Micro Controller 3.1

ATMega328P .... Basics

FY – DESH – VIT

Vishwakarma Institute of Technology

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Mechatronics & Robotics

All about Arduino and ATMega ....

MCQ test ......!

Q) What is Arduino ?

a) It is a MuP

b) It is a MuC developed by ATMega company

c) It is a Development Board made by ATMega company

d) It is a MuC developed by AVR company along with ATMega

e) It is nothing but ATMega 328P Microcontroller only ...!

Important about Arduino !

Arduino is a "Development Board" on which

ATMega 328P microcontroller (manufactured by
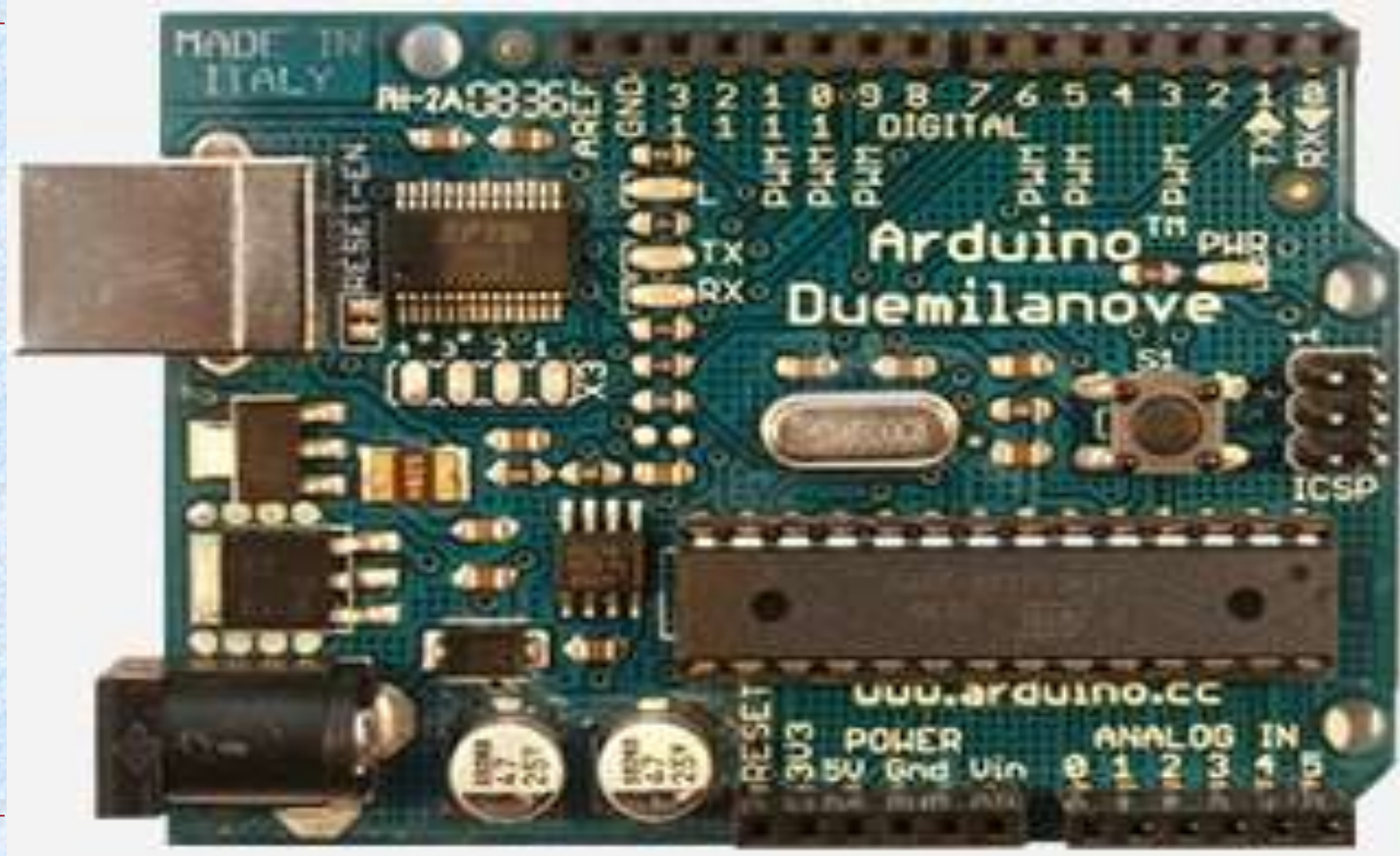
Atmel company) is mounted !

So, what is AVR ????

AVR is a series / family of microcontrollers developed by Atmel in 1996.

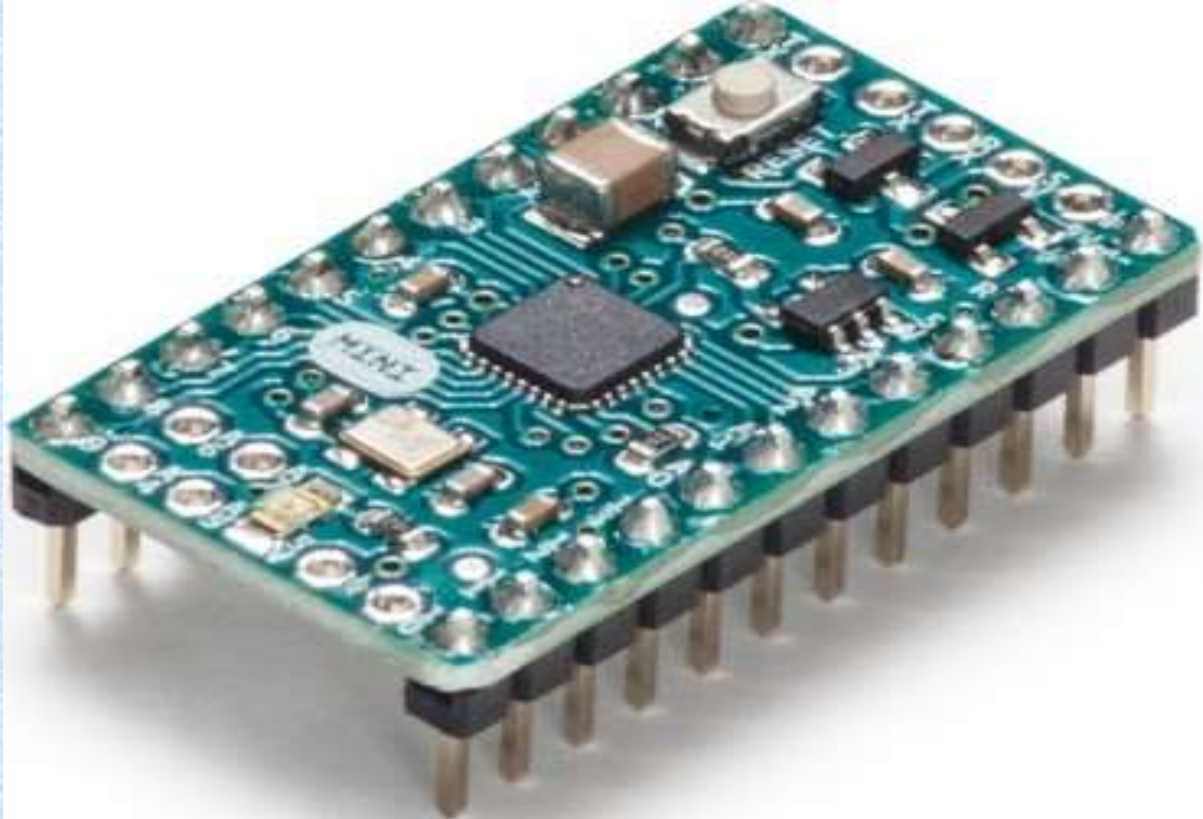Atmel is now taken over by Microchip Technology in 2016.

Arduino boards : Duemilanove

Arduino boards : NG 240
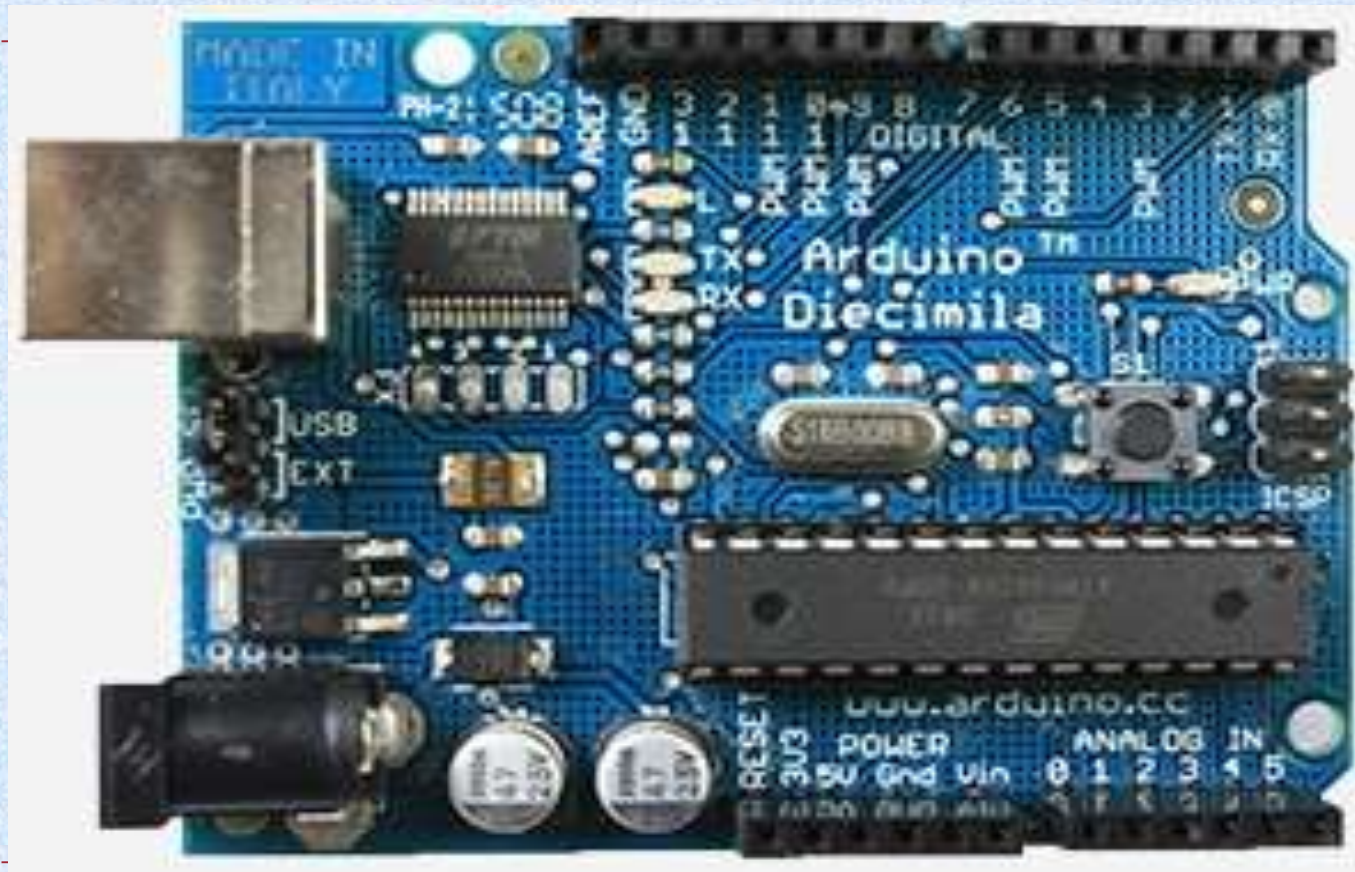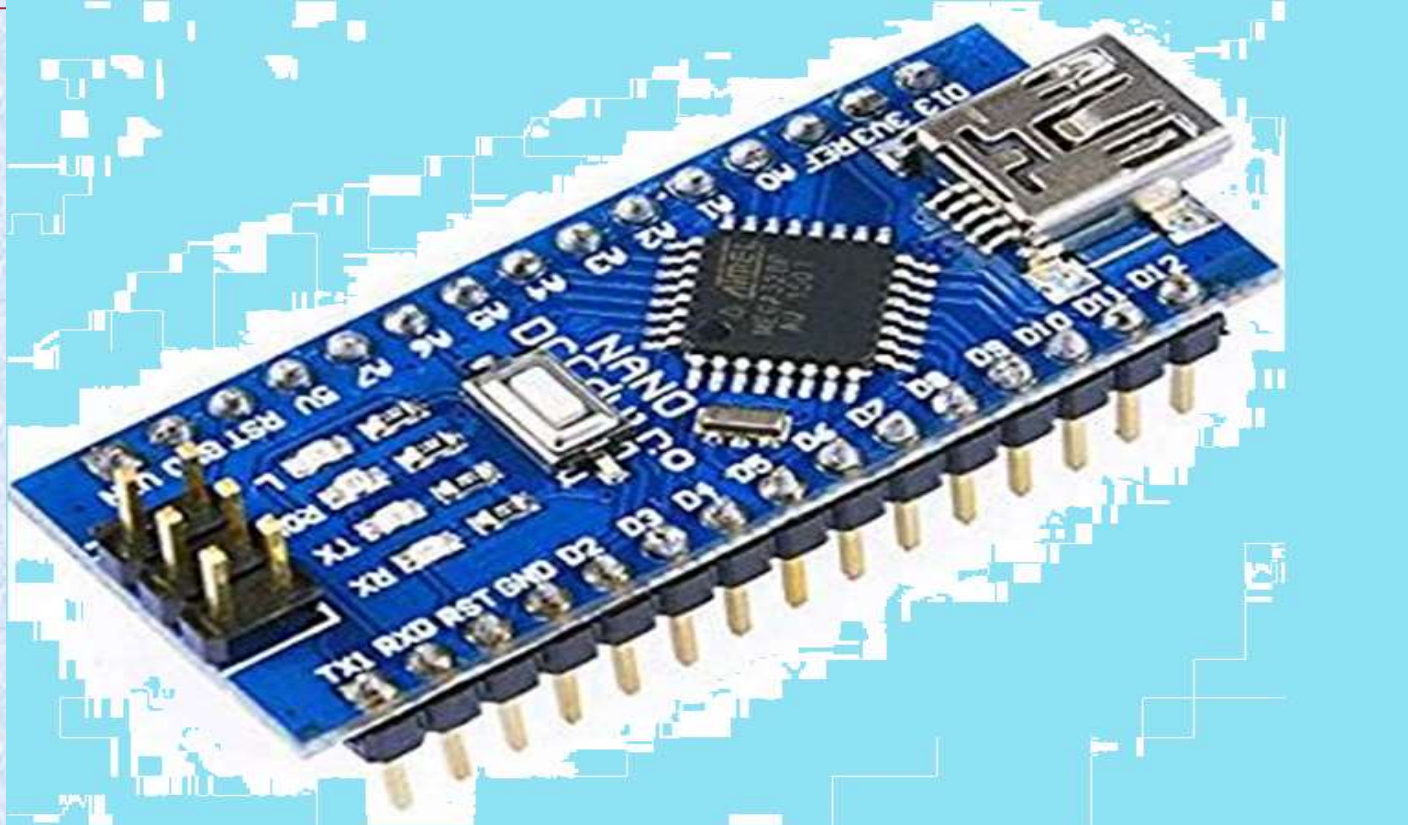
Arduino boards : Diecimila
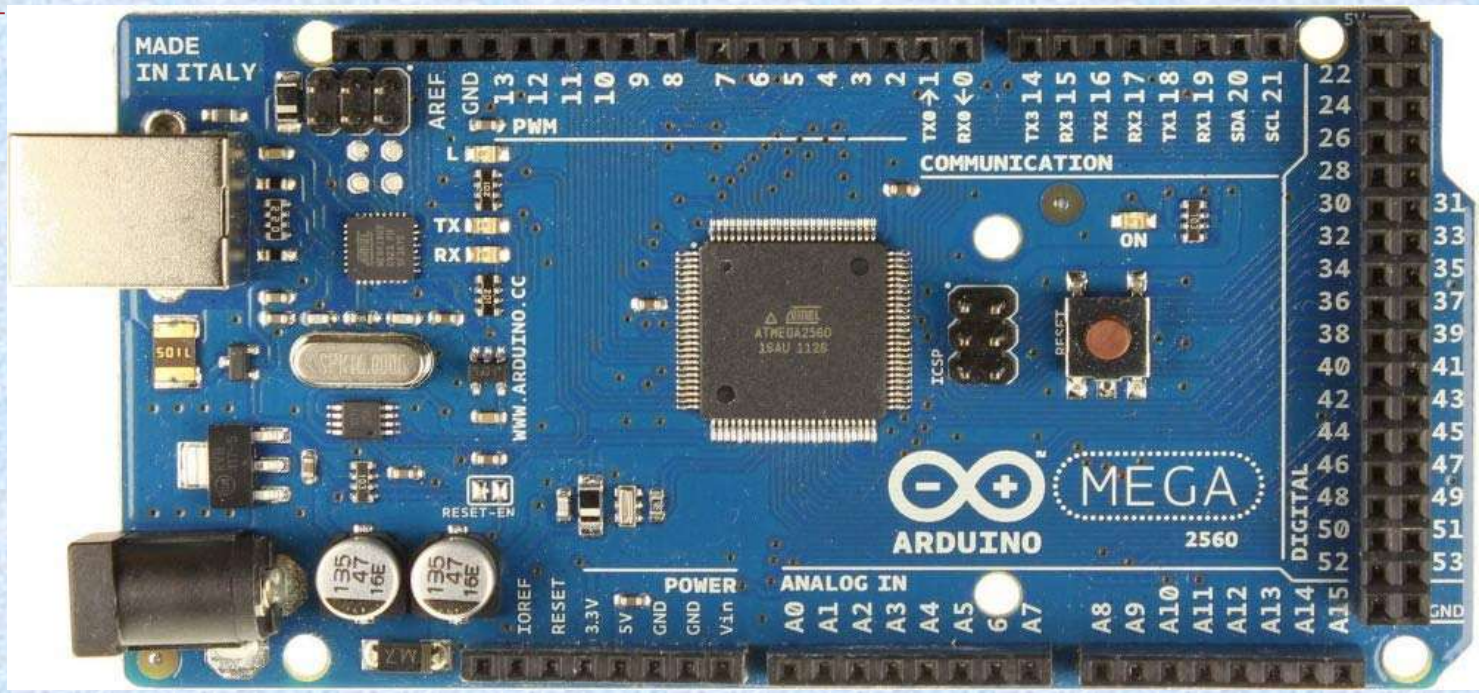
Arduino boards : Extreme

Arduino boards : Nano V3

Arduino boards : BT

Arduino boards :   MEGA

Arduino boards : Due
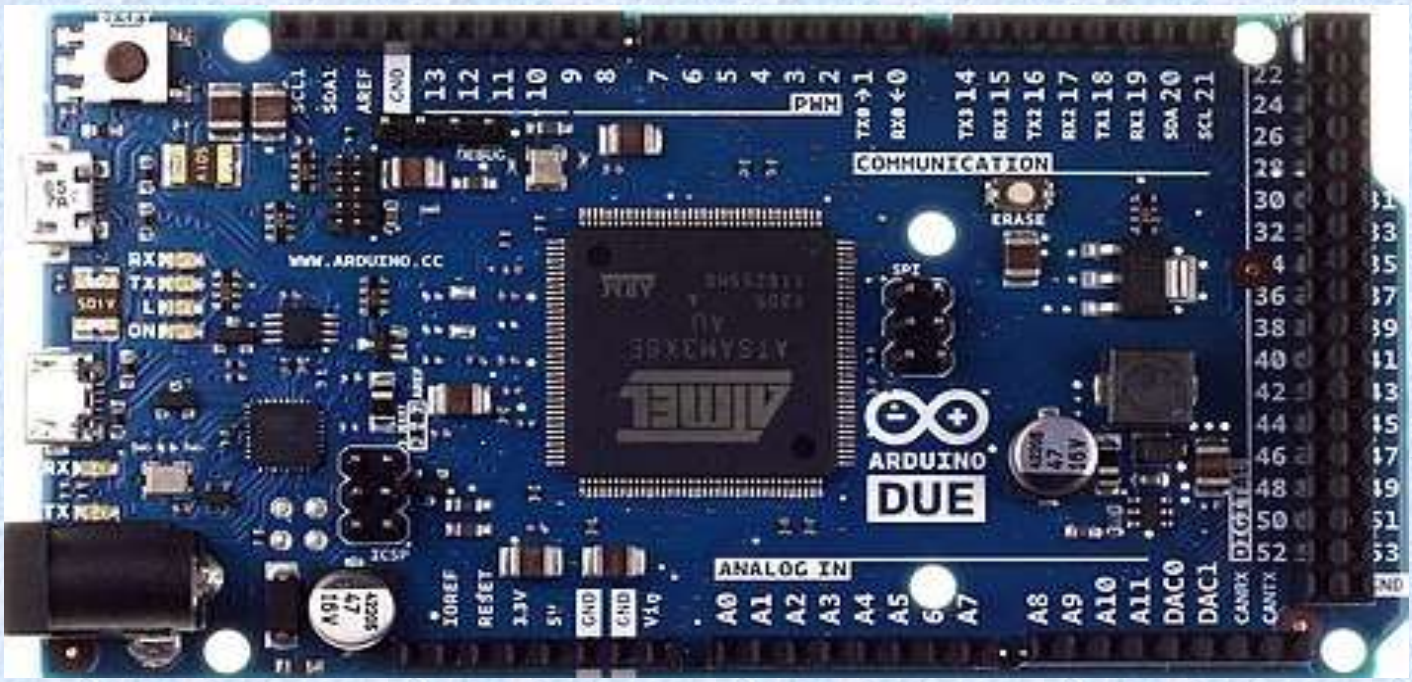
Arduino boards : YUN
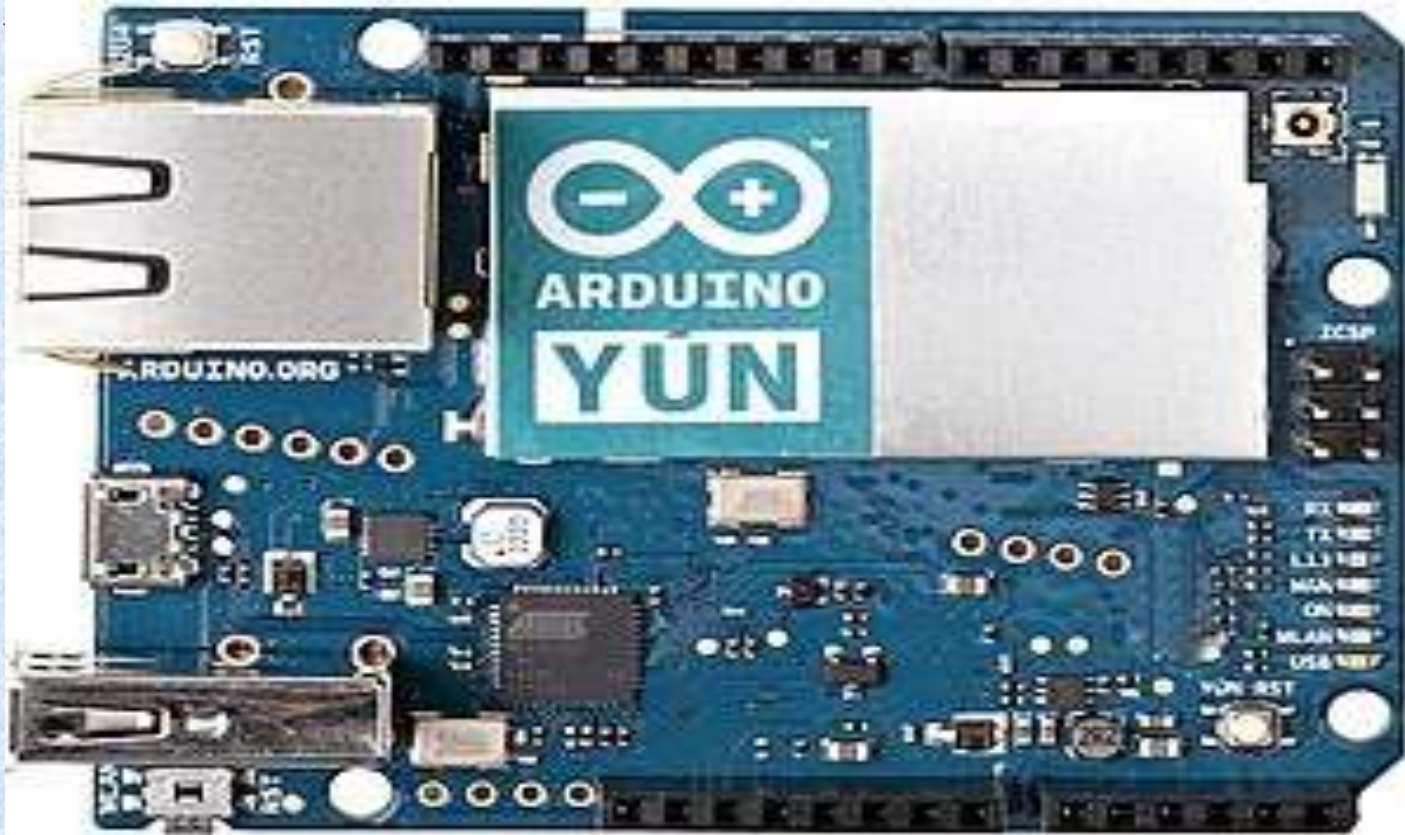
Arduino boards :   ESPLORA
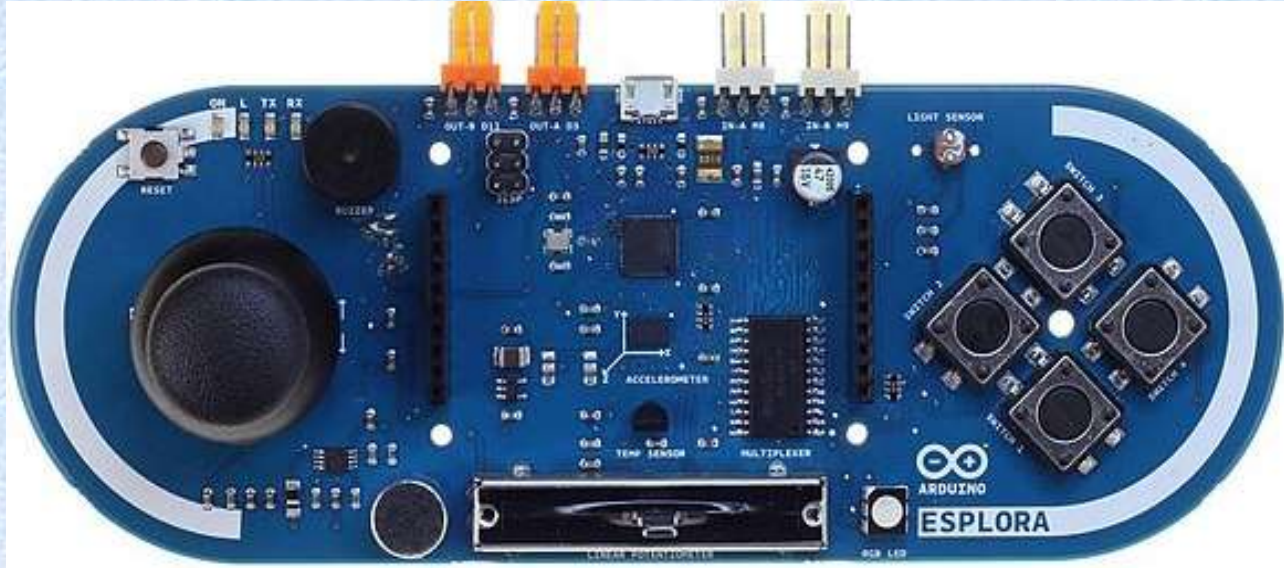
Arduino boards : ROBOT
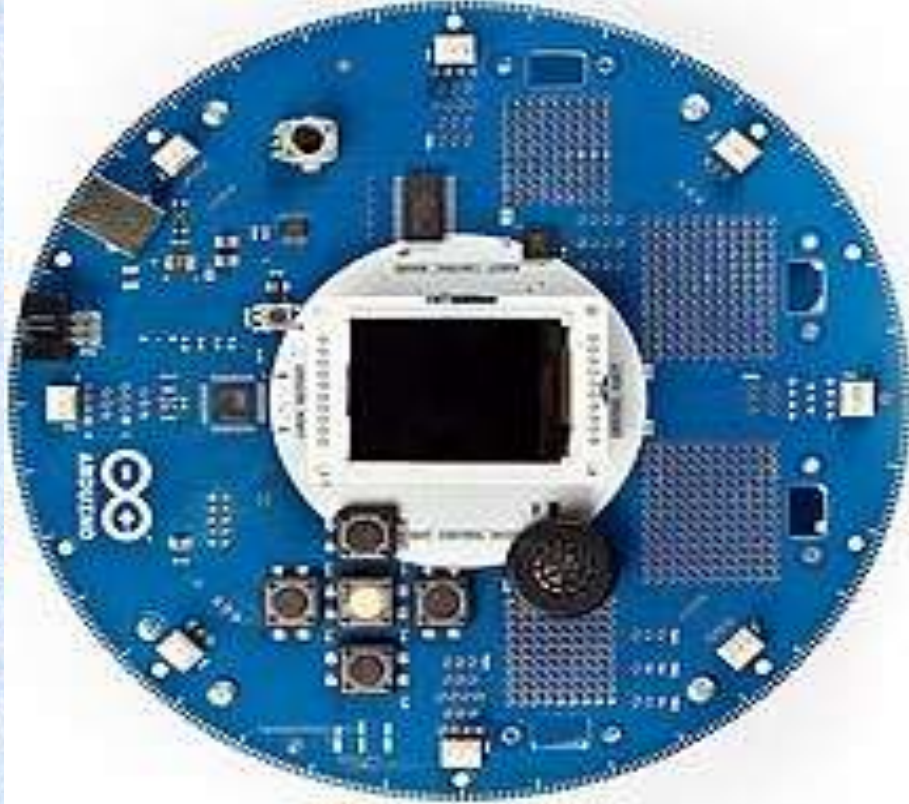
Arduino boards : UNO
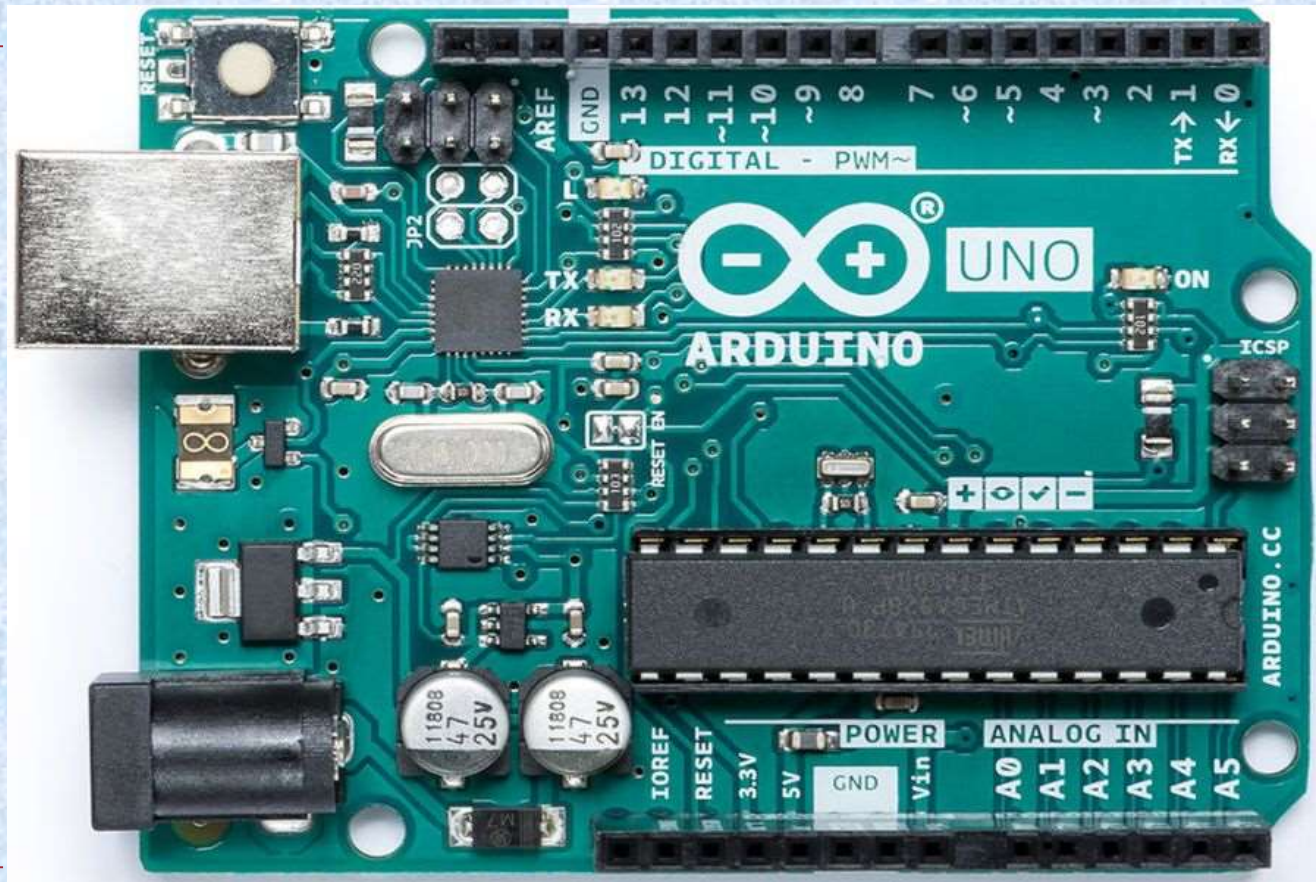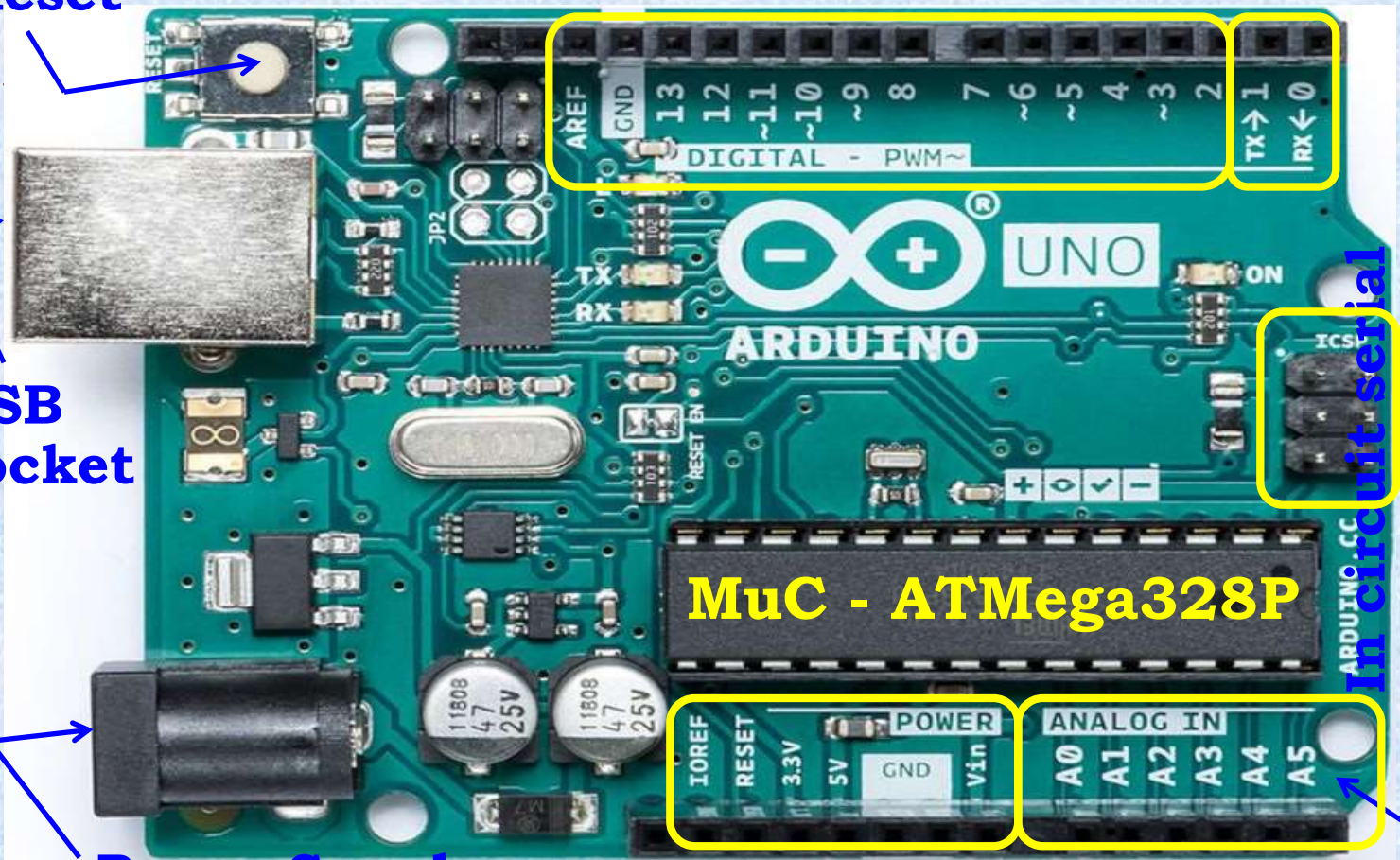
Some interesting facts about Arduino !

The Arduino project started in 2005 as a program for students in Italy to provide a low-cost and easy way for begineers to create devices which can interact with other devices and environment using sensors and actuators.

Arduino is a open source hardware and software company who has permitted manufacturing of Arduino boards and kits by anyone.

Arduino boards use a variety of Micro Controllers on them.

Some interesting facts about Arduino !

Arduino boards consist of an Atmel make 8-bit AVR MuC like ATMega 8, ATMega168, ATMega 328, ATmega1280, ATMega 2560 etc.

The software – Program for Arduino hardware may be written in any programming language with compilers that can convert the program to binary machine code.

Atmel provides a development environment - AVR Studio (older) and Atmel Studio (newer)

Pin diagram of ATMega328P

(PCINT14/RESET) PC6 — 1 — 28 — PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0 — 2 — 27 — PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1 — 3 — 26 — PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2 — 4 — 25 — PC2 (ADC2/PCINT10)
(PCINT19/OC2B/INT1) PD3 — 5 — 24 — PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4 — 6 — 23 — PC0 (ADC0/PCINT8)
VCC — 7 — 22 — GND
GND — 8 — 21 — AREF
(PCINT6/XTAL1/TOSC1) PB6 — 9 — 20 — AVCC
(PCINT7/XTAL2/TOSC2) PB7 — 10 — 19 — PB5 (SCK/PCINT5)
(PCINT21/OC0B/T1) PD5 — 11 — 18 — PB4 (MISO/PCINT4)
(PCINT22/OC0A/AIN0) PD6 — 12 — 17 — PB3 (MOSI/OC2A/PCINT3)
(PCINT23/AIN1) PD7 — 13 — 16 — PB2 (SS/OC1B/PCINT2)
(PCINT0/CLKO/ICP1) PB0 — 14 — 15 — PB1 (OC1A/PCINT1)

ARDUINO UNO R3 SMD PINOUT
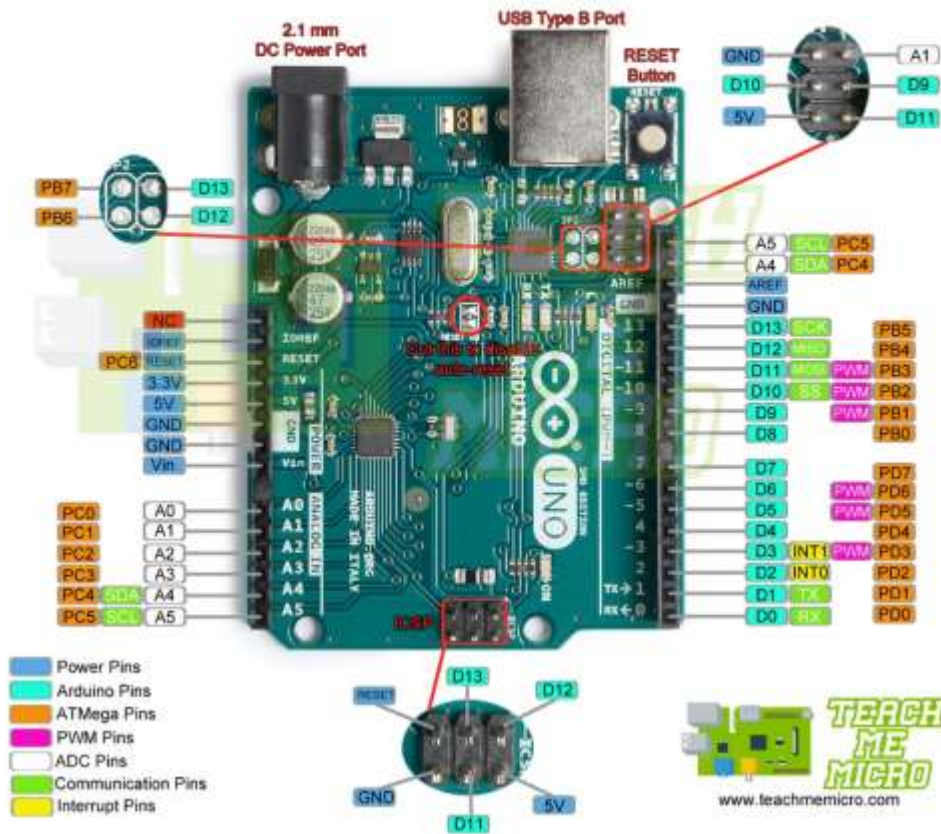
Features of ATMega328P

1) 8 bit MuC with 32 KB flash memory
2) 1 KB EEPROM with 2 KB internal SRAM
3) Total of 28 pins
4) 14 pins are digital i/o pins. 6 of which can be used for PWM o/p

5) 6 pins are for analog input
6) Thus, 14 + 6 = 20 pins for i/o
7) Internal ADC is available. 3 pins for control of analog i/p
8) 2 pins for clock and 2 pins for power
9) 1 pin for Reset
10) Arduino UNO board uses 16MHz crystal frequency. But crystal frequency ranging from 4 MHz to 40 MHz can be used.

Features of ATMega328P

11) ATMega328P has 3 Ports – Port B, Port C and Port D.

12) Port B and Port D are digital ports – 8 pins each.

13) Port B – Pin PB0 to PB7 (including 2 **XTAL** pins)

(Pin 14, 15, 16, 17, 18, 19, **9, 10**)

14) Port D – Pin PD0 to PD7 (including 2 RX and TX pins)

(Pin 2, 3, 4, 5, 6, 11, 12, 13)

15) Port C is an analog Port – with **7** pins.

16) Port C – Pin PC0 to PC6 (including **Reset** pin)

(Pin 23, 24, 25, 26, 27, 28, **1**)

17) Total digital pins of B and D together – 14

Features of ATMega328P

18) AVR is series of MuCs developed by Atmel.

19) Harvard – RISC architecture is used.

20) Separate memories and buses for program and data.

21) Instructions are executed with a single level pipelining.

22) While one instruction is being executed, the next instruction is

pre-fetched from the program memory.

Features of ATMega328P

23) 16 MHz quartz crystal

24) Operating voltage 1.8 – 5.5 V

25) Max. DC current for i/o pins at 5 V = 20 mA

26) Max. DC current for i/o pins at 3.3 V = 50 mA

27) Temperature range = − 40 deg. C to +105 deg. C

28) 8 bit 32 registers.

29) 23 general purpose i/o lines.

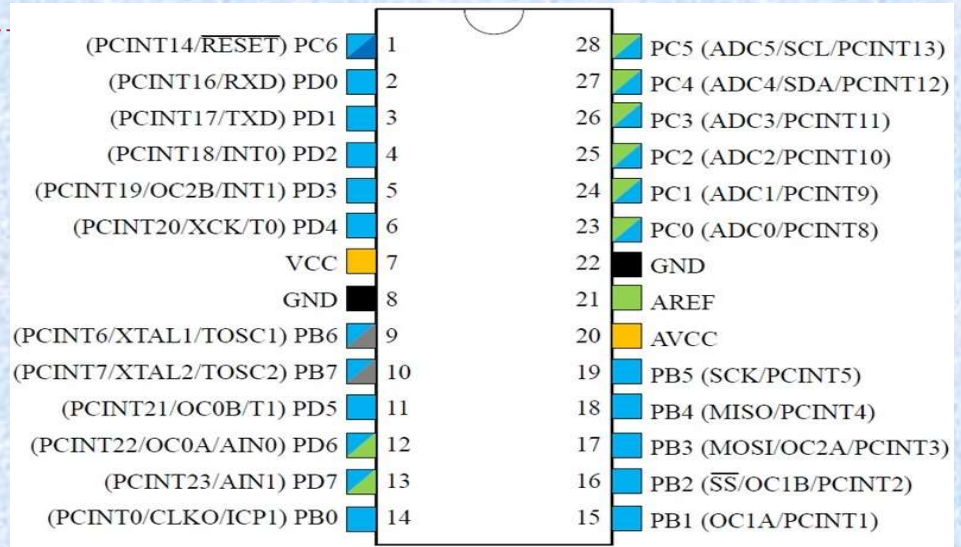30) Most of the instructions need single cycle for execution.

31) 6 channel, 10 bit ADC

Features of ATMega328P

32) 2 timers / counters – 8 bit.

33) 1 timer / counter – 16 bit.

34) 1 Real time counter (RTC)

35) 1 SPI – Serial Peripheral Interface

36) 1 USART - Universal Synchronous Asynchronous Receiver
       Transmitter

37) Chip can be locked through s/w for security.

38) Read while Write capacity

Pin description of ATMega328P

Port D – Pin PD0 to PD7 –

Port D – Pin PD0 to PD7
– Pin 2, 3, 4, 5, 6, 11, 12, 13.
Port D is 8 bit bidirectional
digital port including RXD on
pin 2 and TXD on pin 3.

(PCINT14/RESET) PC6 1	28 PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0 2	27 PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1 3	26 PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2 4	25 PC2 (ADC2/PCINT10)
(PCINT19/OC2B/INT1) PD3 5	24 PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4 6	23 PC0 (ADC0/PCINT8)
VCC 7	22 GND
GND 8	21 AREF
(PCINT6/XTAL1/TOSC1) PB6 9	20 AVCC
(PCINT7/XTAL2/TOSC2) PB7 10	19 PB5 (SCK/PCINT5)
(PCINT21/OC0B/T1) PD5 11	18 PB4 (MISO/PCINT4)
(PCINT22/OC0A/AIN0) PD6 12	17 PB3 (MOSI/OC2A/PCINT3)
(PCINT23/AIN1) PD7 13	16 PB2 (SS/OC1B/PCINT2)
(PCINT0/CLKO/ICP1) PB0 14	15 PB1 (OC1A/PCINT1)

Pin description of ATMega328P

Port B – Pin PB0 to PB7 –

Port B – Pin PB0 to PB7 –

    Pin 14, 15, 16, 17, 18, 19, **9, 10.**

If selected through settings, PB6 and PB7 (pins 9 and 10) can be connected to the external oscillator. If internal chip clock is used, then two pins can be used as i/p for the Asynchronous timer/counter – TOSC1 and TOSC2 through ASSR (Asynchronous Status Register)

Left pins		Right pins
(PCINT14/RESET) PC6	1	28 PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0	2	27 PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1	3	26 PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2	4	25 PC2 (ADC2/PCINT10)
(OC2B/INT1) PD3	5	24 PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4	6	23 PC0 (ADC0/PCINT8)
VCC	7	22 GND
GND	8	21 AREF
(XTAL1/TOSC1) PB6	9	20 AVCC
(XTAL2/TOSC2) PB7	10	19 PB5 (SCK/PCINT5)
(PCINT21/OC0B/T1) PD5	11	18 PB4 (MISO/PCINT4)
(OC0A/AIN0) PD6	12	17 PB3 (MOSI/OC2A/PCINT3)
(PCINT23/AIN1) PD7	13	16 PB2 (SS/OC1B/PCINT2)
(CLKO/ICP1) PB0	14	15 PB1 (OC1A/PCINT1)

Pin description of ATMega328P

Port C – Pin PC0 to PC6 –

Pin 23. 24, 25, 26, 27, 28, **1**

Port C is a 7 bit bidirectional i/o port.

Pin 1 – PC6 (RESET) – This Pin by default is used as RESET pin. Active low required for longer than 1 pulse length. Additional function - PC6 can be used as i/o pin when RSTDISBL Fuse is programmed.

(PCINT14/RESET) PC6	1	28	PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0	2	27	PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1	3	26	PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2	4	25	PC2 (ADC2/PCINT10)
(PCINT19/OC2B/INT1) PD3	5	24	PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4	6	23	PC0 (ADC0/PCINT8)
VCC	7	22	GND
GND	8	21	AREF
(PCINT6/XTAL1/TOSC1) PB6	9	20	AVCC
(...OSC2) PB7	10	19	PB5 (SCK/PCINT5)
(...B/T1) PD5	11	18	PB4 (MISO/PCINT4)
(...IN0) PD6	12	17	PB3 (MOSI/OC2A/PCINT3)
(...IN1) PD7	13	16	PB2 ($\overline{SS}$/OC1B/PCINT2)
(...CP1) PB0	14	15	PB1 (OC1A/PCINT1)

Pin description of ATMega328P

Port C – Pin PC0 to PC5 – 6 Analog pins

Pin 28 – PC5 – Analog pin/Serial bus clock SCL / Ext. Interrupt pin

Pin 27 – PC4 – Analog pin/Serial bus data SDA / Ext. Interrupt pin

Pin 26 – PC3 – Analog pin / Ext. Interrupt pin

Pin 25 – PC2 – Analog pin / Ext. Interrupt pin

Pin 24 – PC1 – Analog pin / Ext. Interrupt pin

Pin 23 – PC0 – Analog pin / Ext. Interrupt pin

Pin PC0 to PC5 – Above 6 Analog pins can be programmed to handle digital i/o data as well. (These are not dedicated analog pins)

Question - In all, how many pins can handle digital data ?
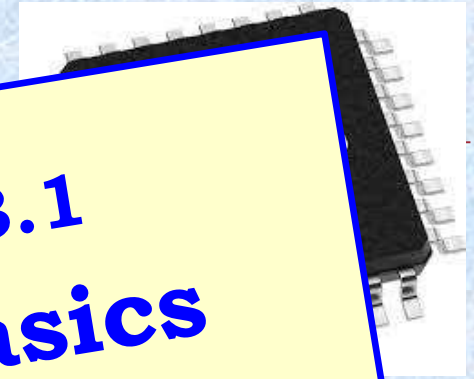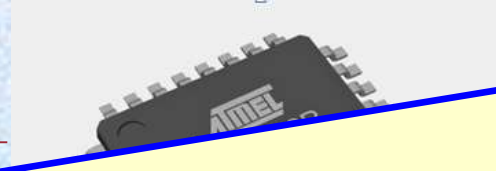
Pin description of ATMega328P

Pin 7 – VCC – Connected to positive voltage (1.8 V to 5.5 V)

Pin 8 – GND – This is ground (0V) for digital connections.

Pin 20 – AVCC – Supply voltage pin for ADC. This is to be connected to Vcc even if ADC is not being used. When ADC is being used, it should be connected to Vcc through a inductor. (low pass filter)

Pin 21 – AREF – This is for *external* analog reference voltage pin for the ADC.

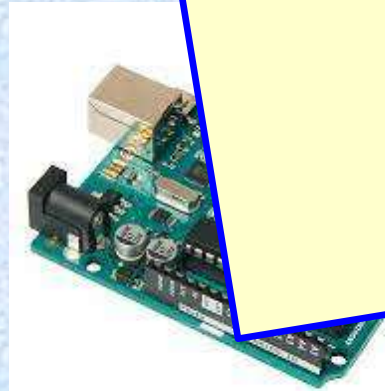Pin 22 – GND – This is ground (0V) for analog connections.