POSTGRADUATE INSTITUTE OF SCIENCE

UNIVERSITY OF PERADENIYA

Master of Medical Microbiology Degree Programme
(SLQF Level 9)

Master of Science (M.Sc.) in Medical Microbiology Degree Programme
(SLQF Level 10)

1. INTRODUCTION

Human infections remain a common cause of morbidity and mortality in Sri Lanka and the rest of the world. Immunization, the availability of antibiotics and improved standards of living has caused an appreciable reduction in several important and previously common infectious diseases. However, vaccines and effective antimicrobial agents are still not available for many viral, bacterial, fungal and parasitic diseases which continue to affect millions of human beings every year. In addition, the emergence of multi-resistant microbes has reduced the effectiveness of many currently available antimicrobial agents. Newly emerging infections, travel associated infections and the treat of bioterrorism bring fresh threats to human beings throughout the world. Effective control of infective diseases requires a multi-pronged approach, central to which is the availability of a network of efficient and reliable microbiology diagnostic and reference laboratories.

The establishment and running of diagnostic and research laboratories requires persons trained in laboratory methodology, including molecular techniques which are being increasingly used for diagnostic and epidemiological purposes. Laboratory personnel also require training in laboratory management and competence in using information technology for accurate record keeping, archiving and analysis of data.

2. AIMS

(i) The postgraduate training programme in medical microbiology aims to produce scientists ready to apply modern methods of diagnosis of infective diseases caused by viruses, bacteria, fungi and other parasites.
(ii) These scientists will be able to pursue a career in research or in diagnostic microbiology

3. LEARNING OBJECTIVES

On completion of the course, the successful candidates shall have achieved the following overall objectives:

(i) A knowledge of the morphology, genetics, growth characteristics, laboratory identification, habitat, transmission and pathogenicity of viruses, bacteria, fungi and parasites commonly associated with human infections.

(ii) Acquired practical skills in the laboratory diagnosis of human infections caused by viruses, bacterial, fungi and other parasites

(iii) An understanding of the applications of molecular biology in the diagnosis of human infections

(iv) Understood the safety and public health aspects of virus, bacterial, fungal and other parasitic infections and the principles of prevention and control

(v) Acquired the knowledge and skills required to establish and manage a diagnostic microbiology laboratory

(vi) Understood current trends in medical microbiology and be able to critically appraise published work

(vii) Be able to communicate information clearly, both verbally and in writing

(viii) Demonstrate an ability to design, undertake and interpret a research project and present it in the form of a dissertation

4. PROGRAMME ELIGIBILITY

Candidate having a Bachelor's Degree in Biological, Medical, Veterinary, Dental or Agricultural sciences from a recognized University or equivalent qualifications acceptable to the PGIS are eligible to enroll in the programme. The final selection will be made according to the selection procedure stipulated by the Postgraduate Institute of Science. Employed candidates who are eligible for admission should produce evidence of leave granted to follow the programme and a letter of release from the Head of the relevant Department/Institution.

5. PROGRAMME FEE

Category	**Programme Fee**	
	Master of Medical Microbiology Degree Programme	**M.Sc. in Medical Microbiology Degree Programme**
Local candidates	Rs.225,000/- (1 year)	Rs.325,000/- (2 years)
Foreign candidates	Rs.450,000/- (1 year)	Rs.650,000/- (2 years)

Students registered for the Master of Medical Microbiology degree programme shall pay the Programme fee in full or in two *(1/2 at the registration and the balance at the end of the first semester)* or three *(1/3rd at the registration, another 1/3rd after 4 months from the date of registration and the balance after 8 months from the date of registration)* installments. An additional payment of Rs. 100,000/- (or Rs. 200,000/- form foreign students) should be made at the end of the first year to continue for the M.Sc. in Medical Microbiology degree programme. Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS. (N.B. The Programme fees given above may be revised as per recommendation of the Board of Management of the PGIS.)

6. THE PROGRAMME STRUCTURE AND DURATION

6.1 Masters Degree by Course Work (SLQF Level 9)

The Master of Medical Microbiology degree can be obtained by completing only the course work component.

Course work, comprising of theory courses, laboratory and/or fieldwork and an independent study, shall be conducted over a period of two semesters of 15 weeks each. The total duration of the degree, including examinations, shall be about 12 months. Satisfactory completion of a minimum of 30 credits of course work with a GPA of not less than 3.00 is required for the successful completion of the degree (Students who do not satisfy the above criteria but obtain a GPA in the range 2.75 to 2.99 for course work of 25 credits are eligible for the Postgraduate Diploma in Medical Microbiology, and those who obtain a GPA in the range 2.75 to 2.99 for course work of 20 credits are eligible for Postgraduate Certificate).

6.2 Masters Degree (SLQF Level 10)

Completion of 30 credits of Course work as stated in 6.1 with a GPA of not less than 3.00 is a prerequisite for the Masters Degree by Course work and Research. The research project for the degree should be conducted on full-time basis, and completed during the second year. The research component is allocated 30 credits, totaling 60 credits for the entire programme. Therefore, duration of the entire programme shall be 24 months. After successful completion of the research project, the student shall be eligible for the award of the M.Sc. in Medical Microbiology degree - SLQF Level 10 (Students who do not complete the research project within the stipulated time period shall be awarded the Master of Medical Microbiology degree - SLQF Level 9).

6.3 Extension of the programme for M.Phil. or Ph.D.

After conducting research for a period of six months in the M.Sc. degree programme under 6.2, students who have demonstrated exceptional progress may apply for upgrading the degree status to M.Phil. The student should continue the research project and any additional research work/assignments recommended by the PGIS for a total of two years (60 credits of research) to qualify for the award of the M.Phil. degree.

During the second year of research, students who have demonstrated exceptional and continuous progress may apply for upgrading the degree status from M.Phil. to Ph.D. The student should continue the research project and any additional research work/assignments recommended by the PGIS for another year on full-time basis (to complete 90 credits of research in total) to qualify for the award of the Ph.D. degree.

The Masters degree (by course work) programme comprises the following:

1. ***Preliminary courses*** **–** The students are strongly advised to follow the preliminary courses even though they are not considered in the computation of the final GPA. The preliminary courses will not necessarily be conducted at the beginning of the programme.
2. ***Core courses*** – These courses deal with General and Molecular Microbiology and Laboratory management and are compulsory for all students (8 credits).
3. ***Medical Courses*** **–** These courses deal with different aspects of Medical microbiology and will be compulsory for all students (16 credits).
4. ***Independent study*** with a dissertation and a seminar presentation (5 credits).

Students can opt to follow any of the optional courses to complete 30 credits for the course work.

Programme Summary				
Course Code	**Course Title**	**Lecture hrs.**	**Practical hrs.**	**No. of Credits**
Preliminary courses				
PLS 551	* Basic Statistics	10	15	Non-credit
PLS 552	** Scientific writing and presentation skills			Non-credit
Semester I				
Core-courses				
PLS 556	General Microbiology	30	30	3
PLS 557	Laboratory management I	3	24	1
PLS 558	Recombinant DNA Technology	15	30	2
Medical courses				
PLS 566	Bacteriology I	20	50	3
PLS 567	Bacteriology II	20	50	3
Semester II				
Core-courses				
PLS 559	Applied Molecular Biology	15	30	2
Medical courses				
PLS 568	Virology	20	20	2
PLS 569	Mycology	10	40	2
PLS 570	Parasitology	15	30	2
PLS 571	Diagnostic Microbiology	15	60	3
PLS 572	Laboratory management II	5	20	1
PLS 573	*** Immunology	10	10	1
PLS 574	*** Public Health Microbiology	10	10	1
PLS 575	*** Antibiotics	05	10	1
Other courses				
PLS 599	Independent Study	500 notional hours		5
Second Year				
PLS 699	Research Project	3000 notional hours		30

* *Equivalent to PLS 402 (requires a minimum of a 'C' grade)*
** *General course offered by the PGIS*
*** *Optional courses*

7. PROGRAMME CONTENTS

Course code	PLS 599
Course title	Independent Study
Credits	05
Compulsory/optional	Compulsory
Prerequisites	PLS 551 and PLS 552 can be taken concurrently
Time allocation	500 notional hrs.
Aims	Aims: The overall aim is to familiarize the student with concepts and methods involved in scientific research and critically review literature on a selected topic in the discipline of Medical Microbiology. **Specific aims:** 1. To learn the scientific process in the conduct of research. 2. To develop skills to write a review paper and a scientific research proposal. 3. To develop skills to make a presentation. 4. To master the application of statistical methods on quantitative scientific data.
Intended learning outcomes	At the end of the successful completion of the course, students will be able to, 1. Conduct an independent review of literature on a selected topic in the area of Medical Microbiology and Infectious Diseases. 2. Write a formal scientific report conforming to the guidelines provided. 3. Transfer the knowledge gained through (2) and (3) above in the form of a presentation. 4. Complete a research proposal conforming to the guidelines provided. 5. Perform statistical analysis of quantitative data.
Time allocation	500 h
Content	***Review paper***: Review of literature; Development a review paper in a systematic/concise manner and logical presentation of results from previously published work, writing the abstract, compilation of references. ***Proposal writing***: Interpretation and critical evaluation of results of published research; Formulation of a research question: Concise literature review, justification, time line, identification of resources, budgeting if necessary. ***Project***: Collection and statistical analysis of data on a topic associated with the review paper. ***Seminar***: Presentation of literature and previously published data collected on a given topic; Preparation of an abstract, preparation of MS Power Point slides.

Assessment criteria: Continuous Assessment

Component	Review paper	Proposal writing	Project	Seminar
% marks	20	10	40	30

Recommended Texts:

1. Backwell, J., Martin, J. (2011) A Scientific Approach to Scientific Writing, Springer.
2. Postgraduate Institute of Science (2019) Guidelines for Writing M.Sc. Project Report/M.Phil. Thesis/Ph.D. Thesis.

Course code	PLS 699
Course title	Research Project
Credits	30
Compulsory/optional	Compulsory
Prerequisites	GPA of 3.00 at M.Sc. (Course work)
Time allocation	One year (3000 notional hrs.)
Aims	**Aims:** The overall aim is to prepare the student to conduct a research independently. Each student is required to conduct and complete a research project on a topic falling within the discipline of Medical Microbiology. **Specific aims:** 1. To train students to apply scientific method in scientific research. 2. To train students to generate researchable hypotheses. 3. To train students to plan, design and conduct scientific research. 4. To gather reliable scientific data, analyse, and interpret. 5. To develop skills in scientific writing.
Intended learning outcomes	At the end of the successful completion of the course, students will be able to, 1. Apply the scientific method. 2. Design a research project. 3. Complete a research project. 4. Describe ethical issues in scientific research (There are no formal lectures related to this aspect. However, ethical issues are taught and discussed in workshops conducted by the PGIS for which participation is required). 5. Explain the patenting process in research (There are no formal lectures related to this aspect. However, patenting process is taught and discussed in workshops conducted by the PGIS for which participation is required). 6. Make presentations at national/international conferences. 7. Produce a thesis conforming to the requirements of the PGIS. 8. Write manuscripts for publication in refereed journals.
Content	The students will conduct sufficient amount of laboratory/field work on a chosen research topic under the guidance provided by an assigned supervisor/s, make a presentation of research findings at a national/international conference, and produce a thesis.

Assessment criteria

Continuous assessment	End-semester examination
30%	Oral examination - 20% Thesis - 40% Conference presentation - 10%

Recommended Texts:

1. Backwell, J., Martin, J. (2011) A Scientific Approach to Scientific Writing, Springer.
2. Postgraduate Institute of Science (2019) Guidelines for Writing M.Sc. Project Report/M.Phil. Thesis/Ph.D. Thesis

PROGRAMME CONTENTS OF OTHER COURSES

PLS 551: Basic Statistics

(Non Credit: Lectures and Laboratory)

Population and sample; Measures of central tendency and dispersion; Sampling distribution of mean; Introduction to probability; The Z distribution and calculation of probabilities; Principles of hypothesis testing, Type I and II errors, power of test; Two sample paired and non-paired 't' test; Simple linear regression and correlation; Analysis of 2-dimensional categorical tables (chi-square test).

PLS 552: Scientific writing and Presentation skills

(*General course offered by the PGIS*)

Structure/layout of the Project Report, Title and Abstract, Introduction and Bibliography, Computer aided literature survey, Experimental Materials and Methods, Results/Discussion and Conclusion, Problems in report writing and presentation.

PLS 553: Independent Study

(Non Credit)

Students will critically review literature on a selected topic from the course units offered. A written report and an oral presentation are expected at the conclusion of the study.

PLS 556: General Microbiology

(3 Credits: Lectures and laboratory)

Introduction to Microorganisms: The common attributes and differences (diversity), discovery, early studies and pioneering microbiologists, usefulness in other areas of science, occurrence and importance. **Scope of microbiology**: Based upon the organisms – Virology, Bacteriology, Protozoology, Phycology, Mycology and Microparasites. Based upon applied fields – Agricultural microbiology, Environmental microbiology (water, waste, soil etc.), Exomicrobiology (microbes in outer space), Food microbiology (post harvest technology), Geochemical microbiology (fossil fuel energy), Industrial microbiology, Medical microbiology, Microbial biotechnology and Pathology.

Study of microorganisms: Microscopy – Compound, Oil immersion, Ultra-violet, Dark field, Phase contrast, Fluorescence and Immuno-fluorescence, Scanning and transmission electron microscopy. Sterile techniques, culturing of microorganisms, isolation, purification, characterization (morphological, physiological, biochemical and serological) and identification. Application of modern techniques based upon molecular characterization of proteins and nucleic acids. Classification – Position among major kingdoms, uncertainties and controversies. **Major groups**: Viruses, Mycoplasmas, Rickettsiae and Chlamydiae, Bacteria, Cyanobacteria (blue-green algae), Micro-algae, Fungi and Protozoa. **Growth, Development and Reproduction:** Population curves, limiting factors, methods of reproduction and perennation. **Genetics of microorganisms**

PLS 557: Laboratory Management I

(1Credit: Lectures and laboratory)

Calibration and maintenance of equipment; Safety and occupational Health in a Microbiology Laboratory; Principles of safety; safety cabinets – use and maintenance; immunization; incident report and action

PLS 558: Recombinant DNA Technology

(2 Credits: Lectures and laboratory)

Function of DNA and RNA, Introduction to gene cloning, Bacterial chromosome, episomes and plasmids, extraction of genomic DNA and plasmids, restriction enzymes, cloning vectors, DNA amplification by PCR, manipulation and transformation, expression of recombinant genes in microbial system, isolation and purification of recombinant clones, screening of recombinants, probes, Identifying, Analyzing and

Sequencing cloned DNA, Enzymes in cloning, Application of Recombinant DNA Technology, DNA fingerprinting.

PLS 559: Applied Molecular Biology

(2 Credits: Lectures and laboratory)

Genomics: Genome structure and organization, Gene expression of Prokaryotes and Eukaryotes, construction of genomic and cDNA libraries, screening libraries. Proteomic analysis: 1D & 2D gel electrophoresis, Immunoblotting, hybridization, Blotting techniques, MALDI-TOF MS (Matrix Assisted Laser Desorption Ionization-Time Of Flight- Mass Spectrometry), RFLP (Restriction Fragment Length Polymophism), AFLP (Amplified Fragment Length Polymorphism) and RAPD (Random Amplified Polymophic DNA). Nutrigenomics (Nutritional Genomics): Connection between human genetic diversity and nutrition. Bioinformatcs: application in molecular biology databases of biological information, Sequence analysis, structure and alignment of nucleic acids & proteins using data banks -NCBI, EMBL, Swiss-Prot, Protein structure and function-prediction.

PLS 566: Bacteriology I

(3 Credits: Lectures and laboratory)

Bacterial morphology, classification and methods of visualizing bacteria as applied to bacteria causing human disease; Micrometry and enumeration of bacteria; Bacterial habitat, transmission and pathogenicitiy; Koch's postulates and proof of causation of disease; Bacterial isolation and principles of identification; Bacteria of clinical importance with emphasis on laboratory identification : Gram positive cocci; Gram negative cocci; Gram positive bacilli; Parvobacteria

PLS 567: Bacteriology II

(3 Credits: Lectures and laboratory)

Bacteria of clinical importance with emphasis on laboratory identification : Enterobacteria; Anaerobes; Mycobacteria; RIckettsiae; Chlamydia; Mycoplasma;
Antibiotics and antibiotic susceptibility testing; Testing for resistance mechanisms

PLS 568: Virology

(2 Credits: Lectures and laboratory)

Viral structure, classification and growth characteristics ; methods of identification of viruses; Viruses of clinical importance in human disease; diagnosis of viral infections in diagnostic laboratories; prevention of viral infections and relevance to diagnostic laboratories; antiviral agents and their mode of action

PLS 569: Mycology

(2 Credits: Lectures and laboratory)

Morphology, classification and growth characteristics of fungi of clinical importance; Isolation and identification of fungi of clinical importance; antifungal agents and their mode of action

PLS 570: Parasitology

(2 Credits: Lectures and laboratory)

Aetiology, pathogenesis, clinical presentation, diagnosis, epidemiology and prevention of parasitic diseases with particular emphasis on those commonly occurring in Sri Lanka; Diagnosis of parasitic infections. Life cycles, breeding habits and biology relating to disease causation or transmission of medically important arthropods; Identification of medically important arthropods, with emphasis on those prevalent in Sri Lanka.

PLS 571: Diagnostic Microbiology

(3 Credits: Lectures and laboratory)

Specimen collection and transport; processing of specimens in clinical laboratories ; reporting; turn around time; confidentiality; Data storage and retrieval; Archiving; Diagnostic molecular methods for infective diseases; Malaria, Molecular entomology:

PLS 572: Laboratory management II

(1 Credit: Lectures and laboratory)

Quality assurance; Accreditation – national and international standards (ISO); Administration, finance, human resources in laboratory management; audit in the laboratory

PLS 573: Immunology

(1 Credit: Lectures and laboratory)

The cells and molecules of importance in the immune response; Components of the immune response in terms of the innate and adaptive response; Antigen specificity; Immune protection, immunopathology and immune-diagnostics; Laboratory techniques using immune specificity and laboratory testing of the immune system.

PLS 574: Public Health Microbiology

(1 Credit: Lectures and laboratory)

General principles, methods and applications of public health microbiology; Outbreak investigations measures of disease frequency and other relevant variables including disease screening and surveillance; Foundations of public health surveillance systems for communicable and other diseases; Management of emerging infections from a public health and laboratory standpoint, including biosafety and strategies for emergency preparedness.

PLS 575: Antibiotics

(1 Credit: Lectures and laboratory)

Classes of antimicrobial agents and their mechanisms of actions and common uses; Testing for antimicrobial susceptibility using standardized and comparative methods; Determination of minimum inhibitory concentrations; Antimicrobial resistance; Epidemiology, Factors promoting the emergence and preventive measures: Screening for antimicrobial activity of novel compounds.

8. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Handbook.

9. PANEL OF TEACHERS

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RECOMMENDED REFERENCES

1. Ash L. A. and Oriel T.C. A Guide to Laboratory procedure and Identification. American Society of Clinical Pathologists. Chicago – More Advanced Edition
2. Atlas R. Principles of Microbiology, Mosby Publishers – More Advanced Edition
3. Attwood T. K. and Parry-Smith D. J. Introduction to Bioinformatics. Henry Ling Limited, Dorset Press, Great Britain – More Advanced Edition
4. Brown T.A. Genetics: A Molecular Approach, Stanley Thornes Publishers Ltd. – More Advanced Edition
5. Cheesbrough Monica. Medical Laboratory Manual for Tropical Countries. Vol: 1 &11, Butterworth- Heinmann Ltd. Oxford – More Advanced Edition
6. Cook G. Manson's Tropical Diseases, WB Saunders – More Advanced Edition
7. Fleck S. L. and Moody A. H. Diagnostic Techniques in Medical Parasitology. University Press, Cambridge – More Advanced Edition
8. Garcia, Lynne Shore. Clinical Laboratory Management. LSG and Associates – More Advanced Edition
9. Griffiths A. J. F., Miller J. H., Suzuki D. T., Lewontin R. C. and Gelbert W. M. An introduction to genetic analysis. W.H. Freeman and Company, New York – More Advanced Edition
10. Isenberg, Henry D. (editor). Clinical Microbiology Procedures Handbook – More Advanced Edition
11. Laboratory Biosafety Manual WHO Geneva – More Advanced Edition
12. Larone Davise H. Medically important fungi: a guide to identification. ASM Publications

– More Advanced Edition
13. Lim D. Modern Microbiology. WCB/MacGraw Hill – More Advanced Edition
14. Lodish H., Baltimore D., Berk A., Zipursky S.L., Matsudaira P. and Darnell J. Molecular Cell Biology Scientific American Books Inc – More Advanced Edition
15. Madigan M.T., Martinko J.M. and Parker J. Brock Biology of Microorganisms (8th ed). Prentice Hall – More Advanced Edition
16. Murray Patrick R. Manual of Clinical Microbiology – More Advanced Edition
17. Old R.W. and Primrose SB. Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Science Ltd, Australia – More Advanced Edition
18. Persing D. H., Tenover F.C., Versalovic J., Tang Yi-Wei, Unger E. R., Relman D.A. and White, T. J. Molecular Microbiology: Diagnostic Principles and Practice. ASM Publications – More Advanced Edition
19. Sambrook J, Fritsch E. F. and Maniatis T. Molecular Cloning: Laboratory Manual. Coldspring Harbour Laboratory Press, USA – More Advanced Edition
20. Snustad D. P. and Simmons M. J. Principles of Genetics, John Wiley and Sons Inc. New York – More Advanced Edition
21. Specter Steven, Hodinka Richard L and Young A. Stephen. Clinical Virology Manual – More Advanced Edition
22. Walker J. M. & Gingold E. B. Molecular Biology and Biotechnology. The Royal Society of Chemistry – More Advanced Edition
23. WHO Bench Aids for diagnosis of malaria. Geneva – More Advanced Edition
24. WHO Manual of Basic techniques for a Health laboratory. Geneva – More Advanced Edition

Journals

Annales de l'Institut. Pasteur (French)
Annual Review Microbiology
Applied Microbiology
Bacteriology Reviews
Clinical Infectious Diseases - USA
Journal of Bacteriology
Journal of General Microbiology
Journal of Infectious Diseases
International Journal of Infectious Diseases
Virology
Journal of Virology
Journal of Medical Virology
Virology Journal
Journal of Medical Microbiology
Infection and Immunity – Cambridge Press, UK
Epidemiology and Infection
Mikrobiologia (English translation of Russian)
Reviews of Clinical Microbiology - USA
Southeast Asian Journal of Tropical Medicine - Bangkok
Transactions of the royal Society of Tropical Medicine & Hygiene – Oxford Press, UK
American Journal of Tropical Medicine & Hygiene - USA
World Journal of Applied Microbiology and Bacteriology

Web sites

1. http://www.who.ch.- World Health Organization
2. http://www.ncbi.nlm.nih.gov/PubMed- PubMed -Medline on the Web.
3. http://www.cdc.gov- US Centres for Disease Control (Atlanta)
4. http://www.who.int/emc/- WHO Communicable Disease Surveillance and Response

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