Q1. What are the major structural components of a CPU. Briefly explain them

A1.

1. Control unit: Controls the operation of the CPU
2. ALU: Performs the computer's data processing functions
3. Registers: Provides storage internal to the CPU
4. CPU interconnection: provides communication among control unit, ALU, and registers

Q2. Consider a hypothetical 64-bit microprocessor having 64-bit instructions composed of two fields: The first word contains the opcode and the remainder the immediate operand or an operand address.

a. What is the maximum directly addressable memory capacity (in bytes)?

b. How many bits are needed for the program counter and the instruction register?

A2.

a. 2^{48}
b. The program counter must be at least 48 bits. If the instruction register is to contain the whole instruction, it will have to be 64-bits long.

Q3. A set associative cache consists of 64 lines, or slots, divided into four-line sets. Main memory contains 4K blocks of 128 words each. Show the format of main memory addresses.

A3. The cache is divided into 16 sets of 4 lines each. Therefore, 4 bits are needed to identify the set number. Main memory consists of 4K = 2^{12} blocks. Therefore, the set plus tag lengths must be 12 bits and therefore the tag length is 8 bits. Each block contains 128 words. Therefore, 7 bits are needed to specify the word.

	TAG	SET	WORD
Main memory address =	8	4	7

Q4. What are the differences among EPROM, EEPROM, and flash memory?

A4. **EPROM** is read and written electrically; before a write operation, all the storage cells must be erased to the same initial state by exposure of the packaged chip to ultraviolet radiation. Erasure is performed by shining an intense ultraviolet light through a window that is designed into the memory chip. **EEPROM** is a read-mostly memory that can be written into at any time without erasing prior contents; only the byte or bytes addressed are updated. **Flash memory** is intermediate between EPROM and EEPROM in both cost and functionality. Like EEPROM, flash memory uses an electrical erasing technology. An entire flash memory can be erased in one or a few seconds, which is much faster than EPROM. In addition, it is possible to erase just blocks of memory rather than an entire chip. However, flash memory does not provide byte-level erasure. Like EPROM, flash memory uses only one transistor per bit, and so achieves the high density (compared with EEPROM) of EPROM.

Q5.

a. What are the major functions or requirements for an I/O module
b. Write principle I/O techniques used in a computer systems.