CSE-3103: Microprocessor and Microcontroller

Dept. of Computer Science and Engineering
University of Dhaka

Prof. Sazzad M.S. Imran, PhD
Dept. of Electrical and Electronic Engineering
sazzadmsi.webnode.com

Course Outline

Syllabus:

8086 microprocessor:

architecture,
instruction set,
interrupts and 8259A,
higher versions of 8086.

Pentium microprocessor:

architecture,
register sets,
addressing modes,
instruction set,
interrupt.

Next generation microprocessors:

Intel core architecture,
Intel dual core,
core 2 duo/2 quad/i,
ARM.

Microcontrollers:

8051 microcontroller,
architecture,
operation and instruction set,
interfacing: memory, I/O,
external devices.

Programmable Logic Controller (PLC):

structures,
programming,
relays and counters,
data control,
I/O control.

Course Outline

Reference Books:

(1) Intel Microprocessor: Architecture, Programming and Interfacing, B. Brey.
(2) ARM System-on-Chip Architecture; Steve Furber.
(3) The 8051 Microcontroller A Systems Approach; Mazidi & McKinlay.
(4) Programmable Logic Controllers; Frank D. Petruzella.

Class Hour:

Sunday: 08.30am ~ 10.00am
Wednesday: 08.30am ~ 10.00am

Place:

Room #429, Dept. of CSE, DU

Notices:

Available at- sazzadmsi.webnode.com
Class code @google-classroom- **r3h2ukwc**

Marks Distribution:

(1) Attendance: 5
(2) Incourse: 25
(3) Final: 70 (5 out of 7; 5×14=70; 3 hours)

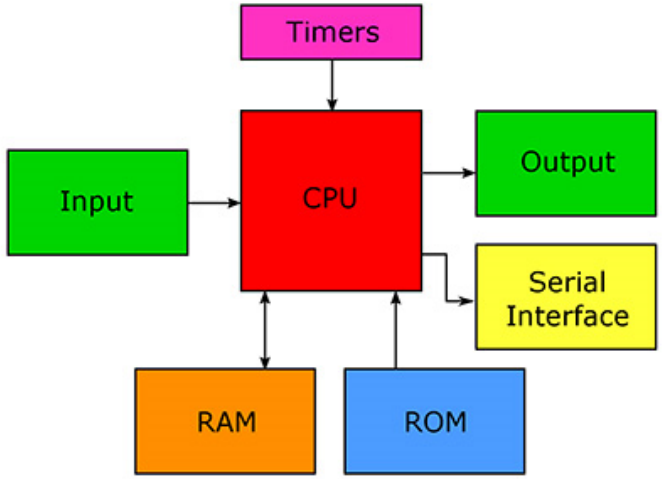
Incourse Exam:

Only one compulsory incourse exam will be taken.
5 questions will be given from any consecutive 6 lectures.
Students have to answer all 5 questions in 1.30 hour (marks- 5×5=25).

Microprocessors and Microcontrollers

Microprocessor executes lists of instructions, called programs.

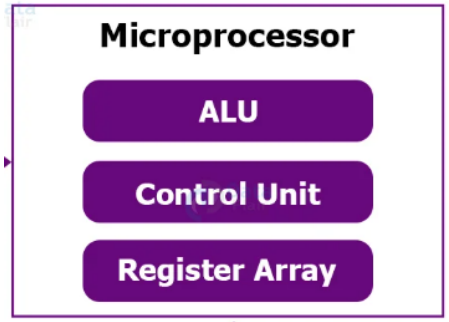
2 types of processors → i) Microprocessor,
ii) Microcontroller.

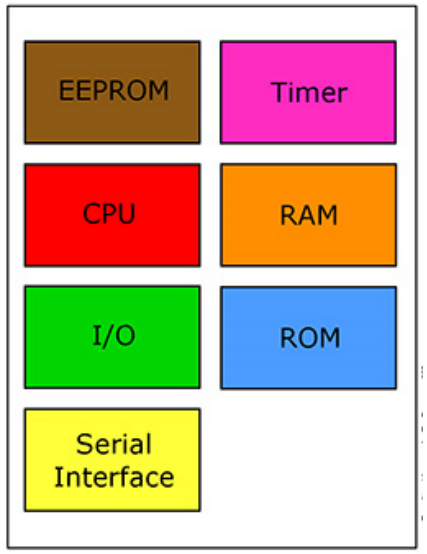


Microprocessors →
CPU on single chip,
requires → external memory devices,
I/O ports to connect I/O devices.

2 types of memories → i) RAM- storage of data.
ii) ROM- storage of programs, start-up program.

Microcontrollers →
inside single chip → CPU,
memory units,
I/O ports.
used to control and operate smart machines.





Evolution of Microprocessor

1930 mechanical calculating devices, used mechanical relays.
1950 vacuum tubes, quickly replaced by transistors.
1960 introduction of minicomputers.
1970 introduction of personal computer.

6 generations of microprocessors evolution →

1st generation (1971-1973):

Processed instructions serially.
4-bit 4004 microprocessors by Busicom and Intel.
Ran at 108 kHz, contained 2300 transistors.
Used PMOS technology- low cost, slow speed, low output currents.
Not compatible with TTL.
8-bit 8008 and 8080 microprocessors by Intel.

2nd generation (1974-1978):

Efficient 8-bit microprocessors- Motorola's 6800, 6809, Intel's 8085, Zilog's Z80.
Used NMOS technology- faster speed, higher density.

Evolution of Microprocessor

3rd generation (1978-1980):

- Dominated by Intel's 8086 and Zilog's Z8000.
- 16-bit processors with minicomputer-like performance.
- 16-bit arithmetic and pipelined instruction processing.
- IC transistor counts ≈ 250,000.
- Used high density MOS (HMOS) technology.

4th generation (1981-1995):

- Contained ≥ 1 million transistors.
- Beginning of 32-bit microprocessors- Intel 80386, Motorola 68020/68030.
- Used high density, high speed CMOS (HCMOS).

5th generation (1996-2000):

- Employ decoupled superscalar processing.
- Contain ≥ 10 million transistors.
- Devices carry on-chip functionalities.
- Introduced high speed memory and I/O devices.
- 64-bit microprocessors- Intel Pentium, Celeron, AMD Athlon.

Evolution of Microprocessor

6th generation (2000-till date):

High-speed cache, advanced pipelining, parallel execution.
Multi-core processors- Intel Core i3/i5/i7/i9, AMD Ryzen, Apple M1/M2.
Used in PCs, laptops, smartphones, servers, AI applications.

Timeline of microprocessor →

1971	Intel 4004	4-bit processor	2300 transistors	108 kHz
1971	Intel 8008		3500 transistors	200 kHz
1974	Intel 8080	8-bit processor	6000 transistors	Up to 2 MHz
1976	Intel 8085		6500 transistors	3-5 MHz
1978	Intel 8086	16-bit processor		
1979	Intel 8088		29,000 transistors	5 MHz, 8 MHz, 10 MHz
1985	Intel 80386	32-bit chip	275,000 transistors	5 MIPS
1989	Intel 80486		8 KB shared cache memory	25 to 100 MHz
1993	Intel Pentium	32-bit address bus 64-bit data bus	Two 8 KB dedicated cache 20-stage pipeline 3-level cache memory	Superscalar architecture Up to 1.75 GHz

Evolution of Microprocessor

Timeline of microprocessor →

1997	Intel Pentium II	Processes video, MMX audio, graphics data		200 MHz, 233 MHz, 266 MHz, 300 MHz
1999	Intel Celeron Pentium III	512 KB L2 cache	9.5 million transistors	600 MHz
2000	Intel Pentium 4		42 million transistors	1.4-3.8 GHz
2005	Intel Pentium-D	Dual-core chips	233 million transistors	
2008	Intel Core i3, i5, i7, i9	Up to 8 cores on single chip Large L2 cache (2-12 MB) Introduction of L3 cache		995 million transistors
2023	Apple M2 AMD Ryzen Intel Raptor Lake	Advanced 5 nm, 7 nm fabrication AI and GPU integration improving		Up to 80 billion transistors

Technological Improvement

Technological improvements → taking place rapidly,
microprocessor,
microcomputer,
personal computer systems.

1) Increase in data bus/address bus width.
2) Increase in processing speed.
3) Reduction in size and increase in capability.
4) Increase in transistor count and integration.
5) Development of external peripherals.
6) Increase in memory unit size and speed.
7) On-chip cache memory introduction and enhancement.
8) Reduction of power consumption.
9) Multi-core architecture and parallel processing.
10) Integration of peripherals and controllers.
11) Integration of GPU cores, AI accelerators and neural engines.