VLSI- Activity 1

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Q1) When an IC designer chooses a full custom IC design methodology, two key resons for this choice are -

i) Optimization & Power efficiency - As full custom design allows for fine tuned circuit optomization leading to higher speed, lower power consumption and better area utilization.

ii) Unique or Specilized requirements - Some applications like RF circuits require custom transistor level design to meet the requirements.

Q2) When a functionally equivalent off the shelf component is not available and time to market is concern, an IC designer can choose the semi custom IC design methodology, such as ASIC using standard cell or gate-arrow design.

□ Reson for choosing it →

i) Faster Development time - Semi-custom design leverages pre designed standard cells or gate arrays, reducing the design effort compared to full custom IC design.

ii) Balance between customization & speed - It allows for some level of customization while significantly cuts down design, verification, fabrication time ensuring a quicker time to market.

Q3) When a fonctionally equivalent off-the-shelf component is not available, and there are no existing cell libraries available then an IC designer can choose the full custom IC design methodology if time to market is not a concern.

*Reason for choosing it-

i) Compleate design flexibility - It allows designers to create specific fonctional components as per requirements

ii) Optimized Performance & Power

Q4) Recommended VLSI design style is Full custom IC design

Explanation→

i) optimized Performance→ since full custom design allows transistor level optimization critical video processing operation such as image ~~enchant~~ enhancement, compression can be designed to achieve with minimal latency.

ii) Lower Power consumption→ Power efficiency is crucial in video processing ICs espeially for battery powered devices. Full custom design allows for optimized power gating technique reducing power consumption.

iii) Minimal chip Area→ The ability to design compact transistor layouts ensures that IC occupies the smallest possible area.

Q5)

a) Pros and Cons of FPGA-Based prototyping system for proof of concept and verification →

Pros:

i) Faster proof of concept & verification - FPGA based prototyping allows designers to test and validate hardware implementations in real time helping in early detection of design flaws.

ii) Reconfigurability - unlike ASICs, FPGAs can be reprogrammed multiple times allowing iterative improvement, and debugging without requiring new fabrication.

iii) Closer to Final Hardware Behaviour: FPGA based prototyping provides a real world testing environment ensuring that timing, logic and power functions behave ~~as~~ as expected before moving to final ASIC production.

Cons:

i) slower performance than Final ASICs → while FPGAs are faster than simulations, they are not as fast as custom ASICs due to the overhead of programmable logic and routing delays.

ii) Higher Power Consumption → FPGAs are less power efficient than ASICs, which can be a limiting factor for batery powered devices.

b) Comparison Hardware Prototyping vs computer simulation Model →

Hardware Prototyping	Computer simulation Model
i) Execution speed is Faster since FPGA executes in real hardware.	i) Execution is slower as it runs on general purpose CPU
ii) Debugging is challenging since real-time testing is required	ii) Easy to debug with break points and visualization tools.
iii) can be reprogrammed but requires hardware modifications.	iii) Easy to modify in software and rerun the program.