# CV *of* Dr. Mohammad Abu Sayem Karal

**NATIONALITY:** Bangladeshi
**DATE OF BIRTH:** 10th December 1980


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| **CONTACT INFORMATION** | Professor, Department of Physics<br>Bangladesh University of Engineering and Technology (BUET)<br>Dhaka, Bangladesh | Cell: 01712863844<br>Tel: +880-2-9665613 (off)<br>Fax: +880-2-58613046<br>E-mail: asayem221@phy.buet.ac.bd E-mail: asayem221@yahoo.com<br>http://asayem221.buet.ac.bd/ |


**Research:** Biophysics, Biomaterials, Nerve conduction, Bioimpedance

**Education**

- Doctor of Philosophy (PhD) 2015

Biophysics, Graduate School of Science and Technology, Shizuoka University, JAPAN

- Master of Philosophy (MPhil) 2011

Materials Sciences, Department of Physics, BUET

- Master of Science (MS) 2002 (held in 2005)

Bio-Medical Physics, Department of Physics, University of Dhaka *Result:* First class First

- Bachelor of Science (BSc) 2001 (held in 2004)

Department of Physics, University of Dhaka, *Result:* First class Ninth

**Principal Investigator & Founder**
Biophysics Research Laboratory, Department of Physics, BUET

**Professional Carrier**

- Professor [December 20, 2020 to date]
- Associate Professor [March 12, 2018 – December 19, 2020]
- Assistant Professor [Dec 28, 2011 – March 11, 2018]
- Lecturer [Feb 18, 2008– Dec 28, 2011]

Department of Physics, BUET

**Teaching:** Undergraduate and Graduate Levels in BUET
*Part time teaching experience:*

- Department of Civil & Environmental Engineering, Islamic University of Technology (IUT), Gazipur

**Contribution to the University**
Teaching, research, and administration

**Publications**
Text Book: 01, Peer reviewed journals: 60, Peer reviewed proceedings: 16, Abstracts in conferences presentations: 142

| NUMBER OF TOTAL RESEARCH PUBLICATIONS | NUMBER OF PUBLICATIONS IN LOCAL/ NATIONAL JOURNALS | NUMBER OF PUBLICATIONS IN INNATIONAL JOURNALS | NUMBER OF PUBLICATIONS IN Q1 & Q2 JOURNALS | CITATIONS IN GOOGLE SCHOLAR |
|---|---|---|---|---|
| 60 | 6 | 54 | 27 & 21 | 1439 |

**Supervision**

- Research Assistant supervised (Biophysics Research Lab, BUET): 06
- M.Sc. student supervised (Department of Physics BUET): 15
- M.Sc. student co-supervised (Public Universities): 04
- M.Sc. student supervising (Department of Physics BUET): 05
- M.Phil. student supervised (Department of Physics BUET): 02
- M.Phil. student supervising (Department of Physics BUET): 02
- Ph.D. student supervising (Department of Physics BUET): 05

*List of supervised M.Sc. students and the date of their degree offered from the Department of Physics, BUET:*

- Mir Jubair Ahamed (0423142501) 12 November, 2025
- Zarin Tasnim Rakhy (0423142504) 09 November, 2025
- Md. Moniruzzaman (0421142509), 18 November, 2023
- Md. Abdul Wadud (0421142507), 07 November, 2023
- Sharif Hasan (0419142503), 26 November, 2022
- Salma Akter (0419142501), 29 October, 2022
- Md. Towhiduzzaman (1018142514), 26 June, 2021
- Urbi Shyamolima Orchi (1018142513), 19 June, 2021
- Shareef Ahammed (1017142501), 10 December, 2019
- Md. Kamrul Islam (1017142503), 08 December, 2019
- Marzuk Ahmed (0417142513), 27 July, 2019
- Md. Kabir Ahamed (0417142511), 23 July, 2019
- Mostafizur Rahman (0417142519), 20 July, 2019
- Mohammad Moniruzzaman (0416142503), 04 September, 2018
- Shamor Kanti Roy (0416142507), 25 July, 2018

*List of supervised M.Phil. students and the date of their degree offered from the Department of Physics, BUET*

- Tawfika Nasrin (0419143001), 18 December, 2021
- Nadia Akter Mokta (1018143002), 31 July, 2021

*List of supervised Ongoing P.hD. students from the Department of Physics, BUET*

- Nazia Ahmed (0423144005) Comprehensive exam held in 24 September, 2025
- Rajia Sultana (0422144002) Comprehensive exam held in 29 October, 2025
- Tawfika Nasrin (0422144003) Comprehensive exam held in 28 May, 2025
- Malay Kumar Sarkar (1018144003) Comprehensive exam held in 07 August, 2021
- Sabrina Sharmin (0418144004) Comprehensive exam held in 03 April, 2021

**Publication Incentive from BUET for publishing Q1 journals**
Obtained publication incentive several times for publishing high quality peer reviewed journals.

**Experience in implementing project/research**

**TOTAL AMOUNT RECEIVED = 1,65,62,347/- TAKA**

| TITLE OF THE PROJECT/ RESEARCH ACTIVITY | DONOR/ SOPNSOR | POSITION IN THE PROJECT | YEAR FROM TO | AMOUNT (TAKA) |
|---|---|---|---|---|
| Biophysical insights into cell damage mechanisms induced by silver and magnetite nanoparticles for biomedical applications | Ministry of Science and Technology | Principal Investigator | July 2025 – June 2026 | 750000 |
| Electric field induced rupture kinetics of cell like vesicles and determination of pore edge tension using Arrhenius equation | CASR, BUET | Principal Investigator | July 2023 – June 2024 | 531447 |
| Basic Research Grants | BUET | Principal Investigator | July 2023 – June 2025 | 300000 |
| Frequency-dependent rupture, fusion and deformation of lipid vesicles using electroporation for biomedical applications | Ministry of Education | Principal Investigator | July 2022 – June 2025 | 1460000 |
| Development of electro- mechanical technique for probing the single cell-like lipid vesicles for biomedical application | Ministry of Science and Technology | Principal Investigator | July 2021 – June 2024 | 950000 |
| Development of the irreversible electroporation and micropipette aspiration techniques for rupturing the vesicles with the aim of cancer cell destruction | ICT Division | Principal Investigator | July 2021 – June 2022 | 1000000 |
| Effects of membrane potential on the magnetite nanoparticles induced deformation and poration in cell-mimetic lipid vesicles for biomedical application | UGC | Principal Investigator | July 2021 – June 2022 | 300000 |
| Static and dynamic responses of cell like vesicles to magnetite nanoparticles under various concentrations of cholesterol in membranes for biomedical applications | CASR, BUET | Principal Investigator | July 2021 – June 2022 | 576400 |
| Basic Research Grants | BUET | Principal Investigator | July 2021 – June 2023 | 200000 |
| Effects of cholesterol on the irreversible electroporation (IRE) induced rupture of cell like vesicles for biomedical application | CASR, BUET | Principal Investigator | July 2020 – June 2021 | 684500 |
| Shape change and pore formation in cell like vesicle using eco-friendly synthesized nanoparticles for antibacterial application | UGC | Principal Investigator | July 2020 – June 2021 | 300000 |
| Irreversible electroporation induced rate constant of pore formation in the lipid membranes of vesicles for biomedical application | Ministry of Science and Technology | Principal Investigator | July 2019 – June 2021 | 1000000 |
| Investigation of nanoparticles- induced shape change and pore formation in the lipid membranes of vesicles for antibacterial application | Ministry of Education | Principal Investigator | July 2019 – June 2022 | 1300000 |

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|---|---|---|---|---|
| Mechanism of nanoparticles- induced pore formation in lipid membranes of vesicles | The World Academy of Science (TWAS), Italy | Principal Investigator | July 2019 – June 2021 | 1430000 |
| Investigation of pore formation in lipid membranes of giant unilamellar vesicles (GUVs) using electroporation for the possible application in cancer cell ablation | Ministry of Science and Technology | Principal Investigator | July 2016 – June 2019 | 1700000 |
| Development of a microcontroller- based electroporation technique for the study of pore formation in artificial nano membranes targeting cancer cell ablation | ICT Division | Principal Investigator | July 2019 – June 2021 | 1650000 |
| Synthesis of artificial membranes for the possible application in cancer cell destruction and antibacterial effect examination | Ministry of Education | Principal Investigator | July 2017 – June 2019 | 1500000 |
| Study of pore formation in lipid membranes using electroporation for possible application in cancer cell ablation | CASR, BUET | Principal Investigator | July 2017 – June 2018 | 670000 |
| Water spinach leaf extract mediate green synthesis of magnetite nanoparticles and its antibacterial application | UGC | Principal Investigator | July 2017 – June 2018 | 260000 |

**Awards, Fellowships and Honors**

- Guest Associate Professor, Shizuoka University, Japan (April 2017 – March 2019).
- Guest Associate Professor, Shizuoka University, Japan (Nov. 2015 – March 2017).
- Japan Government Scholarship (Monbukagakusho) for PhD study (Oct 2012 – Sept 2015)
- Prize for 1$^{st}$ class 1$^{st}$ in MS from University of Dhaka (2002)
- Scholarship for undergraduate result, University of Dhaka (2001)
- Fazlul Haque Hall scholarship, University of Dhaka (1999)

**Administrative Works**

- Provost, Titumir Hall, BUET (25 September 2021 to 18 August 2024)
- Moderator, Sotyan Bose Science Club, BUET (October 2021 to date)
- Assistant Provost, Kazi Nazrul Islam Hall, BUET (May 2016 to September 2011)
- BPGS Secretary, Department of Physics, BUET (March 2018 to September 2020)
- BUGS Secretary, Department of Physics, BUET (November 2015 to March 2018)

**Memberships**

- Student Member, Japan Biophysical Society [2013 - 2016]
- Life Member, Bangladesh Medical Physics Association (BMPA)
- Life Member, Bangladesh Physical Society (BPS)
- Life member, Bangladesh Academy of Advancement and Science (BAAS)
- Life Member, Dhaka University Alumni Association (DUAA)
- Life Member, Registered Graduate, University of Dhaka, Bangladesh
- Member, BUET Alumni Association
- Member, UNESCO Club Association, Bangladesh

**Teaching Courses//Undergraduate Lectures:**

[1] Geometrical Optics [2] Physical Optics [3] Modern Physics [4] Sound

[5] Heat and Thermodynamics [6] Electricity and Magnetism [7] Waves and Oscillations [8] Waves Mechanics [9] Laboratory Classes

**Postgraduate Lectures:**
[1] Medical Physics [2] Radiation Biophysics [3] Health Physics [4] Nuclear Physics [5] Physics of Radiology [6] Advanced Biophysics

**Examiners**
1) Department of Physics, Department of Theoretical Physics, Department of Biomedical Physics and Technology, University of Dhaka 2) Department of Physics, Department of Environmental Sciences, Jessore Science and Technology University, Jessore 3) Department of Physics, Jagannath University, Dhaka 4) Department of Physics, Barisal University, Barishal

**Laboratory Development**
After doing my Ph.D. degree in Bioscience from Japan, I returned to the Department and set-up a Biophysics Research Laboratory in the Department of Physics, BUET. At first, I have to manage a space in the Department and then managed some financial supports for its infrastructure development from BUET authority. So far, I have found several research grants for the development of research facilities from different organizations. Currently, I am working as a Group Leader of Biophysics Research Laboratory in BUET.

**Syllabus Development**
- A syllabus for the Biophysics theory course was designed for the postgraduate studies in the Department of Physics, BUET. The course has been approved by the faculty of Engineering, BUET. Now it is waiting for the approval of Academic Council of BUET.
- As a Secretary of Board of Undergraduate Studies (BUGS) of the Department of Physics, BUET, I have actively worked for the preparation of revised syllabus of Physics theory and sessional courses (total 5 courses) offered by the Department of Materials and Metallurgical Engineering (MME), BUET.

**Reviewer in Scientific Journals**
- Bioinformatics Advances [Oxford University Press]
- European Biophysics Journal [Springer Nature]
- Scientific Reports [Nature publishing]
- Bangladesh Journal of Physics
- Dhaka University Journal of Sciences

**Other Activities**
- Chair, Workshop on Biophysics, Funded by BANBEIS, Ministry of Education (28 June 2024)
- Local Subject Expert, External Peer Review Team (EPRT) on Quality Assurance (QA) aspects of the Department of Biomedical Physics and Technology, University of Dhaka, Bangladesh of duration 11-13 December, 2017. The team comprised of Foreign QA Expert, Local QA Expert and Local Subject Expert
- External member, Tender Evaluation Committee, Department of Biomedical Physics and Technology, University of Dhaka.
- Member, Academic Council, BUET.
- Member, Faculty of Engineering, BUET
- Member, Board of Undergraduate Studies (BUGS), Department of Physics, BUET.
- Member, Board of Postgraduate Studies (BPGS), Department of Physics, BUET
- Examiner and Scrutinizer in undergraduate examinations.
- Examiner and Scrutinizer in postgraduate examinations.
- Examiner and Scrutinizer for the Undergraduate Admission Test in several years.

- Coordinator, Undergraduate Admission Test, BUET, FY 2023-2024
- Members, Executive Committee, BUET Teacher's Association, FY 2024

**Research Collaborators**

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| [1] Dr. Victor Levadnyy<br>Senior Scientist<br>Theoretical Problem Center of Physico-Chemical Pharmacology<br>Russian Academy of Sciences<br>Moscow 117977, Russia<br>Email: levadny@commgroup.ru | [4] Dr. Khondker Siddique-e Rabbani<br>Honorary Professor<br>Department of Bio-Medical Physics & Technology<br>University of Dhaka, Bangladesh<br>Tel: +88-02-9661920-73 (Ext.7011, 7001), +88-01817022834 (cell)<br>Email: ksrabbani@gmail.com |
| [2] Dr. Marina Belaya<br>Professor, Department of Mathematics<br>Russian State University for the Humanities<br>Moscow GSP-3 125993, Russia<br>Email: Mbelaya@mail.ru | [5] Dr. Zaid Bin Mahbub<br>Associate Professor<br>Department of Mathematics and Physics<br>North South University, Dhaka-1229, Bangladesh<br>Email: zaidbin@gmail.com |
| [3] Dr. Masahito Yamazaki<br>Professor, Department of Bioscience<br>Graduate School of Science and Technology<br>Shizuoka University, Japan<br>Email: spmyama@ipc.shizuoka.ac.jp | [6] Dr. Md. Masum Billah<br>Assistant Professor<br>Department Physics<br>Jashore University of Science and Technology, Jashore 7408, Bangladesh<br>Email: mm.billah@just.edu.bd |

**Language skills** English (Fluent), Japanese (Simple communications)

**Country visit:** Japan, Italy, Nepal

**PUBLICATIONS:**
**Text BOOK:**
[1] Name of author: Dr. Mohammad Abu Sayem Karal
Name of the Book: Biomedical Physics
Course content: Undergraduate final year and Postgraduate level
Written language: Bengali
Publication date: Publish from Prothoma (published January 2019)
(A publishing company of Prothom Alo, Bangladesh)

## Peer Reviewed Journals [Impact Factor = I.F.]

[60] Shah Sajnin Anna, Shahariar Emon, Md. Asaduzzaman, Shovon Saha, Md. Atikur Rahman, Mohammad Abu Sayem Karal, Md Lokman Hossen, Samiron Kumar Saha, Hiromitsu Takaba, Md. Akhtaruzzaman & Md. Khorshed Alam; Simulation of intracellular delivery through permeabilized multivesicular vesicles; European Biophysics Journal (Springer Nature), (2026). [I.F. 2.4]

[59] Md. Tariqul Islam Bhuiyan, Mir Jubair Ahamed, Rajia Sultana, Tawfika Nasrin, Md. Kabir Ahamed, Md. Masum Billah & Mohammad Abu Sayem Karal; Electric field-induced rupture kinetics

of giant unilamellar vesicles with varying gramicidin A content in membrane; PLoS ONE (PLOS) 21(1): e0338817 (2026). [I.F. 3.7]

[58] Zarin Tasnim Rakhy, Tawfika Nasrin, Mir Jubair Ahamed, Md. Masum Billah, Md. Wahadoszamen, Aminul I. Talukder, Mohammad Abu Sayem Karal; Effects of silver nanoparticles on the morphology and membrane permeability of giant unilamellar vesicles and their mechanistic insights; Chemistry and Physics of Lipids (Elsevier) 274, 105564 (2026) [I.F. 3.570]

[57] Malay Kumar Sarkar, Md. Atikur Rahman, Tawfika Nasrina and Mohammad Abu Sayem Karal; Electroporation in lipid vesicles by varying PEG-grafted lipids in their membranes: an experimental and simulation study; RSC Advances (Royal Society of Chemistry), 15, 43891-43904 (2025). DOI: 10.1039/D5RA03862F [I.F. 4.6]

[56] Sabrina Sharmin, Mohammad Abu Sayem Karal, Zaid Bin Mahbub, Khondkar Siddique-e Rabbani; Effect of stretch on conduction in myelinated nerve due to wrist movement: An experimental and analytical study; PLoS ONE (PLOS) 20(10): e0333925 (2025). [I.F. 3.7] [Click here]

[55] Shahariar Emon, Al Amin, Md. Hossain, Shovon Saha, Md. Asaduzzaman, Md Lokman Hossen, Mohammad Abu Sayem Karal, Hiromitsu Takaba & Md. Khorshed Alam; Optimizing electroporation via pulse modulation: a molecular dynamics study; European Biophysics Journal (Springer Nature), (2025) [I.F. 2.4]

[54] Mir Jubair Ahamed, Tawfika Nasrin, Zarin Tasnim Rakhy, Md. Masum Billah, Mohammad Abu Sayem Karal; Effect of gramicidin A on the constant tension-induced rupture of giant unilamellar vesicles and the underlying mechanisms; Chemistry and Physics of Lipids (Elsevier) 105525 (2025) [I.F. 3.570]

[53] Thuhedur Rahman, Md. Asaduzzaman, Shahariar Emon, Md. Imran Hossain, Md. Saif Ishtiaque, Mohammad Abu Sayem Karal, Md. Masum Billah, Hiromitsu Takaba & Md. Khorshed Alam; Molecular transport by varying the size of nanopore in the membrane of guv using simulation; Applied Biological Research (Centre for Advancement of Applied Sciences) 27(2), 223-233 (2025) [I.F. 0.2]

[52] Nazia Ahmed, Tawfika Nasrin, Mohammad Abu Sayem Karal; Exploring the dynamics of a single vesicle induced by Fe3O4 nanoparticles using micropipette manipulation; PLoS ONE (PLOS) 20(7): e0327639 (2025). [I.F. 3.7]

[51] Md. Asaduzzaman, Shahariar Emon, Md. Saif Ishtiaque, Md. Imran Hossain, Mohammad Abu Sayem Karal, Md. Masum Billah, Hiromitsu Takaba & Md. Khorshed Alam; Molecular transport through nano-sized multipores of lipid vesicles: a COMSOL simulation study; European Biophysics Journal (Springer Nature), 54, 159–169 (2025). [I.F. 2.4]

[50] Mohammad Abu Sayem Karal, Md. Masum Billah, Tawfika Nasrin, and Md. Moniruzzaman; Interaction of anionic $Fe_3O_4$ nanoparticles with lipid vesicles: A review on deformation and poration under various conditions; RSC Advances (Royal Society of Chemistry -RSC), 14, 25986 (2024) [Q1, I.F. 3.9]

[49] Md. Tariqul Islam Bhuiyan, Mohammad Abu Sayem Karal, Urbi Shyamolima Orchi, Nazia Ahmed, Md. Moniruzzaman, Md. Kabir Ahamed, and Md. Masum Billah; Probability and kinetics of

rupture and electrofusion in giant unilamellar vesicles under various frequencies of direct current pulses; PLoS ONE (PLOS) 19(6): e0304345 (2024) [Q1, I.F. 2.9]

[48] Mohammad Abu Sayem Karal, Md. Masum Billah, and Md. Kabir Ahamed; Determination of pore edge tension from the kinetics of rupture of giant unilamellar vesicles using the Arrhenius equation: Effects of sugar concentration, surface charge and cholesterol; Physical Chemistry Chemical Physics (PCCP), (Royal Society of Chemistry - RSC), 26, 6107-6117 (2024) [Q1, I.F. 3.3]

[47] Mohammad Abu Sayem Karal, Md. Masum Billah, Marzuk Ahmed, and Md. Kabir Ahamed; A review on the measurement of the bending rigidity of lipid membranes; Soft Matter (Royal Society of Chemistry - RSC), 19, 8285-8304 (2023) [Q1, I.F. 3.4]

[46] Md. Abdul Wadud, Mohammad Abu Sayem Karal, Md. Moniruzzaman, Md. Mamun Or Rashid; Effects of membrane potentials on the electroporation of giant unilamellar vesicles; PLoS ONE (PLOS), 18(9): e0291496 (2023) [Q1, I.F. 2.9]

[45] Md. Moniruzzaman, Mohammad Abu Sayem Karal, Md. Abdul Wadud, Md. Mamun Or Rashid; Increase in anionic $Fe_3O_4$ nanoparticle-induced membrane poration and vesicle deformation due to membrane potential – an experimental study; Physical Chemistry Chemical Physics (PCCP), (Royal Society of Chemistry - RSC), 25, 23111-23124 (2023). [Q1, I.F. 3.3]

[44] Mohammad Abu Sayem Karal, Sharmin Sultana, Md. Masum Billah, Md. Moniruzzaman, Md. Abdul Wadud, R. C. Gosh; Effects of polyethylene glycol-grafted phospholipid on the anionic magnetite nanoparticles-induced deformation and poration in giant lipid vesicles; PLoS ONE (PLOS), 18(7): e0289087 (2023) [Q1, I.F. 2.9]

[43] Sabrina Sharmin, Mohammad Abu Sayem Karal, Zaid Bin Mahbub, and Khondkar Siddique-e Rabbani; Increase in conduction velocity in myelinated nerves due to stretch – an experimental verification; Frontiers in Neuroscience (Frontiers), 17, 1084004 (2023) [Q2, I.F. 3.2]

[42] Salma Akter, Mohammad Abu Sayem Karal, Sharif Hasan, Md. Kabir Ahamed, Marzuk Ahmed, and Shareef Ahammed; Effects of cholesterol on the anionic magnetite nanoparticles-induced deformation and poration of giant lipid vesicles; RSC Advances (Royal Society of Chemistry), 12, 28283-28294 (2022) [Q1, I.F. 3.9]

[41] Sharif Hasan, Mohammad Abu Sayem Karal, Salma Akter, Marzuk Ahmed, Md. Kabir Ahamed, and Shareef Ahammed; Influence of sugar concentration on the vesicle compactness, deformation and membrane poration induced by anionic nanoparticless; PLoS ONE (PLOS), 17(9): e0275478 (2022) Q1, [I.F. 2.9]

[40] Md. Imran Hossain, Mohammad Abu Sayem Karal, Md. Kamruzzaman, Ishtiaque M. Syed, Sharif Hasan and Md. Kabir Ahamed; Effects of hydrocarbon chain on the vesicle size distribution, kinetics of average size, bending modulus, and elastic modulus of lipid membranes; The European Physical Journal E (Springer Nature), 45, 55 (2022) [Q2, I.F. 1.8]

[39] Malay Kumar Sarkar, Mohammad Abu Sayem Karal, Victor Levadny, Marina Belaya, Marzuk Ahmed, Md. Kabir Ahamed, and Shareef Ahammed; Effects of sugar concentration on the electroporation, size distribution and average size of charged giant unilamellar vesicles; European Biophysics Journal (Springer Nature), 51:401–412 (2022) [Q2, I.F. 2.2]

[38] Mohammad Abu Sayem Karal, Nadia Akter Mokta, Victor Levadny, Marina Belaya, Marzuk Ahmed, Md. Kabir Ahamed and Shareef Ahammed; Effects of cholesterol on the size distribution and bending modulus of lipid vesicles; PLoS ONE (PLOS), 17(1): e0263119 (2022) [Q1, I.F. 2.9]

[37] Md. Kabir Ahamed, Marzuk Ahmed and Mohammad Abu Sayem Karal; Quantification of pulsed electric field for the rupture of giant vesicles with various surface charges, cholesterols and osmotic pressures; PLoS ONE (PLOS), 17(1): e0262555 (2022) [Q1, I.F. 2.9]

[36] Mohammad Abu Sayem Karal, Md. Kabir Ahamed, Marzuk Ahmed and Zaid Bin Mahbub; Recent development on the kinetics of rupture of giant vesicles under constant tension; RSC Advances (Royal Society of Chemistry), 11(47), 29598-29619 (2021) [Q1, I.F. 3.9]

[35] Mohammad Abu Sayem Karal, Tawfika Nasrin, Marzuk Ahmed, Md. Kabir Ahamed, Shareef Ahammed, Salma Akter, Sharif Hasan and Zaid Bin Mahbub; A new purification technique to obtain specific size distribution of giant lipid vesicles using dual filtration; PLoS ONE (PLOS), 16(7): e0254930 (2021) [Q1, I.F. 2.9]

[34] Malay Kumar Sarkar, Mohammad Abu Sayem Karal, Marzuk Ahmed, Md. Kabir Ahamed, Shareef Ahammed, Sabrina Sharmin and Sayed Ul Alam Shibly; Effects of osmotic pressure on the irreversible electroporation in giant lipid vesicles; PLoS ONE (PLOS), 16(5): e0251690 (2021) [Q1, I.F. 2.9]

[33] Marzuk Ahmed, Mohammad Abu Sayem Karal, Md. Kabir Ahamed and Muhammad Samir Ullah; Analysis of purification of charged giant vesicles in a buffer using their size distribution; The European Physical Journal E (Springer Nature), 44 (4), 62 (2021) [Q2, I.F. 1.8]

[32] Mohammad Abu Sayem Karal, Md. Kabir Ahamed, Urbi Shyamolima Orchi, Md. Towhiduzzaman, Marzuk Ahmed, Shareef Ahammed, Nadia Akter Mokta and Muhammad Samir Ullah; An investigation into the critical tension of electroporation in anionic lipid vesicles; European Biophysics Journal (Springer Nature), 50, 99-106 (2021) [Q2, I.F. 2.2]

[31] Mohammad Abu Sayem Karal, Urbi Shyamolima Orchi, Md. Towhiduzzaman, Md. Kabir Ahamed, Marzuk Ahmed, Shareef Ahammed, Nadia Akter Mokta, Sabrina Sharmin and Malay Kumar Sarkar; Electrostatic effects on the electrical tension-induced irreversible pore formation in giant unilamellar vesicles; Chemistry and Physics of Lipids (Elsevier) 231, 104935 (2020) [Q2, I.F. 3.4]

[30] Mohammad Abu Sayem Karal, Md. Kabir Ahamed, Nadia Akter Mokta, Marzuk Ahmed and Shareef Ahammed; Influence of cholesterol on electroporation in lipid membranes of giant vesicles; European Biophysics Journal (Springer Nature), 49, 361-370 (2020) [Q2, I.F. 2.2]

[29] Md. Kabir Ahamed, Mohammad Abu Sayem Karal, Marzuk Ahmed and Shareef Ahammed; Kinetics of irreversible pore formation under constant electrical tension in giant unilamellar vesicles; European Biophysics Journal (Springer Nature), 49, 371-381 (2020). [Q2, I.F. 2.2]

[28] Mohammad Abu Sayem Karal, Md. Kabir Ahamed, Marzuk Ahmed, Shareef Ahammed and Zaid Bin Mahbub; Location of Peptide-Induced Submicron Discontinuities in the Membranes of Vesicles Using ImageJ; Journal of Fluorescence (Springer Nature), 30, 735–740(2020). [Q2, I.F. 2.6]

[27] Mohammad Abu Sayem Karal, Shareef Ahammed, Victor Levadny, Marina Belaya, Md. Kabir Ahamed, Marzuk Ahmed, Zaid Bin Mahbub and A. K. M. Atique Ullah; Deformation and poration of giant unilamellar vesicles induced by anionic nanoparticles; Chemistry and Physics of Lipids (Elsevier), 230, 104916 (2020) [Q2, I.F. 3.4]

[26] Mohammad Abu Sayem Karal, Marzuk Ahmed, Victor Levadny, Marina Belaya, Md. Kabir Ahamed, Mostafizur Rahman, and Md. Mostofa Shakil; Electrostatic interaction effects on the size distribution of self-assembled giant unilamellar vesicles; Physical Review E (American Physical Society-APS), 101, 012404 (2020) [Q1, I.F. 2.2]

[25] Mohammad Abu Sayem Karal, Md. Kamrul Islam and Zaid Bin Mahbub; Study of molecular transport through a single nanopore in the membrane of giant unilamellar vesicle using COMSOL simulation; European Biophysics Journal (Springer), 49(1),59–69 (2020) [Q2, I.F. 2.2]

[24] Mohammad Abu Sayem Karal, Md. Kabir Ahamed, Mostafizur Rahman, Marzuk Ahmed, Md. Mostofa Shakil, Khondkar Siddique-e-Rabbani; Effects of electrically-induced constant tension on giant unilamellar vesicles using irreversible electroporation; European Biophysics Journal (Springer), 48(8),731–741 (2019) [Q2, I.F. 2.2]

[23] Shamor Kanti Roy, Mohammad Abu Sayem Karal, Muhammad Abdul Kadir, Khondkar Siddique-e Rabban; A new six-electrode electrical impedance technique for probing deep organs in the human body; European Biophysics Journal (Springer), 48(8),711–719 (2019) [Q2, I.F. 2.2]

[22] Mohammad M. Zaman, Mohammad Abu Sayem Karal, Mohammed Nazrul Islam Khan, Abu Rayhan M. Tareq, Shareef Ahammed, Dr. Mahmuda Akter, Aslam Hossain, A. K. M. Atique Ullah; Eco-Friendly Synthesis of $Fe_3O_4$ Nanoparticles Based on Natural Stabilizers and Their Antibacterial Applications; Chemistry Select (Wiley Online Library), 4, 7824-7831 (2019) [Q2, I.F. 1.9]

[21] Mohammad Abu Sayem Karal, Mostafizur Rahman, Md. Kabir Ahamed, Sayed Ul Alam Shibly, Marzuk Ahmed, Md. Mostofa Shakil; Low cost non-electromechanical technique for the purification of giant unilamellar vesicles; European Biophysics Journal (Springer), 48(4),749–759 (2019) [Q2, I.F. 2.2]

[20] Moynul Hasan, Mohammad Abu Sayem Karal, Victor Levadnyy, and Masahito Yamazaki; Mechanism of Initial Stage of Pore Formation Induced by Antimicrobial Peptide Magainin 2; *Langmuir* (American Chemical Society), 34, 3349–3362 (2018) [Q1, I.F. 3.7]

[19] Shibly Sayed Ul Alam, Chiranjib Ghatak, Mohammad Abu Sayem Karal, Md. Moniruzzaman and Masahito Yamazaki; Experimental Estimation of Membrane Tension Induced by Osmotic Pressure; *Biophysical Journal* (Elsevier), 111, 2190–2201 (2016). [Q1, I.F. 3.2]

[18] Sabrina Sharmin, Md. Zahidul Islam, Mohammad Abu Sayem Karal, Shibly Sayed Ul Alam, Hideo Dohra, and Masahito Yamazaki; Effects of lipid compositions on the entry of cell-penetrating peptide oligoarginine into a single vesicle; *Biochemistry* (American Chemical Society), 55, 4154–4165 (2016). [Q1, I.F. 2.9]

[17] Mohammad Abu Sayem Karal, Victor Levadny and Masahito Yamazaki; Analysis of Constant Tension-Induced Rupture of Lipid Membranes Using Activation Energy; *Physical Chemistry Chemical Physics (PCCP)*, (Royal Society of Chemistry - RSC) 18, 13487–13495 (2016). [Q1, I.F. 3.3]

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[98] M. Asaduzzaman, T. Rahman, M. S. Istiaque, M. I. Hossain, M. A. S. Karal and M. K. Alam; Investigation of molecular transport through multipore into giant unilamellar vesicles using COMSOL simulation; *(PP-33) National Conference on Physics (BPS-2021), Organized by Bangladesh Physical Society (BPS),* Dhaka, Bangladesh, 06-07 August, 2021,(Poster Presentation), page. 76

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**Statements of Researcher including proposed work**

• After completing my Ph.D. in Biophysics in Japan, I returned to the Department of Physics at BUET and established the Biophysics Research Laboratory. Biophysics, especially membrane biophysics, has broad applications in soft matter, material science, nanoscience, and biophysical chemistry. In our research, we have synthesized cell mimetic vesicles, such as cell-sized giant unilamellar vesicles (GUVs), where the membranes of GUVs consist of lipids, proteins, and cholesterol. These GUVs act as a mimic of biological cells. By using GUVs in vitro, it is possible to understand the behavior of real cells through an optical microscope. We have focused on the following three different types of investigations using these GUVs:

• Irreversible electroporation (IRE): IRE is a non-thermal technique involving the application of high electric field direct current (DC) pulses to ablate localized cancer cells or tumors. Pore formation in the cell membranes due to IRE is one of the main reasons for the ablation of tumor and cancer cells. When an IRE signal is applied to the GUVs, Maxwell stress tension is induced in the membranes. If the tension exceeds a critical value, pores form in the membranes, leading to the ablation of cells or the rupture of vesicles. We locally developed an IRE technique for manipulating a single GUV. A major advantage of this system is that it was developed at a relatively low cost compared to commercially available products. The system has potential applications in various biomedical research areas.

• Interaction of nanoparticles with GUVs: Magnetite ($Fe_3O_4$) nanoparticles (MNPs) are found in the environment through various sources, including natural occurrences like volcanic eruptions and meteorite impacts, as well as anthropogenic sources such as industrial processes, power plants, and marine sediments. The presence of MNPs can potentially impact human health and the environment. The deformation and poration of GUVs are two vital processes resulting from interactions between MNPs and membranes. Understanding the mechanisms of these interactions at the molecular level is pivotal for ensuring the safe and efficient utilization of MNPs in medicine. This study contributes to revealing the fundamental mechanisms underlying MNPs-cells/vesicles interactions and offers crucial insights for the secure and efficient advancement of nanotechnology-based biomedical applications.

• Micropipette manipulation of a single GUV: Studying the mechanical properties of membranes is crucial for understanding the behavior of a single cell or GUV. In this technique, a single GUV is manipulated to study the elastic modulus and bending rigidity of cell membranes, as well as the rupture formation of GUVs.

• Currently, we are studying the behavior of GUVs in in-vitro situations. In the future, we expect to use these techniques in real conditions. To achieve this, we need collaboration with doctors, microbiologists, and other specialists. We hope this research will be helpful for cancer cell ablation and can be implemented in hospitals for medical diagnosis. This research represents an important advancement in science and technology.

## Quality of the research

We have strived to conduct high-quality research in the Biophysics Research Laboratory, Department of Physics, BUET. I am the founder of this laboratory and currently serve as the principal investigator. We have received both international and national research funding to support our cutting-edge research. Over the past six years, we have published 30 research articles in several prestigious international journals, with me acting as the corresponding author for these publications. Many students have completed their M.Sc. and M.Phil. degrees under my supervision. Currently, several Ph.D., M.Phil., and M.Sc. students are conducting their research under my guidance. Our articles are regularly cited by renowned scientists worldwide, and we consistently maintain the highest standards of research quality.

My personal website: https://asayem221.buet.ac.bd/

Google scholar citation: 1439, h-index: 21, i10-index: 27

Google scholar link: https://scholar.google.ca/citations?user=-KU_SXgAAAAJ&hl=en

## Research-related knowledge dissemination

We always strive to present our research at international and national conferences through oral and poster presentations. As part of this effort, I have given several invited talks at various conferences. Students from my research laboratory also present their findings at these conferences. On June 28, 2024, I organized a 'Workshop on Biophysics' as a Chair. The workshop featured one keynote speaker and twelve invited speakers who presented their research. About 50 postgraduate students from different universities participated in the workshop.

## Research Impact to benefit the society

As a faculty member of BUET, we have to take the challenge for solving the contemporary growing problems. It is mentioned that the research on Biophysics is very limited in the universities of Bangladesh due to the lack of skill person in this area. Now-a-days, Bangladesh Government has taken different initiatives to enrich the field of Biomedical physics/Engineering research in the institutions. As a part of the vision 2021 of Bangladesh Government, BUET opened Biomedical Engineering Department in 2015. It will be possible to enrich the research in the field of Biophysics with the cooperation of Biomedical Engineering in BUET. We highly expect that this research will bring a tremendous development for Bioscience research which will meet the requirements of the special allocation for science and technology of the Government of Bangladesh.

There has been an increasing dialog between the physicists and an ever-growing number of biologists, mathematicians and engineers over the past two decades. The main reason behind this mutual attraction is obviously the contemporary biology’s principal role on the front lines of scientific investigations. Cells are the key building blocks of living system which are covered by plasma membranes. These membranes primarily separate the interior of a cell from its exterior, selectively control the movement of molecules across them, and most importantly, maintain an electrical potential

difference between the interior and exterior of a cell. It is to be noted that cancer, Alzheimer, Parkinson and various infectious diseases originated in individual cellular compartments, including the biomembranes. Lipid molecules are the main elements of biomembranes, and artificially prepared lipid membranes are considered to be the mimic of biomembranes. Therefore, the investigations of pore formation in lipid membranes play an important role for the cell death or rupture of vesicles. These researches will be helpful for the faculty members as well as M.Sc., M. Phil., and Ph.D. students.

### Industry-academia collaboration/ Inter-disciplinary works

We have conducted interdisciplinary research in biophysics, particularly in membrane biophysics, which has broad applications in soft matter, material science, nanoscience, and biophysical chemistry. Consequently, faculty members from the departments of Physics, Applied Physics, Materials Science, Medical Physics, and Biomedical Engineering can collaborate in the Biophysics Research Laboratory.

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