

কেমিক্যাল বিভাগ

বাংলাদেশ প্রকৌশল বিশ্ববিদ্যালয়

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There has been a rapid growth in the field of Bioengineering in the last few decades. BUET has never focused on the application of engineering principles to use biological systems and technologies for process and product development. In the last decade, the need for research and education in Bioengineering at BUET has been emphasized by renowned faculties, institutions and alumni from abroad. Research on emerging topics such as cell and tissue engineering, biomaterials, biological imaging and synthetic biology are well in line with the engineering education at BUET. With the appropriate knowledge base, BUET can play an important role to address important health care, food preservation and water safety and sustainability issues in Bangladesh.

I am pleased to announce that The Bioengineering Initiative at BUET, initiated by the Department of Chemical Engineering (ChE), BUET and the Non-Resident Alumni (NRB) of ChE BUET, has been launched recently. This project aims to establish a platform allowing researchers from relevant disciplines to perform and facilitate cutting edge research in biotechnology, biochemical engineering, food and health issues. This unique platform has already initiated different high-impact computational and experimental projects in collaboration with the internationally renowned Abbott Laboratory, USA; Texas A&M University, USA; and reputed local research institutions (such as: Renata; ICDDR,B; BCSIR). The Bioengineering Initiative also aims at building strong academic collaborations with leading institutions from the United States, United Kingdom, Canada, Australia, and Singapore, such as: UC Berkeley, NUS-Singapore, Monash-Australia and McGill-Canada.

To achieve these goals we are planning to raise funds from home and abroad. We hope that our alumni, professionals and different organizations engaged in the social and academic development will come forward by encouraging innovative ideas in Bioengineering area through financial contributions. Please feel free to contact me if you require any further information or have any questions concerning this proposal.

Thank you,

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The recommendation of Bioengineering panel from ICCHE 2017

UC Berkeley and BUET concluded International Chemical Engineering conference, ICChE 2017, at BUET. The Bioengineering area and healthcare need solutions were major points of emphasis at the conference.

The panel consisted of: Professor Liepmann and Professor Hossainy - UC Berkeley & Abbott Lab; Dr Fazila Malik- National heart foundation; Mr. Mukhtadir-Incepta Pharmaceuticals, and Prof Nazmul Karim-Texas A&M Univ. The panel made following key recommendations with a great sense of urgency:

- Establishing Applied Bioengineering Centers of Excellence (CoE) at BUET is a key strategic imperative for Bangladesh. This will enable a pipeline of innovators and entrepreneurs who can help Bangladesh compete globally in the field of Healthcare need solutions.
- The first CoE can be established in BUET Chemical engg department with National Heart Foundation (NHF), Bangladesh University - Urban Lab, being the major local and UC Berkeley being the major international partners.
- All panel members affirms their wholehearted support to make the center of excellence a success. The commitment includes but is not limited to: Provide technical expertise and training; Supply with relevant, high impact problem statement to solve; Bring more collaborators into the mix). UC Berkeley and Texas A&M already triggered faculty exchange with BUET Chemical Engg. Abbott labs already provided problem statements.
- BUET and other institutions have key talents who can hit the road running now. Successful completion of recent Abbott projects by BUET Chemical Engg faculties is an example. But more grooming and mentoring needed to prepare for Pharma sector boom in Bangladesh. A center of excellence will enable this aspect.

Executive Summary on: Bioengineering Initiative- BUET

Rationale: Why Bioengineering Initiative-BUET?

- Worldwide healthcare business is currently valued at over 5 trillion USD. Increasing clinical need, higher population density, and greater wealth accumulation will significantly grow healthcare industry.
- Therefore in order to add to country's topline growth, we need to compete globally in the Bioengineering area. This will be achieved by creating, enabling, and sustaining innovation and entrepreneurship.
- Currently BD is seriously lagging behind, regionally and globally. BUET has the talent pool and capability to deliver in this field. (Ref: Appendix 3 & 4)

Bioengg-BUET initiative:

Vision and goals: What is Bioengineering Initiative-BUET?

- It's NOT an academic department, rather a world class research facility that provides a platform and infrastructure for bioengineering research— both applied and fundamental. The initiative is launched under the precinct of Chemical Engineering Department initially however All BUET departments (BME, CHE, ME, EE, CSE etc.) are encouraged to engage with meaningful projects. Outside institutes and Universities are also encouraged to collaborate. This is the Stanford BioX model. Outcome from high impact research output expected within 1 yr.
- The initiative is divided into two phases, Phase 1-Immediate and Phase 2-Long term, running in parallel. Phase 1 starts off with a set of tasks, Phase 2 includes a world-class brick-and-mortar, applied problem-solving infrastructure.
- Key US (UC Berkeley, Texas A&M, Abbott Lab) and BD partners (Bangladesh U, National Heart Foundation, Atomic energy commission) are firmly committed to implement. This will help consolidate BUET resource, streamline projects with efficiency, and help focus on prioritized projects.
- No need to hire new faculties, however a designated head for the CoE (center director) is a must in order to ensure timely result and impact of the output. And also the center should be insulated from all traditional bureaucracy and the center head should directly report to the VC

Phase 1: Start acquiring know-how in the Bioengineering field by problem-solving high-impact topics.

- Create an overall blueprint- short term and long term. COMPLETE (Appendix 1)
- Identify and implement computational solution in high-impact, applied problem statement by partnering with global leaders in the field. COMPLETE (Appendix 3)
- Develop a list of computational and experimental projects that are targeted and high-impact in Bioengineering area. COMPLETE ((Appendix 3 and 4)
- Assign 2nd Naser Chair Professor Position to implement tactical and strategic tasks in bioengineering area. COMPLETE (Appendix 2)
- Initiate fund-raising for Phase 2. ONGOING

Phase 2: Establish a Bioengineering center of excellence (CoE) within the precinct of BUET

- Partnership and implementation structure:
 - Committed partners: US- UC Berkeley, Texas A&M, and Abbott labs; BD- National Heart Foundation (NHF); Bangladesh University (BU);
 - Projects are initially managed by BUET-CHE Dept. but rotation occurs
 - Faculties from other BUET departments and all Universities highly encouraged to participate
 - Bioengineering center leverages know-how of BUET alumni home and abroad.
- Sustained result will be ensured:
 - Identify and screen high-impact --- both strategic and tactical—problem statements.
 - Establish project milestones, budget, and success criteria up front
 - Resource each project with minimal red-tapes.
 - Bioengineering center leverages know-how of BUET alumni home and abroad.
- Compensation and incentives:
 - Project participants will be financially compensated for their time.
 - Additional incentive exists commensurate with milestone achievements (e.g. Publication, Intellectual property generation, Licensing etc.)
- Funding:
 - Initial Fund will be used to jump-start the CoE by retrofitting existing CHE lab areas.
 - The variable funds will support projects for 1st 2 years. The CoE operational expenses will be self-sustained by Industry partnership
 - Establish project milestones, budget, and success criteria up front
 - Resource each project with minimal red-tapes.
 - Bioengineering center leverages know-how of BUET alumni home and abroad.

Funding Requirement

Phase 1 Fund: Ask= 1 crore. This is already secured and utilized:

- Chemical Engineering-BUET disbursed Taka 65 Lakhs through the HEQEP¹ project
- Large cap Biomed Co.-USA disbursed \$ 25,000 towards 4 projects, thru 2015-2016.
- BCEF² contributed Taka 9 Lakhs as Boeing research grant AND Taka 2 Lakhs for high-performance computers for Bio-simulation lab.

Phase 2 Fund: Total Ask= Taka 9.2 Crore (US \$ 1.2 M); (Breakdown, see table below)

Table: Phase 2 Infrastructure expenses: Taka 8 Crore; to complete in 1 yr

Phase 2 cost breakdown (Infrastructure/retrofitting existing CHE lab areas)	Expenses (US \$ M)
<i>Specialized Microscopy</i>	0.25
<i>Specialized physicochemical Analysis Techniques</i>	0.50
<i>Build Laboratory Infrastructure</i>	0.15
<i>Computer/IT</i>	0.10
TOTAL= US \$1.00M, i.e. Taka 8 crore	

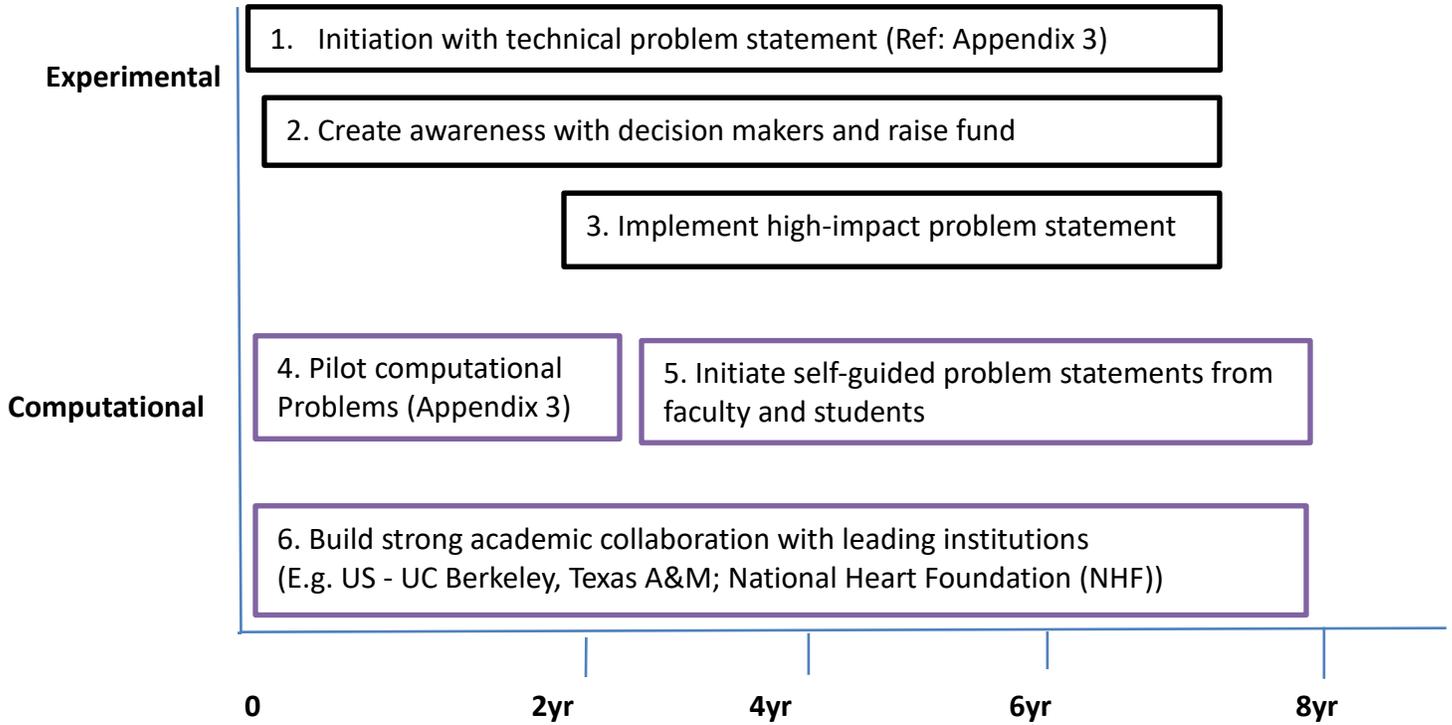
Table: Phase 2 Operational expenses: 1.2 crore for 2 yrs., at a rate of 0.6 crore/yr),

Phase 2 need areas (Operational Expenses)	Operational Need Expense Area	Expenses (US \$ M/year)
Laboratory Operation Cost	<ul style="list-style-type: none"> • Project Variable Expenses • Laboratory Maintenance • Chemicals and Auxiliaries 	0.05
Remuneration/Salaries	<ul style="list-style-type: none"> • Research Headcounts • Faculty/student compensation • Administrative 	0.025
TOTAL for 1 yr		US \$ 0.075M/year; i.e. 0.6 crore/yr; 1.2 crore/2 yr

¹ Higher Education Quality Enhancement Project

² BUET Chemical Engineering Forum

Appendix 1: Roadmap



Appendix 2

Summary: Naser Chair Professor 2017 Bioengineering Initiative task outline

Tasks	Topics
1. Computational Projects	<ul style="list-style-type: none"> • Complete 3 ongoing projects (items 1-3, Appendix 3); Establish process for joint publication with UC Berkeley, Dept of Bioengineering: COMPLETE • Initiate at least 1 new project from Appendix 3; COMPLETE
2. Experimental Projects	<ul style="list-style-type: none"> • Initiate at least 2 projects from the list in Appendix 4; COMPLETE
3. Academic/Curriculum	<ul style="list-style-type: none"> • Modify existing undergrad course to include: “Applied Bioengg topics”. COMPLETE; <ul style="list-style-type: none"> ○ Content highlights: <ul style="list-style-type: none"> ▪ Selected Biomedical device examples ▪ Applied math quantification of some of the selected Biomedical devices ▪ Contents compiled from UC Berkeley Bioengineering Departmental courses. • At least 1 seminar in 2017 on bioengineering topics. COMPLETE • Establish faculty exchange program between BUET and UC Berkeley Bioengineering Dept; COMPLETE <ul style="list-style-type: none"> ○ UC Berkeley ex-Bioengg dept head Prof Dorian Liepmann visits BUET ○ Prof Nafisa Islam form CHE visist to Berkeley Bioengg lab ○ Berkeley committed to support 2 faculties per yr. from BUET
4. Funding for Bioengineering Initiative	<ul style="list-style-type: none"> • Funding: Create external funding opportunity to implement Bioengineering initiative Phase 2 goals; ONGOING <ul style="list-style-type: none"> a. BUET Alumni b. Corporate funding from BD and Overseas c. NRB funding from US d. Govt sources

Appendix 3

Current and future computational projects in collaboration with Med tech companies, academic institutions in US

(Applied, product-oriented problem-solving)	Status
1. Drug-device combination product to treat occlusive cardiovascular disease <ol style="list-style-type: none">Drug-eluting stent, mass transportDrug-coated Balloon, mass transportParametric quantitation of cell migration and proliferation in contact with a mechanical load –bearing cardiovascular implant.Failure mode analysis of biomedical coating devices. Case study: Drug Eluting Stent (DES) coating	1a. COMPLETE; Published 1b-To Initiate 1c- ONGOING 1d- ONGOING
2. Radio frequency thermal ablation of tissue (heat transport): <ol style="list-style-type: none">Ablate and necrose tumor tissue for oncology therapy.Renal denervation to treat resistive hypertension	2a- COMPLETE 2b-ONGOING
3. Computational analysis for protein deposition: Time-dependent changes of culprit proteins and thromboresistant proteins on the surface of blood-contact implants.	COMPLETE; Publication in progress
4. Absorption kinetics and mass loss from an absorbable vascular implant (Rxn kinetics/ mass transport).	To Initiate

Appendix 4

High-value, experimental applied Research topic in Bioengineering. (This is a running list and subject to change/modification by PIs and review bodies)

TOPIC	STATUS
MEDICAL DEVICE	
1. Stroke Prediction APP: Predictive, patient-specific stroke potential analysis in a patient friendly APP. It has TWO components: <ul style="list-style-type: none">a. Hardware: Wearable/implantable digital readout. Doppler shift experiment with signal analysis in simulated blood flow with suspended particulate. This is to predict any TIA episode, Stroke precursor events etc. The results will serve as proof of feasibility for an eventual wearable/implantable product.b. Software: Signal processing, Machine learning application to process aberrant electrical potential calculation and pathological fluid flow fluctuations.	ONGOING: In collaboration with UC-Berkeley; National Heart Foundation (NHF); BME-BUET
2. Evaluate microfluidic substrate for blood platelet interaction- single platelet and cooperative effect from multiple platelet	ONGOING: In collaboration with BioEngg, UC Berkeley
3. Electronics embedded polymeric implant device. Device can be heated by triggering Electromagnetic (EM) field remotely from outside the body. (Jointly by EE, CHE, MSE); Potential application: Heart failure, Diabetes Type II	TO INITIATE
4. Electronics embedded millimeter-sized tubular device. Device can generate electrical pulse by triggering Electromagnetic field (EM) field remotely from outside the body. (Jointly by EE, CHE, MSE); Potential application: Spinal injury, nerve regeneration, Diabetes Type II	TO INITIATE

Appendix 4 (cont'd)

PHARMACEUTICAL TOPICS	
5. Downstream processing in local Pharma industry	TO INITIATE w Incepta
6. API formulation, processing, and characterization <ul style="list-style-type: none">a. Sustained release API technologyb. Pharmacokinetic calculations- For predictive PK (bioavailability, AUC etc.; For regulatory filingc. Pharmacokinetic experimentation- To validate predictive PK analysis; For regulatory filing	TO INITIATE w Renata
7. APP enabled paper diagnostics for the qualitative and quantitative detection of biomarkers of kidney diseases. (Point-of-care devices)	ONGOING
8. Nutraceuticals research to develop cost-effective manufacturing techniques.	TO INITIATE
Food Technology	
9. APP-enabled bio-active paper filters and diagnostic devices for the qualitative and quantitative detection of toxins and pathogens in food and water. (Point-of-care devices). (CHE, ICDDRB and Renata Ltd.)	ONGOING
10. APP-enabled real-time identification of artificial coloring and other food adulterants	ONGOING
11. APP-enabled, Real-time detection of waterborne and biological fluid based pathogens/parameters.	ONGOING
12. APP enabled quick detection of Adulteration of milk:	ONGOING