_3]
	b)	Summarize about the scaling principles of transistor.	7	CO2	[K_2]
22.	a)	Construct the circuit of a 2:1 Multiplexer using pass transistor and transmission gate logic, and provide a detailed explanation of its working.	7	CO3	[K_3]
	b)	Describe in detail about the static and dynamic power dissipation	7	CO3	[K_2]
23.	a)	Describe the characteristics and functionalities of static and dynamic latches in digital circuits.	7	CO4	[K_2]
	b)	Discuss in detail the timing issues encountered in sequential circuits.	7	CO4	[K_2]
24.	a)	Construct the architecture of 4 bit array multiplier in digital circuits.	7	CO5	[K_3]
	b)	Discuss the speed and area trade-offs associated with different types of adders used in arithmetic operations.	7	CO5	[K_3]
25.	a)	Compare full custom and semi-custom design methodologies in VLSI.	7	CO6	[K_2]
	b)	Explain the routing procedures used in FPGAs, explaining the steps involved from logic block placement to programming the FPGA.	7	CO6	[K_2]
26.	a)	Discuss the operational principles and characteristics of PMOS and NMOS transistors in digital circuits.	7	CO1	[K_2]
	b)	Elaborate on the functioning and significance of the CMOS inverter, including its advantages and applications in integrated circuits.	7	CO1	[K_2]

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