National University
Of Computer and Emerging Sciences

2026-2028

Master of Science in Electrical Engineering *with* ***Specialization in IC Design & Verification***

"A Training from Idea to Product Design"

Salient Features and Objectives:

- ***Pioneer of Integrated Circuits (IC) design graduate program*** *in Pakistan.*
- *First time in Pakistan an academic opportunity for IC designing on* ***Licensed Cadence Tool Suite.***
- ***Well Established collaboration*** *with public and private industrial partners.*
- *Hands on design experience on* ***TSMC officially provided 65nm, 130nm and 150nm*** *CMOS PDKs.*
- ***Fully developed ICD lab and curriculum*** *with 4 full time faculty members with degrees in IC design and cumulative experience of* ***over a dozen of IC tapeouts****.*
- ***A bridge between the industry-and-academia*** *to pave the way to FAB-less innovations resulting in commercialization IC design houses.*
- ***32 students fully funded by Ignite*** *currently enrolled in the Program*
- ***25 fully industrial funded MS students*** *graduated in Fall-2021, hired by public sector organization.*
- *Taped out 8 Projects on two IC's by MS students graduated in Fall-2021.*
- ***Active Participation in IEEE SSCS PICO Design Contest, 3 projects granted in 2021, 8 projects granted in 2022.***
- ***ICD Lab*** *actively participates in international IC design contests and achieved significant success in* ***2023****, winning* ***6 Project Grant Awards*** *out of* ***13*** *in the* ***SSCS PICO Chip Design Contest****, covering tapeout and packaging costs for projects taped out in the Global Foundries* ***180nm process****.*
- ***Collaboration with Oman*** *and deliver a 10-month training program for* ***100 Omani engineers****, leading to the establishment of the GSME IC Design Centre in Oman.*
- ***ICD Lab won 17 out of 44 project*** *grant awards from* ***SSCS PICO*** *over the last five years, representing over 30% of the total awards distributed globally, including the USA, France, South Korea, Egypt, Brazil, and others.*
- *Currently* ***collaborating with KSA*** *to deliver a training program for 24 graduate students in* ***KSA****.*
- *Fast Integrated Circuits Design Lab has started the first graduate program in Pakistan - dedicated to IC design in 2019. Over past 7 years the program* ***produced more than 100 IC Design graduates****, and currently have 33 fully funded graduate students.*

MS EE Program Objectives:

This program prepares a graduate in Electrical Engineering to acquire expertise in the area of Integrated Circuits. This program is fully dedicated and focused on the IC design knowledge and skills, each student in this program will do the real world tape out from project conception to the working silicon microchip under the guidance of faculty supervisor from university and industry experts.

Eligibility:

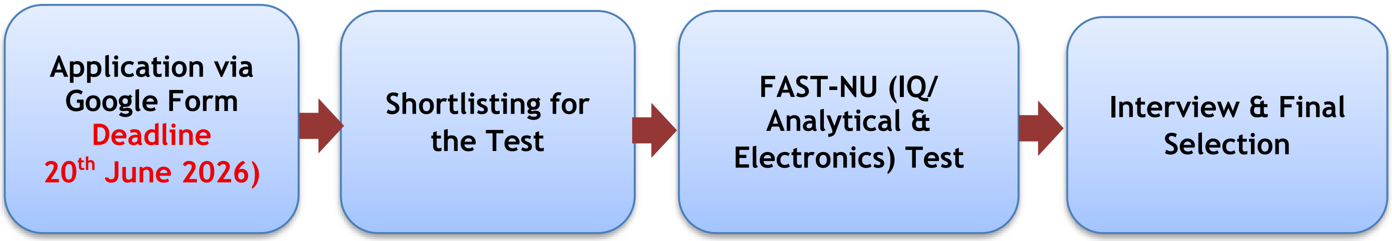
Bachelor's degree in a relevant engineering discipline, recognized by Pakistan Engineering Council (PEC).
Minimum CGPA of 2.0, Preferably 2.5 (on a scale of 4.0) or at least 60% marks.

I. BS Electrical Engineering (Major: Electronics)
II. B.S Electrical Engineering (Major: Embedded)
III. B.S Electrical Engineering (Major: Telecom)
IV. B.S Electrical Engineering (Major: Power)
V. B.S Electronics Engineering
VI. B.S Telecom Engineering
VII. B.S Electronics (4-Year Degree program, such as BS Electronics degree offered by Quaid-i-Azam University)

Application & Admission Process:

Master of Science in Electrical Engineering with Specialization in Integrated Circuit Design application deadline is 20th June 2026.

The admission process consists of the following steps



Shortlisting Criteria for Test:

I. Matric (10th Grade) or Equivalent Marks (10%)
II. Intermediate (12the Grade) or Equivalent Marks (20%)
III. B.S or Equivalent Degree CGPA (50%)
IV. Grade in Circuit Analysis or Equivalent Course (4%)
V. Grade in Calculus-I or Equivalent Course (4%)
VI. Grade in Electronics-I or Equivalent Course (4%)
VII. Grade in Signal & Systems or Equivalent Course (4%)
VIII. Grade in Digital Logic Design or Equivalent Course (4%)

Final Selection Criteria after Test:

The final admission merit will be determined after interviews and will comprise the following:

I. Matric (10th Grade) /Secondary School Certificate (SSC) or Equivalent Marks (5%)
II. (12th Grade) Higher Secondary School Certificate (HSSC) or Equivalent Marks (5%)
III. BS Degree CGPA (35%)
IV. Admission Test (Consisting of IQ/Analytics (20%) & Electronics (15%)
V. Interview (20%)

Fellowships by IRADA (https://www.linkedin.com/company/irada-pk):

The selected candidates will be offered fellowships sponsored by IRADA that covers full fee waiver and PKR 25,000/- monthly stipend for Pakistani nationals.

International Students:

- **Admission Criteria:** International applicants are subject to the same selection and testing criteria as local students.
- **Students from Bangladesh:** The **two top-ranked students** from Bangladesh will be awarded a monthly stipend of **50,000 PKR and tuition fee waiver along with air ticket**, sponsored by ICD Lab and a member of the UET Lahore Alumni Association.
- **Other International Students:** Responsible for standard tuition fees. Sponsorship opportunities may be available through relevant foundations, and individual fee details will be provided upon request.

Admission Test and Test-Related Information

Only Short-listed candidates will be called for the Test. The ***tentative*** test date, at designated test locations, mentioned below, is 30th June 2026. The admission test will consist of Multiple-Choice Question (MCQ) only. For exact test date keep visiting the web page.

Test Centers:

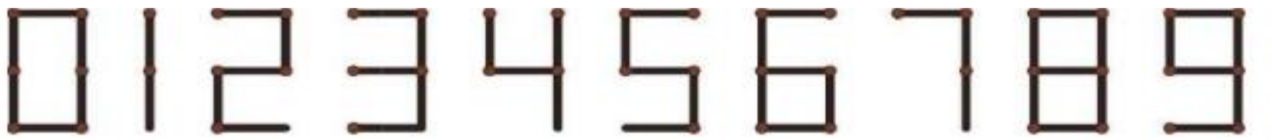
FAST-NUCES Islamabad Campus
FAST-NUCES Lahore
FAST-NUCES Faisalabad
FAST-NUCES Peshawar
FAST-NUCES City Campus Karachi
BUITEMS Quetta

Guide for the Analytical/ Math & Electronics Test

Analytical & Math: This standard multiple-choice test is designed for candidates with a math that uses concepts covers concepts of math and physics till high school (garde10). It primarily aims to evaluate their IQ, analytical reasoning, and abstract thinking skills. While multiple-choice, the test will require basic calculations to determine the correct answers. To discourage random guesswork, negative marking will be applied.

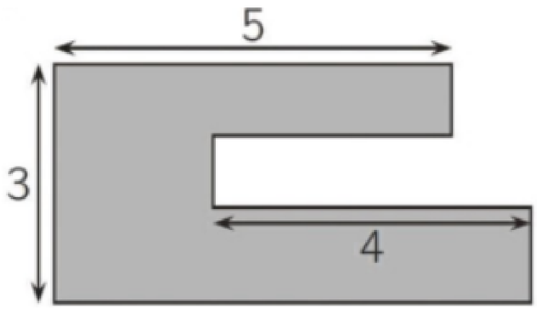
See couple of examples here:

Q1 (Level Easy): Matchsticks can be used to write digits, as shown in the diagram. How many different ***positives integers*** can be written using exactly five matchsticks in this way?



Ans： Ⓐ 3 Ⓑ 4 Ⓒ 6 Ⓓ 8 Ⓔ 9;

Q2 (Level Hard): Observe the shape of Chaudary Allahdita sugarcane field as shown in the diagram. Its sides are all either parallel or perpendicular, and some dimensions are given.
Determine the perimeter:



Ans： Ⓐ 22 Ⓑ 23 Ⓒ 24 Ⓓ 25 Ⓔ 26

Electronics Admission Test: This test will consist of MCQs covering the following topics:

Part1 – Signals, Devices & Basic Circuits: Chapter 1, 3, 4 & 5 (4 Chapters)

Part2 – Chapter-9 Frequency Response, Only 9.1 to 9.3)

Reference Book: Microlelectronic Circuits by Sedra & Smith, 6th Edition.

Chapters 1, 3, 4, 5, and Chapter 9 (Sections 9.1–9.3 only)

https://drive.google.com/file/d/11OnQp3HZ-nRItJyri6GI1p-hgIBTzs9z/view?usp=sharing

Part3 - Digital Logic Design

Reference Book: Digital Design by Morris Mano

Chapter 1, 2, 3 and Chapter 4 (up to Section 4.4)

https://drive.google.com/file/d/1XWkpEjlcuzs6EvavQMUKTlBZF5fDIdjl/view?usp=sharing

Tentative Study Plan:

After 24 credit hours' completion in two semesters, there are two options for M.S completion.

Option1: Take 6 credit hours Thesis-I & II in Semester 3 & 4 respectively along with 2 Credit hour Holy Quran-I & II. Degree Completes in 4 semesters

Option2: Take 8 credit courses in 3rd Semester and complete the degree in three semesters (Can take courses in the evening).

Semester I		
SS	Core Course-I(RM)	3
EE	Core Course-II	3
EE	Core Course-III	3
EE	Core Course-IV	3
Total		12 credits

Semester-II		
EE	Core Course-V (RM)	3
EE	Core Course-VI	3
EE	Core Course-VII	3
EE	Core Course-VIII	3
Total		12 credits

Thesis/Project Option

Semester-III		
EE	MS Thesis-I/ Project - I	3
SS	Understanding Holy Quran-I	1
SS	Understanding Holy Quran-II	1
Total		5 credits

Semester-IV		
EE	MS Thesis-II/Project-II	3
Total		3 credits

Coursework Option

Semester-III		
EE	Elective-I	3
EE	Elective-II	3
SS	Understanding Holy Quran-I	1
SS	Understanding Holy Quran-II	1
Total		8 credits

The total credits of the MS programs are 32, which includes the 24 credits of the course work including the 03 credit Research Methodology Course and 06 credits of the MS thesis/project work.

Note: Registration in "Thesis – I / Project – I" is allowed provided the student has:

- Earned at least 15 credits
- Passed the "Research Methodology" course;
- CGPA is equal to or more than 2.5

Integrated Circuits Master's Program (Thesis Option)

SEMESTER-1

1. Analog & Discrete Electronics
2. Digital Integrated Circuit
3. Digital ICs: Synthesis 7 Physical Design
4. IC Design Project: From Concept to Chip Tapeout-I
5. Research Methodology

Fall-2026

SEMESTER-2

1. Mixed Signal Integrated Circuit Design
2. SoC, Packaging & Signal Integrity
3. VLSI Design Verification & Test
4. IC Design Project: From Concept to Chip Tapeout-II

Spring-2027

SEMESTER-3

1. Master Thesis/Project (Part-II)
2. Understanding Holy Quran I

Fall-2027

SEMESTER-4

1. Master Thesis/Project (Part-II)
2. Understanding Holy Quran II

Spring-2028

Integrated Circuits Master's Program (Coursework Option)

SEMESTER-1

1. Analog & Discrete Electronics
2. Digital Integrated Circuit
3. Digital ICs: Synthesis 7 Physical Design
4. IC Design Project: From Concept to Chip Tapeout-I
5. Research Methodology

Fall-2026

SEMESTER-2

1. Mixed Signal Integrated Circuit Design
2. SoC, Packaging & Signal Integrity
3. VLSI Design Verification & Test
4. IC Design Project: From Concept to Chip Tapeout-II

Spring-2027

SEMESTER-3

1. Elective-I
2. Elective-II
3. Understanding Holy Quran I
4. Understanding Holy Quran II

Fall-2027

Recommended Electives:

1. **Signal Integrity, Packaging and SoC Design**
2. **Digital ICs Synthesis & Physical Backend Design**
3. **IC Design Project: From Schematic to Chip Tapeout**
4. **VLSI Design Verification and Testing**
5. **Advanced Digital Signal Processing (ADSP)**
6. **Advanced Embedded Systems**

MS (Electrical Engineering – Specialization in Integrated Circuits):

Core Courses for MS-EE with Specialization in Integrated Circuits:

1. Research Methodology (03 Credits) (HEC Requirement)
2. Digital Integrated Circuits (03 Credits)
3. Analog & DT Integrated Circuits (03 Credits)
4. Mixed Signal Integrated Circuits (03 Credits)
5. Understanding Holy Quran I (01 Credit)
6. Understanding Holy Quran II (01 Credit)

Elective Courses (One must select minimum of 4 courses from this list of Electives)

1. Signal Integrity, Packaging and SoC Design (03 credits)
2. Digital ICs Synthesis & Physical Backend Design (03 Credits)
3. IC Design Project: From Schematic to Chip Tapeout (03 credits)
4. VLSI Design Verification and Testing (03 Credit)
5. RF Integrated Circuits (03 Credits)
6. Advance Microwave Engineering (03 Credits)
7. Advance Embedded Systems (03 Credits)
8. Advance Digital Signal Processing (03 Credits)
9. Advanced Wireless Communication (03 Credits)
10. IC Marketing and Business Management (03 Credits)

Teaching Faculty:

Teaching faculty is hands on IC designer with cumulative experience of over dozen IC tape outs in different technologies.

For CVs of faculty, please see (https://www.fasticdlab.com/team-page)

- Prof. Dr. Rashad Ramzan
- Dr. Hassan Saif
- Dr. Khurram Javed
- Dr. Muhammad Saeed

06 Compulsory Courses (14 Credit Hours):

1. **Research Methodology:** The course is mandatory for all graduate programs offered under HEC umbrella. The course covers central aspects of the research process, as well as principles and questions related to sate of art search, research planning, problem formulation, statistical data analysis, quality assessment, presentation of a research project, and research ethics. (03 credits; HEC requirement)

2. **Digital Integrated Circuits:** Review of integrated circuit fundamentals, CMOS Device Characteristics, Layout Rules, CMOS Inverter, Basic Gates, Combinational Logic Multiplexers, Transmission Gates, Sequential logic circuits, Latches, Flip Flops, Adders, Multiplier, Accumulators, Memory cells, Layout strategies, Basic of Logic synthesis and use of CAD tools.
   Lab Tutorials: Design of Basic Logic Gates, Flip Flop, Adders, Multiplexer, Demultiplexer, Memory Cells, Complex Circuits, and layout in cell library format in Cadence tool suite. (03 credits)

3. **Analog & DT Integrated Circuits:** Review of fundamentals, Analog building blocks, CMOS Device and Noise – Fundamentals, Single-stage (CS, CG, CD), Differential pair and multistage amplifiers, CMOS operational amplifier, Noise in CMOS Circuits, Feedback Principles, Current Sources and Current Mirrors, MOS Switched- Capacitor (SC) circuits, OTA, and Gm cells
   Lab Tutorials: CMOS DC Analysis, Common Source Amplifier, Common Gate Amplifier, Multi Stage Amplifiers, Common Drain Amplifier, CMOS Current Mirrors, Differential Amplifiers, Two Stage Op-Amp, CMOS Noise Analysis, Advanced Layout Techniques in Cadence Tool Suite. (03 credits)

4. **Mixed-Signal Integrated Circuits:** Non-Linearity and mismatch, CMOS Processing Technology, Layout Fundamentals, Sample & Hold Circuits, Voltage Comparators, Band-gap References, Data converters – Fundamentals and Performance Metrics, Nyquist Digital-to-Analog Converters, Nyquist Analog-to-Digital Converters, Z-Transform, Oversampling ΣΔ Data Converters, PLL and Frequency Synthesizers
   Lab Tutorials: Advanced op-amp Design & Simulation, CMOS Comparators Design, Bootstrap Circuits Design, Switched Capacitor Circuits Design, Discrete circuit Layout Techniques, Nyquist Rate DAC Design, Nyquist Rate ADC Design, Sigma-Delta Converters, Oscillator & PLL circuits, Bandgap Reference Circuits in Cadence tool suite. (03 credits)

5. **Understanding Holy Quran - I**
   Nature and purpose of the Qurʾān, Revelation and preservation, Qurʾān as guidance, not a technical manual, Qurʾān as a value-framework for modern life, Qurʾānic relevance in modern disciplines

6. **Understanding Holy Quran - II**
   Ethical coherence in professional life, Accountability in authority and expertise, AI ethics, data responsibility, research integrity, Corporate ethics and professional honesty, Fraud, manipulation, and misuse of authority

Elective Courses (12 Credit Hours):

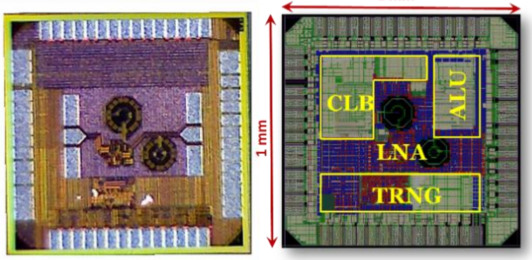
1. **Signal Integrity, Packaging and Chip Design:** Signal Integrity Principals, Chip interconnect and Transmission Lines, PCB and IC Materials, Impedance Matching, Power Distribution Network, Parallelism & Cross Talk. EMI and EMC, Reflections and Termination and IO Pads, On-Chip Passives, ESD Protection Management, IC and Discrete Component Packaging, Thermal Consideration, IC Failure and Reliability, Microsystems Packaging and Applications.
   Lab Tutorials: Impedance Matching using Lumped Model, Impedance Matching using Microstrip Model, EMC and TL Discontinuity Modeling and Simulation, Bond wire Modeling and Simulations, Power Distribution Network Modeling, Parallelism Transmission Line Modeling & Analysis, Crosstalk and Noise Analysis, EMI/EMC Interference Analysis, On-Chip Passives and Corner Analysis.

2. **RTL Synthesis, & Digital Backend:** Basics of HDL (Verilog) Coding. Synthesizable RTL, State Machine Design, HDL Testbench Design, RTL Code Compilation Scripts Development, Placement and Routing, Static Timing Analysis (STA), CLK Insertion, RISC-V for Embedded Systems. (03 credits)
   Lab Tutorials: Introduction to Verilog and Modelsim, State Machine Design, RTL Synthesis using Standard Cell Libraries, Place, Route, and Static Timing Analysis, Physical Layout using Cadence Genus, Innovus etc. Fullchip Physical Verification (DRC/LVS)

3. **IC Design Project: From Schematic to Chip Tapeout:** Project selection, Pre-study, and Floor planning, Schematic/HDL Capture, Architectural level, Gate/Transistor level, Synthesis and simulations, Pad Frame Selection and Design, Library Mapping and Optimization, Analog ad Digital Layout Strategies, DRC, Post-Layout Verifications, Back Annotations, Generation of Mask data-base for Chip-Layout, Final Tapeout. (03 credits)
   This is hand-on IC design course, which needs intensive LAB work.

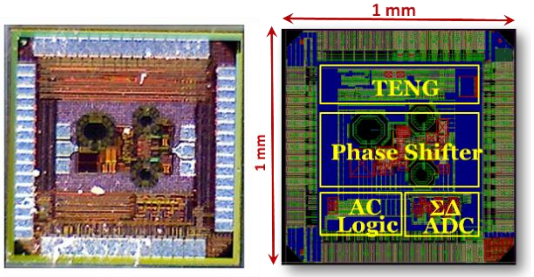
Taped out Projects Layout and Die Photographs

Kamal-1

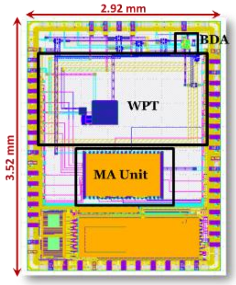


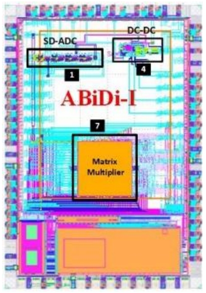
PICO 2021 TAPEOUTS: 3 Projects

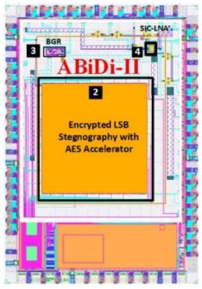
Kamal-2



PICO 2022 TAPEOUTS: 6 Projects







4. **VLSI Design Verification and Testing:** Understand the UVM hierarchies and various components needed to build a comprehensive UVM Testbench, Design and implement various testbench components, such as driver, monitor, sequencer, agent, environment, scoreboard, coverage, and environment, and understand the configuration databases, factory override, Transaction Level Modeling (TLM), understand virtual sequences and virtual sequencers and Building a framework for UVM Testbench. **(03 credits)**

5. **RF Integrated Circuits:** Basics Concepts of RF Electronics, Linearity (1dB CP and IIP3) and noise (Noise Figure) in radio circuits, High frequency model of the CMOS and BJT circuits, IC technology suitable for radio circuit design, Radio Standards, Radio Transceiver Architectures, Radio Transceiver Calculations, Transmission lines and impedance matching, Wideband and Narrow band design issues, Low Noise Amplifiers (LNAs), Active and Passive Mixers, Voltage Controlled Oscillators and Phase Lock Loops, Power Amplifiers. (03 credits)

6. **Advanced Microwave Engineering:** Introduction to microwave engineering, microelectronics device and device models, Transmission lines theory, reflection and transmission analysis, Microwave network analysis, impedance matching networks and tuning, wideband impedance matching issues microwave resonators, Power Dividers and directional couplers, Microwave filters and their implementation, Noise in microwave circuits, Microwave amplifier design, Microwave oscillators and mixers circuits. (03 credits)

7. **Advance Embedded Systems:** Basics of processor architectures. Memory organization and caches. Worst-Case Execution Time (WCET) Analysis, Compositional Timing Analysis for embedded systems, Embedded software platforms, Performance analysis, memory hierarchy, buses, peripherals, Wireless Sensor Networks, Internet of Things, Embedded systems platforms: MCUs, DSPs, GPU, FPGAs, Code optimization, Factors affecting Execution time, Multi-tasking and real-time operating systems, Scheduling algorithms and their performance. (03 credits)

8. **Advance Digital Signal Processing:** Introduction, Discrete-time Fourier transform (DTFT), Sampling & reconstruction, Fast Fourier transform (FFT), Using z-transform to represent linear time-invariant (LTI) systems, Digital filter design fundamentals, IIR, FIR and CIC filter design and implementation, DSP algorithm implementation issues and optimization, Linear prediction and optimal linear filters, Power spectrum estimations. (03 credits)
   Lab Tutorials/Class Project: Implementation of FIR, IIR or CIC comb filter on FPGA.

9. **Advanced Wireless Communication:** Introduction to Wireless & Mobile Communications, Propagation Models, Channel Models, Channel Sounding, Equalization, Transmission & Multiple Access techniques: OFDM/OFDMA, SC-FDMA etc., space-time coding (STC), BLAST architecture, massive MIMO, MIMO-OFDM transceiver design, Current Wireless Standards: IEEE 802.11n/ac WiFi, 4G mobile: 3GPP LTE, 3GPP LTE-, 5G RAN, Satellite Communications. (03 credits)

10. **IC Marketing and Business Management:** Trends in the IC business: Technology and manufacturing trends, Demand, applications and product trends. Market Appearances: The customers, overall Business cycles, The bull-whip effect), IC industry, supply & value chain, Geo distribution of Technology and fabrication centers, The dis-integration of the value chain, outsourcing trends, Managing the marketing function: The sources of product ideas, The role of standard and intellectual property, The strategic partnership, distributorship and matching supply with demand. (03 credits)

Feedback from Industry:

Farhat Jahangir (CEO, GSME Inc, USA):

We are pleased with our experience of the training of 93 Omani engineers one-year, which comprehensively covers the IC Design basics and includes invaluable tape-out experience. The training was a significant and ambitious undertaking, and we commend FAST-NUCES for their dedication and expertise in delivering such high-quality instruction. The skills and knowledge gained by the Omani engineers will undoubtedly play a key role in the continued development of the semiconductor industry in Oman.

The collaboration between GMSE and FAST-NUCES has been a very positive experience, and we truly appreciate the commitment to excellence demonstrated by all involved. We look forward to potential future collaborations and continued success in advancing the semiconductor industry.

Dr. Nasir (Deputy DG NECOP):

MS IC Design graduates from FAST-NU Islamabad campus are very professional and have good knowledge base in all domains (Digital, Analog, Mixed Signal and RF) of IC design. They have been trained using state of the art IC Design Tools. Having gone through the complete IC design and fabrication cycle during their MS through a tape out project using TSMC 65nm Technology has enhanced their confidence to take up real world IC Design projects. They are comfortably working with IC Design teams at NECOP giving valuable inputs. Their performance in the National IC Design Center at NECOP has enhanced our trust in home grown solutions for trained HR in the advanced field of IC Design. The level of their competence and confidence shows the quality of teaching and Lab work at NU FAST Islamabad campus in the field of IC Design.

Aziz ur Rehman (General Manger NECOP):

NECOP IC Design Fellows joined NIDC (NECOP) after completing their Master’s degree in EE with specialization in IC design from NUCES, FAST Islamabad. The fellows are serving in the fields of analog/mixed signals and digital IC design. They have a sound understanding of Integrated circuit design and relevant theory. During this period, they acquired hands-on experience on the industry standard IC design tools leading to the tape-out of chips (e.g. KAMAL-1, KAMAL-2). KAMAL-1 and KAMAL-2 includes Fault tolerant CLB, Approximate ALU, True random number generator, mm-Wave LNA, AC logics, sigma delta converters, tribo electric nano-generator and mm-Wave phase shifter projects respectively. The courses were specifically designed to provide the students with a strong knowledge of electronics and IC design skills.

Feedback from Alumni:

Jaffar Hussain (Fellow MS IC Design):

After bachelors I was looking for graduate program that can enhance my technical skills in practical domain. The Master program in IC Design at FAST provided me that opportunity. IC design is a field in which Pakistan need qualified human resource and this Master program at FAST is working towards it. This program is perfect for, Engineers seeking in-depth training from concept to tape-out in analog and digital IC design.

M. Usman (Fellow MS IC Design):

I have very unique experience while studying IC Design at FAST-NU. It was the only program of its kind in Pakistan, where I was able to learn IC design from scratch to tape out. The program offered me a variety of skills including; design, plan, management, economy, and art of designing practical circuits, that are much needed while designing real world chips. Definitely, it is a lot of work, but the experience worth it.

Hamza Saleem (Fellow MS IC Design):

All the faculty members at FAST are dedicated, passionate and supporting, especially Prof. Rashad Ramzan. He's more than a teacher for me. He changed the way of thinking, helped me develop my intuitions about design concepts. Besides, I remember the time when I asked a question to Dr. Hassan via WhatsApp message. He called me back and discuss the issue briefly. I did several meetings with faculty about Tape-out project and thesis and remember the positive criticism and highlighting the design issues from faculty. In a nutshell, I learnt several new concepts and developed design intuitions under the guidance of all faculty member. One thing I must say! After working with the faculty, if you put your whole effort too, you will be a practical Chip designer.

Our Alumni: