

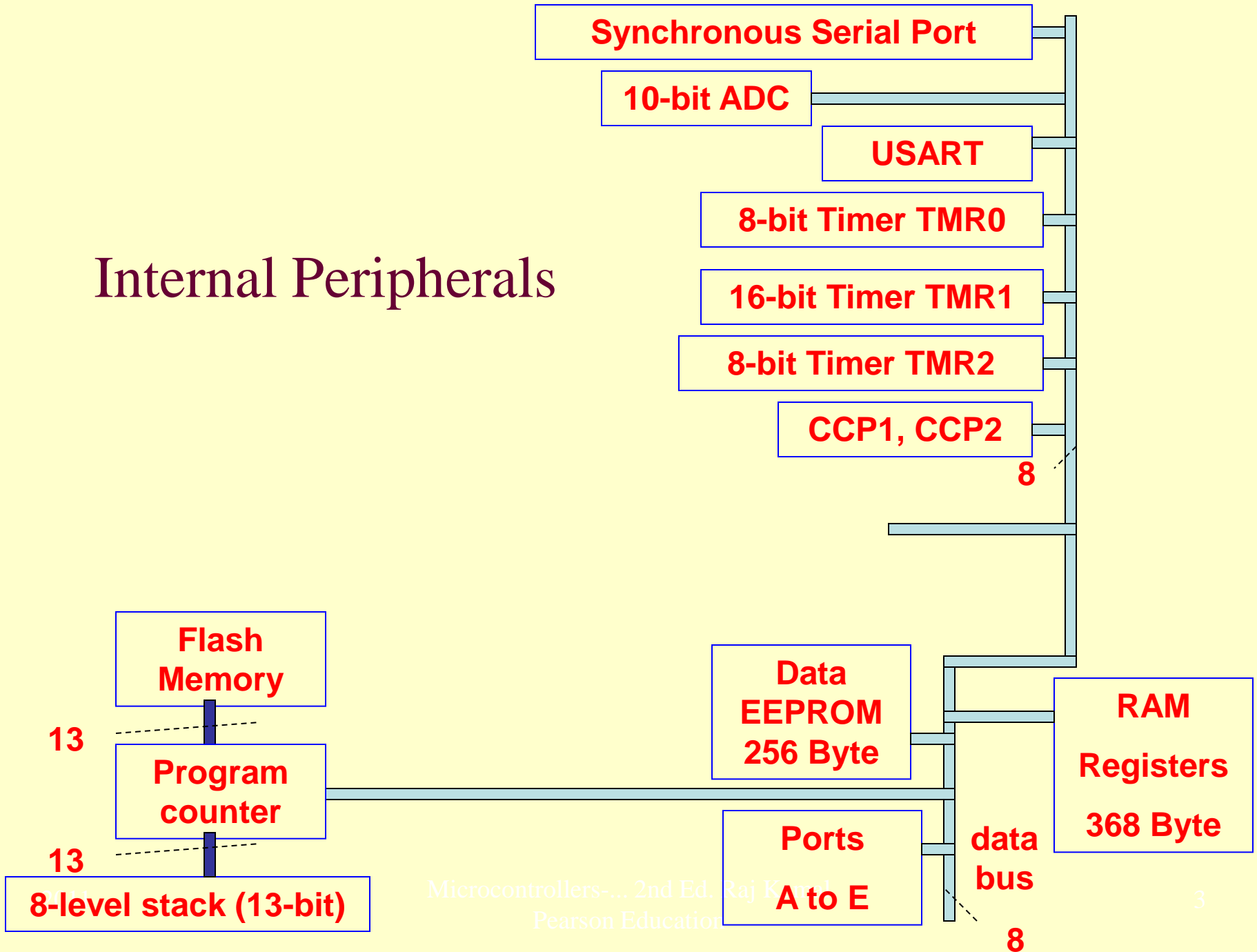
# Chapter 13

## PIC Family Microcontroller

# Lesson 05

## **Peripherals and Ports**

# Internal Peripherals



# Two data communication peripherals

- 1-A/E/USART [Universal synchronous asynchronous receiver and transmitter USART]
- 1-MSSP (SPI/I<sup>2</sup>C)

# MSSP (master synchronous serial port)

- Operate in master SPI mode
- or master/slave mode I<sup>2</sup> C

# Synchronous serial port

- Can be configured as 3-wire Serial Peripheral Interface (SPI™) option 1
- 2-wire Inter-Integrated Circuit (I<sup>2</sup>C™) bus in The option 2 [A Universal Asynchronous Receiver Transmitter]

# Timers

- Two 8-bit timers, TMR0 and TMR2  $2 \times 8$ -bit
- One 16-bit timer, TMR1  $1 \times 16$ -bit

# CCP1, CCP 2 functions

- Two capture/compare/PWM peripherals
- Input capture
- Out-compare and
- Pulse width modulation (PWM) functions



# ADC

- 8-input channel 10-bit ADC

# PIC 16F877 Five Ports

- 6-bit PORTA
- 8-bit PORTB
- 8-bit PORTC
- 8-bit PORTD
- 3-bit PORTE.

# Port Addresses

- PORTA Address 0x05H in bank 0 has 6 bits (RA0 to RA5)
- PORTB Address 0x06/0x106 in bank 0/2 has 8 bits (RB0 to RB7)
- PORTC Address is 0x07 in bank 0. It has 8 bits (RC0 to RC7)
- PORTD/PSP Address is 0x08 in bank 0. It has 8 bits (RD0 to RD7)
- PORTE Address 0x09 in bank 0 has 3 bits (RE0 to RE2)

# Each port's data-direct register

- TRISA, TRISB, TRISC, TRISD and TRISE for PORTS A, B, C, D and E, respectively.

# TRIS data-direct registers for PORTS A, B, C, D and E

- TRISA
- TRISB
- TRISC
- TRISD
- TRISE

# 6-bit port A

- Inputs/outputs
- Also multiplexes with the multi-channel analog inputs, AN0, AN1, AN2, AN3, clock-input to timer TMR0 when counting and AN4. Analog inputs connect the internal ADC (Analog to Digital Converter).

# RA2, 3 and 4 pins

- RA2 also  $V_{ref-}$  and
- RA3 also  $V_{ref+}$ .
- RA4 input has ST a input
- RA4 output is open drain

# ST Input

- Schmitt Trigger input
- When analog  $V$  exceeds a +Threshold, the output is logic 1
- When analog  $V$  falls below a -Threshold, the output is logic 0



# Output Open Drain

- Internally output MOSFET drain not connected to  $V_{DD}$
- Active or passive pull up resistance required and connection to  $V+$ .

# 8-bit port B for the inputs/outputs,

- RB0 also functions as INT and has ST input when MCU programmed for external interrupt.
- RB4, RB5 and RB6 also functions as interrupt on-program change.

# RB6 Pin

- RB6 has *ST* input when MCU pin programmed for serial programming clock (PGC) when used in serial programming mode.
- RB6 also used in in-circuit debugger mode.

# RB7 Pin

- RB7 also functions as interrupt on-program change
- RB7 has *ST* a input when MCU pin programmed for serial programming data (PGD) when used in serial programming mode.
- RB7 is also used in in-circuit debugger mode.

# Port C

- 8-bit port for the inputs/outputs, and peripherals when they are programmed for use.
- RC0 also functions as T1OSC output or TMR1 clock input.
- RC1 also functions as T1OSC input or Capture 2 input or Compare 2 output or PWM2 output
- RC2 also functions as Capture 1 input or Compare 1 output or PWM1 output.

# RC3 and 4 Pins SPI Option 1

- RC3 also as synchronous serial clock in or clock Out for SPI
- RC4 also as synchronous serial for SPI data-in/data-out modes

# RC3 and 4 Pins I<sup>2</sup>C Option 2

- RC3 also as synchronous serial clock in or clock Out for I<sup>2</sup>C mode
- RC4 also as synchronous serial for I<sup>2</sup>C data-in/data-out modes

# RC3 Pin Capture/Compare/PWM2 Option 3

- RC3 Capture 2 input or Compare 2 output or PWM2 output



# RC5, 6 and 7 Pins

- RC5 also as synchronous serial for data out in SPI mode.
- RC6 also as USART synchronous clock or asynchronous data transmit
- RC7 also as USART synchronous data or asynchronous receive

# Parallel Slave Port

- PSP— a handshake mode port
- Port D pins are used for PSP input/output
- PORTD can either function as general purpose port or PSP. PSP control and status bits are at TRISE bit b4, b5, b6 and b7 and the control signals are through PORTE when PORTD is programmed for the PSP8-bit port for the inputs/outputs.
- PORTD also multiplexes with the PSP when a microprocessor bus is interfaced to the MCU

# Microprocessor bus interfacing

- PORTD also multiplexes with the PSP when a microprocessor bus is interfaced to the MCU

# Port E pins

- Used for control signals RD, WR and CS

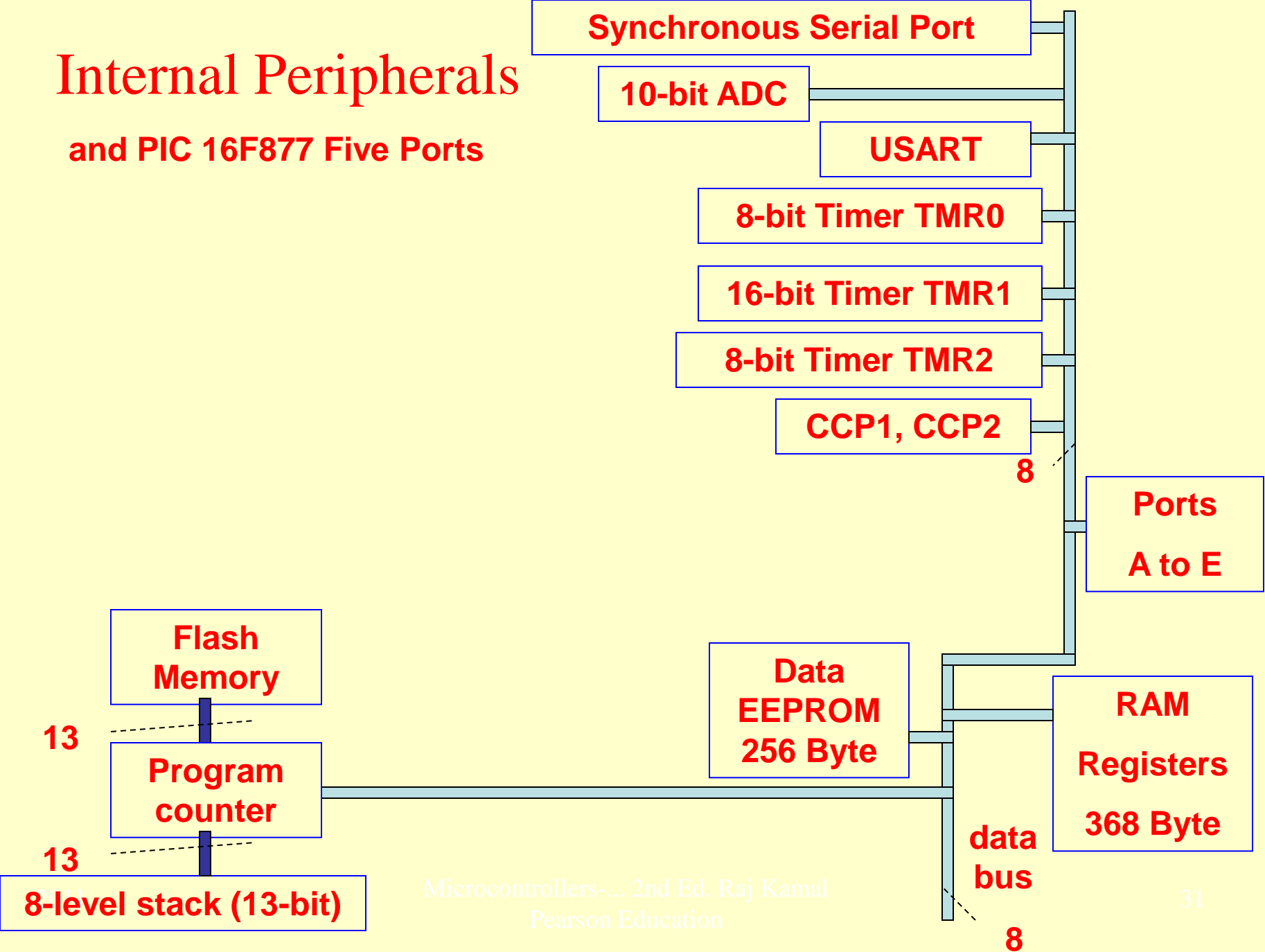
# Port E

- 3-bit port for the inputs/outputs. PORTE also controls the PSP when a microprocessor bus is interfaced to the MCU.
- RE0 also functions as read control for PSP or as analog input AN5
- RE1 also functions as write control for PSP or as analog input AN6
- RE2 also functions as chip select (CS) control for PSP or as analog input AN7

# Summary

# Internal Peripherals

## and PIC 16F877 Five Ports



# We learnt

- PIC 16F877 Five Ports
- 6-bit PORTA
- 8-bit PORTB
- 8-bit PORTC
- 8-bit PORTD
- 3-bit PORTE.



End of Lesson 05 on  
**Peripherals and Ports**