NAME : MIAN AHSAN JAN
SUBJECT: COMPUTER ARCHITECTURE
ID# 13213
ASSIGNMENT : MAJOR ASSIGNMENT
SUMMER

Q1

A)

Ans:

1. Upto sx active cores (PUs) per chip
2. Dedicated co-processor (COP) per core
3. Improved out of order and superscalar instruction execution
4. Second level branch prediction table supports 3.5 times more entries
5. On chip 48MB eDRAM L3 cache(shared by all six cores)
6. Interface to sc chip
7. I/O bus controller
8. Memory controller

B)

Ans :

The **IAS machine** was the first electronic computer to be built at the Institute for advanced study (IAS) in Princeton, New jersey.The IAS machine was a binary computer with a 40-bit word, storing two 20-bit instructions in each word. The memory was 1,024 words (5.1 kilobytes). Negative numbers were represented in two's complement format. It had two general-purpose registers available: the Accumulator (AC) and Multiplier/Quotient (MQ). It used 1,700 vacuum tubes (triode types: 6J6, 5670, 5687, a few diodes: type 6AL5, 150 pentodes to drive the memory CRTs, and 41 CRTs (type: 5CP1A): 40 used as Williams tubes for memory plus one more to monitor the state of a memory tube).[10] The memory was originally designed for about 2,300 *RCA Selectron* vacuum tubes. Problems with the development of these complex tubes forced the switch to Williams tubes.It weighed about 1,000 pounds (450 kg).

C)

Ans:

Definition

An embedded system is a computer system, made from a combination of hardware and software, that is used to perform a specific task. It may or not be programmable, depending on the application. Examples of embedded systems include washing machines, printers, automobiles, cameras, industrial machines and more.

Use in daily lives

mobile phones and tablet are also considered embedded systems. Embedded systems are named as such because they're part of a larger device, providing a special function. They use both microcontrollers and microprocessors, as well as specially designed processors such as digital signal processors (DSP).

E)

Ans:

I. Pipelining is when computers receives multiple instructions and carry them out as they're received.Branch prediction is the process of being able to predict the next set of instructions so that they can becarried out.Superscalar execution is when you're able to give more than one set of instructions at time.Data flow analysis analyzes instructions that need each otherSpeculative execution carry out instructions before they are actually executed
II. Explain the concept of performance balance.Adjust the organization and architecture to compensate for the mismatch among thecapabilities of the components
III. Explain the differences among multicore systems, MICs, and GPGPUs.2.4 Briefly characterize Amdahl's law.A formula used to find the maximum improvement possible by improving a particular part of asystem
IV. Briefly characterize Little's law

F)

Ans:

A **faster CPU** uses more energy and creates more heat. A computer will normally have a maximum **clock speed** set by default, but it is possible to change this **speed** in the computer BIOS . Some people increase a **CPU clock speed** to try to make their computer run **faster** - this is called overclocking.

Power—Power density increases with density of logic and clock speed—Dissipating heat•RC delay—Speed at which electrons flow limited by resistance and capacitance of metal wires connecting them—Delay increases as RC product increases—Wire interconnects thinner, increasing resistance—Wires closer together, increasing capacitance•Memory latency—Memory speeds lag processor speeds •Solution:—More emphasis on organizational and architectural approaches

G)

Ans)

This elegant expression is known as Amdahl's Law [Amdahl] and is usually expressed as an inequality. This is in almost all cases the best speedup one can achieve by doing work in parallel, so the real speed up $S(N)$ is less than or equal to this quantity.

Amdahl's Law immediately eliminates many, many tasks from consideration for parallelization. If the serial fraction of the code is not much smaller than the part that could be parallelized (if we rewrote it and were fortunate in being able to split it up among nodes to complete in less time than it otherwise would), we simply won't see much speedup no matter how many nodes or how fast our communications. Even so, Amdahl's law is still far too optimistic. It ignores the overhead incurred due to parallelizing the code

H)

Ans)

1) **Multicore** refers to an **architecture** in which a single physical processor incorporates the core logic of more than one processor. A single integrated circuit is used to package or hold these processors. ... **Multicore architecture** places multiple processor cores and bundles them as a single physical processor

2) MIC is really Intel's response to GP-GPU programming. The idea is simply that many workloads provide ample concurrency, and thus can be executed on lots of lower-clocked, SIMD-oriented processors. Graphics rendering is such a workload, which is why GPUs gave rise to GP-GPU frameworks like Cuda and OpenCL.

3) General-purpose **computing** on graphics processing units (**GPGPU**, rarely GPGP) is the use of a graphics processing unit (**GPU**), which typically handles computation only for **computer** graphics, to perform computation in applications traditionally handled by the central processing unit (CPU).

I)

Ans)

QPI is specified as a five-**layer** architecture, with separate physical, link, routing, transport, and **protocol layers**. In devices intended only for point-to-point **QPI** use with no forwarding, such as the Core i7-9xx and Xeon DP processors, the transport **layer** is not present and the routing **layer** is minimal.

J)

Ans)

The **PCI Express** protocol consists of a Transaction Layer, a Link Layer, and a **Physical** Layer. ... The **Physical** Layer consists of the **Logical** and Electrical Sublayers. The **Logical** Sublayer of the PHY contains a **Physical** Coding Sublayer (PCS), which encodes/decodes each 8-bit data-byte to a 10-bit code.

Q2

A)

Ans)

The main elements associated with a computer system are as follows:

1. Central Processing Unit (CPU)
2. Main Memory
3. Secondary Storage Devices 4. Input and Output (I/O) Devices 5. Busses

i. The Processor (CPU) The CPU or processor acts as the controller of all actions or services provided by the system. It is the Brain and the Heart of the Computer. The operations of a CPU can be reduced into the following : 1. Fetch the next instruction from memory. 2. Decode the instruction. 3. Execute the instruction. 4. Store the result of the instruction into main memory.

ii. Memory The memory in a computer system is of two fundamental types: Main Memory: used to store information for immediate access by the CPU. Main Memory is also referred to as Primary Storage or Main Store. Closely connected to the processor. The contents are quickly and easily changed. Stores the programs that the processor is actively working with. Main memory includes: Random Access memory (RAM): for temporary storage. Read-only memory (ROM): for permanent storage. Secondary Storage Devices: devices provide permanent storage of large amounts of data. Secondary storage is also called: secondary memory, external memory. This storage may consist of magnetic tapes, magnetic disk, optical memory device. Connected to main memory through the bus and a controller. The contents are easily changed, but this is very slow compared main memory. Used for permanent storage of programs and data.

iii. Input/Output Devices Input/output devices provide an interface between the computer and the user. There is at least one input device (e.g. keyboard, mouse, measuring device such as a temperature sensor) and at least one output device (e.g. printer, screen, control device such as an actuator). Input and output devices like keyboards and printers, together with the external storage devices, are referred to as peripherals.

B)

Ans)

The **key characteristics** of a **computer family** are : Similar or identical instruction set: In many cases, the exact same set of machine is instructions are supported on all members of the **family**. Thus, a program that executes on one machine will also execute on any other

C)

Ans)

A stored-program computer is a computer that stores program instructions in electronically or optically accessible memory. This contrasts with systems that stored the program instructions with plugboards or similar

mechanisms.The **stored program concept** means that data and instructions are both logically the same and can both be **stored** in memory. The von Neumann architecture is built around this principle. It is **important** because the human does not have to execute instruction from without the machine.

D)

Ans)

Moore's Law refers to Moore's perception that the number of transistors on a microchip doubles every two years, though the cost of computers is halved. Moore's Law states that we can expect the speed and capability of our computers to increase every couple of years, and we will pay less for them. Another tenet of Moore's Law asserts that this growth is exponential.

Understanding Moore's Law

In 1965, Gordon E. Moore —co-founder of Intel (NASDAQ: INTC) —postulated that the number of transistors that can be packed into a given unit of space will double about every two years. Today, however, the doubling of installed transistors on silicon chips occurs closer to every 18 months instead of every two years

E)

Ans)

The **instruction cycle** (also known as the fetch–decode–execute **cycle**, or simply the fetch-execute **cycle**) is the **cycle** that the central processing unit (CPU) follows from boot-up until the computer has shut down in order to process **instructions**.

F)

Ans)

An **interrupt** is a hardware enforced transfer of control within an I-stream engine. ... In addition to the current PSW, which is the PSW in control of an I-stream engine, there are PSWs associated with each **class of interrupts**. There are six **classes of interrupts** possible

G)

Ans)

A **bus** that connects major components (CPU,Memory,I/O) is called System **Bus**. ... The most common computer **interconnection** structures are based on the use of one or mor e system **buses.**

Three types of bus are used.

- Address **bus** - carries memory addresses from the processor to other components such as primary storage and input/output devices. …
- Data **bus** - carries the data between the processor and other components. …
- Control **bus** - carries control signals from the processor to other components.

Q3

A)

Ans)

Computer Architecture is concerned with the way hardware components are connected together to form a **computer** system. **Computer Organization** is concerned with the structure and behaviour of a **computer** system as seen by the user. ... A programmer can view **architecture** in terms of instructions, addressing modes and registers.

B)

Ans)

RISC stands for 'Reduced Instruction Set Computer Whereas, **CISC** stands for Complex Instruction Set Computer. The **RISC** processors have a smaller set of instructions with few addressing nodes. The **CISC** processors have a larger set of instructions with many addressing nodes

C)

Ans)

Microcontroller and **Microprocessor** both terms seem similar but there is a huge difference between these two ICs. **Microprocessor** only have CPU in the chip like most of the Intel Processors but **Microcontroller** also have RAM, ROM and other peripherals along with the CPU or **processor**

D)

Ans)

The **Cortex** portfolio is split broadly into three main categories: **Cortex**-A -- application processor cores for a performance-intensive systems • **Cortex**-**R** – high-performance cores for real-time applications • **Cortex**-**M** – microcontroller cores for a wide range of embedded applications.

F)

Ans)

In a **nested interrupt** system, an **interrupt** is allowed to anytime and anywhere even an ISR is being executed. But, only the highest priority ISR will be executed immediately. The second highest priority ISR will be executed after the highest one is completed.

By **disabling interrupts** the CPU will be unable to switch processes. This guarantees that the process can use the shared variable without another process accessing it. But, **disabling interrupts**, is a major undertaking.

G)

Ans)

Programing hardware can be as simple as DAPA/bsd to USB based ones (AVRISP, USBasp, Usbprog) etc.

Or, if your PC still has a parallel port, you can try to control say a set of LEDs using an application written in VB.

In order to make a computer functional, a set of instructions need to be programmed, as these programmed languages are carriers to the performance of a task. Likewise, a computer accepts users' instructions in the form of computer **programming** and then carries out the given task.