Program: Master of Science Program in Microbiology
Degree: Master of Science (Microbiology)
Study Plan:

1) Research Program (Scheme A 1)

Year	First Trimester	Cr	Second Trimester	Cr	Third Trimester	Cr
Year 1	108798 M.Sc. Thesis	3	108798 M.Sc. Thesis	3	108798 M.Sc. Thesis	3
			Qualifying Examination		Thesis Proposal Defense	
	Total	**3**	**Total**	**3**	**Total**	**3**
Year 2	108798 M.Sc. Thesis	13	108798 M.Sc. Thesis	13	108798 M.Sc. Thesis	13
	108781 Seminar 1		108782 Seminar 2		Thesis Examination	
	Total	**13**	**Total**	**13**	**Total**	**13**

2) Regular Program (Scheme A 2)

Year	First Trimester	Cr	Second Trimester	Cr	Third Trimester	Cr
Year 1	Core Course	4	Core Course	4	Core Course	4
	Major Course	3-4	Major Course	3-4	Major Course	3-4
	and/or		and/or		and/or	
	Elective Course	3-4	Elective Course	3-4	Elective Course	3-4
	Total	**7/12**	**Total**	**7/12**	**Total**	**7/12**
Year 2	Core Course	4	108782 Seminar 2	1	108799 M.Sc. Thesis	10
	108781 Seminar 1	1	108799 M.Sc. Thesis	3	Thesis Examination	
	108799 M.Sc. Thesis	3	Thesis Proposal Defense			
	Qualifying Examination					
	Total	**8**	**Total**	**4**	**Total**	**10**

Program: Master of Science Program in Microbiology
Degree: Master of Science (Microbiology)
Course Description:

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
Core Courses				
108601 Graduate Microbiology	4(4-0-8)	108201 Microbiology or Equivalent, or Consent of the School	Studies of microorganisms associated with food, industry, agriculture, environment, medicine, and immune system.	explain the principles and theory of microbiology.
108602 Microbiological Information Technology	4(4-3-3-10)	None	Concepts and applications of information technology in Microbiology, perspective on information technology to enhance Microbiology research and education, focuses on two computer-based learning tools, interactive multimedia and electronics and on-line learning, On-line database searching with background and supported resources and activity ideas. Endnote and References program, References system, Impact factor, Journals choosing technique, Write the Manuscript, Presentation technique	create web-page for on-line learning, search, analyze, and transfer database to references program, can choose appropriate journal for publication, write manuscript by using reference program.

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
109700 Graduate Biochemistry	4(4-0-8)	Undergraduate Biochemistry or Consent of the School	Cellular structures, organelle functions, structure and properties of lipids, carbohydrates and other biomolecules, methods of study and their physical basis, enzymes, intermediary metabolism and metabolic control, membrane structure and transport, bioenergetics, Information transfer, and cell signalling.	explain the principles and theory of biochemistry.
115701 Cellular and Molecular Biology	4(4-0-12)	104650 Cell Biology or Consent of the School	Studies of structures and functions of cells at molecular levels, including recent research advances in cell organelles, cell processes and applications of cell biology. Presentations and reports on recent advanced research on cell molecular biology.	1. demonstrate knowledge of how cellular and molecular biology is used to elucidate the function of cells and their organization into tissues. 2. apply the knowledge of cellular and molecular biology to research project. 3. able to present advanced knowledge in the specialized fields of molecular and cell biology
115702 Molecular and Cellular Research Techniques	2(1-3-4)	None	Studies of necessary skills for theoretical and laboratory research techniques, such as immunology and microbiology, cell and tissue culture, molecular biology, stem cells and genes.	1. describe the basic technique in molecular biology 2. have skills in using information technology for searching data from bioinformatics data base 3. able to design and carry out experiment to obtain recombinant DNA 4. have skills in animal tissue culture 5. analyze and detect protein 6. analyze and conclude the results

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
314512 Biotechnological Instrumentation	4(3-3-9)	None	Classroom and Advanced laboratory techniques designed for practical experience in chemical and biological techniques especially in cell cultivation, bio-molecule purifications, quantifications and other important analytical methods involved in biotechnology research. Some analytical methods: electrophoresis analysis, gas chromatography (GC), high performance liquid chromatography (HPLC), atomic absorption, mass spectrometer, thermal analysis and fermentation are also provided.	1. explain key concepts in biotechnological instrumentation for using in biological and chemical investigation. 2. have skilled knowledge in biotechnology and life science techniques to design useful methodology in research.
Major Courses				
108610 Microbial Physiology	4(4-0-12)	108201 Microbiology or Equivalent, or Consent of the School	Basic concept in microbial physiology which includes the study of microbial cell and particle structures and functions, microbial growth, factors affecting growth, energy generation, synthesis of biomolecules, control of metabolism, and organization of microbial genome.	1. elucidate knowledge regarding microbial physiology, growth and survival of microorganisms in different conditions 2. exploit knowledge for carrying out research in microbiology concerning with microbial cultivation and control, and for daily life

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108612 Sanitary Microbiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	Studies of sanitation principles with the emphasis on the application in microorganism-involved factory and infirmary to prevent and control public health problems of infectious diseases. The study of state health laws and regulations is included.	1. elucidate knowledge regarding sanitation principles with the emphasis on the application in microorganism-involved factory and infirmary according to state health laws and regulations 2. exploit knowledge for carrying out research in microbiology concerning with sanitation, and for daily life
108613 Quality-System Management of Microbiological Laboratory	3(2-3-4)	108201 Microbiology or Equivalent, or Consent of the School	Studies of quality assurance and microbiology laboratory's analytical activities. Topics include sample selection and handling, methods for the detection and enumeration of microorganisms, laboratory environment, maintenance, calibration and performance verification of the equipment, preparation of reagents and media, and the direction of a person qualified in microbiology laboratory.	1. elucidate knowledge regarding quality assurance and microbiology laboratory's analytical activities, calibration and performance verification of the equipment, and qualified person in microbiological laboratory 2. exploit knowledge for carrying out research in microbiology concerning with quality assurance and microbiology laboratory's analytical activities, and for daily life
108630 Dairy Microbiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	The roles of microorganisms in milk and milk products, microbes present in dairy products that may cause disease or spoilage, using microorganisms to produce daily products such as yogurt and cheese, and microbiological standards and quality of dairy products.	1. elucidate knowledge regarding roles of microorganisms in milk and milk products, and microbiological standards and quality of dairy products 2. exploit knowledge for carrying out research in microbiology concerning with agriculture (animals), food and industry, and for daily life

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108810 Microbial Technology	4(4-0-12)	108201 Microbiology or Equivalent, or by Consent of the School	Studies of commonly used and/or newly discovered technological principles to both naturally occurring and genetically engineered microorganisms in fields of industry, agriculture, medicine, and environment.	1. elucidate knowledge regarding microbial technology in fields of industry, agriculture, medicine, and environment 2. exploit knowledge for carrying out research in microbiology concerning with the application of microorganisms, and for daily life
108711 Molecular Biology of Lactic Acid Bacteria	4(4-0-12)	108201 Microbiology, 104203 Genetics, 109201 Biochemistry or Equivalent, or Consent of the School	The importance and taxonomy of lactic acid bacteria, metabolism, gene organization and regulation, gene transfer and genetic engineering, bacteriophage and bacteriophage resistance mechanisms, and biopreservation of lactic acid bacteria.	1. elucidate knowledge regarding taxonomy of lactic acid bacteria, metabolism, gene organization and regulation, gene transfer and genetic engineering, bacteriophage and bacteriophage resistance mechanisms, and biopreservation of lactic acid bacteria 2. exploit knowledge for carrying out research in microbiology concerning with lactic acid bacteria, and for daily life
108730 Industrial Microbiology	4(4-0-12)	108201 Microbiology or Equivalent, or Consent of the School	Current detail knowledges associated with the application of microorganisms used in industrial processes, importance properties of the microbial strains used in industrial fermentation, fermentation processes, microbial growth kinetics and their metabolism during fermentation, products obtained from microbial metabolism in industry and control of the production procedures.	1. elucidate knowledge regarding the application of microorganisms used in industrial processes in order to obtain the desirable products 2. exploit knowledge for carrying out research in microbiology concerning with utilization of the interested microorganism(s) for product production that could be scaled up to the industrial scale, and for daily life

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108731 Microbiology for Factory	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	Studies of microbiological techniques in factory involving the use of microorganisms; often-found problems caused by microorganisms, and how-to-solve approaches; factory management of equipment, surroundings, sanitation, important and reference strains. Field trip may be included.	1. elucidate knowledge regarding microbiological techniques in factory involving the use of microorganisms; often-found problems caused by microorganisms, and approaches to solve the problems 2. exploit knowledge for carrying out research in microbiology concerning with the management of equipment, surroundings, sanitation, important and reference strains, and for daily life
314541 Applied Microbiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	Microorganisms are widely used in several applications including industry, food, environment, pharmaceutical and agriculture. Microbial technologies involving in these applications are different and dynamics. The background information, the current application concepts and methodologies of applying microorganisms in several aspects will be discussed in this course.	1. understand the key concepts in microbiology and its physiology in relation to biotechnology. 2. explain the key principal technology that can be applied with microbiology for making new innovation in biotechnology.

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
335611 Advanced Food Microbiology	3(3-0-6)	Consent of the School	Relationship of microorganisms and their functions in food processing and food preservation. Molecular microbiology in food technology. Microbial stress response and recovery cell in food processing. Bacteriocin and probiotic in food industry. Role of bacteriocin and Lactic acid bacteria in fevaluation and safety of microorganisms in food by modern rapid and automatic techniques.	
335612 Microbial Metabolites for Food Industry	3(3-0-6)	Consent of the School	Microbial metabolites production in food industry. Primary and secondary metabolites production based on kinetic growth of microorganism in fermentation system. Traditional fermentations and genetics improvement of microorganism. Design and preparation of media for bioprocess. Screening, development and storage for industrial level. Production of food ingredients, food additives or food biopreservatives and other metabolites related to food, health and agricultural products.	

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
335613 Risk Assessment of Microbiological Safety in Food Industry	3(3-0-6)	Consent of the School	Recent emerging pathogens related to food safety. Microbiological contaminants in food and plant environment. Emerging pathogens related to food safety. Microbiological contamination level in foods and its severity to human consumption. Control of the biological safety of food. Microbiological criteria and risk assessment in HACCP system. Microbiological risk analysis methodology.	
Medical Microbiology				
115742 Infectious Immunology	4(4-0-12)	115744 Immunology in Microbiology and 115743 Microbiology in Microbiology or Consent of the School	Immune response against bacterial, rickettsiae, viral, fungal and parasitic infections.	1. understand the immunological responses to infections from pathogenic bacteria, viruses, fungi, and parasites 2. apply new technologies used to examine the immunological reactions to infections from variety of pathogenic microorganisms

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
115743 Microbiology in Biomedical Sciences	4(4-0-12)	108201 Microbiology or equivalent or Consent of the School	Studies in details on recent medically important microorganisms including bacteria, virus and fungi, new knowledge or changing in pathogenesis, drug resistance, modes of transmission and carriers. Emergent technologies for laboratory diagnosis and vaccine development.	1. describe in details of the knowledge of medically important microorganisms including bacteria, viruses and fungi, especially the up-to-date knowledge 2. evaluate the trends of infectious diseases, antimicrobial resistance patterns, transmission, and carriers 3. apply newly developed methods used to diagnose the causative microorganisms of infectious diseases and study microbiology
115744 Immunology in Biomedical Sciences	4(4-0-12)	108201 Microbiology or equivalent or Consent of the School	Studies in details about immunological system and mechanisms for protection from microbes, immune response to foreign substances, immunological tests, mechanisms of tissue damages, hypersensitivity, tumor, immunological disorder, autoimmunity, immunization, new technologies, such as nanomedicine and applied knowledge for diagnosis and treatments with immunotherapies.	1. understand the immune system and protective defenses from foreign particles and pathogens 2. apply new technologies used to examine the immunological reactions 3. analyze the mechanisms of tissue destruction, hypersensitivity, and diseases caused by immunological defects
Environmental Microbiology				

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108621 Environmental Microbiology	4(3-3-6)	108201 Microbiology and 104202 Microbiology Laboratory or Consent of the School	Relationship between microbial population and environmental factors in freshwater soil and atmosphere habitats; impact of some microorganisms on some habitats; microbial interaction with some inorganic and organic wastes; possibility of using of microorganisms in the control of pests and the treatment of wastes.	1. explain the relationship between microbial population and environmental factors in freshwater soil and atmosphere habitats 2. know and explain an impact of microorganisms on their surrounding habitat
108720 Aquatic Microbiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	Studies of microorganisms that are found in aquatic environments including marine and freshwater. Topics include microorganisms and water pollution, interactions between microbes and other aquatic organisms, pathogens in aquatic plants and animals, the chemical transformations caused by aquatic microorganisms which might affect the quality of water.	1. know the principles and theory of aquatic microbiology 2. explain an interaction between microbes and other aquatic organisms 3. explain an impact of microorganisms on aquatic habitat 4 .apply the basic knowledge of aquatic microbiology in daily life and scientific research
108721 Soil Microbiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	General principles of the significant roles of microbes in soil, the effect of their activities on the character of soil, the growth of plant and other soil organisms, their roles in biogeochemical cycling of elements.	1. know the principles and theory of soil microbiology 2. explain an interaction between microbes and other soil organisms 3. explain an impact of microorganisms on soil habitat 4. apply the basic knowledge of aquatic microbiology in daily life and scientific research

Courses		Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108722	Aeromicrobiology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	Studies of microorganisms that are found in atmospheric environments. Topics include a distribution of microorganisms in air, a role of atmospheric microorganisms, an effect of microorganisms in air pollution, as well as diseases caused by air-borne pathogens.	1. know the principles and theory of atmospheric microbiology 2. explain an impact of microorganisms on atmospheric habitat 3. apply the basic knowledge of aeromicrobiology in daily life and scientific research
Elective Courses					
205501	Entrepreneurship and Innovation	2(2-0-4)	Consent of the School	Study of entrepreneurship and innovation and technology business, open innovation, attitudes and motivation of innovative entrepreneurs and social entrepreneurs, characteristics of successful entrepreneurs, new venture process model generation and business plan, business frost & Sullivan feasibility and problems of ventures.	
Seminar, Special Problems, Special Topics and Thesis					
Seminar					
108781	Seminar 1	1(1-0-6)	None	Literature review and seminar presentation on specific topics in microbiology.	1. have skills to read academic papers 2. have skills to present academic papers 3. have skills in using information technology for searching data and presentation

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108782 Seminar 2	1(1-0-6)	Seminar 1	Literature review and seminar presentation on specific topics in microbiology.	1. improve skills to read academic papers 2. improve skills to present academic papers 3. improve skills in using information technology for searching data and presentation 4. have skill to write an abstract 5. understand basics in microbiology research
Special Problems and Special Topics				
108761 Special Problems in Microbiology	3(0-9-9)	108201 Microbiology or Equivalent, or Consent of the School	Research work on to be completed within one trimester on a specific topic on microbiology	1. improve skills in using information technology for searching data and presentation 2. design and carry out their own experiment in microbiology 3. apply scientific principles and methodologies in microbiology researches 4. select the appropriate tools, equipment and materials for the experiment 5. analyze, interpret and evaluate data from the experiment 6. debate and criticize the results from the experiment using microbiology knowledge 7. improve writing and presentation skills

Courses		Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108861	Special Problems in Agricultural, Food, and Industrial Microbiology	3(0-9-9)	108201 Microbiology or Equivalent, or Consent of the School	Research work on agricultural, food, and industrial microbiology to be completed within one trimester on a specific topic on agricultural, food, and industrial microbiology.	1. improve skills in using information technology for searching data and presentation 2. design and carry out their own experiment in agricultural, and/or food, and/or industrial microbiology 3. apply scientific principles and methodologies in agricultural, and/or food, and/or industrial microbiology researches 4. select the appropriate tools, equipment and materials for the experiment 5. analyze, interpret and evaluate data from the experiment 6. debate and criticize the results from the experiment using agricultural, and/or food, and/or industrial microbiology knowledge 7. improve writing and presentation skills
108862	Special Problems in Medical Microbiology	3(0-9-9)	108201 Microbiology or Equivalent, or Consent of the School	Research work in medical microbiology which can be completed within one trimester	1. searching problem in current medical microbiology and generate research topic 2. design experiments suitable for research problem solving 3. apply appropriate principles, instruments, methods, materials and chemicals for experiments 4. analyze, interpret and evaluate data from the experiments 5. solving problem and improve the experiment procedure 6. debate and criticize the experiment results using medical microbiology knowledge and other related knowledge 7. improve writing and presentation skills

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108863 Special Problems in Environmental Microbiology	3(0-9-9)	108201 Microbiology or Equivalent, or Consent of the School	Research work to be completed within one trimester on a specific topic on environmental microbiology	1. improve skills in using information technology for searching data and presentation 2. design and carry out their own experiment in environmental microbiology 3. apply scientific principles and methodologies in environmental microbiology researches 4. select the appropriate tools, equipment and materials for the experiment 5. analyze, interpret and evaluate data from the experiment 6. debate and criticize the results from the experiment using environmental microbiology knowledge 7. improve writing and presentation skills
108771 Special Topics in Bacteriology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	An assignment with presentation and discussion in the field of bacteriology, taken only through consultation with an assigned instructor. This selected topic varies depending on student selections and interests	1. have skills on presentations of selected special topics in the field of bacteriology 2. interpret and assess the data received from the special topics on bacteriology 3. discuss and criticize the data from the special topics
108772 Special Topics in Mycology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	An assignment with presentation and discussion in the field of mycology, taken only through consultation with an assigned instructor. This selected topic varies depending on student selections and interests	1. have skills on presentations of selected special topics in the field of mycology 2. interpret and assess the data received from the special topics on mycology 3. discuss and criticize the data from the special topics

Courses		Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108773	Special Topics in Virology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	An assignment with presentation and discussion in the field of virology, taken only through consultation with an assigned instructor. This selected topic varies depending on student selections and interests	1. have skills on presentations of selected special topics in the field of virology 2. interpret and assess the data received from the special topics on virology 3. discuss and criticize the data from the special topics
108774	Special Topics in Parasitology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	An assignment with presentation and discussion in the field of parasitology, taken only through consultation with an assigned instructor. This selected topic varies depending on student selections and interests	1. have skills on presentations of selected special topics in the field of parasitology 2. interpret and assess the data received from the special topics on parasitology 3. discuss and criticize the data from the special topics
108775	Special Topics in Immunology	3(3-0-6)	108201 Microbiology or Equivalent, or Consent of the School	An assignment with presentation and discussion in the field of immunology, taken only through consultation with an assigned instructor. This selected topic varies depending on student selections and interests	1. have skills on presentations of selected special topics in the field of immunology 2. interpret and assess the data received from the special topics on immunology 3. discuss and criticize the data from the special topics
Thesis					

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108798 M.Sc. Thesis Scheme A 1	48(0-0-0)	None	M.Sc. Thesis for Scheme A1	1. select, use and critically evaluate a variety of appropriate information sources for data searching and presentation 2. apply scientific principles and methodologies in thesis research 3. describe concepts in microbiology for questions or problems related to the thesis 4. demonstrate the skills required to plan, implement, draw conclusions, evaluate and report on a program of thesis 5. learn and follow ethical guidelines for working in microbiology 6. perform research that will create new knowledge 7. select the appropriate tools, equipment and materials for the experiment 8. analyze, interpret and evaluate data from the experiment 9. debate and criticize results from the experiment using knowledge in microbiology 10. communicate effectively in written and oral formats, as well as, appropriate graphical style 11. prepare and present scientific reports according to professional standards 12. work independently and as part of an ability-developing team to work autonomously

Courses	Credit (Lect.-Lab-Self stud.)	Prerequisite	Course Description	Expected Learning Outcomes
108799 M.Sc. Thesis Scheme A2	18(0-0-0)	None	M.Sc. Thesis for Scheme A2	1. select, use and critically evaluate a variety of appropriate information sources for data searching and presentation 2. apply scientific principles and methodologies in thesis research 3. describe concepts in microbiologyfor questions or problems related to the thesis 4. demonstrate the skills required to plan, implement, draw conclusions, evaluate and report on a program of thesis 5. learn and follow ethical guidelines for working in microbiology 6. perform research that will create new knowledge 7. select the appropriate tools, equipment and materials for the experiment 8. analyze, interpret and evaluate data from the experiment 9. debate and criticize results from the experiment using knowledge in microbiology 10. communicate effectively in written and oral formats, as well as, appropriate graphical style 11. prepare and present scientific reports according to professional standards 12. work independently and as part of an ability-developing team to work autonomously