Master of Engineering in Biotechnology and Food Technology

Three benefits from the program:

Studying with Swedish professors

Industrial track Thesis
Research track Thesis

Opportunity to Full scholarship (Tuition fee and salary 200 USD)

Due Date for application submission October 15th, 2021

Application submission → Entance Exam → Scholarship selection → Kick off → Exit Exam → Graduation

	REQUIREMENT
☑	Must pass the entrance exam
☑	Must hold bachelor in Bioengineering, Biotechnology, Food Engineering, Biochemistry, Chemistry, Biology, Agro-industry, or Food Technology
☑	Complete application form
☑	Personal statement (In English)
☑	Resume (Max. 2pages)
☑	Verified Copy of Bachelor degree and transcript
☑	TOEFL (500) or IELTS (5.5) or equivalent
☑	Photos (4x6: 3) and (3x4: 2)
☑	Tuition fee 1,200 USD (English program), 10 full scholarships
☑	20 students

LUND UNIVERSITY · SLU · UMEÅ UNIVERSITET

"MBFT will be offered to the crème de la crème of domestic students, based purely on academic merit"

MASTER OF ENGINEERING IN BIOTECHNOLOGY AND FOOD TECHNOLOGY

CURRICULUM TITLE

Master of Engineering in Biotechnology and Food Technology

DEGREE TITLE

Master of Engineering (Engineering Technology)

CURRICULUM OUTLINE

The Master Program in Biotechnology and Food Technology (MBFT) intends to prepare engineers for life-long achievement through both education in Biotechnology, Food technology, and sustainable refining of natural products in Cambodia and also development of communication, teamwork, leadership and entrepreneurship skills. The applied program includes the establishment of a master program in Biotechnology and Food Technology with two profile "**Research**" and "**Industrial**". Two cycles of training of master students are proposed. To ensure the quality of the program, all courses will be fully developed by Swedish partners. Local lecturers will accompany all courses with purpose to take over the teaching activities in the future. The aim of master program is to strengthen the educational system, to establish a research culture and to form a base for the establishment of a PhD program in the next phase.

With this program, Department of Bioengineering of RUPP intends to develop partnerships with three different Swedish universities, the Swedish Agricultural University, Lund University, and Umeå University. The Department of Bioengineering at RUPP sees this as a clear possibility to create a stronger and more sustainable research group within the Faculty of Engineering. For researchers at all involved universities this represents a unique opportunity to form an interdisciplinary research team around challenging research issues of large human relevance.

The program consists of research training at the master level that will be established at RUPP in cooperation with the partner universities and subsequently transferred here. By this approach, we believe we will meet the demands for quality in higher education and that a stepwise selection scheme will warrant that the upper levels of education will be offered to the *crème de la crème* of our domestic students, based purely on academic merits.

With current availability at MSc level, programs should follow the same course package for the first 2½ semesters, after which the best students – based on their overall score – will be offered a possibility to continue on the **"Research Master"**, while the remaining will be offered an **"Industrial Master"** track as (Fig.1)

- **Industrial Master Track** is designed for student who outstanding student who would like to conduct their research project under the supervision of BE faculty members.
- **Research Master Track** is designed for outstanding students who continue directly their thesis work after $2^{1/2}$ semester, where they will be offered projects and supervision by faculty member at RUPP.

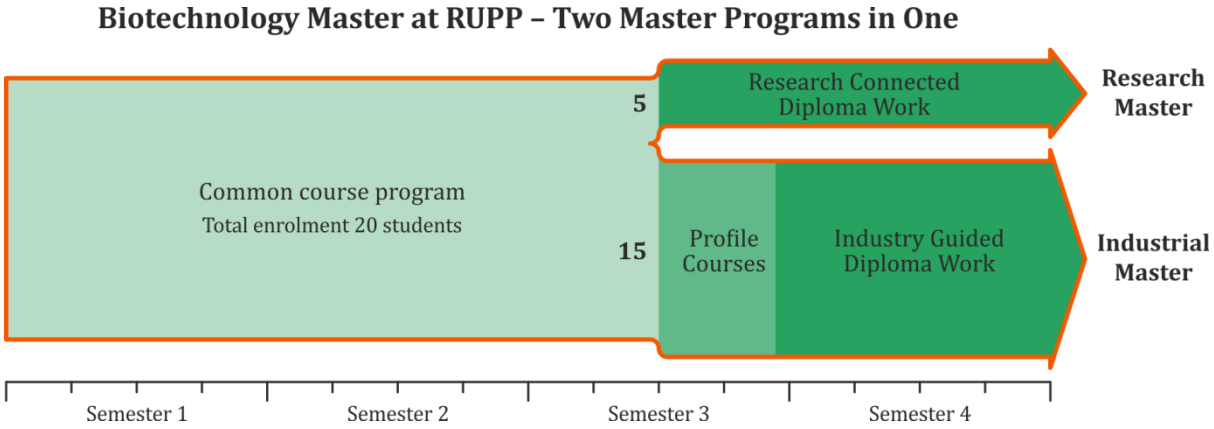


Fig. 1: Structure of the combined Research and Industry Master Programs in Biotechnology.

PROGRAM LEARNING OUTCOMES

Master Degree in Biotechnology and Food Technology (MBFT)
Upon a successful completion, a graduate of this program will be able to

Knowledges

- Explain and evaluate on food and biotechnology's values (1) instrumental analysis, (2) advance biochemistry, (3) industrial biotechnology, (4) plant biotechnology, (5) advance food technology, (6) fermentation technology, (7) Bioprocess Engineering, (8) entrepreneurship skill and project management
- Experience in scientific research both direct and industrial work environment
- Experience in establishment and management on project with innovative business model in food and biotechnology to meet the job current and future job market in food and biotechnology industries.
- Develop business and start-up project in biotechnological fields.

Interpersonal Skills & Responsibility

- Work independently, as part of a team and able to carry responsibilities in operation process and research
- Illustrate the value of biotechnology to the public
- Evaluate the performance of commonly used process in biotechnological fields such as gene technology, industrial microbiology, Enzyme technology, food technology and plant cell technology.

Communication, Information Technology, Numerical

- Demonstrate skill in the usage of computer, network, and software packages relevant to chemistry, biotechnology, basic statistic and engineering.
- Oral and/or poster presentation in national and international conferences/symposium
- artical

Psychomotor

- Manipulate and handle glass-wares, lab. Instruments, chemicals and biological materials
- Operate engineering process equipment in biotechnological field such as food processing and bioprocessing.
- Perform and experiment qualitative and qualitative experimentation in biotechnological field such as gene technology, industrial microbiology, Enzyme technology, food technology and plant cell technology.

SCHOLARSHIP

In collaboration between the Royal University of Phnom Penh and Swedish International Development Agency (SIDA), Department of Bioengineering will select 20 students to join first generation of graduate program Master in Biotechnology and Food Technology (English medium) in academic year 2021-2022. The program will be conducted by national and international instructors from Sweden.

10 students will be awarded for full scholarships on tuition fee (1,200 USD) and salary 200 USD per month. Scholarship students must require full research under supervision of local supervisor and fulfill the term of reference (TOR) of research activities.

JOB PROSPECTS

The Department provides its graduates a competitive edge in the labor market. We prepare high quality professionals to work as food and agro-industry specialists, bimolecular engineer, biomaterial engineer, biomedical scientist and lab technician, and lecturer/researcher in the field.

CORE ACADEMIC STAFF

FULL FACULTY MEMBERS

No	Name	Gender	Degree	Country of study
1	Siteng TIENG	M	PhD in Materials Chemistry	France
2	Leang KHIM	M	PhD in Biotechnology	Japan
3	Chanrith PHOEURK	F	PhD candidate in Biochemistry	Sweden
4	Laingshun HUOY	F	PhD candidate in Microbiology	Sweden
5	Solida LONG	F	PhD in Pharmaceutical and Medical Science	Portugal
6	Chamroeun YEN	M	Master in Materials Chemistry	South Korea
7	Sivlin UNG	F	PhD candidate in Veterinary Science	Japan
8	Hangsak HUY	M	PhD in Bioscience majoring in Functional Genomics	South Korea

PARNERSHIP FACULTY MEMBERS

No	Name	Sex	Specialty	Country	Affiliation
1	Prof. Knut Irgum	M	Analytical Chemistry	Sweden	Umeå University
2	Dr. Solomon Tesfalidet	M	Analytical Chemistry	Sweden	Umeå University
3	Prof. Leif Jönsson	M	Biotechnology	Sweden	Umeå University
4	Prof. Jyri-Pekka Mikkola	M	Industrial Chemistry	Sweden	Umeå University
5	Dr. Erik Alexandersson	M	Plant Molecular Biology	Sweden	Swedish University of Agricultural Sciences
6	Dr. Per Hofvander	M	Biotechnology	Sweden	Swedish University of Agricultural Sciences
7	Dr. Salme Timmusk	M	Microbial Biotechnology	Sweden	Swedish University of Agricultural Sciences
8	Dr. Anders S. Carlsson	M	Plant Physiology	Sweden	Swedish University of Agricultural Sciences
9	Prof. Björn Bergenståhl	M	Food Technology	Sweden	Lund University

10	Dr. Yvonne Granfeldt	F	Food Technology	Sweden	Lund University
11	Dr. Åsa Håkansson	F	Food Technology	Sweden	Lund University
12	Dr. Federico Gomez	M	Food Technology	Sweden	Lund University
13	Dr.Phat Phana	F	PhD in Agricultural Biology	Cambodia	Department of Forestry

CURRICULUM: 64 credits

Course	*Credits (l-p-s)**	*Course*	*Credits (l-p-s)**
First Year			
Semester I		***Semester II***	
1. Instrumental Analysis	4 (2-4-6)	1. Bioinformatics	4 (2-4-6)
2. Applied and Multivariate Statistics	4 (2-4-6)	2. Techniques in Biotechnology	4 (2-4-6)
3. Surface and Colloid Chemistry	4 (2-4-6)	3. Industrial Biotechnology	4 (2-4-6)
4. Cell and Organism Metabolism	4 (2-4-6)	4. Sustainable Bioprocess Engineering	4 (2-4-6)
Sub-Total	**16 (8-16-18)**	**Sub-Total**	**16 (8-16-18)**
Second Year (Research Master Track)			
Semester I		***Semester II***	
1. Fermentation Technology	4 (2-4-6)	1. Thesis Work	16 (0-32-24)
2. Plant Biochemistry/Molecular Biology	4 (2-4-6)		
3. Thesis work	8 (0-16-12)		
Sub-Total	**16 (4-24-18)**	**Sub-Total**	**16 (0-32-24)**
Second Year (Industrial Master Track)			
Semester I		***Semester II***	
1. Fermentation Technology	4 (2-4-6)	1. Thesis Work	16 (0-32-24)
2. Plant Biochemistry/Molecular Biology	4 (2-4-6)		
3. Food Science and microbiology	4 (2-4-6)		
4. Advanced food technology	4 (2-4-6)		
Sub-Total	**16 (8-16-24)**	**Sub-Total**	**16 (0-32-24)**

*** (Lecture-Practice-Self-study hours)**

COURSE DESCRIPTIONS

Instrumental Analysis with Process Analytical Chemistry, 4 UCTS

The use of agrochemicals in Cambodia is widespread and largely uncontrolled, and chemical agents that are banned in most countries in the world are available to farmers on an over-the-counter basis with little or no knowledge provided for their proper use and the dangers to the farmers and those eventually consuming their produce. Without means to identify and eliminate the most contaminated products from the food chain, this practice is likely to continue. Skills in chemical analysis are therefore of paramount interest to ensure food safety. The instrumental analysis course will focus on sampling, sample preparation and analytical techniques that are suitable for analysis of agricultural products, and also on techniques used to monitor chemical and biochemical processes. The aim is that students that have passed the course should have acquired knowledge of the techniques that are available for sampling and analyzing foodstuff, as well as soil and water used for cultivation and animal production, and be able to communicate with trained analytical chemistry personnel in the choice of methods, and in interpreting the results of chemical analyses. The students should also have an insight in the most important physical and chemical measurements principles used in industrial monitoring and control of chemical and biochemical processing.

Applied and Multivariate Statistics, 4 UCTS

Maximum yield of high quality products at efficient raw material utilization are the ultimate goals of any process industry with ambitions to stay competitive on the global market. Data from industrial processes are, however, often complicated to analyze, since a variety of control parameters and measured responses have to be correlated with often fuzzy product quality criteria, which are normally difficult to measure during processing. Getting to terms with this is hence a complex problem, where the best solution is to apply multivariate statistics to reveal hidden information that is not apparent if each variable is observed alone. Continuous processing also requires that these parameters are measured over time, so that a process can be adjusted in real time in order to achieve the goals mentioned initially. The aims of this course is hence that the students should be capable of selecting and using the most common multivariate statistical methods, and to have an insight on how these can be expanded to involve time series analyses and can be applied to on-line monitoring and control of industrial (bio)chemical processes.

Surface and Colloid Chemistry, 4 UCTS

The aim of the course is to describe technical surface and colloid chemical phenomena at the molecular level. The course is based on surface-active components, where a variety of phases (micellar, liquid crystalline, and microemulsions) are studied, as well as aggregates such as vesicles. A central concept is interparticular interactions in relation to colloidal stability. A generally important aspect is how the material properties of dispersed systems are influenced by colloidal interactions and surface phenomena. The exercise part of the course treats quantitative aspects of the theory as well as problem solving in colloid chemistry. The projects consist of an analysis of the surface and colloidal aspects of manufacturing, formulation, or application of a consumer product relevant to the interest of the student. The projects are reported in written and oral form.

Metabolism Related to Human Nutrition and Biotechnical Production, 4 UCTS

The aim is to provide a scientifically based holistic perspective on the metabolism of a cell, as well as an organism perspective, with relevance for human nutrition and generation of biotechnical products. The course intend to provide an in-depth description of metabolic aspects of digestion as well as the formation of the major nutrients and cell components (*e. g.*, carbohydrates, proteins, and lipids) and essential minor components such as polyphenols and vitamins.

Bioinformatics, 4 UCTS

Bioinformatics is fundamentally about the application of computer-based approaches to the understanding of biological processes. This course will cover the theories, algorithms, and practical applications of computer-based methodology for the analysis of DNA sequences and protein structures through sequence alignment, sequence motifs, gene and protein expression analysis, and also introduce the current methods used to interpret the vast amounts of data generated by modern high-throughput sequencing technologies as well as form an introduction to systems biology. It will enable the learners to develop their research skills in authentic bioinformatics-related problems. Indicative content: Unix OS, Use of databases and repositories for molecular data, Literature databases, Homology analyses, Structure predictions, Web-based analytical tools including gene ontology and pathway analysis, Comparative and functional genomics, RNAseq expression analysis, Annotation of new genomes, Sequence analysis and alignment, Systems biology.

Techniques in Biotechnology, 4 UCTS

This module aims to provide the learners with advanced level theoretical knowledge as well as practical experience and training on core techniques in biotechnology. It is designed to provide learners with deep insight on topics such as tissue culture, recombinant nucleic acid techniques, biochemical analysis, genomics/molecular markers, and the use of random and targeted mutations. Students will also get an overview of existing and emerging policies and regulations governing the application of biotechnology in society. Indicative content: Cell culture, Plant biotechnology, Cloning and microbial production, Separation technologies, including chromatography, Industrial and environmental biotechnology, Fermentation biotechnology, Mutation technologies.

Industrial Biotechnology, 4 UCTS

Industrial biotechnology provides a way for industry to produce new chemicals and materials in ways that have previously not been possible. The course will focus on the central enabling technologies of industrial biotechnology, namely enzyme discovery and engineering, systems- and synthetic biology, and biochemical process engineering. The examples dealt with in the course will include industrial production of pharmaceuticals, intermediates, and base chemicals. The aim is that students after passing the course should understand the function and catalytic modes of enzymes, and be familiar with technologies and methodologies of systems and synthetic biology, as well as the principles and roles of bioprocessing and biochemical engineering in industrial biotechnology.

Sustainable Bioprocess Engineering, 4 UCTS

Sustainability has emerged as a competitive instrument in industry, and the environmental footprint of industrial activities has become a factor that is considered as part of the overall quality of any product. This creates has a huge potential for innovation and economic gain, in particular for processes that make use of what it otherwise considered as waste. The course will focus on implementation of bioprocesses in cyclic economies and include techniques that can be employed for efficient utilization of agricultural side streams for the production of new chemicals, unique materials, and renewable energy. The innovative process is central in this course and the students should, after having passed the course, be able to identify raw materials sources for sustainable bioprocesses, to design conversion

processes that maximize the use of raw materials with minimal waste production, and to determine the potential economy of these processes.

Fermentation Technology, 4 UCTS

The aim of the course is to describe the application of microorganisms and their bioactive compounds for crop improvement, bioconversion of agriculturally, and industrially related products including waste management. The course comprises the following sections: Microorganisms in their natural context, their relationships with the environment, interaction with host and other organisms, including biofilms. Attack and defense, secondary metabolism and biochemical regulation. Bioreactors and life cycle analysis. Wild type and genetically engineered bioactive compounds produced by microorganisms. Fundamentals of synthetic microbiology, design and construction of microorganisms with desired metabolism. Structure and function relation of enzymatic proteins. Nanostructured material-based formulation technology and functionalization of the carrier materials. (Please note the Ultuna Metabarcoding Laboratory at SLU handy for the course; http://www.slu.se/en/ew-news/2017/9/umbla/)

Plant Biochemistry and Molecular Biology, 4 UCTS

The course concerns the biochemistry and molecular biology of plants with a focus on the utilization of plants as "green factories" for food, feed, and industrial production. It is designed to provide learners with deep insight on different molecular biology and biochemistry techniques and procedures that have had significant impact on plant research, such as cloning, restriction enzymes, recombinant nucleic acid and vector procedures, nucleic acid purification, amplification, hybridization and modifications, protein purification and modifications, enzymatic reactions, and other biochemical analyses such as separation techniques. Indicative content: Molecular biology; Cloning, Recombinant nucleic acid technique, Nucleic acid purification and amplification, Nucleic acid hybridization. Biochemistry; Major nutrient components, Protein purification, Enzymatic reaction, Separation techniques including chromatography.

Food Science and Microbiology, 4 UCTS

The aim of the course is to describe the gut bacterial flora and how bacteria, associated to man, interact with the host, how administration of specific probiotic bacteria could prevent and counteract disease and how probiotic food could be designed. The following sections are

dealt with in the course: Fundamental biological troubleshooting; bacterial systematics and methods to classify and identify bacteria; the importance of gut health; the composition and ecology of the bacterial flora of the gastro-intestinal tract; effects of probiotics in health and disease; immunological and genomical aspects of probiotics; probiotic mechanisms of action; probiotic interaction with dietary fibers and antioxidants; design of probiotic foods and supplements; patent search; food hygienic considerations and safety of probiotics.

Advanced Food Technology, 4 UCTS

The aim of this course is to provide a science-based holistic approach to structural and functional properties of foods. The course will bring up to date scientific knowledge about a) chemical and physical-chemical properties of protein, fat and carbohydrates in food as well as the role of water for the properties of foods; b) contribution from food components to the structure of foods at a microscopic and a macroscopic level; c) chemical and enzymatic reactions, *e.g.*, lipid oxidation, the Maillard reaction, and caramelization; and d) the chemistry of taste, flavor, and color.

Innovation Projects in Food and Biotechnology, 0-2 UCTS

The aims of this course are to train the student in project-oriented work and to give an insight into the important steps needed in the development of a product, and to deepen knowledge in food engineering and food technology by accomplishing a technical development project. The project consists of a product or process development for a consumer product performed from a commercial consumer perspective, including regulations and food safety aspects. The project steps encompass an innovation process which involves planning, literature search, laboratory work, evaluation, reporting, and recommendations for commercialization and industrialization. Important aspects of the development process such as risk assessment, experimental design, and economical considerations are supported by lectures. The students should be able to present their novel concept in a "selling way" and to discuss and defend their proposed product and production methods from a sustainability perspective. The course includes lectures, seminars with written reports, practical development work, and study visits.

THESIS AND EVALUATION

Research project is designed for outstanding students (Research project track). Students are required to publish and do the oral presentation to national and international symposium or conference at least once. The thesis must consist of 6 chapters including introduction, literature review, methodology, results, discussions, and conclusion. The results

of research must be answered to the objectives and hypothesis. The evaluation of thesis will be conducted every year, and each student must be defensed in front of Master's thesis committees. Thesis books must be sent to each committee at least 3 months before the defense date. The correct thesis must be sent to administration office for reference after evaluation.

Students are allowed to do final defense according to the approval from the program council. After feedback from the committees, students must do the correction as minor or major revision in which 2nd presentation is required to conduct while the unqualified work is not approved.

INFRASTRUCTURE FOR RESERCH

There is an existing research infrastructure available already today. It includes basic capacity for microbiology and genetics. To ensure that the research can be performed at RUPP, necessaries equipment and apparatus (some are in a pilot scale) are installed in 8 laboratories under SIDA and HIEP-WB programs. Students are fully access to all equipment for research and study purpose. The

Existing infrastructure at RUPP and proposed expansion in the instrumental capacities

Existing instrumental capacity	**Major equipment**
▪ Basic microbiology and Genetic	▪ UV-visible spectrophotometer ▪ Biosafety cabinet ▪ Autoclave ▪ 2 Incubators (with &without orbital shaker) ▪ Freezer (-20 °C) ▪ PCR (Thermal cycler/96 well) ▪ UV Trans illuminator ▪ Gel Electrophoresis system for RNA/DNA ▪ Gel Electrophoresis system for protein gel ▪ Mechanical Convection Oven ▪ Muffle furnace (T_{max} 1100 °C) ▪ Centrifuge ▪ Orbital shaker/vortex mixer ▪ 3D shaker ▪ Optical microscope
Proposed expanded instrumental capacity	**Proposed equipment**
▪ Developed capacity for microbiology and genetics.	▪ Incubator with shaker and refrigerator ▪ Thermocycle ▪ Pulse-field Gel Electrophoresis (PFGE) ▪ Gel electrophoresis system ▪ Freezer -80°C ▪ Microplate reader ▪ Real-time PCR ▪ Electroporation machine ▪ UV-vis spectrophotometer ▪ SDS-PAGE ▪ Nanodrop spectrophotometer ▪ Thermomixer ▪ Fluorescence Spectrometer
▪ Capacity for pathogenic microorganisms.	▪ Biosafety cabinet ▪ Autoclave ▪ Incubator

	▪ Isolation of an area for work with Pathogenic organisms.
▪ Capacity for food development and analysis.	▪ Biosafety cabinet ▪ Water bath ▪ Convective oven with balance ▪ Data logger ▪ Texture analyzer ▪ Water activity analyzer ▪ Freeze dryer ▪ Kjeldahl for protein determination ▪ GC-FID ▪ Optical Microscope with camera, heating stage, polarized light. ▪ Colorspectrometer ▪ Moisture analyzer ▪ Analysis apparatus (conventional)
▪ Capacity for food product development and sensory evaluations	▪ Establishment of a trial kitchen (freezer, stove, dishwasher, balances, furniture)
Proposed additional expanded instrumental capacity included in the World Bank application	**Equipment**
Capacity for analysis and characterization	▪ HPLC ▪ GC-MS ▪ ICP ▪ LC-MS ▪ IR spectrometer
Capacity for Plant biotechnology	▪ Laminar flow cabinet ▪ Autoclave ▪ Environmentally controlled Incubator ▪ Green house ▪ Stereo microscope ▪ Nursery house for plant tissue culture
Animal Cell culture lab	▪ Safety cabinet type II ▪ Microscope ▪ Cell incubator
Capacity for Protein Lab	▪ Water purification system ▪ Gel filtration Chromatography ▪ Ion Exchange Chromatography ▪ Protein purifier ▪ Biosafety cabinet ▪ Microwave reaction system ▪ Multiple vacuum filtration system
Bio and Food processing	▪ Mini spray dryer ▪ UHT/HTST System ▪ Homogenizer ▪ Bioreactor/fermenter ▪ Pasteurizer ▪ Heat plate exchanger ▪ Essential oil extraction system ▪ Drum drier ▪ Freeze drier ▪ Chiller ▪ Food process equipment
Cosmetic and natural product Lab	▪ Reactor for cosmetic development ▪ Skin care analyzer ▪ Viscometer ▪ Microwave extractor ▪ Evaporator ▪ Microplate reader ▪ Extraction equipment ▪ Water bath ▪ Homogenizer

EVALUATION AND GRADUATION

Assessment of study will be performed at the end of each semester. Evaluation will be shown as the Grade Point Average (GPA) (4.00 scale) and the Cumulative Grade Point Average (4.00 scale).

Score	GPA	Letter grade
85-100	4.0	A = Excellent
80-84	3.5	B+ = Very good
70-79	3.0	B = Good
65-69	2.5	C+ = Fairly good
50-64	2.0	C = Fair
45-49	1.5	D = Poor
<40	0.0	E = Fail

CONTACT US

(855)77 23 5040/078 78 4154

103 STEM Building, Campus I, Russian Confederation Bolvd., Toul Kok, Phnom Penh, Cambodia

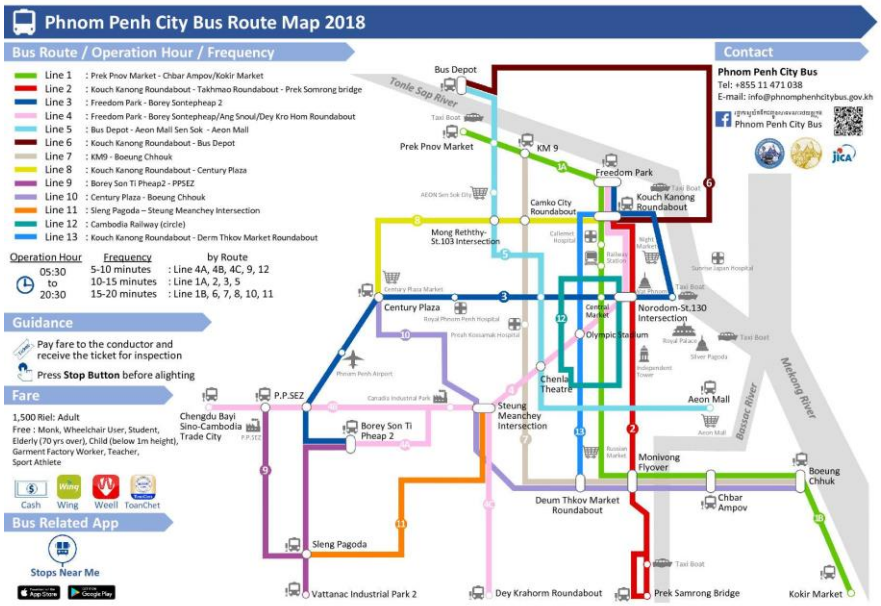
bioeng.info@rupp.edu.kh

www.rupp.edu.kh

How to find us

1. If you are from Phnom Penh airport, you can go straight along with Russian confederation boulevard. It takes about 15 to 20 minutes by bus No. 3. You can get off at the station No. 41 (7 makara flyover), then walk about 2min to Russian confederation boulevard to the main gate of the university.
2. If you are from National route 1,2 and 5, you can go on road 217 (From Char Ampov or kilometer 9). It takes about 20 to 30 minutes by bus No.7. You can get off at the station No. 36 (Hun Sen library). You can get the side gate of the university.

It is convention to use bus in Phnom Penh. It costs 1500 riel per ride



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