

# Md. Raisul Islam Rifat

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Chittagong, Bangladesh

## EDUCATION

### • Bachelor of Science in Electrical and Electronic Engineering

August 2025

Chittagong University of Engineering and Technology

- CGPA: 3.48 / 4.00;

### • Higher Secondary Certificate

May 2019

Chittagong College

- GPA: 5.00 / 5.00

### • Secondary School Certificate

March 2017

Nasirabad Govt. High School

- GPA: 5.00 / 5.00

## PUBLICATIONS

C=CONFERENCE, J=JOURNAL

- [J.1] **QSAC: Quantum-assisted Secure Audio Communication using Quantum Entanglement, Audio Steganography, and Classical Encryption.** (*Published in Engineering Science and Technology, an International Journal [Q1, IF: 5.4]. Article reference: <https://doi.org/10.1016/j.jestch.2025.102167>*)  
*Md. Raisul Islam Rifat, Md. Mizanur Rahman, Md. Abdul Kader Nayon, Md Shawmoon Azad and M.R.C. Mahdy.*
- Designed a novel scheme of secure audio communication by incorporating **E-91** Quantum Key Distribution with **SHA-3** Hashing Algorithm, **ChaCha20-Poly1305 AEAD** and **LSB** steganography.
  - Implemented **entanglement-based** key generation with SHA-3 hashing and validated security using the **CHSH** inequality to detect eavesdropping.
  - Engineered an LSB-based audio steganography module to **embed** and reliably **extract** secret audio while maintaining **audible imperceptibility** through constrained sample-level modification.
  - Achieved high cryptographic robustness, demonstrating near-maximum **entropy (15.9984)**, high **UACI (49.9977%)** and **NSCR (99.9985%)**, and low **correlation ( $1.4627 \times 10^{-5}$ )** in encrypted audio signals.
  - Ensured **end-to-end confidentiality, integrity, and authenticity** through authenticated encryption and steganographic concealment.
- [J.2] **Detection of Hallucination in Multimodal Large Language Models Across the Modalities: A Comprehensive Review.** (*In Preparation.*)  
*Md. Mizanur Rahman, Md. Raisul Islam Rifat.*
- Systematically analyzed **hallucination detection benchmarks for multimodal LLMs** across **text, image, audio, and video**, identifying critical gaps in existing literature related to audio and video modalities.
  - Developed a novel taxonomy to categorize and analyze over **50 benchmarks**, including over **10 benchmarks** for audio and video addressing a critical gap in existing literature, focusing on text and image hallucinations.
  - Compiled and analyzed key benchmarks attributes (e.g. dataset size, task type, evaluation metrics) across **4 detailed tables**, facilitating direct comparison and offering researchers valuable insights to guide the development of more robust MLLMs and effective mitigation strategies
- [C.1] **Design of a Negative Refractive Index THz Metamaterial Biosensor For Cancer Cell Detection.**  
(Accepted and presented at **EICT, 2025**. Published in IEEE Xplore (<https://doi.org/10.1109/EICT68394.2025.11355514>))  
*Md. Abdul Kader Nayon, Md. Raisul Islam Rifat, Nipa Dhar.*
- Designed a **non-invasive Biosensor** capable of detecting **Cancer Cells** by utilizing the **Negative Refractive Index of Double Negative Metamaterials** in the **THz** region.
  - Conducted full-wave **THz electromagnetic simulations** of the biosensor made up of **rectangular, orthogonal SRRs** on an **FR4 substrate** in **CST Microwave Studio (0.5–2.0 THz)**.
  - Retrieved and analyzed **effective constitutive parameters** ( $\epsilon_{\text{eff}}, \mu_{\text{eff}}, n_{\text{eff}}$ ), confirming **simultaneous negative permittivity and permeability** over the **0.6–1.8 THz** band.
  - Quantified biosensing performance via **resonance shift, sensitivity ( $\leq 0.4125 \text{ THz/RIU}$ ), Q-factor ( $\leq 12.64$ )**, and **Figure of Merit ( $\leq 3.30$ )**.
  - Demonstrated **cell-type discrimination** (normal vs. cancerous cervical, blood, breast, and skin cells) through **spectral redshift and refractive index analysis**.

## RESEARCH EXPERIENCE

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### • Photonic Implementation and Security Analysis of MDI-QKD

2025-Ongoing

*Supervisor: Dr. Md. Istiaque Reja, Associate Professor, Department of EEE, Chittagong University of Engineering and Technology.*

- Conducting a research on photonic Measurement-Device-Independent Quantum Key Distribution (MDI-QKD), focusing on optical system modeling, security assumptions, and mitigation of detector-side-channel attacks, with particular emphasis on multi-party and extended MDI-QKD schemes through analytical modeling and simulation.

### • Familiarization with Quantum Computing, Quantum Key Distribution & Post-quantum Cryptography.

2024-2025

*Supervisor: Dr. Mahdy Rahman Chowdhury, Professor, Department of ECE, North South University.*



- Learned about Quantum Matrix Mechanics and implemented BB84, B92 and E91 Quantum Key Distribution protocols as well as Quantum-safe Cryptography schemes such as Lattice-based cryptography using QISKit SDK.

### • Design of a Negative Refractive Index THz Metamaterial Biosensor for Cancer Cell Detection

2024-2025

*Supervisor: Nipa Dhar, Assistant Professor, Department of EEE, Chittagong University of Engineering and Technology.*



- Learned about the Negative Refractive Index property of metamaterials and attempted to implement this property in THz frequency range using CST Microwave Studio.

## INTERNSHIP EXPERIENCE

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### • Bangladesh Telecommunications Company Ltd. (BTCL)

24th November, 2024 - 12th December, 2024

*BTCL Regional Exchange, Nandankanan, Chittagong*



- Participated in a 15-day long internship training program hosted by BTCL as part of the academic curriculum.
- Studied carrier-grade telecommunication systems, including PSTN and GPON-based access networks, and IMS-controlled voice transmission architecture.
- Analyzed national internet service infrastructure, covering IIG-BRAS-AAA workflow, cache and NIX servers, and router-switch hierarchy in ISP operations.
- Gained exposure to optical transmission technologies, including PDH/SDH/DWDM systems, single-mode vs multimode fiber, and wavelength windows used in long-haul communication.

## KEY PROJECTS

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### • Design and Deployment of a Self-Hosted, Containerized Service Infrastructure.

2022-Ongoing

*Tools: Docker, Docker Compose*



- Designed and maintaining a **Docker Compose-based homelab** hosting 25+ containerized services across networking, security, media, and productivity domains.
- Implemented **reverse proxy-based internal routing** and **private DNS infrastructure** using Pi-hole and Unbound to minimize attack surface.
- Deployed **secure secrets management** and access control for internal services using Vaultwarden and environment-based configuration.
- Automated service lifecycle management and updates using Portainer and Watchtower.
- Emphasized **reproducibility and documentation**, publishing sanitized configurations, architecture diagrams, and operational screenshots.
- Built the system as **private-by-default**, with no public IP exposure or port forwarding.

### • Implementation of Neural Reasoning Models from First Principles

2025-Ongoing

*Tools: Python, PyTorch*



- Forked and explored Sebastian Raschka's *reasoning-from-scratch* project to study **neural reasoning mechanisms** beyond standard language modeling.
- Implemented **reasoning-oriented model components**, focusing on structured computation, intermediate representations, and step-wise inference behavior.
- Analyzed the **limitations of end-to-end learning** for reasoning tasks and explored architectural design choices that influence reasoning performance.
- Conducted controlled experiments to observe how model structure affects **generalization and reasoning depth**.
- Maintained a focus on **educational and research-oriented experimentation**, prioritizing transparency and interpretability.

### • Implementation and Analysis of Large Language Models from First Principles

2024

*Tools: Python, PyTorch, NumPy*



- Forked and **systematically studied** Sebastian Raschka's *LLMs-from-scratch* implementation to understand transformer architectures from foundational components.
- Implemented and analyzed **core LLM building blocks**, including tokenization, embeddings, self-attention, positional encoding, and transformer blocks.
- Experimented with **training dynamics**, loss behavior, and scaling considerations using small-scale models for educational and research-oriented analysis.
- Extended and modified code to **improve clarity, modularity, and experimentation**, focusing on interpretability rather than performance optimization.

- **Design and Implementation of a PIC Microcontroller-Based Capacitance Measurement System.** 2023  
Tools: MikroC Pro, PICKit, Proteus
  - Developed a **digital capacitance meter** using the **PIC16F628A** microcontroller, capable of measuring capacitors in the **1 nF** to **1 µF** range, leveraging built-in analog comparators and TIMER2 module for precise measurements.
  - Implemented a method to **charge a capacitor through a series resistor** and calculate capacitance based on the **time to reach a defined voltage threshold**.
  - Verified functionality through **simulation on Proteus** and fabricated a **PCB prototype**, demonstrating practical system integration.
  - Evaluated the system's **accuracy** and **reliability**, providing a cost-effective and versatile tool for electronic testing and educational purposes.
- **Design and Performance Analysis of a Medium-Voltage Three-Phase Distribution Transformer.** 2023  
Tools: AutoCAD Electrical, MATLAB
  - Designed a 470 kVA, 6.6 kV/415 V, 3-phase, 50 Hz distribution transformer with high-voltage tap settings of  $\pm 2.5\%$  and  $\pm 5\%$  and self-oil cooling (Oil Natural Air Natural(ONAN)).
  - Ensured **temperature rise over oil below 60°C** and **load loss limited to 6 kW**, meeting design specifications.
  - Calculated **percentage impedance ( $\%Z = 4.5\%$ )**, and evaluated **efficiency at full load, 75% load, and 50% load** under unity power factor.
  - Assessed **voltage regulation at full load** for both **unity** and **0.8 lagging power factor**, verifying reliability.
  - Integrated **electrical and thermal design considerations** to develop a practical, functional distribution transformer suitable for power distribution applications.
- **Design and Implementation of an Optical Heart Rate Monitoring System using Atmel microcontroller.** 2022  
Tools: Arduino, C++, Proteus
  - Designed and implemented a **ATmega328P microcontroller-based biomedical monitoring system** for real-time heart rate (BPM) measurement using **photoplethysmography (PPG)** principles.
  - Developed an **end-to-end sensing pipeline** using the **MAX30102 pulse sensor** and **Arduino Uno**, including signal acquisition, basic conditioning, and BPM computation.
  - Performed **software-level validation and debugging** through **Proteus simulation**, integrating Arduino firmware and virtual instrumentation (LCD and oscilloscope outputs).
  - Implemented a **hardware prototype on PCB**, integrating sensor, display, power management, and alert components into a compact embedded system.
  - Gained early exposure to **biomedical instrumentation, embedded systems, and experimental validation**, forming a foundation for later research-oriented coursework and projects.

## RELEVANT COURSEWORK

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- **Quantum Computing & Quantum Information:** Quantum Information Theory; Quantum Computing (Matrix Mechanics-Based Formalism); Quantum Algorithms; Quantum Communication; Quantum Key Distribution; Post-Quantum Cryptography; QISKit-Based Quantum Simulation. (*Private Research Thesis Course, Mahdy Research Academy; supervised by Dr. Mahdy Rahman Chowdhury — completed first half with >80% performance*).
- **Mathematics & Theoretical Foundations:** Differential and Integral Calculus; Differential Equations; Linear Algebra & Matrices; Vector Calculus & Complex Variables; Engineering Statistics.
- **Core Electrical & Electronic Engineering:** Electrical Circuits I-II; Electromagnetic Field Theory; Signals and Systems; Control Systems; Semiconductor Physics and Devices.
- **Electronics, Devices & VLSI:** Electronics I-II; Digital Electronics; Microprocessor and Interfacing; VLSI Technology; Power Electronics.
- **Communication, RF & Photonics:** Electronic Communication; Telecommunication Engineering; Microwave and Antenna Engineering; Optoelectronics (*Elective*).
- **Power Systems & Energy Engineering:** Electrical Machines I-II; Power Transmission and Distribution; Power System Analysis; Switchgear and Protection; Power Stations; Renewable Energy Conversion (*Elective*).
- **Interdisciplinary Systems:** Biomedical Instrumentation (*Elective*).
- **Computing & Numerical Methods:** Computing Methods for Engineering Analysis; Object-Oriented Programming; Digital Signal Processing; Numerical Methods.

## UNDERGRADUATE THESIS

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- **Design of a Negative Refractive Index THz Metamaterial Biosensor for Cancer Cell Detection** 2024-2025  
Supervisor: Nipa Dhar, Assistant Professor, Department of EEE, Chittagong University of Engineering and Technology
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## SKILLS

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- **Programming Languages:** C, C++, C#, Python, Assembly, Verilog.
- **Quantum SDKs:** QISKit, QRISPr.
- **Data Science & Machine Learning:** NumPy, Pandas, Matplotlib, Scikit-Learn, TensorFlow, Keras.
- **VLSI Design Tools:** Cadence, LTSpice, ModelSim.
- **Operating System:** Arch Linux, Ubuntu, Debian, Linux Mint, Windows.
- **Other Tools & Technologies:** MATLAB, Multisim.

## CERTIFICATION

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• <b>IQM Quantum School Certificate</b> <i>IQM Quantum Computers</i>	2nd December, 2025– 4th December, 2025 []
• <b>Digital Design for Industrial Control</b> <i>Enhancing Digital Government and Economy (EDGE) Project of Bangladesh Computer Council, ICT Division</i>	2024-2025 []
• <b>Networking Basics</b> <i>Cisco Networking Academy</i>	2025 []
• <b>Introduction to Cybersecurity</b> <i>Cisco Networking Academy</i>	2025 []
• <b>Introduction to Packet Tracer</b> <i>Cisco Networking Academy</i>	2025 []

## AWARDS

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- **Education Board Scholarship**  
*Board of Intermediate & Secondary Education, Chittagong* Chittagong, Bangladesh
  - Received General Grade Scholarship in Secondary School Certificate (2017-2019).
  - Received General Grade Scholarship in Higher Secondary Certificate (2019-2025).

## LANGUAGE PROFICIENCY

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- **English:** IELTS Overall Band Score: 8.0 (Listening: 9.0; Reading: 9.0; Writing: 7.0; Speaking 7.0) – CEFR level: C1
- **German:** CEFR level: A1
- **Bengali:** Native Language

## REFERENCES

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Nipa Dhar Assistant Professor, Department of EEE, CUET, Chittagong Supervisor - Undergraduate Thesis Email: <a href="mailto:nipa@cuet.ac.bd">nipa@cuet.ac.bd</a> Google Scholar	Dr. Mahdy Rahman Chowdhury Professor, ECE Department, North South University, Dhaka Supervisor - Research Project ( <i>Quantum Computing</i> ) Email: <a href="mailto:mahdybuet@gmail.com">mahdybuet@gmail.com</a> Google Scholar
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Associate Professor, Department of EEE,  
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Supervisor – Research Project (*Quantum Photonics*)  
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