

# **BMM 407**

## **Methods to Diagnose Diseases**

### **Syllabus Fall 2024**

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#### **Course Introduction**

**Course Title: Methods to Diagnose Diseases**

**Subject Code and Course Number:** BMM 407 (former BIOC 407)

**Credit Hours:** 2

#### **Prerequisite Courses**

BMM 235, Introduction to Molecular Medicine (former BIOC 235);

prior or concurrent Introduction to Biochemistry: BMM 339 (former BIOC 339) or AGBI 410

#### **Instructors**

Peter Stoilov, PhD, Associate Professor, Department of Biochemistry, School of Medicine

#### **Day and Time**

Time: Thursday 10:00 am - 11:40 am (see the schedule at the end of this syllabus);

Room: BMRFH (HSC-Erma Byrd) 101.

Class meets once a week.

#### **Course Description**

The course is an introduction to the principles governing the development and use of molecular methods for clinical testing in modern science-based medicine. The students will learn how advanced clinical tests derive from basic research, how these tests are developed to produce reliable results, and how the outcomes of testing are interpreted. To illustrate these points the course will follow step-by-step the development of a test for an infectious disease based on nucleic acid amplification. The course will explore common and modern approaches used in clinical testing, including enzymatic assays, immunoaffinity assays, cytology, and next generation sequencing. Students will be exposed to experiment design and will learn to interpret and analyze data. Students who wish to pursue healthcare careers or are interested in biomedical research and the causes and treatment of diseases will benefit from the course.

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#### **Faculty Contact Information**

Peter Stoilov, PhD

Professor

Department of Biochemistry and Molecular Medicine

School of Medicine

WVU

HSC-N 3131

Phone: 304-293-6334

Email: pstoilov@hsc.wvu.edu

**Office Hours:** upon request

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## Instructional Materials

**Course website:** A course website will be maintained on the SOLE site of the WVU Health Sciences Center (<http://sole.hsc.wvu.edu>) where all the resources and files related to the course will be available.

**Recommended/optional:** tentative

Hofmann, A., & Clokie, S. (Eds.). (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge: Cambridge University Press. doi:10.1017/9781316677056

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## Course Learning Outcomes:

The Molecular Medicine Minor program outcomes are:

- A. Explain the “big picture” concept of molecular medicine, both in terms of current use and future potential;
- B. Explain how scientists deal with terabytes of genomic information to understand disease;
- C. Apply a knowledge of molecular medicine to the etiology, diagnosis, prevention, and treatment of disease;
- D. Analyze molecular mechanisms that are associated with aging and disease processes that are inter-related with human aging;
- E. Demonstrate analytical skills and teamwork during real bench research in active laboratories.

These program learning outcomes are reflected in the course learning outcomes. Upon completion of this course, students will be able to:

1. Describe the scientific foundation and principles underlying clinical tests. (A, B, C)
2. Describe the approaches and procedures that ensure reliability of clinical tests. (A, C)
3. Interpret and critically evaluate results and data from clinical tests taking into account the test specificity, selectivity, and precision in the context of the frequency of disease among the population. (B, C)
4. Describe whole-genome approaches to study and diagnose diseases and the challenges in analyzing large datasets. (A, B, C)
5. Locate and critically assess information in the scientific literature. (A, C)

## Assessment

### Expected Timeline of Major Assessments and Assignments

Block 1 will comprise weeks 1-6 of the course, block 2 will comprise weeks 6-14. Each week the topic will be introduced by a didactic lecture. During most weeks students will be asked to complete an assignment based on the didactic material. Knowledge of the material covered in each block will be assessed by block exams in an open notes format taken in class.

**Assignments.** There will be eight assignments issued throughout the course. Students will have one week to complete the assignment. The turned in assignments will be discussed at the beginning of class in the week they are due. The assignments and the associated discussions will reinforce the didactic material, provide a platform for active learning, and allow the students to apply what they have learned.

Participation in discussion of the assignments will be assessed by the instructor and incorporated in the score for each assignment accounting for total of 30% of the maximum score. The participation will be assessed based on the following rubric:

Criteria	Needs Improvement	Satisfactory	Good	Excellent
Frequency and quality of participation	Needs prompting to participate, not engaged, answers show minimal effort.	Participates occasionally, provides comments related to the discussion, asks questions.	Participates often, asks relevant questions, provides answers and examples for clarification.	Participates often, able to answer questions and make connections between ideas, prompts further discussion and expands the understanding of all participants.
Command of material	Shows gaps in knowledge.	Displays good grasp of the material discussed.	Demonstrates mastery of the material, able to summarize the material and connect ideas.	Statements, questions and opinions show in-depth understanding of key concepts and

				provide insight and perspective.
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**Group Project.** Students will need to complete one group project. The class will be split in small groups depending on class size and each group will be assigned a topic based on the material taught in Blocks 1 and 2. The students will be given a task to design a clinical test for a virus. To facilitate the project development the last part of the course and associated assignments will be dedicated to developing the course project.

Criteria	Needs Improvement	Satisfactory	Excellent
Subject knowledge	Limited understanding of the diagnostic methods discussed.	Knowledge of the main steps of the diagnostic methods and understanding of appropriate controls.	In-depth knowledge of the principles of the diagnostic methods, detailed knowledge of the procedures, and awareness of limitations in their use.
Contribution to the group effort	Minimal effort to complete the tasks assigned.	Satisfactory and timely completion of assigned tasks.	Consistent effort to complete assigned tasks, organization of the group activity, provides motivation and help to others.

**Weight/Distribution of Course Points:**

Assignments (7 x 20)	140 (70% of final grade)
Group project (1 x 20 points)	20 (10% of final grade)
Block exams (2 x 20 points)	40 (20% of final grade)

**Total points                    200**

**Final Grade Assignment**

Letter Grade	Percent of Total Points	Points
A	90 - 100%	180 and above

B	80 – 89%	160-179
C	70 – 79%	140-159
D	60 – 69%	120-139
F	<60%	Below 120

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## Course and Institutional Policies

### Attendance Policy

Students are expected to attend the lectures, assignment discussion and final project presentation. Participation in the assignment discussions is part (30%) of the grade for each assignment. Students with a legitimate reason to miss a class should inform the instructors in advance and work with them to make up the assignments.

### Late and Make-up Assignments and Exams

Students who miss class will only be able to make up an assignment and exams if they have a legitimate reason and have informed the instructor about the absence in a timely fashion. The group project will be presented in class. Students who have a legitimate reason to miss class when these projects are due should inform the instructor in advance about their absence and will have the possibility of either rescheduling the presentation (time-permitting). Block exams will be completed in class and absence from the exam will result in 0 points. Assignments missed without informing the instructor about the absence or with no legitimate reason will result in 0 points.

### Inclusivity

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with the Office of Accessibility Services.

More information is available at the Division of Diversity, Equity, and Inclusion website as well.

### Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University [Academic Standards Policy](#). Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

## Mental Health Statement

Mental health concerns or stressful events can adversely affect your academic performance, social relationships and quality of life. WVU's BeWell office offers free, confidential counseling services to assist you with addressing these and other concerns that you may be experiencing. You can schedule an appointment in the HSC BeWell clinic by calling 304-293-1292 or 304-293-1353. You can also email the BeWell Coordinator, Layne Hitchcock, at [layne.kehl@mail.wvu.edu](mailto:layne.kehl@mail.wvu.edu) or request an appointment online at [health.wvu.edu/bewell](http://health.wvu.edu/bewell).

BeWell is an extension of the Carruth Center for Counseling and Psychological Services, and you can learn more about mental health resources on their website at [carruth.wvu.edu](http://carruth.wvu.edu).

If you are in need of crisis services, call the Carruth Center's main number 24/7: (304) 293-4431. You can also text WVU to 741741.

[A longer version of this optional statement](#) is available for reference.

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## Tentative Course Schedule

Class #	Date	Topic	Assignment issued	Assignment discussed in class
1	8/22/2024	Course Intro; Why we use the scientific method; How we base decisions on science	#1 Benefit-risk analysis	
2	8/29/2024	Clinical chemistry tests	#2 Clinical chemistry tests	#1 Benefit-risk analysis
3	9/5/2024	Immunoassays and molecular labels		#2 Clinical chemistry tests
4	9/12/2024	Enzyme linked immunoassays	#3 What can go wrong with ELISA?	
5	9/19/2024	Controls, ensuring accuracy and reproducibility; Homogeneous assays; Flow cytometry		#3 What can go wrong with ELISA?
6	9/26/2024	Egg hunt in the clinical lab; Nucleic acid structure and nomenclature; Properties of the DNA polymerases		
7	10/3/2024	Exam #1 Clinical chemistry and Immuno- assays; Nucleic acids hybridization methods; PCR principles	#4 DNA polymerase error rates and speed	
8	10/10/2024	Real time PCR; Tracking the		#4 DNA polymerase error

		amount of DNA in real time with fluorescent labels		rates and speed
9	10/17/2024	Performance and utility of clinical tests	#5: Good or bad test?	
10	10/24/2024	Nucleic acid sequencing: Sanger and NGS		#5: Good or bad test?
11	10/31/2024	Discussion of the course project; Considerations when selecting PCR controls	#6: PCR test overall design and controls	
12	11/7/2024	Choosing reagents primers and probes	#7: Reagents, primers and probes	#6: PCR test overall design and control
13	11/14/2024	Assay validation and QC	#8: Validation and quality control	#7: Reagents, primers and probes
14	11/21/2024	Final presentations		#8: Validation and quality control (discussed as part of the group project presentation)
No class	11/28/2024	Thanksgiving		
15	12/5/2024	Exam #2: Nucleic acid methods		