LECTURE 31

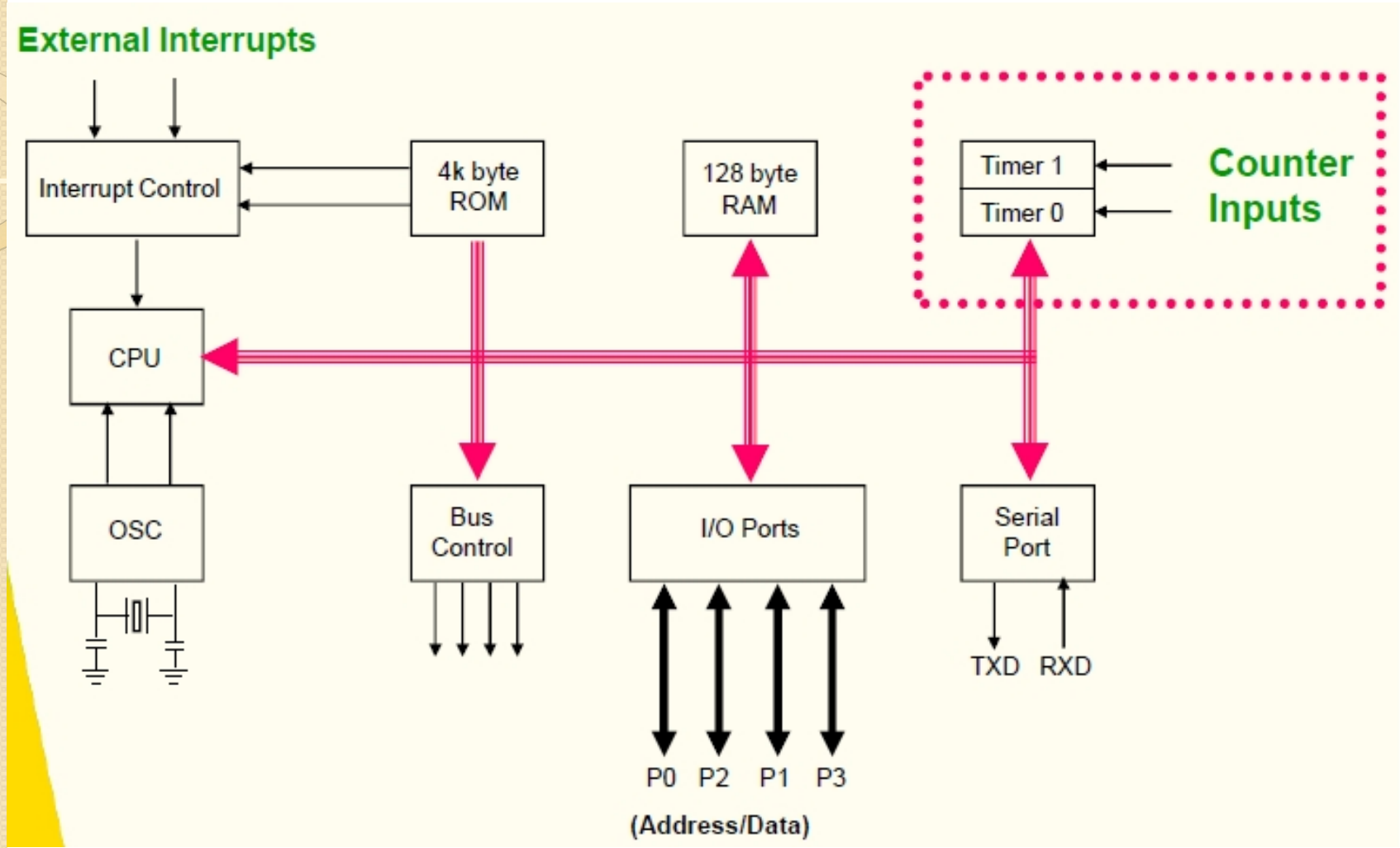
Timers and Counters

Topics to be covered

- Timers
- Counters

What is a Timer/Counter?

- A counter is a device that generates binary numbers in a specified count sequence when triggered by an incoming clock pulse.
- Timers are counters that count pulses. If the pulses are “clock” pulses, then the timers count time.


External Interrupts
Interrupt Control
4k byte ROM
128 byte RAM
Timer 1
Timer 0
Counter Inputs
CPU
OSC
Bus Control
I/O Ports
Serial Port
TXD
RXD
P0
P2
P1
P3
(Address/Data)

Timers/Counter on the 8051

- The 8051 comes with two 16-bit timers/counters, both of which may be controlled, set, read, and configured individually.
- The 8051 timers have three general functions:
  - Keeping time and/or calculating the amount of time between events (Timer Mode).
  - Counting the events themselves (Event Counter Mode)
  - Generating baud rates for the serial port.
- Always count UP irrespective of function as a timer or a counter.

Difference between a Timer and a Counter

When the incoming clock frequency is known, we can generate a fixed period of time known to the designer by setting a preloaded value. This is called a "timer".

It is also called an "interval timer" since it is measuring the time of the interval between two events.

When the incoming clock is irregular and we are only interested in the number of occurrences of the pulse, this is called a "counter". Since we are counting events, is also known as an "event counter".

In 8051, timer gets its clock from the oscillator (crystal that connected to the CPU) frequency (1/12 of it).

Counter gets the clock from an external pin:

- P3.4 for timer 0, and
- P3.5 for timer 1.

- Timer mode (if the timer control bit is set to timer, the timer uses the system clock)
  - Increments by 1 every machine cycle.
  - A single machine cycle consists of 12 crystal pulses.
- Event mode (if the timer control bit is set to event, the timer/counter uses a port bit)
  - Increments by 1 for each pulse on P3.4 for Timer 0, and P3.5 for Timer 1, respectively.

Applications of Timers/Counters

- Generating time delays.
- Measuring pulse duration or timing intervals.
- Counting pulses or events.
- Generating baud rate clock for the internal 8051 serial I/O port.
- Generating interrupts.