PERIPHERALS & REGISTERS

This is where the "real embedded work" starts. You'll move from theory into configuring **GPIO, timers, UART, ADC, I²C, SPI** etc. directly at **register level**.

C.1 GPIO (General Purpose I/O)

What to Study

- Input vs Output modes.
- Pull-up, pull-down, floating, open-drain.
- Debouncing (hardware & software).
- Alternate functions (e.g., pin multiplexing for UART/SPI).

Practical

- Blink LED (output).
- Read push button (input with pull-up/down).
- Debounced button → LED toggle.

MCU: STM32F103 or PIC18F4520

C.2 Timers

What to Study

- Timer basics: up-counter, prescaler, auto-reload.
- Compare mode (PWM generation).
- Capture mode (measuring signal frequency/duty).
- Watchdog timers.

Practical

- Generate square wave using timer interrupt.
- Use PWM to fade LED brightness.

C.3 UART (Serial Communication)

What to Study

- Asynchronous serial basics: baud rate, start/stop bits, parity.
- TX (transmit) vs RX (receive).
- Interrupt vs polling mode.

Practical

- Send “Hello” from STM32/PIC to PC via UART.
- Receive character from PC and echo it back.

C.4 ADC (Analog to Digital Converter)

What to Study

- Resolution (8/10/12 bits).
- Reference voltage.
- Sampling time.
- Channel selection.

Practical

- Read a potentiometer → vary LED brightness.
- Print ADC values over UART.

C.5 SPI & I²C

What to Study

- **SPI**: master/slave, MOSI, MISO, SCK, CS.
- **I²C**: master/slave, address, SDA/SCL, pull-ups.
- Common uses: sensors, displays, EEPROMs.

Practical

- SPI: Interface STM32 → external EEPROM or sensor.
- I²C: Read from a temperature sensor (LM75 / MPU6050).

Purpose

- Build confidence in configuring **all major peripherals**.
- Industry expects you to be comfortable with UART, I²C, SPI, ADC, Timers.
- Helps in **driver development** and future **RTOS projects**.

References

Datasheets / Manuals

- STM32F103 Reference Manual — GPIO, RCC, TIM, USART, ADC, SPI, I²C sections.
- PIC18F4520 Datasheet — Peripherals section.

Websites / Search Keywords

- STM32 Peripheral Programming
- I²C Explained
- SPI Explained

Summary

- Learned **GPIO, timers, UART, ADC, SPI, I²C** at register level.
- Practiced LED blink, PWM, UART echo, ADC read, I²C sensor read.