IIITB COMET FOUNDATION

CERTIFICATE PROGRAM IN

Future Wireless Communications

Gain Knowledge of Future Wireless Communication (5G/6G) Both HARDWARE & SOFTWARE with 5G/6G R&D at IIIT-BANGLORE and IIITB COMET Foundation's Testbed

comet.iiitb.ac.in

What you get

- Opportunities to work as intern/full time on cutting edge wireless system design at IIIT-Bangalore and IIITB COMET Foundation Testbed.
- Understanding of 3GPP standards for 5G-NR wireless system design.
- Expertise in embedded system design and programming for 5G wireless system design, a very demanding field.

Stipend

Meritorious Students who qualify through the test are entitled to avail a scholarship of 15,000/- per month after successful enrollment into the program.

Qualification

- Diploma/BSc/B.Tech or equivalent in any branch of Science/ Engineering.
- Final year project students are eligible upon producing an NOC from their institute.

Module 1

Digital Design and Programming

This course covers the basics of digital design and programming, including installation, documentation, digital design, applied logic, assembly programming, embedded C programming, internet of things, ARM programming, and Verilog programming.

Module Name	Content
Digital Design	Combinational and Sequential Logic using the Arduino Framework
Applied Logic	Porting digital logic to the arduino using Platformio
Assembly Programming	Introduction to AVR-Assembly, ATMEGA328Pperipheral programming, Timers, Memory Management
Embedded C Programming	Introduction to AVR- GCC, Functions, BIT- FIELDS Pointers, Threads, Socket programming.
Internet of Things	Establishing a wireless sensor network using the Vaman-ESP
ARM Programming	Simple hardware interfacing using the Vaman-Cortex-M4
Verilog Programming	Digital Design usingthe Vaman-EOS-S3 FPGA

Module 2

Advanced Digital Design and Programming

This course covers advanced topics in digital design and programming, including advanced digital logic, micro- controllers, and embedded systems.

Module Name	Content
Python Programming	Numpyfor vector/matrix operations
C Programming	Using pointer arrays for vector/matrix operations
Data Structures	Pointers and lists for vector/matrixoperations
Math Computing on hardware	78 Inter chip communication on the Vaman board for vector/ matrixoperations

Module 3

Introduction to 5G: Comprehensive Course Details

1. EVOLUTION OF MOBILE TECHNOLOGIES

- Introduction to Mobile Technologies
- Early Mobile Telephony
- 1G: First Generation (Analog)
- 2G: Second Generation (Digital)
- 3G: Third Generation (Mobile Broadband)
- 4G: Fourth Generation (Fast Data and IP Networks)
- 5G: Fifth Generation (Ultra-Fast, Low Latency)
- Towards 6G: Sixth Generation (The Future)
- Comparison of Generations
- Impact on Society

2. INTRODUCTION TO 5G, KEY TECHNOLOGIES, USE CASES

- **Role of ITU and 3GPP in 5G Evolution**
- **5G Adoption, Global Proliferation, and Deployment**
- **5G Usage Scenarios and Key Capabilities**
- **ITU-Defined 5G Usage Scenarios**
- **Key 5G Use Cases**
  - Enhanced Mobile Broadband (eMBB)
  - Ultra-Reliable Low Latency Communications (uRLLC)
  - Massive Machine Type Communications (mMTC)
- **5G Network Architectures**
- **Standalone (SA) vs Non-Standalone (NSA)**
- **5G Releases by 3GPP and Impact on Key Sectors**

3. 5G CORE

- **Introduction to 5G Core Network**
- **Key Functions of the 5G Core**
- **Service-Based Architecture (SBA)**
- **Network Slicing in 5G Core**
- **5G Core Interfaces: N1, N2, N3, N4, N5, N6, N7, N8**
- **5G Core and 5G NR (New Radio) Integration**
- **Role of 5G Core in eMBB, uRLLC, and Mmtc, Security features in 5G Core**

4. 5G RANL2/L3

- **5G RAN Split Architecture**
  - Centralized Unit (CU)
  - Distributed Unit (DU)
  - Radio Unit (RU)
  - Overview of ORAN architecture
- **5G Interfaces**
  - NGAP (Next Generation Application Protocol)
  - F1AP (F1 Application Protocol)
  - Xn (Interface between gNBs)
  - E1 (Interface between CU-Control Plane and CU-User Plane)
  - NG (Interface between gNB and 5GC)
- **Layer 2 (L2) Protocols**
  - SDAP, PDCP, RLC, MAC
- **Layer 3 (L3) Protocols**
  - NAS, RRC

5. PHYSCIAL LAYER L1

- **1. Key physical layer technologies for 5G-NR**
  - Hybrid ARQ
  - Orthogonal Frequency Division Multiplexing (OFDM),
  - Adaptative Modulation and coding (AMC)
  - MIMO, Massive MIMO
- **2. 5G-NR radio interface introduction**
  - Frequency Bands supported by 5G NR
  - Channel Bandwidth Supported in 5G New Radio
  - Waveform and Modulation used in 5G NR
  - 5G NR Numerologies
- **3. Uplink/downlink data and control channel design for 5G NR**
  - PDCCH, PDSCH, PUCCH, PUSCH
- **4. Intial Access and Synchronization**
  - PBCH: MIB and SIB
  - SS Block
  - PSS and SSS

6. 5G SA / NSA CALL FLOWS

- **5G NSA Call Flow**
- **5G SA Call Flow**
- **5G Registration**
- **PDU Session Establishment**

Module 4

AI/ML for 5G and 6G Wireless Communication

Introduction to Machine Learning:

- Overview of machine learning types: supervised, semi-supervised, unsupervised learning
- Detailed exploration of regression models

Introduction to Wireless Communication:

Python code examples on:

- Single Carrier Systems
- OFDM (Orthogonal Frequency-Division Multiplexing)
- MIMO (Multiple Input Multiple Output)
- OTFS (Orthogonal Time Frequency Space) systems

AI/ML in Wireless Communications:

- Massive MIMO receiver design
- Modulation classification techniques

Signal Estimation and Detection using AI/ML:

- Direction of arrival (DOA) and channel estimation in Massive MIMO systems
- STO (Sample Time Offset) and CFO (Carrier Frequency Offset) estimation techniques for OFDM/OTFS systems
- MIMO/OFDM/OTFS symbol detection strategies

IIITB COMET FOUNDATION

FWC Program Instructors

S Srikanth Reddy
Training Specialist

Prem Singh
Professor, IIIT-Bangalore

Vivek Yadav
Technology Officer & Adjunct faculty
IIIT-Bangalore

Amrita Mishra
Professor, IIIT-Bangalore

Ajay Bakre
Professor, IIIT-Bangalore

Sridhar Pillalamarri
CEO, IIITB COMET Foundation

Selection Process

- Selection for the course is based on an offline written test at "IIIT-B Campus".
- Students who clear a minimum threshold but below the qualification marks can still join the program by paying the fee but will not be entitled to avail any scholarship, those students who clear Module 1&2 are entitled to avail a scholarship during module 3.

Module	Course	Duration	Fees
Module1	Digital Design Through Embedded Programming	2 Months	30,000/-
Module2	Advanced Digital Design and Programming	2 Months	45,000/-
Module3	Design of 5G Networks with hands-on	3 Months	75,000/-
Module4	AI/ML for 5G and 6G Wireless Communication	3 Months	75,000/-

Note: Model 3 and 4 will have a month of overlap.

Fees in INR

- Each Module have a separate fee & Fee will be separately collected before the start of each module.
- Students can exit after each module
- Fee will be charged per module.
- Candidate has the option to drop out any time.
- Fee won't be refunded after payment.

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