

Embedded Firmware Engineering with RTOS & AI

Course Syllabus

"From Coding to Real-Time Systems & AI"

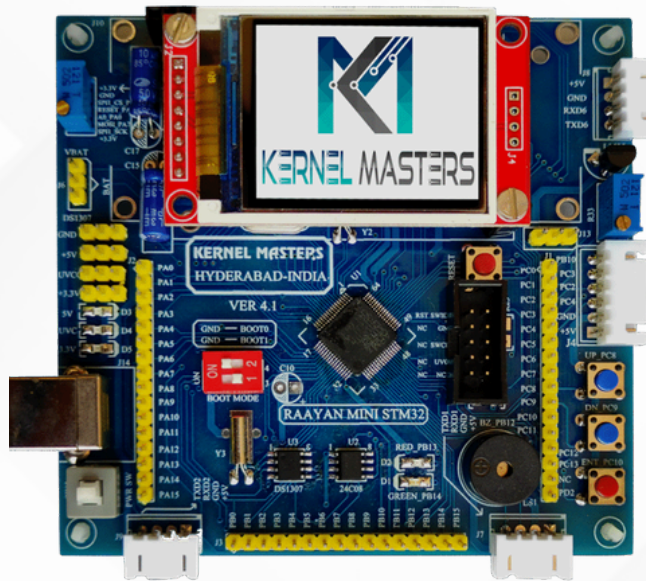


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“

Our Mission & Vision: To empower young Electronics Engineers with the right skills and training to build successful careers in Embedded Systems, while becoming a trusted bridge between talented engineers and the semiconductor industry by delivering quality, industry-ready professionals.

”



Kishore Kumar Boddu
Founder & Director of Kernel Masters

Course Roadmap

"From Coding to Real-Time Systems & AI"

01

Module 1:
Embedded Firmware
Development



02

Module 2:
Real time System with FREE
RTOS



03

Module 3:
Embedded AI & Edge
Intelligence



Module 1: Embedded Firmware Development



Build strong foundation in Embedded C and hardware control



Enable students to write firmware at register level



Transition from basic coding → embedded system thinking



**Course
Objectives**

Module 2: Real time System with FREE RTOS



Teach real-time system design & multitasking



Enable students to build complex embedded applications



Introduce industry-level debugging



**Course
Objectives**

Module 3: Embedded AI & Edge Intelligence



**Introduce AI in embedded systems
(future skill)**



**Enable students to build smart embedded
applications**

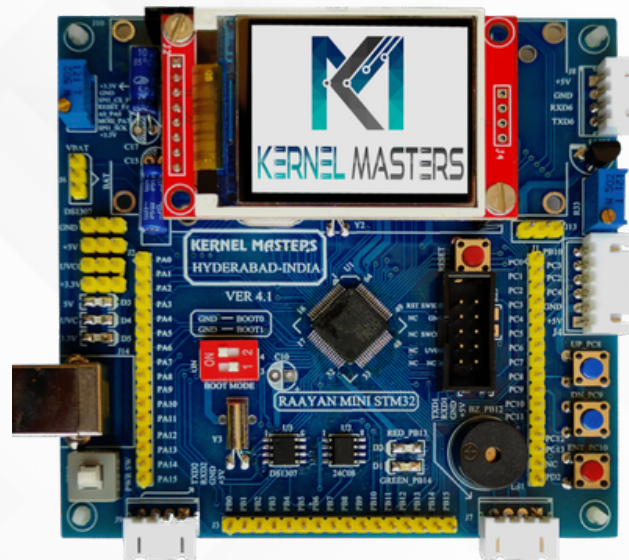


Bridge Embedded + AI domain



**Course
Objectives**

STM32 Based Raayan Mini Development Board

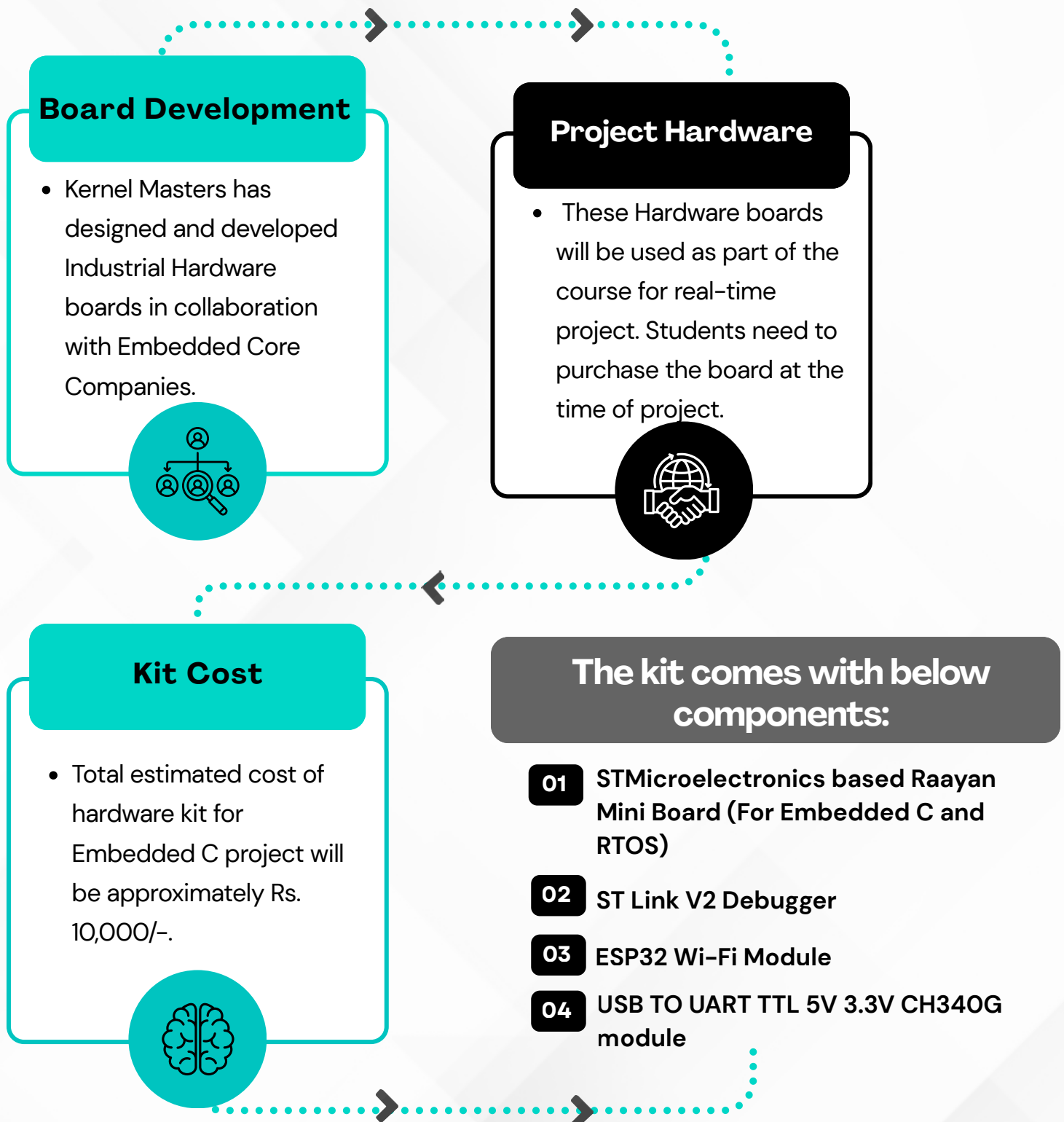


Board Specifications

- ✓ ARM Cortex M0/M1/M2/M3/M4
- ✓ STM32 Controller
- ✓ Serial comm Protocols: UART, I2C, RS485, CAN, SPI & USB
- ✓ ADC Controller
- ✓ 16 X 2 monochrome LCD display
- ✓ 3G GSM Module
- ✓ Wireless Protocols: Zigbee, BT, Wi-Fi
- ✓ RTC, EEPROM
- ✓ 40 GPIO Pins

Hardware Requirements

Essential tools and hardware to power practical embedded learning

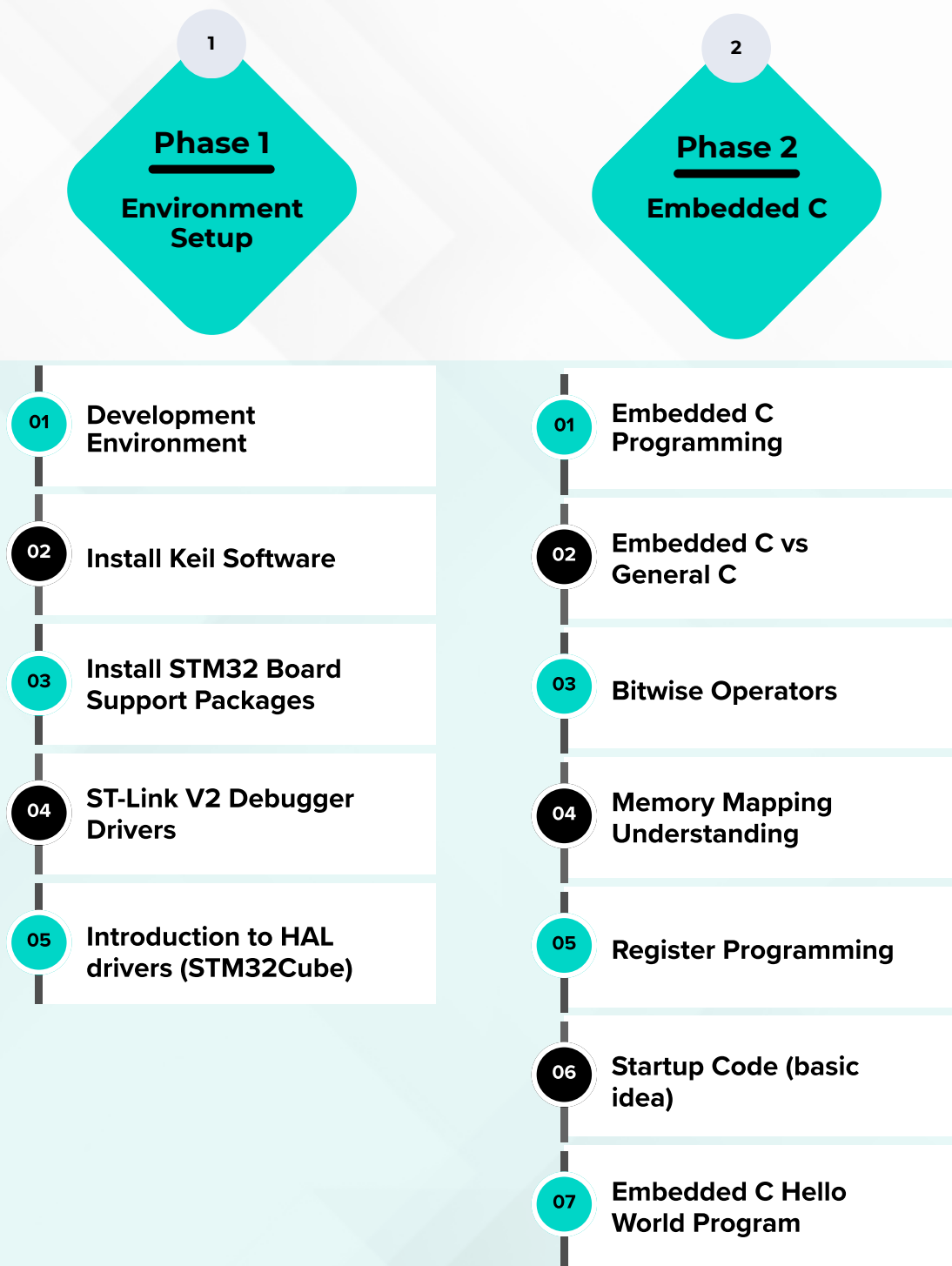


Module 1: Embedded Firmware Development

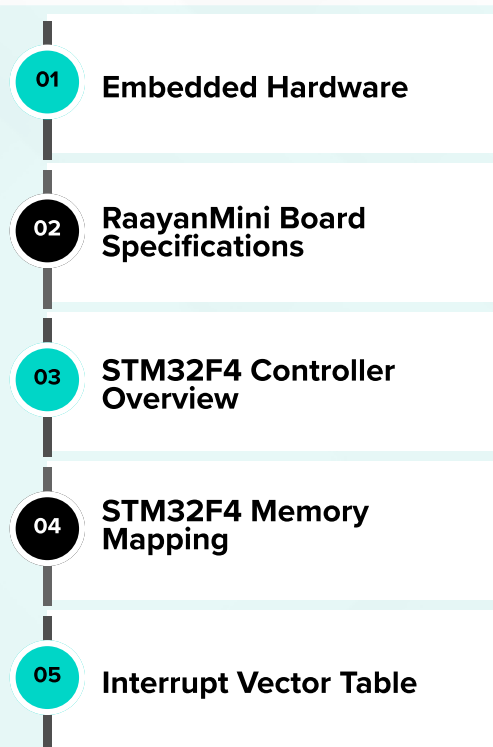
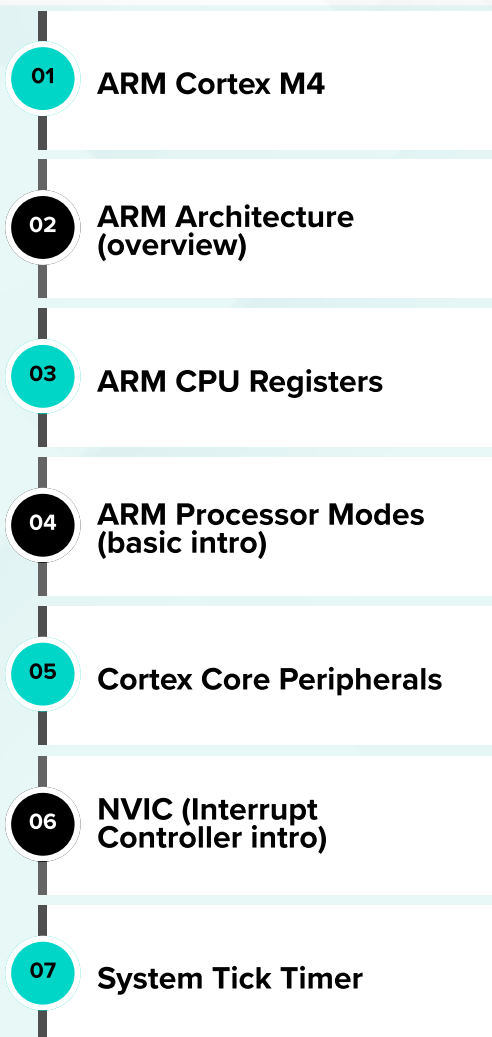
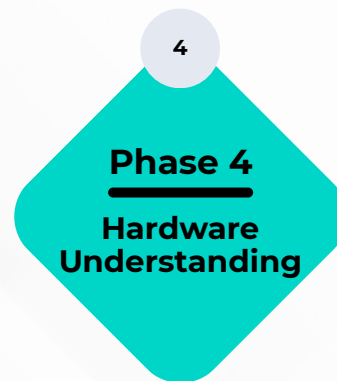
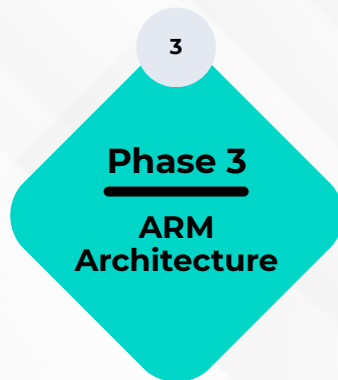
Final Structured Flow (Quick View)



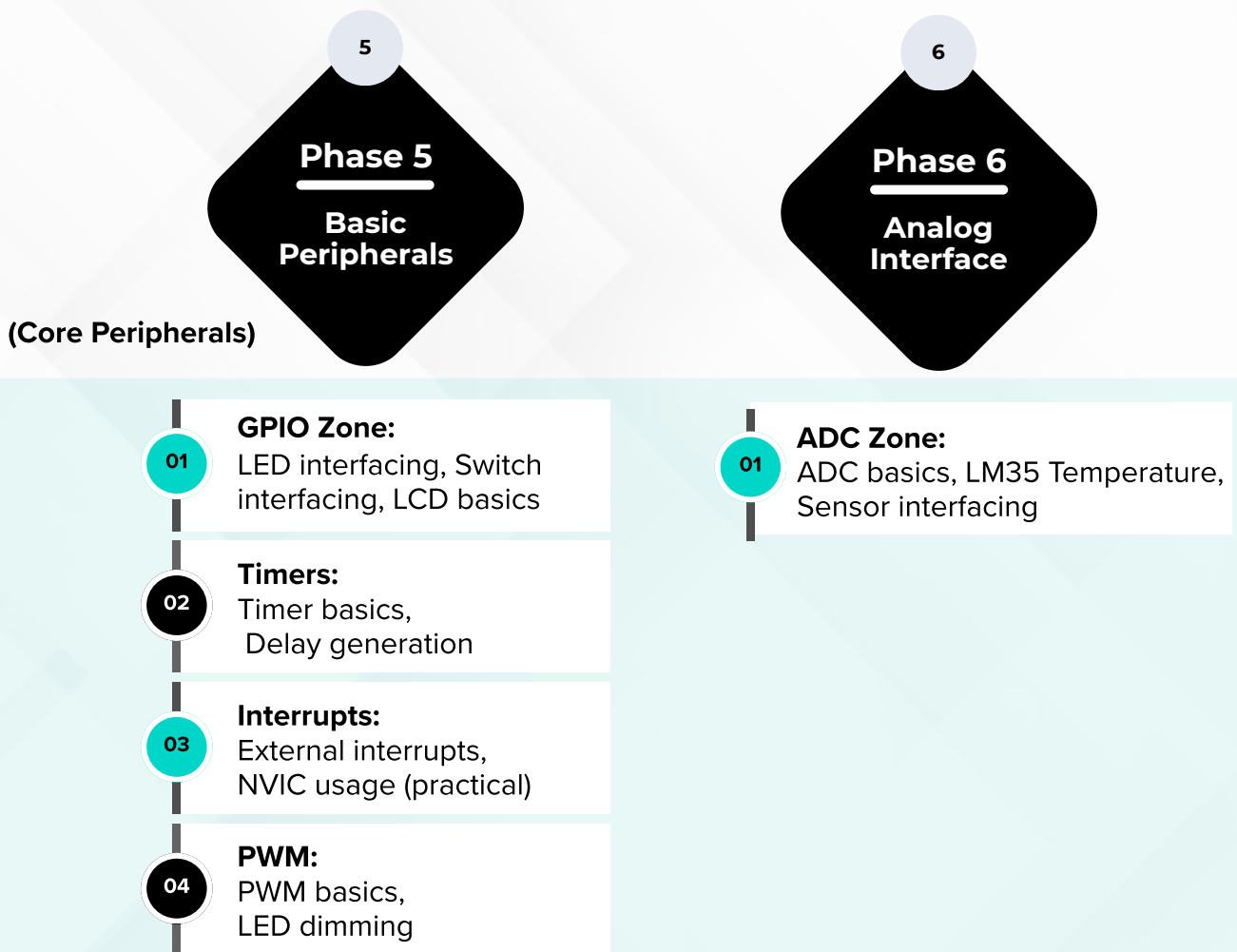
Module 1: Embedded Firmware Development



Module 1: Embedded Firmware Development



Module 1: Embedded Firmware Development



Module 1: Embedded Firmware Development



- 01 **STM32 Communication Protocols**
- 02 **UART Zone:**
UART basics, Wi-Fi, Bluetooth, GPS interfacing
- 03 **I2C Zone:**
RTC interfacing, EEPROM, ADXL345 Sensor
- 04 **SPI Zone:**
TFT LCD, SD Card
- 05 **CAN Zone:**
CAN basics, IoT Node communication

Module 1: Embedded Firmware Development

Final Outcome of Module 1

Students will be able to:

- 01 Write Embedded C code
- 02 Understand registers & memory
- 03 Interface peripherals
- 04 Build real embedded applications

Module 2: Real time System with FREE RTOS

Final Structured Flow (Quick View)



Module 2: Real time System with FREE RTOS

1

Phase 1

**Introduction
to RTOS**

01

What is RTOS?

02

**Need for RTOS vs
Bare-metal systems**

03

**Types of RTOS (Hard,
Soft, Firm)**

04

**Real-time constraints
& deadlines**

05

**RTOS vs General
Purpose OS**

Hands-on:

Understanding scheduler
behavior using simple task

2

Phase 2

**RTOS
Internals &
Real time
scheduling**

01

**RTOS architecture
overview**

02

Task Control Block (TCB)

03

Scheduler types:
Cooperative scheduling,
Preemptive scheduling

04

Context switching concept

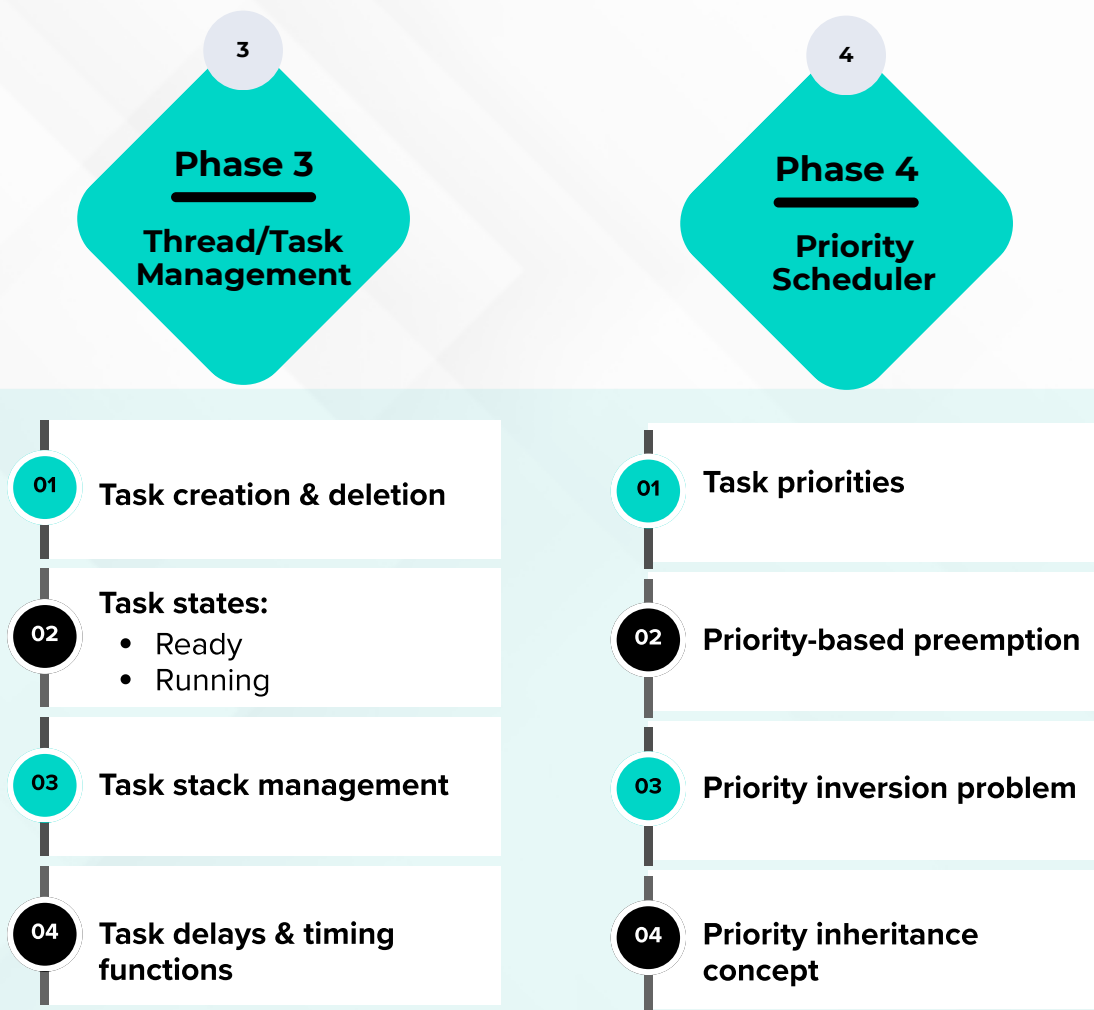
05

Tick interrupt & system tick

Hands-on:

Understanding scheduler
behavior using simple task

Module 2: Real time System with FREE RTOS



Hands-on:

Multiple task creation (LED
blinking at different rates)

Module 2: Real time System with FREE RTOS

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Phase 5 Inter-Task Communication

- 01 Need for synchronization
- 02 Queues
- 03 Semaphores:
Binary semaphore
Counting semaphore
- 04 Mutex (mutual exclusion)
- 05 Event groups (optional advanced)

Hands-on:

- Producer–consumer using queue
- Task synchronization using semaphore
- Shared resource protection using mutex

6

Phase 6 Application Programming on RTOS

- 01 Designing RTOS-based applications
- 02 Task splitting strategy
- 03 Resource sharing
- 04 Real-time constraints handling

Hands-on:

- Sensor reading + display + communication (multi-task system)
- Button-controlled multi-task system

Module 2: Real time System with FREE RTOS

7

Phase 7 Interrupt Handling in RTOS

- 01 ISR vs Task context
- 02 Interrupt-safe APIs
- 03 Deferred interrupt processing
- 04 Synchronization between ISR & task

Hands-on:

- External interrupt triggering a task
- ISR to queue communication

8

Phase 8 FREE RTOS Porting on Raayan mini

- 01 What is RTOS porting?
- 02 FREE RTOS architecture (portable layer)
- 03 Porting steps overview
- 04 Memory configuration
- 05 Stack & heap management

Hands-on:

- Running FreeRTOS on RaayanMini
- Configuring FreeRTOS for STM32

Module 2: Real time System with FREE RTOS

7

Phase 9

Building RTOS
for Target
systems using ST
Cube Software

01

FreeRTOS integration in
STM32CubeIDE

02

Configuration using
CubeMX

03

Task creation using GUI

04

Middleware integration

Hands-on:

- Create RTOS project using Cube
- Configure tasks, queues, timers

Module 2: Real time System with FREE RTOS

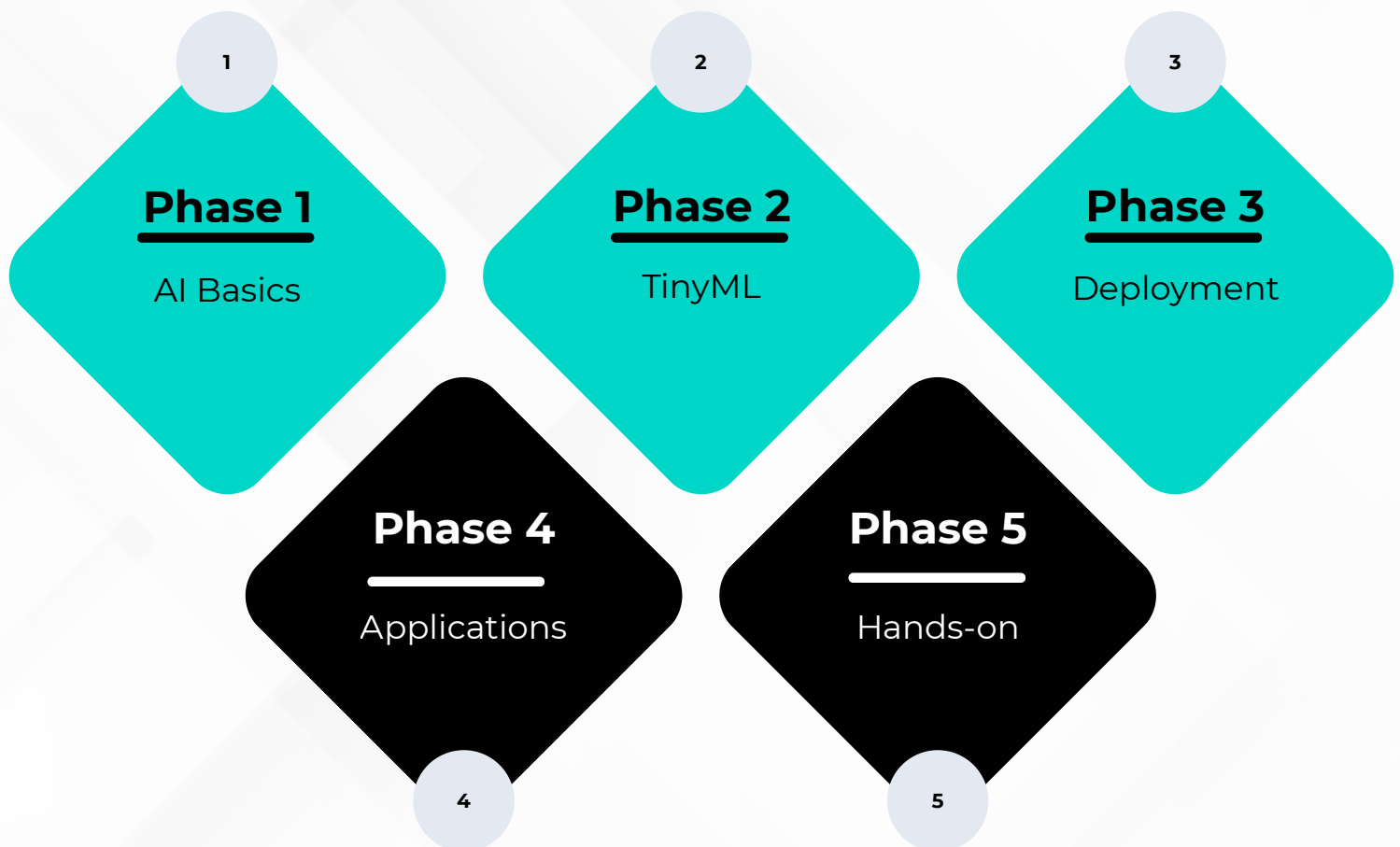
Final Outcome of Module 2

Students will be able to:

- 01 Design real-time embedded systems
- 02 Implement multitasking using FreeRTOS
- 03 Handle inter-task communication
- 04 Debug RTOS-based applications
- 05 Build industry-level projects

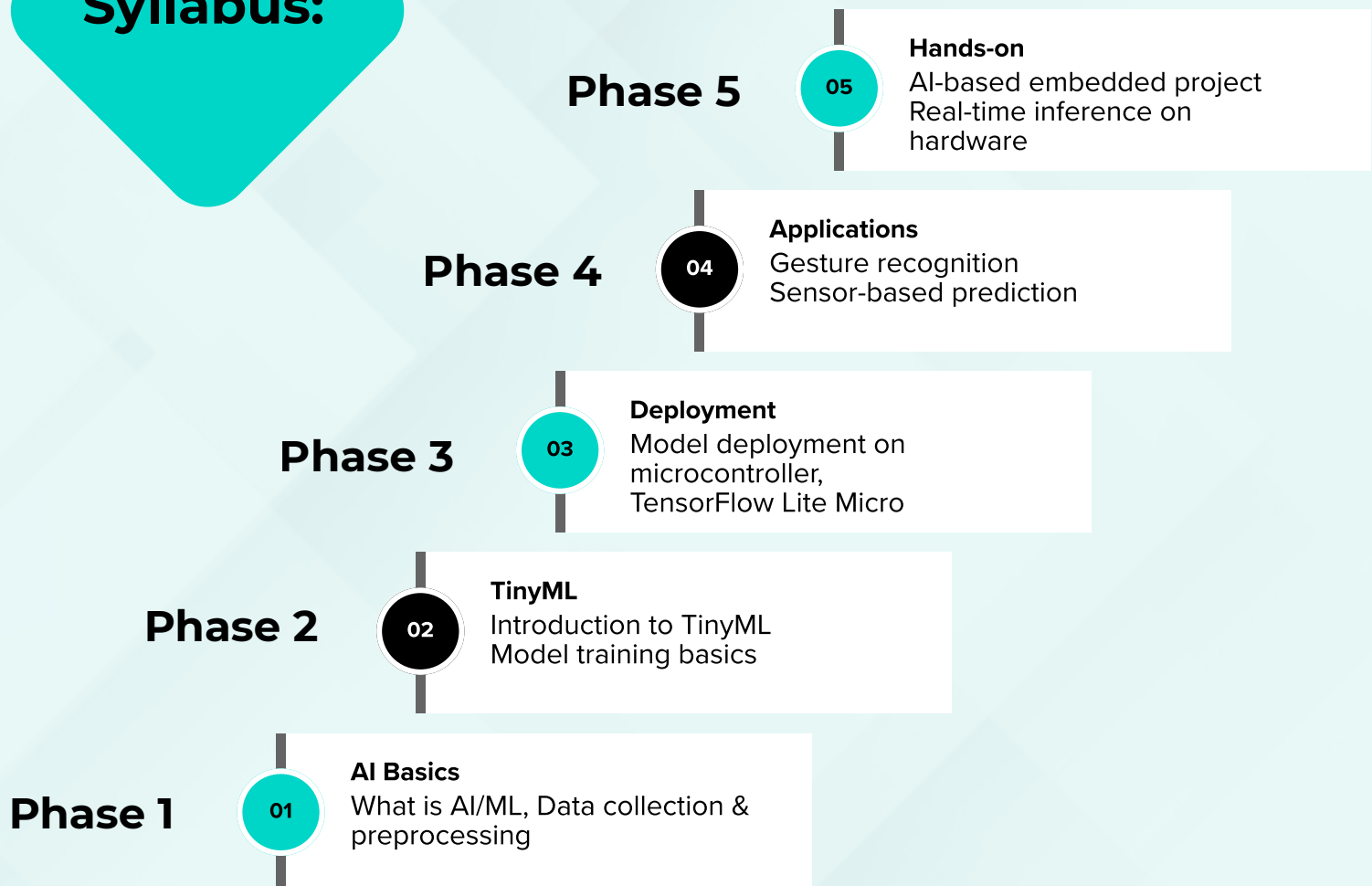
Module 3: Embedded AI & Edge Intelligence

Final Structured Flow (Quick View)



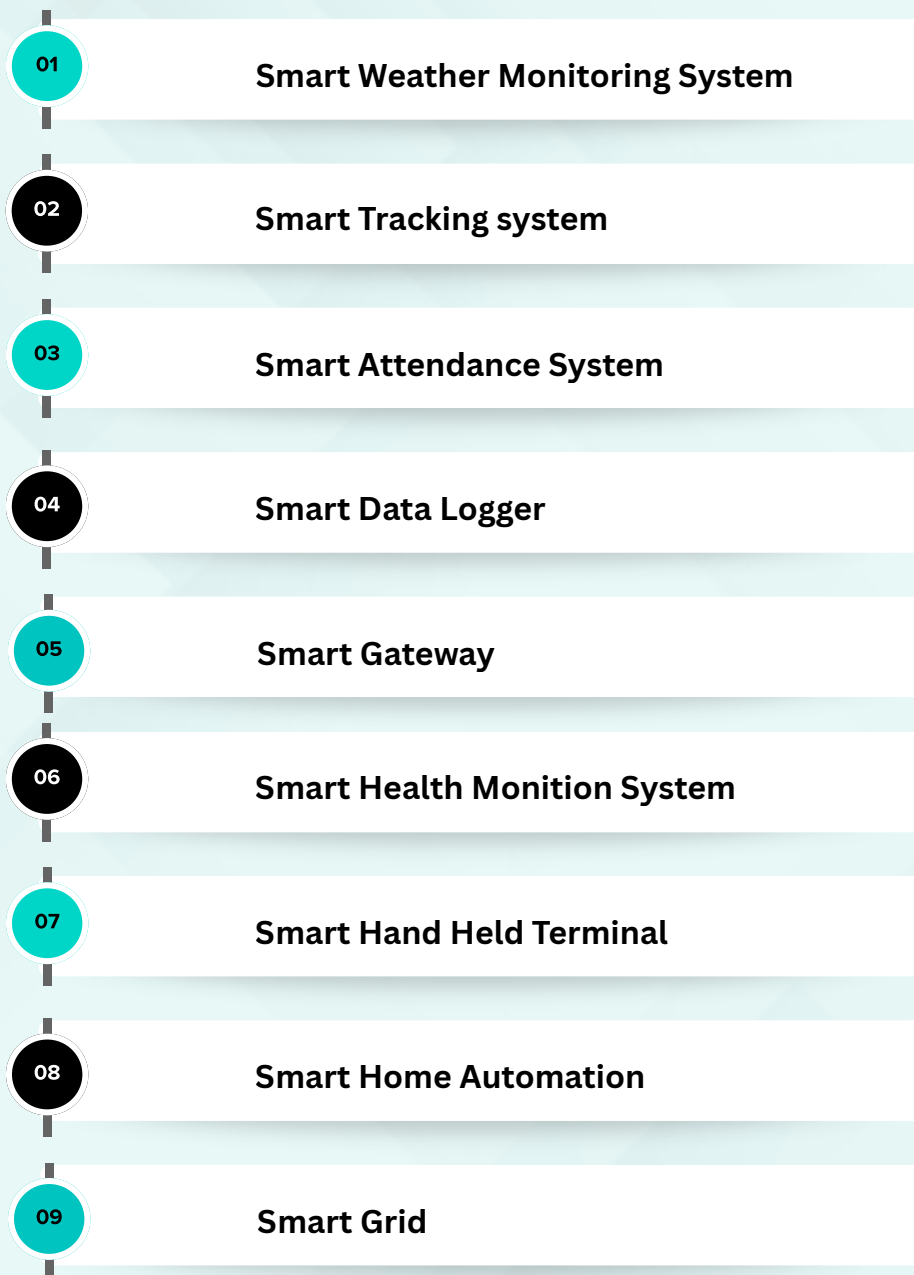
Module 3: Embedded AI & Edge Intelligence

Syllabus:



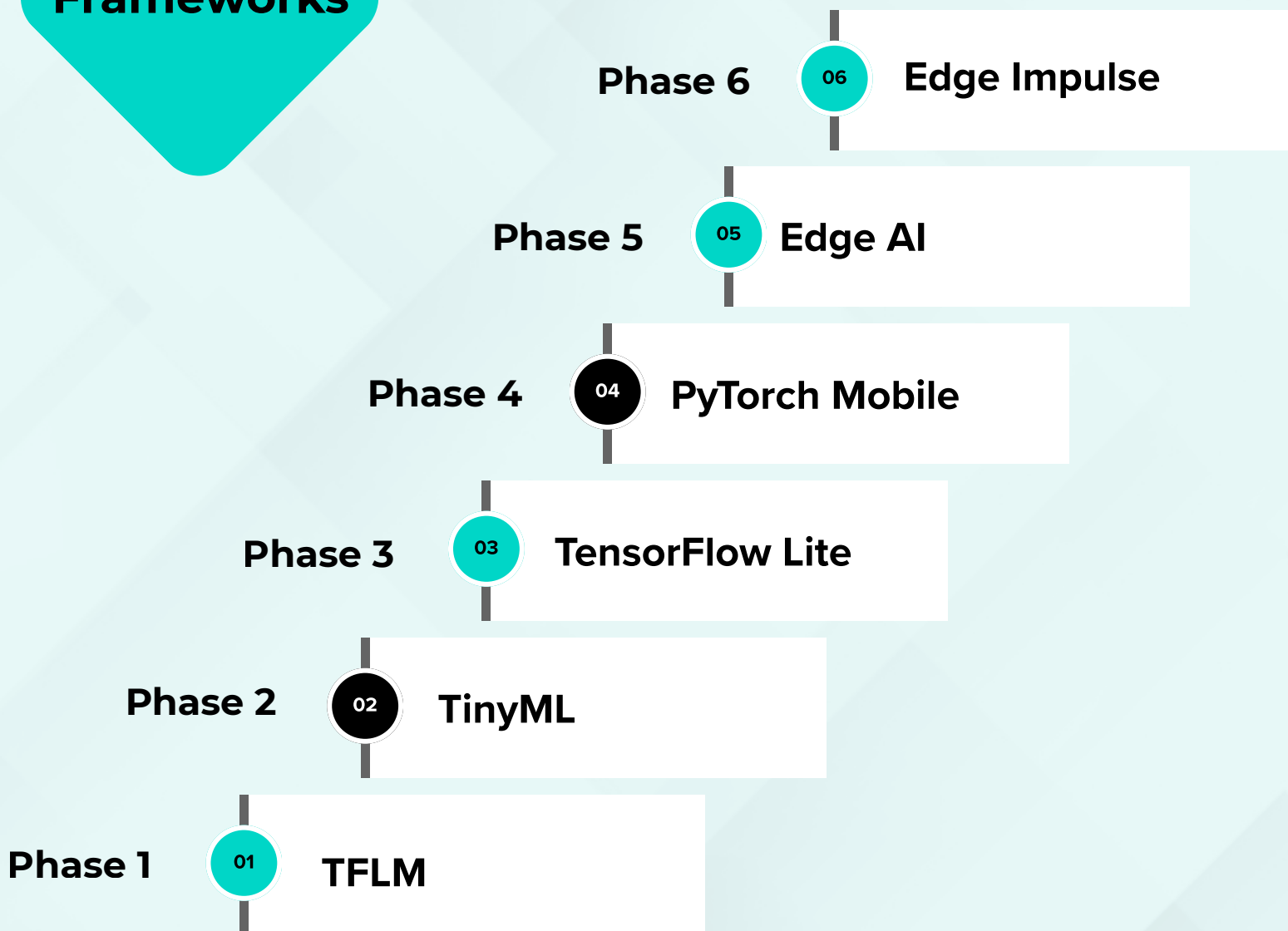
Module 3: Embedded AI & Edge Intelligence

Embedded Firmware Projects:



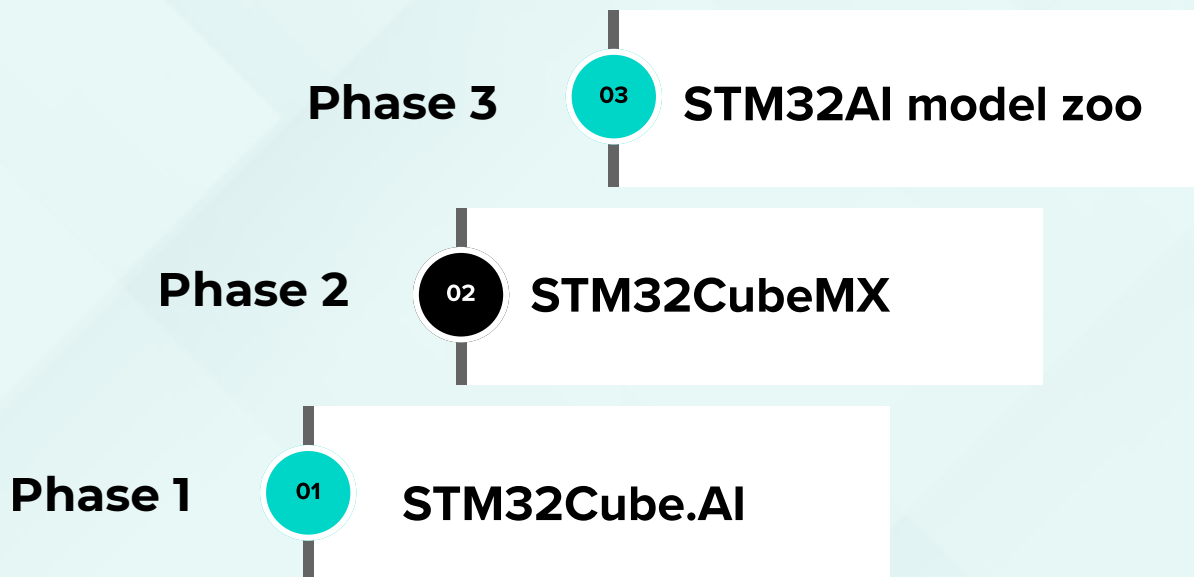
Module 3: Embedded AI & Edge Intelligence

AI Frameworks



Module 3: Embedded AI & Edge Intelligence

Embedded AI Tools



About Us



Kernel Masters, established in November 2012, has **completed 14 years** of dedicated service in embedded systems training. We have **trained 15,000+** students across **55 batches** and supported **16,000+ learners** in building careers in the embedded industry.

Our programs are designed for both **freshers** and experienced **professionals**, with nearly 30% of our learners coming from **Embedded Systems** or related domains to **upskill and advance their careers**. Our students are now working in reputed companies such as **Qualcomm, Sasken, Collabera, GlobalEdge, Mirafra, SmartPlay, AmericanMegatrends, Visiontek, Qolsys, and Elear Solutions**, reflecting the strong industry relevance of our training in Device Drivers and Embedded Linux.



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Recognition of Excellence



Kernel Masters is proud to have been recognized as **"Embedded Training Institute of the Year"** for both **2022–2023** and **2023–2024** under the Global Education Award category. Receiving this recognition in consecutive years reflects **our consistent commitment to excellence** in embedded training, **practical learning**, and **industry-oriented skill** development.

These awards stand as a testament to our dedication in **shaping skilled embedded professionals** and delivering **quality technical education** that aligns with industry needs. Such achievements inspire us to continue **empowering students** and **professionals** with strong fundamentals, **hands-on experience**, and **career-focused training**.



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Thank You

For your attention

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