



# Master Class on' “Embedded C” Programming



DAY 6/30



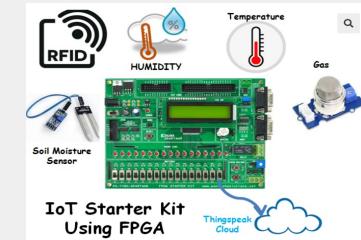
# *What you will learn Today*

STM32CUBE IDE

Build Process and Analyzing Embedded C Code

# About Pantech ProLabs India Pvt Ltd

- ✓ Started in the Year 2004
- ✓ Lab equipments and Sensor Interface
- ✓ Manufacturer of Brainsense EEG Headset
- ✓ Reconfigurable Algorithms on AI
- ✓ Manufacture of AI development Boards
- ✓ Power electronics, Fuel cell and Renewable Energy trainers



## Vision

To help 10 Million students around the globe to learn technology in a easy way

[www.pantechsolutions.net](http://www.pantechsolutions.net)

# About me



**PANTECH SOLUTIONS**  
Technology Beyond The Dreams  
helping 10 million people to learn and source technology in a easy way  
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**Jeeva Rajan M K**  
Founder and Director, Pantech ProLabs  
Chennai, Tamil Nadu, India · 500+ connections

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...  
www.pantechsolutions.net  
College of Engineering, Guindy  
Company Website

## Education



**College of Engineering, Guindy**  
Masters of Engineering, Applied Electronics  
2002 – 2004



**Govt College of Engg,Bargur**  
Bachelor of Engineering (B.E.), Electrical, Electronics and Communications Engineering, A  
1998 – 2002

## My Primary Expertise

Microcontroller Architecture: 8051,PIC,AVR,ARM,MSP430,PSOC3

DSP Architecture: Blackfin,C2000,C6000,21065L Sharc

FPGA: Spartan,Virtex,Cyclone

Image Processing Algorithms: Image/Scene Recognition, Machine Learning, Computer Vision, Deep Learning, Pattern Recognition, Object Classification ,Image Retrieval, Image enhancement and denoising.

Neural Networks : SVM,RBF,BPN

Cryptography :RSA,DES,3DES,Ellipti curve,Blowfish,Diffe Hellman

Compilers: Keil,Visual DSP++,CCS, Xilinx Platform studio,ISE, Matlab, Open CV

<https://www.linkedin.com/in/jeevarajan/>

[www.pantechsolutions.net](http://www.pantechsolutions.net)

# **Announcement**

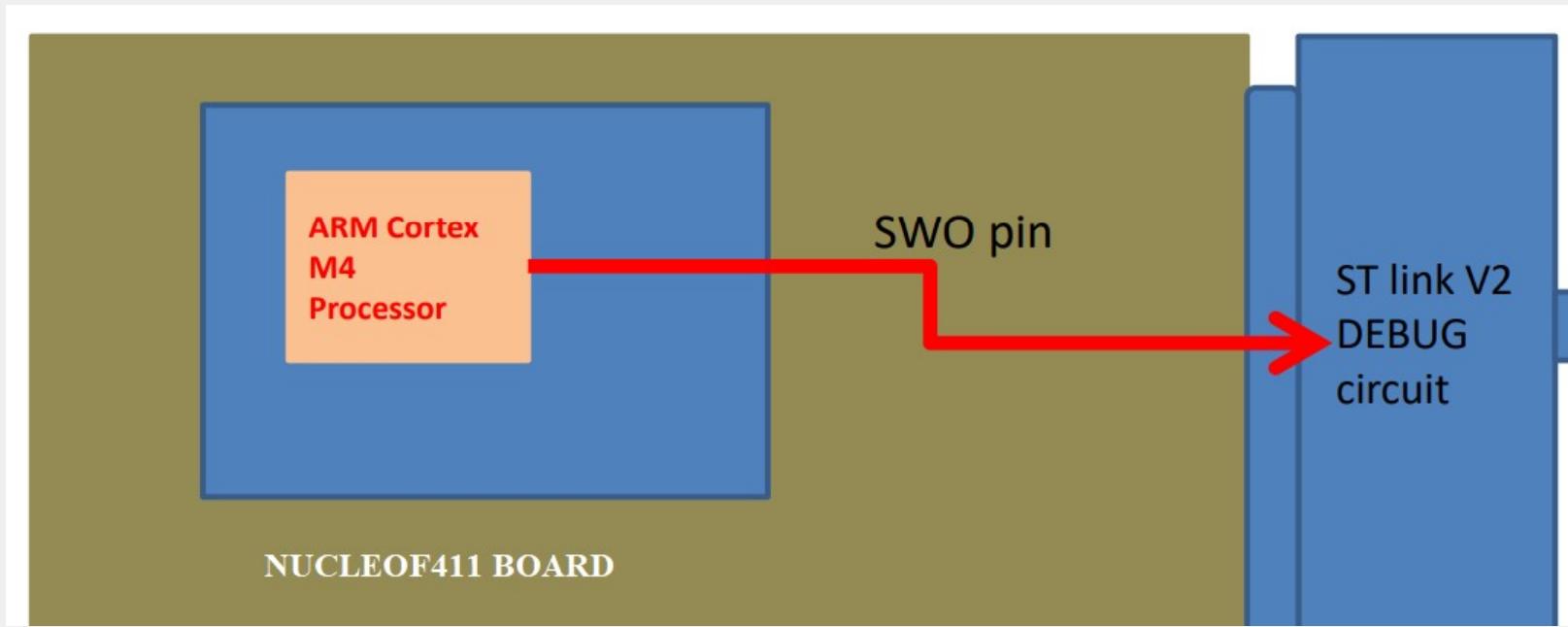
- ✓ Attendance Link at anytime of the session.
- ✓ Minimum attendance required for an E-Certificate is 25 Days. Attendance link will be closed at the end of the event.
- ✓ For Internship Candidates no attendance required ,it will be accessed from the LMS Portal. ([learn.pantechsolutions.net](http://learn.pantechsolutions.net))
- ✓ **Recorded Video Streaming for LAB classes** to improve Learning Experience or if I am not able to present on Live.
- ✓ PPT in facebook group and Telegram Group
- ✓ Source code and projects available download only for Internship candidates

# Mindset Lesson

✓ Your Environment is stronger than your will power

*Are you Ready to learn?*

# Creating a Project in Target



## ARM Cortex M4 Processor

ITM unit

Debug connector(SWD)

SWD(Serial Wire Debug)

2 pin (debug) + 1 pin (Trace)

### Instrumentation Trace Macrocell Unit

The **ITM** is an optional application-driven trace source that supports printf style debugging to trace operating system and application events, and generates diagnostic system information

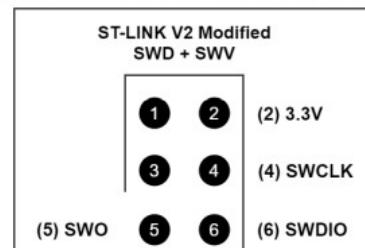
**Serial Wire Debug (SWD)** is a two-wire protocol for accessing the ARM debug interface

# SWD

- ✓ Serial Wire Debug (SWD) is a two-wire protocol for accessing the ARM debug interface
- ✓ It is part of the ARM Debug Interface Specification v5 and is an alternative to JTAG
- ✓ The physical layer of SWD consists of two lines
  - SWDIO: a bidirectional data line
  - SWCLK: a clock driven by the host
- ✓ By using SWD interface should be able to program MCUs internal flash , you can access memory regions , add breakpoints, stop/run CPU.
- ✓ The other good thing about SWD is you can use the serial wire viewer for your printf statements for debugging.

# SWD and JTAG

JTAG was the traditional mechanism for debug connections for ARM Cortex-M microcontrollers, but with the Cortex-M family, ARM introduced the Serial Wire Debug Interface. SWD is designed to reduce the pin count required for the 4 pins used by JTAG (excluding GND) down to 2. In addition, SWD provides one more pin called SWO(Serial Wire Output) which is used for Software-based Wire Viewing (SWV), which is a low cost tracing technology.



# JTAG

ARM 10-PIN Interface

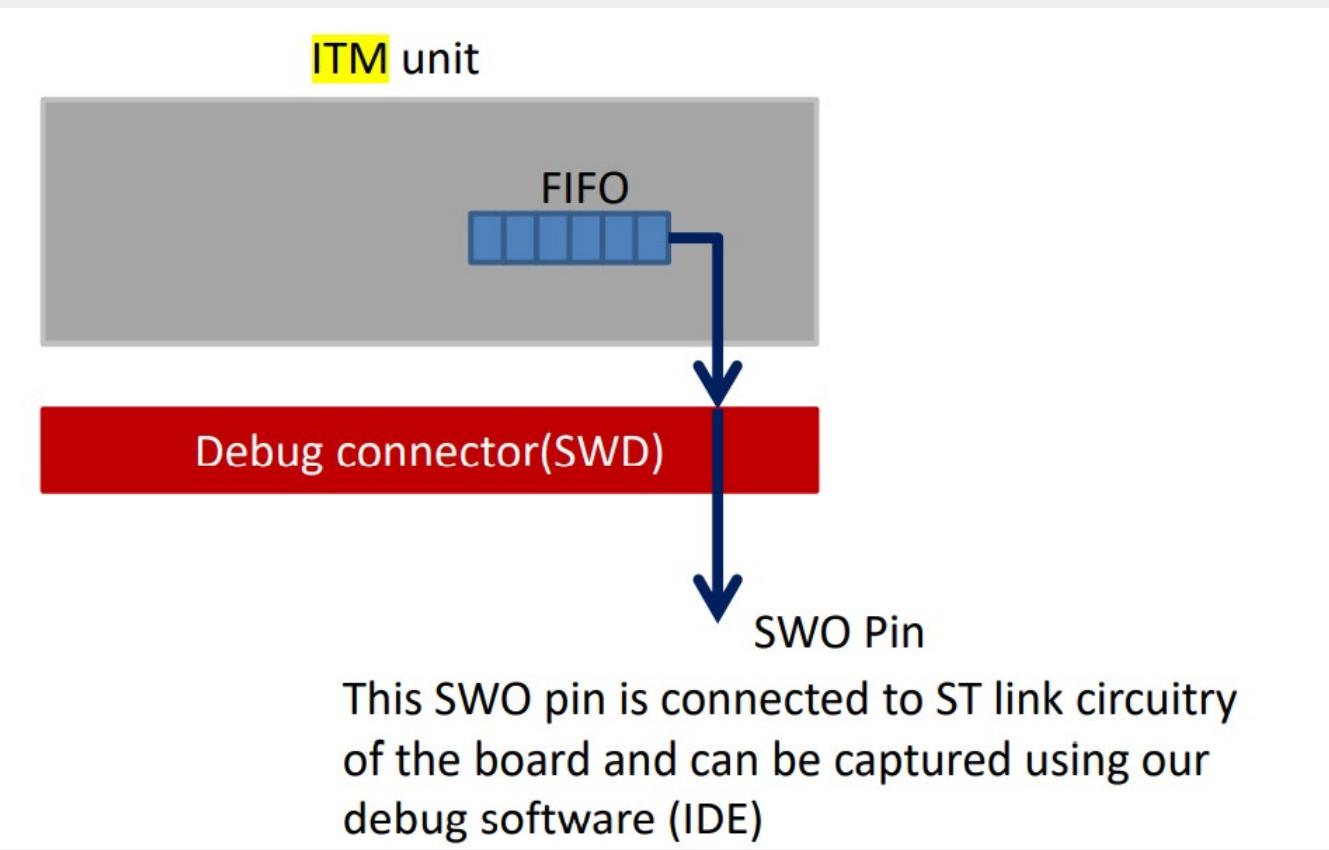
VCC	1	<input type="checkbox"/>	<input type="checkbox"/>	2	TMS
GND	3	<input type="checkbox"/>	<input type="checkbox"/>	4	TCLK
GND	5	<input type="checkbox"/>	<input type="checkbox"/>	6	TDO
RTCK	7	<input type="checkbox"/>	<input type="checkbox"/>	8	TDI
GND	9	<input type="checkbox"/>	<input type="checkbox"/>	10	RESET

ST 14-PIN Interface

I/JEN	1	<input type="checkbox"/>	<input type="checkbox"/>	2	/TRST
GND	3	<input type="checkbox"/>	<input type="checkbox"/>	4	N/C
TDI	5	<input type="checkbox"/>	<input type="checkbox"/>	6	TSTAT
VCC	7	<input type="checkbox"/>	<input type="checkbox"/>	8	/RST
TMS	9	<input type="checkbox"/>	<input type="checkbox"/>	10	GND
TCLK	11	<input type="checkbox"/>	<input type="checkbox"/>	12	GND
TDO	13	<input type="checkbox"/>	<input type="checkbox"/>	14	/TERR

OCDS 16-PIN Interface

TMS	1	<input type="checkbox"/>	<input type="checkbox"/>	2	VCC (optional)	VCC	1	<input type="checkbox"/>	<input type="checkbox"/>	2	VCC (optional)
TDO	3	<input type="checkbox"/>	<input type="checkbox"/>	4	GND	TRST	3	<input type="checkbox"/>	<input type="checkbox"/>	4	GND
CPUCLK	5	<input type="checkbox"/>	<input type="checkbox"/>	6	GND	TDI	5	<input type="checkbox"/>	<input type="checkbox"/>	6	GND
TDI	7	<input type="checkbox"/>	<input type="checkbox"/>	8	RESET	TMS	7	<input type="checkbox"/>	<input type="checkbox"/>	8	GND
TRST	9	<input type="checkbox"/>	<input type="checkbox"/>	10	BRKOUT	TCLK	9	<input type="checkbox"/>	<input type="checkbox"/>	10	GND
TRST	9	<input type="checkbox"/>	<input type="checkbox"/>	11	GND	RTCK	11	<input type="checkbox"/>	<input type="checkbox"/>	12	GND
TCLK	11	<input type="checkbox"/>	<input type="checkbox"/>	12	GND	TDO	13	<input type="checkbox"/>	<input type="checkbox"/>	14	GND
BRKIN	13	<input type="checkbox"/>	<input type="checkbox"/>	14	OCDSE	RESET	15	<input type="checkbox"/>	<input type="checkbox"/>	16	GND
TRAP	15	<input type="checkbox"/>	<input type="checkbox"/>	16	GND	N/C	17	<input type="checkbox"/>	<input type="checkbox"/>	18	GND
								<input type="checkbox"/>	<input type="checkbox"/>		
								<input type="checkbox"/>	<input type="checkbox"/>		



# Debug Trace

```
• //Debug Exception and Monitor Control Register base address
• #define DEMCR           *((volatile uint32_t*) 0xE000EDFCU )

• /* ITM register addresses */
• #define ITM_STIMULUS_PORT0    *((volatile uint32_t*) 0xE0000000 )
• #define ITM_TRACE_EN         *((volatile uint32_t*) 0xE0000E00 )

• void ITM_SendChar(uint8_t ch)
• {
•     //Enable TRCENA
•     DEMCR |= ( 1 << 24);
•
•     //enable stimulus port 0
•     ITM_TRACE_EN |= ( 1 << 0);
•
•     // read FIFO status in bit [0]:
•     while(!(ITM_STIMULUS_PORT0 & 1));
•
•     //Write to ITM stimulus port0
•     ITM_STIMULUS_PORT0 = ch;
• }
```

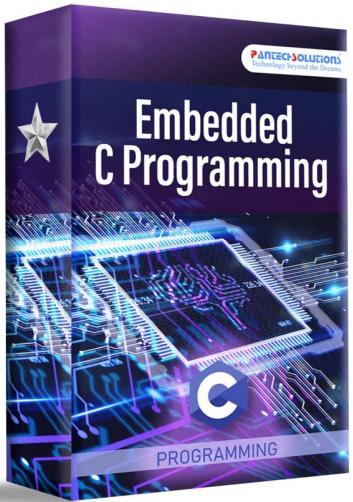
# Change the write function

- **\_\_attribute\_\_((weak)) int \_write(int file, char \*ptr, int len)**
- {
- **int DataIdx;**
- **for (DataIdx = 0; DataIdx < len; DataIdx++)**
- {
- **//\_\_io\_putchar(\*ptr++);**
- **ITM\_SendChar(\*ptr++);**
- }
- **return len;**
- }

# Embedded code debugging options

- Serial Wire viewer and data tracing
- Single stepping, Stepping over and Stepping out
- Breakpoints
- Disassembly
- Callstack
- Expression and Variable windows
- Memory browser
- Data watch points

# Combo Offer

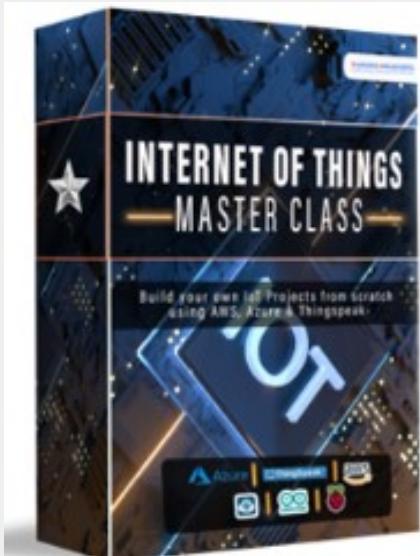


# *Embedded System Design & IOT Master Class(30 Days)*



- 8051 Architecture (5 Days)
- PIC Architecture(5 Days)
- ARM7-LPC2148(5 Days)
- LPC4088 CortexM4(5 Days)
- NodeMCU(5 Days)
- 5+ Projects

# IoT Master Class(30 Days)



- Basics of IoT
- Thingspeak
- AWS
- Microsoft Azure
- 5+Projects

- ✓ **90 Days of Video Coaching Lessons (₹10200 Value )**
- ✓ **Weekend Live Q&A Session for 1 year (₹3999 Value)**
- ✓ **Internship Certificate (90 Days)(E-Certificate) (Priceless)**
- ✓ **15+ Projects (₹12500 Value)**
- ✓ **Get the PPT Download for all 90 Days ) (₹10200 Value)**
- ✓ **Get the Source Code Download (₹9000 Value)**
- ✓ **BONUS: Private Group Access**

**Total Value**

**45899**

**999**

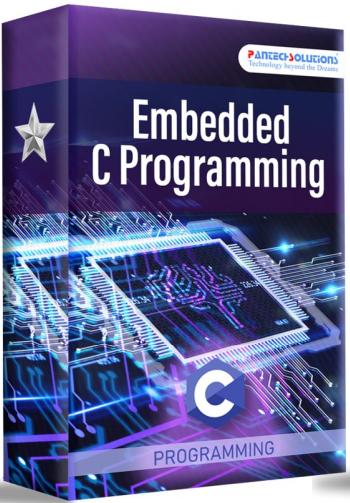
**(Available Only Today)**

# PCB Design Master Class(12 Days)



- ✓ Introduction to Schematic Capture
- ✓ Introduction to Allegro and Footprint Creation
- ✓ Importing Schematics in allegro ,Placement and route
- ✓ Gerber Creation, BOM, PDF
- ✓ How to Design a 8051 Microcontroller Board

# Today and Tomorrow Offer



Total Value

45899

999

(Available Only Today)



## ESD & IoT JOB ASSISTANCE PROGRAM —Warriors Way— *Job Assistance Bundle*

# Launching Warrior Way JOB Guarantee Bundle



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₹115000  
OFFER  
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**19 Courses  
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19 Internship Certificate  
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Soft Skill Courses**



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*Q & A*

*Thank You*