ASSIGNMENT 3

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COURSE : COMPUTER ARCHITECTURE AND LOGIC DESIGN

Question 1:
What are transistors?

A transistor is a miniature semiconductor that regulates or controls current or voltage flow in addition amplifying and generating these electrical signals and acting as a switch/gate for them. Typically, transistors consist of three layers, or terminals, of a semiconductor material, each of which can carry a current.

- **Working :** It can work either as an amplifier or a switch. When it works as an amplifier, it takes in a tiny electric current at one end (an input current) and produces a much bigger electric current (an output current) at the other.

Question 2:
What are capacitors?

A capacitor is a device that stores electrical energy in an electric field by virtue of accumulating electric charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals.

- **Working :** A capacitor works on the principle that the capacitance of a conductor shows increase when an earthed conductor is brought near it. Therefore, the capacitor has two parallel plates facing each other in opposite directions and are separated by some distance or gap. This gap is filled with vacuum or the dielectric material with some constant as per the requirement.

Question 3
Why are both semiconductor devices?

Semiconductor :
Semiconductors are materials which have a conductivity between conductors (generally metals) and nonconductors or insulators (such as most ceramics).

Transistors as semiconductors:

The main reason for using a transistor as a semiconductor is to achieve 'amplification'. A transistor can be used as a current/voltage amplifier in different configurations.
In the case of conductors, they just have free electrons that make it conduct current. However, due to the large number of free electrons, we do not have the provision to control its conduction rate, because in the energy band model, the valence band and the conduction band overlap each other that gives so many free electrons in the conductor.

Whereas insulators are non conducting as they do not have any electrons. There is a big energy band gap between the valence band and the conduction band, as in the energy band model.
The semiconductors are different from the above two, the energy band gap is moderate for semiconductors, neither too large that does not provide it free electrons , not overlapping, that it gets enough free electrons. So when a voltage is applied across its terminals, the electrons 'jump' from the valence band to the conduction band. Leaving behind positively charged 'holes' in the valence band. The amount of current in a semiconductor depends on how many electron-hole pairs are formed, more of them means more current will flow. However, the electron hole pair can also combine again and neutralise. This is known as recombination. This is what happens in the 'Base' region of the transistor. So, the provision for controlling the current flow rate exists only if we use semiconductors.

Capacitors as semiconductors

A semiconducting substance is between the conductor and the insulator. It controls and manages the flow of electric current in electronic equipment and devices.
The capacitor is an integral component of electrical equipment and is therefore almost always found in an electronic circuit. The main purpose of capacitors is to store electrostatic energy in an electric field and, as far as possible, supply this energy to the circuit.
Therefore, capacitors perform the following three important roles in the electronic circuit.
1) Loading and unloading electrical loads. Capacitors can be charged and discharged due to their structure. …
2) Keeping the tension at the same level.
3) Noise removal.

Question 4:
What are flip flops?

A flip-flop is a device which stores a single bit (binary digit) of data; one of its two states represents a "one" and the other represents a "zero". Such data storage can be used for storage of state, and such a circuit is described as sequential logic in electronics.

Flip-flops can be either simple (transparent or asynchronous) or clocked (synchronous). Generally, the simple ones are commonly described as latches,while the clocked ones are described as flip-flops.
Simple flip-flops can be built around a single pair of cross-coupled inverting elements such as vacuum tubes, bipolar transistors, field effect transistors, inverters, and inverting logic gates have all been used in practical circuits.

Clocked devices are specially designed for synchronous systems.

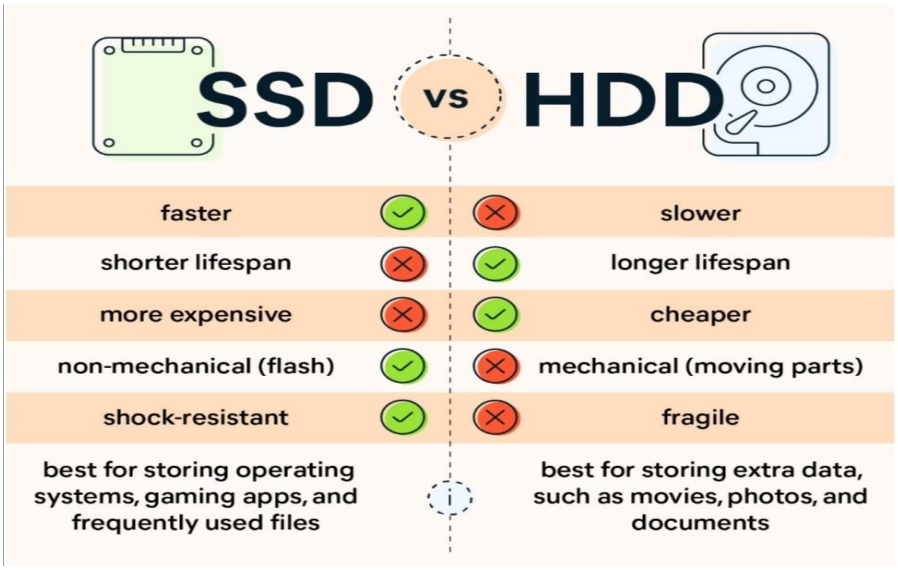
Applications

Flip-flop is a circuit that maintains a state until directed by input to change the state. A basic flip-flop can be constructed using four-NAND or four-NOR gates. Types of flip-flops:

1-RS Flip Flop
2-JK Flip Flop
3-D Flip Flop
4-T Flip Flop

Question 5 :
How solid state drives differ from hard disk. Explain technically?

Main difference :
The main difference between a solid state drive (SSD) and a hard disk drive (HDD) is how data is stored and accessed. HDDs use mechanical spinning disks and a moving read/write head to access data, while SSDs use memory chips. SSDs are a better option especially since modern SSDs are just about as reliable as HDDs.
Solid State Drive stores the data in integrated circuits and a Hard Disk Drive stores data magnetically, through spinning disks. They can also be compared in terms of their speed, adaptability, technical modernity, and user experience.



Failure of SSD:

Although solid state drive (SSD) has multiple advantages over traditional hard disk drive (HDD), recovering data from solid state drive is more difficult than hard disk drive.
The problems associated with HDDs and SSDs are different. Generally, SSD's can be described as more durable than HDDs, because they contain no moving parts. HDDs are mechanical devices, with fast-moving components like the platters and spindle motor. Most

modern hard drives have platters which spin at 7200 RPM, or revolutions per minute. Because of this, a knock or bump could potentially result in a catastrophic head crash. SSDs, on the other hand, store data on NAND flash chips as electrical charges, and contain no moving parts. This doesn't mean that SSDs are totally immune to physical damage, though; a sudden power outage could damage internal components like the capacitor. SSDs are also susceptible to damage from heat, and should be kept below 70 degrees Celsius. This might seem impossibly high, but storing an SSD near other warm components could easily see its temperature climb up.

The main reason SSDs will eventually fail is the fact that NAND flash can only withstand a limited number of read/write cycles. NAND flash is non-volatile memory, meaning it retains data even without a power source. When data is written, the data already stored in the cell must be erased first. Electrons are sent through an insulator, writing data to each cell, and over time, the insulator in the cells will begin to wear. The number of program/erase cycles before an SSD will fail will vary by design; but most modern SSDs can withstand a large number of p/e cycles before they fail.
