MBB/HSCI 478-3: Molecular Epidemiology of Infectious Disease

Pre or Co-requisites: MBB 331 or HSCI/MBB 326 with a minimum grade of C, or HSCI 338 with a minimum grade of C-. Students with credit for HSCI 478 may not complete MBB 478 for further credit.

Final Exam: In person during the final exam period

COURSE DESCRIPTION: This senior seminar course will provide a broad overview of the application of modern molecular and genomics methods to infectious disease epidemiology. Topics will include the identification, classification, characterization, and monitoring of pathogens in human populations; the application of molecular methods to screening, prevention and treatment of infectious diseases; and the analysis of molecular and genomics data for disease. Globally relevant diseases will be highlighted.

The SFU Calendar describes the course as follows: Application of modern molecular methods to epidemiological questions. Globally relevant and emerging infectious diseases will be highlighted. Students with credit for HSCI 432 in 2010 may not complete HSCI 478 for further credit.

COURSE OBJECTIVES:
By the end of the course, students will have a strong foundational knowledge of molecular and genomic epidemiology methods, the distribution of host and pathogen genetic diversity in populations, and an understanding of how genetic factors influence disease risk and outcomes. The assignments for this course will provide students with the opportunity to develop, or hone, their presentation skills, their ability to perform primary literature searches, as well as improve their reading, interpreting, critiquing and summarizing of primary research articles. Hands-on computational data analysis assignments are designed to show students state-of-the-art genomic epidemiology analytic solutions.

- Explain the techniques and applications of modern laboratory methods, including phylogenetic analyses, to the identification, surveillance, prevention, and treatment of infectious diseases
- Describe how host and pathogen genetic variation is distributed globally and enumerate examples of how such variation influences disease acquisition risk and disease outcomes
- Explain how information on pathogen genetic variation is (and can be) incorporated in the design of intervention strategies (e.g.: vaccines, therapeutics)
- Conduct basic literature searches
- Conduct basic genomic epidemiological data analysis
- Demonstrate competence in reading, interpreting and critiquing primary research articles and present the material in an accessible manner

CORE COMPETENCIES:
Molecular Methods for Microbial Typing – Primary
Microbial Phylogenetics and Phylogenomics – Primary
Basic Molecular and genomic Epidemiology – Primary
Public Health Microbiology - Primary
Molecular Biology – reinforced
Microbial Population Genetics – reinforced

TEACHING FORMAT: There will be one 3-hour class each week that will include a lecture by the course instructor or guest lecturer, discussion, in-class activities and/or student presentations.

REQUIRED TEXT: None.

Required readings will be in the form of primary and review articles in scientific journals. These will be made available on Canvas prior to the lecture. This will include PowerPoint versions of the lectures, links to online materials, announcements, and other information. PowerPoint versions of the lectures will be provided by 5pm the day before the lecture. Please check Canvas on a regular basis to ensure you have updated course information.

ASSESSMENTS AND GRADING:

This course comprises a combination of lectures, demoes, in class and online discussions. Six in class short quizzes (2-3 questions / 15 min) at the beginning of the classes (see dates below) are designed to help you keep up with the material. Three take-home computational assignments are designed to help you learn hands-on genomic epidemiology analysis.

1. Assignment #1: Molecular Typing – in-silico MLST

2. Assignment #2: Genomic Variant Analysis - SNP

3. Assignment #3: Genome-wide Association Study

3. Oral Presentation: Peer-reviewed paper related to modern molecular or genomic epidemiology 3-4 min per person on a paper in a

4. Quizzes:
The quizzes will cover material presented in the preceding one or two weeks (non-cumulative) to help you demonstrate your understanding of the course concepts. The test will consist of multiple choice and true/false.

5. Final Exam
The final exam will be based on all course lectures and readings. The exam will consist of short and long answer questions.

6. Mark Breakdown

6 Quizzes (5% each) - missing quizzes count towards final – 30%
3 x Genomic Epi Data Analysis Assignments (10% each) - 30%
Final Exam – 30% (up to 60% if there are missing quizzes)
Participation – 10%

COURSE SCHEDULE:
Please complete the assigned readings before each class as lectures will be presented based on the assumption that you have read these materials.

Class Schedule:

Date (week)	**First Half (2:30-3:45)**	**Second Half (4:00-5:20)**
September 12 2022	**1a Welcome**	**1b Introduction to Molecular Epidemiology**
September 19 2022	**2a Pathogen Evolution - bacterial**	**2b Pathogen Evolution - viral**
September 26 2022	**3a Population Genetics Discussion**	**3b Host Variations and Immunity**
October 3 2022	**Quiz 1 (5%) Population Genetics** **4a Traditional Molecular Epidemiology Techniques**	**4b Modern Molecular Epidemiology Techniques** **Assignment 1 (Molecular Typing Using in-silico MLST)**
October 10 2022 (Thanksgiving)	**No Class**	**No Class**

October 17 2022	**Quiz 2 (5%) Molecular Epi Techniques** **5a Phylogenetic Analysis**	**5b Phylogenetic Analysis Discussion and Demo**
October 24 2022	**Quiz 3 (5%) Phylogenetics** **6a Genomic Epidemiology**	**6b Genomic Epidemiology Discussion and Demo** **Assignment 2 (Genomic Epidemiology - SNP)**
October 31 2022	**7a Genomic Epidemiology of MTB**	**7b Genomic Epidemiology of MTB Discussion**
November 7 2022	**Quiz 4 (5%) Genomic Epi (6a+7a)** **8a Genomic Epidemiology of Foodborne Pathogens**	**8b Genomic Epidemiology of Foodborne Pathogens Discussion**
November 14 2022	**9a Bacterial GWAS**	**9b Bacterial GWAS Discussion and Demo** **Assignment 3 (Bacterial GWAS)**
November 21 2022	**Quiz 5 (5%) Bacterial GWAS** **10a Genomic Epidemiology of Influenza Viruses**	**10b Genomic Epidemiology of Influenza Viruses Discussion**
November 28 2022	**Quiz 6 (5%) Genomic Epi of Influenza** **11a Genomic Epidemiology of SARS-CoV-2 Virus**	**11b Genomic Epidemiology of SARS-CoV-2 Virus Discussion**
December 5 2022	**12a Future of Genomic Epidemiology**	**Course Feedback and Exam Review**

NOTE: The instructor may make changes to this syllabus if necessary, within Faculty/University regulations. This includes the possibility of scaling final grades, if they are too high or too low, to meet FHS and SFU grading guidelines.