

# **BMM 407**

## **Methods to Diagnose Diseases**

### **Tentative 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: TBD; Room: TBD. 2hr of lectures per week. 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:** TBD

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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 1-5 of the course, block 2 will comprise weeks 6-9, block 3 will comprise weeks 10-12, and block 4 will comprise weeks 13-15. Each week the topic will be introduced by a didactic lecture, followed by active learning sessions or by presentations of a group project. The active learning sessions will reinforce the didactic material and allow the students to apply what they have learned. During the course there will be time set for a scheduled visit to a clinical/diagnostic lab at WVU to illustrate the learning material. Knowledge of the material covered in each block will be assessed by block exams in an open book take-home format.

**Active learning sessions.** There will be four active learning sessions during the semester, which will involve discussion of examples of the learning material and/or relevant scientific papers. The scientific papers and required reading for these sessions as well as the lecture slides will be posted on SOLE.

Participation in discussion in the active learning sessions will be assessed by the instructor twice, at the midterm and at the end of the course. 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	Statements, questions and opinions show in-depth understanding of

			material and connect ideas.	key concepts and provide insight and perspective.
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**Quizzes.** 10 quizzes will be given during the semester. Quizzes will be released during class on SOLE and completed in class.

**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 disease for which they will need to propose and describe one to two clinical tests in a 10-15 minute presentation. Grade will be based on the rubric given below.

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:**

Participation (2 x 16 points each)	32
Quizzes (10 x 4 points each)	40
Group project	28
Block exams (3 x 30 points and 1 x 10 points)	100
<b>Total points</b>	<b>200</b>

**Mid-semester Grade:**

The mid-semester grades will be based on the grades for the first two block exams, and four quizzes. The mid-term grade will reflect approximately 38% of the available total points for the course.

### **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 and are required to attend the active learning sessions. Participation in the active learning sessions will be graded and absences will result in 0 points. 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 a quiz if they have informed the instructor about the absence. The group project and the individual projects will be presented in class and there will be no possibility for makeup. 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) or to complete an additional assignment for extra credit. Block exams will be open book take home exams which need to be completed in a certain timeframe. 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

### Weeks 1-5

Course introduction:

- Structure of the course
- Science based medicine and causes of human disease
- Reasons for using diagnostic tests

Common types of testing approaches and their application

- Enzymatic assays
- Immunoaffinity assays (ELISA, Flow Cytometry)
- Nucleic Acid assays (Amplification, Sequencing, Hybridization)
- Histological and Cytological assays (staining, karyotyping, in situ hybridization, immunohistochemistry and immunofluorescence )

### Block 1 exam (30 points)

## **Weeks 6-9**

Differences between research experiments and diagnostic tests

Characteristics of diagnostic tests:

- Sensitivity, specificity, precision
- Positive and negative predictive value of a test
- Understanding the value of clinical tests in the context of disease prevalence

### **Block 2 exam (10 points)**

## **Weeks 10-12**

Case study: Developing a diagnostic test based on Nucleic Acid amplification

- Overall design of the test and testing procedure steps
- Controls: types of controls and reasons for their use
- Amplification and detection procedures (primers, probes, amplification reagents)
  - How the primer/probe design contributes to the test specificity
  - Validating the analytical specificity and sensitivity of the amplification reagents
- Nucleic Acid extraction procedure; How the extraction affects the test sensitivity
- Ensuring the test reproducibility and reliability (automation, training, proficiency testing)
- Validating the test and maintaining the validation status

### **Block 3 exam (30 points)**

## **Weeks 13-15**

Next generation sequencing methods

- How do next generation sequencing methods work
- Clinical application of next generation sequencing (genetic diseases, cancer, infectious diseases)

### **Block 4 exam (30 points)**