

# Syllabus for Advanced Laboratory (PHY 444/544 – CRN: 3409/3414, Section 101)

## Fall 2024 Science Building, Room 180A – (M & W: 3-5 pm)

**Course Description:** This is a 2-credit hour laboratory style class. Students will perform hands-on laboratory experiments that are designed to be completed at the pace of 1 experiment every 2 to 3 weeks (or 4-6 class periods, or 8 to 12 hours per experiment). These labs in most cases will be set-up from scratch by students, building skills not typically found in undergraduate laboratories where labs might be already set-up for students upon their arrival. Each lab will require addressing questions presented in the instructions with those answers reported in a required lab report for each lab. The brief lab reports will not exceed 3 single sided pages total (or 1.5 pages double sided). Guidelines for the reports will be provided in advance. From the 2023-2024 course catalog: “Developments in producing and detecting correlated photon pairs has enabled implementation of undergraduate laboratories demonstrating fundamental quantum mechanical principles. This laboratory also incorporates fundamental solid state and materials science experiments.” Developing the skills to successfully set-up and complete the labs from scratch independently and producing quality concise lab reports are the two primary goals of the lab course.

**Textbook:** No print version required. Custom in-house instructions will be provided for most labs. The following text books are good starting point references to dive deeper into the material. (1) and (2) are for the solid state and materials science experiments and (3) is for the correlated photon experiments. The two photon labs will be based off experiments presented in (3). Click on the permalink for (3), EBSCO will prompt you to log in using your MU credentials. You can create a MyEBSCO account and use the ebook PDF by chapter and even download a copy of the whole book that will stay on your computers for a 52-week loan period.

- (1) Introduction to Solid State Physics. Charles Kittel, 1996. John Wiley and Sons, Inc.
- (2) The Physics and Chemistry of Materials. Joel I. Gersten and Fredrick W. Smith, 2001. John Wiley and Son, Inc.
- (3) Mark Beck. (2012). *Quantum Mechanics : Theory and Experiment*. Oxford University Press. (Permalink): <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=466176&site=ehost-live>.

**Pre/Co-requisite Courses:** PR: PHY 425/525 and PHY 442/542, or  
CR: PHY 425/525 and PHY 442/542

**Course Instructor Info:** Dr. Sean P. McBride, Science Building 152/152A, (304)-696-2758/8852, [mcbrides@marshall.edu](mailto:mcbrides@marshall.edu)  
“[HERD Hours](#)” and Office Hours: (F 10 am - 4 pm, room 179 and S 152 in the Science Building)  
- Additionally, I have an ‘open-door’ policy for office hours as well as an ‘email me anytime with questions’ policy.

**Teaching Homepage:** <https://netapps.marshall.edu/mcbrides/teaching/>  
**Research Homepage:** <https://netapps.marshall.edu/mcbrides//>

**Objectives:** During the first part of this course, students will set up and run some classic laboratory experiments that may have eluded students in their previous undergraduate laboratories. These experiments are focused on looking at the Seebeck effect, the Hall effect, Dia-, Para-, and Ferro-magnetism, superconductivity, and Young’s Modulus. At the surface, some of these experiments will be rather simple, but the underlying mechanisms at work leading to the observations students will see can be quite complex. In the second part of the course, students will work with 2 labs revolving around correlated photons. The lab instructions for each lab guides you through the observations students will encounter and the set-up for each lab. The manuals for each piece of equipment used for each experiment are stored in a 3-ring binder specific to each lab with the instructions. These physical 3 ring binders should not leave the lab room. All these documents will be made available to students via electronic communication, so they can be read and reviewed prior to coming to lab.

**Attendance:** I view all university level students as adults, who can or must do adult things, such as drive a car, vote, pay taxes, and who can also be sentenced to jail as an adult. Thus, as adults, I expect you to be responsible and be in lab at all scheduled meeting times; however, you will not be docked points if you have an emergency. Notify me immediately when you realize a conflict exists so we can come up with an alternative plan. All labs need to be completed for a grade otherwise an ‘Incomplete’ will be recorded.

**Academic Calendar:** For drop/add dates, last day to withdraw from classes, and other important semester dates, see the [Marshall University Academic Calendar](http://www.marshall.edu/academic-calendar/) (<http://www.marshall.edu/academic-calendar/>).

**Grading:** Each lab completed will carry an equal weight of your total grade (100% Total)<sup>‡</sup>

<b>Determination of Final Grade:</b>	90% or above:	A
	80% or above:	B
	70% or above:	C
	60% or above:	D
	59.9% or lower:	F

**‡For Graduate Students Only:** PHY 544 students will be required to either (1) develop a new lab from start to finish, including writing an instruction guide with questions and answers and complete trial runs of the lab in the current semester with existing equipment in the program or (2) revise an existing lab to make it better for the next generation of students (i.e. dive deeper into the underlying physics and develop different/additional content and/or procedures than what is presented currently in the instruction manual to stimulate the next generation of students who complete the lab (develop new/additional questions and answers). Through either of these options students will hopefully gain a deeper understanding of the material for the lab they are designing or revising (diving deeper into). This project is not needed for PHY 444 students. Graduate students can work on the project starting from day 1 of the semester and are encouraged to discuss with the instructor regularly on progress. The new lab or revision of an existing lab is due the Monday of Final Exam week. This project for the graduate students will have equal weight as a lab report, thus count for 1/7 of the grade.

**Learning Outcomes:** In the process of carrying out the laboratory experiments as described above, **the overarching goal**, is for students to work and function together in a team, become confident in setting up experiments effectively from scratch with help from the provided instructions, communicate what they have done and observed through brief, but high quality concise lab reports, and to be able to visualize & better understand some physics concepts that might have been taught in their undergraduate classes (but never directly witnessed or recorded data for). In order to accomplish this goal successfully, students will be given **practice** via conducting weekly labs potentially with a partner and writing individual laboratory reports for those labs. Students' individual success in achieving this goal will be **assessed** by their individual performance on those lab reports graded against provided guidelines. A schedule at the end provides information on when the labs will be conducted and when lab reports are due.

**Lab Reports:** You will have approximately 12 days after completing a lab to turn in your brief concise detailed lab report, See schedule at the end of this document. Your brief concise detailed lab report, should be just that, brief and concise. The font should be Arial 10 or new times roman 11 and the document should be single spaced with 1-inch margins all the way around. The brief lab write up will not exceed 3 pages total (1.5 pages double sided). The lab report must include all required plots and answers to the questions asked in the instructions Sometimes writing such a condensed document and getting all the information in that is required is harder than writing a longer document. Journal articles have word limits, so this is good practice for upper-level students.

Your completed laboratory report should include all questions from the instruction packet answered and all requested plots and data processing/analysis completed and included in your report. Do not turn your plots in separate, include them in your lab report. Format them to make them fit in the 1.5-page limit and make them readable, no unreadable font sizes. The reports should include your findings, observations, and a discussion of the physics involved related to what you observed in the lab. **Reports should include a brief Abstract, Introduction, Results and Discussion section, and a Conclusion section.** Excel can be used to plot data, nothing fancy is needed. It may be a good idea to treat these lab reports as mini journal article submissions. They should look professional. You should be proud of them in the end. You should not be agonizing over the reports or spending excessive amounts of time on them. If you are not sure how to construct such a report come see me. **Before turning in your labs to be graded, it is highly encouraged to come talk to me about if the format of your lab report is correct and follows the guidelines provided.** I can offer suggestions and you can fix before turning in the final version. One of the benefits of the lab course is you will gain some experience with scientific writing experience and presenting your data as figures, which are both needed for journal submissions. Labs will be graded for following the requested guidelines, completeness (addressing all questions from instructions), and how successful students are at communicating what was accomplished through the four main parts of the reports discussed below.

In the one paragraph **Abstract**, concisely state the objective of the experiment, how you meet that objective, what your results were, and did the results support the objective (most of the time these are numerical values to report, but in some cases not). Provide a very brief **Introduction** to lab with the underlying physics and history (include references). In the **Results and Discussion** section be specific, discuss the set-up, discuss errors, discuss how the results support or do not support the objective. Discuss what you learned. Include your plots here (label axes with meaningful names, provide units, provide brief figure captions). Do not stretch or skew figures. All figures should have the same format. Comment on how the data presented in the graphs proves or does not prove the objective of the experiment. Answer the question from the instructions here. As you do experiments try to visualize where errors could arise and how these errors contributed to your results. Evaluating your data and results to understand whether the results are meaningful is a valuable part of experimental science, and often a very difficult part. Discuss these errors in the results and discussion section, this should be part of every lab. The **Conclusion** for every experiment should make a statement about what you have achieved and learned by doing the experiment, what results you have obtained, how the experiment and data supports the involved physics laws, concepts, and principles. The labs are designed to be completed in the allotted time, working on the reports can be done outside of class time or in class time if labs are completed early (or the next lab can be started earlier). The **References** section should go at the end and do not count toward the page limit. These are brief descriptions see full guidelines for format rules and more description.

**The 1-Week Rule:** I am happy to fix any grading errors. Any grading disputes or grading mistakes needs to be brought to my attention within one week of when the assignment was distributed or made available to the entire class. After 1-week from this date, regardless if you did not attend class to receive your graded assignment, grades are permanent. You must turn your assignment back in to be regraded. You must write a cover page what needs regraded and why. It is advisable to take a picture of your work before turning back in for a regrade. Any attempt to alter a previously graded assignment in any way, such as adding information to it, removing information from it, or simply altering the previously presented work for a better grade is considered Academic Dishonesty and will be treated as such. Regrades will be returned any time before the end of the semester and are often very delayed in getting returned due to current grading taking precedence over regrades and there being limited time for grading.

**Statement Regarding Students Requiring Special Accommodations & Accessibility (Students with Disabilities):** For University policies and the procedures for obtaining any services, please go to MU Academic Affairs website (<http://www.marshall.edu/academic-affairs/policies/>) and see information under “Students with Disabilities”. “In order to receive any academic accommodations, you must meet with the coordinator of the [Office of Disability Services](#) (304-696-2271) and provide documentation of your disability.” For help with setting up accommodations, contact the Office of Accessibility and Accommodations in Prichard Hall 117 (304-696-2467). For more information, access the website for the Office of Accessibility and Accommodations: <https://www.marshall.edu/accessibility/>. If no official documentation from the Office of Accessibility and Accommodations is given to the instructor, no accommodations can be made by the instructor. Paperwork must come from Office of Accessibility and Accommodations, not the student. Again, before any type of accommodations can be given by instructors, the instructor must receive official documentation from the Office of Accessibility and Accommodations (a.k.a./formally the Office of Disabilities Services) or the required program; therefore, take care of this the first week of classes (this is true for the [H.E.L.P Center](#) and the [WV Autism Training Center](#) and the [Office of Accessibility and Accommodations](#)).

**Statement Defining Expectations for Student Conduct:** I will expect everyone in all portions of this class and office hours to act in a professional and courteous manner. Students are expected to conduct themselves in a manner that creates a productive learning environment for all members of the class. To this end, disruptive, abusive, or offensive behavior directed at anyone involved in the class will not be tolerated, and offenders may be asked to leave the classroom and forfeit any associated grades for that day. Disruptive behavior is any behavior that interferes with the normal conduct of class or behavior that inhibits a productive learning environment (this includes sleeping in lecture and using any non-approved electronic devices). If you are experiencing, disruptive, abusive, or offensive behavior directed towards you from others in the class (this includes when working together in groups outside of class if desired), please make me aware of the problem as soon as possible. In addition to acting professional and courteous in class, I only respond to emails that are written with professionalism and courtesy. “All members of the Marshall University community are expected to always observe health and safety protocols. This includes general health and safety protocols as well as specific protocols that might emerge in response to community and campus health conditions.”

**Prohibited Use – Generative AI is fully prohibited in the course:** Students are prohibited from using generative AI for graded materials; violation of this, will be considered a violation of both Marshall’s Academic Dishonesty Policy (URL: <https://www.marshall.edu/academic-affairs/policies/#academicdishonesty>) and the Student Code of Conduct (URL: <https://www.marshall.edu/student-conduct/files/Student-Code-of-Conduct-24-25.pdf>). Any assignment deemed as coming from artificial intelligence, at a minimum, will be given zero points with possible additional academic dishonesty sanctions imposed.

**Campus Services:** There are many [Campus Services & Resources](#) that you or someone you know throughout your college career may find useful or desperately need at some point. The above link provides contact information for the Counseling Center (304-696-3111) and Health Services, Services for Students in Financial Need, Tutoring Services, and a wide variety of other services and resources (there are many services within each of these categories - check them out now so you know what is available to students). Chances are a version of this syllabus will always be posted on my [Teaching Homepage](#) if you ever need this information, even well after the class is over.

**University Policies:** By having the privilege of being enrolled in higher education and thus this course, you agree to all the University Policies and Codes listed in the below link. It is the student’s responsibility to read the full text of each policy and code by going to <http://www.marshall.edu/academic-affairs/policies/>. The individual policies and codes are: Academic Dishonesty Policy, Academic Dismissal Policy, Academic Forgiveness Policy, Academic Probation and Suspension Policy, Affirmative Action Policy, Pre-Finals Week Policy, D/F Repeat Rule, Excused Absences, Inclement Weather Policy, Sexual Harassment Policy, Students with Disabilities, University Computing Services Acceptable Use Policy, and the Code of Student Rights and Responsibilities - also referred to as the Student Code of Conduct (<https://www.marshall.edu/student-conduct/files/Student-Code-of-Conduct-24-25.pdf>).

**Technology Assistance:**

If you have technical problems, please contact one or more of the following:

- [Blackboard Student Guide](https://www.marshall.edu/design-center/files/2020/03/Student-Guide-Bb-at-Marshall.pdf) (<https://www.marshall.edu/design-center/files/2020/03/Student-Guide-Bb-at-Marshall.pdf>)
- Marshall [Information Technology \(IT\) Service Desk](#) (Help Desk) (<http://www.marshall.edu/it/departments/it-service-desk/>)
  - Huntington: (304) 696-3200
  - [Email the IT Service Desk](mailto:itservicedesk@marshall.edu) ([itservicedesk@marshall.edu](mailto:itservicedesk@marshall.edu)) or start a chat with a staff member in the browser. The chat will be saved and emailed to you for your records.

**Technical Skill Requirements:** For computer and browser requirements for Blackboard, see [IT: Recommended Hardware](#) (<http://www.marshall.edu/it/recommendations/>).

- To check your browsers, use the [Blackboard Browser Checker](#) and ensure that you set permissions properly and have all the necessary plug-ins:
- [https://help.blackboard.com/Learn/Administrator/Hosting/Release\\_Notes/Browser\\_Support/Browser\\_Checker](https://help.blackboard.com/Learn/Administrator/Hosting/Release_Notes/Browser_Support/Browser_Checker)
- Students must be able to use Marshall email and check it regularly, as well as the basic tools in Blackboard, including the Notification option. Links to Blackboard Help and tutorials are available on the Start Here page and on the Tech Support tab in Blackboard. Blackboard recommends Google Chrome browser or Mozilla Firefox browser.
- The Microsoft Office suite (Office 365) is available at no extra charge to students enrolled at MU. For information visit [Marshall IT: Office 365](#) (<http://www.marshall.edu/it/office365/>).
- See the Tech Support tab in Blackboard for additional information on browsers, technology, and apps.

This current syllabus is based on available information available several days prior to the start of the Fall 2024 semester. If at any time, policies, or a large amount of due dates change, due to covid or for any other reason, an addendum to this syllabus will be provided informing you of what those changes are and the new due dates. The most up to date syllabus will be posted in the syllabus repository when available: <https://mubert.marshall.edu/syllabi/>.

**Campus Carry Policy:** “University Policy, UPGA-12 (Campus Carry Policy) derives its authority from West Virginia State law, including the Campus Self-defense Act (W. Va. Code § 18B-4-5b). It pertains to the exercise of Concealed Carry on Marshall University’s campus, except in designated areas, by individuals with a valid permit to Conceal Carry. Individuals who choose to Conceal Carry are responsible for knowing and understanding all applicable federal, state, and local laws and Marshall University Board of Governors Rules, University Policies, and Administrative Procedures. University Policy, UPGA-12 applies to areas of campus and buildings that are directly under the possession or control of Marshall University. Concealed Handguns are not observable to others and must be holstered and concealed on the body of the permit holder or in a personal carrier, such as a backpack, purse, or other bag that remains under the exclusive and uninterrupted control of the permit holder. This includes wearing the personal carrier with a strap, carrying or holding the personal carrier, or setting the personal carrier next to or within your immediate reach at all times. If your participation in class activities impedes your ability to maintain constant control of your Handgun, please make alternate arrangements prior to coming to class.”

**Statement for Copyright Notification:** Copyright (2024) - Dr. Sean P. McBride, as to this syllabus and all course material. During this course, students are prohibited from selling notes to, or being paid for taking notes by, any person or commercial firm without the expressed written permission of the professor teaching this course. *“All materials used in this class (in any form, electronic, printed, or verbal), including, but not limited to, exams, quizzes, handouts, lectures, homework assignments, and all material on the university’s learning management system (currently Blackboard) and its peripherals, are copyright protected works under US Code Title 17. (1) Unauthorized copying, distribution, recording, selling, or posting of any portion of class materials, in any form, in any way, is a violation of federal law; this specifically includes posting any portion of the class materials to the World Wide Web through the Internet, and/or via any other means of electronic communication. (2) Unauthorized sharing of class materials in any form, specifically including, but not limited to, uploading class materials to websites for the purpose of seeking/providing solutions or sharing those materials with current or future students is a violation of the Academic Dishonesty Policy set forth in Marshall University’s Student Code of Conduct. ‘Unauthorized’ means without explicit permission from the instructor. Violation of (1) or (2) will result in all necessary disciplinary actions taken against the student.”* ~ Marshall University Copyright Statement, updated fall 2016.

**Fall 2024 Schedule:**

Week	Lab	Name	Day	Report Due	Date
1	1	Seebeck Effect	M	-	19-Aug
			W	-	21-Aug
2	2	Young's Modulus	M	-	26-Aug
			W	-	28-Aug
3	Labor Day No Classes		M	-	2-Sep
	2	Young's Modulus	W	-	4-Sep
M			Lab 1	9-Sep	
4	2	Young's Modulus	W	-	11-Sep
			M	-	16-Sep
5	3	Superconductivity and Magnetism	W	-	18-Sep
			M	Lab 2	23-Sep
6	3	Superconductivity and Magnetism	W	-	25-Sep
			M	-	30-Sep
7	3	Superconductivity and Magnetism	W	-	2-Oct
			M	-	7-Oct
8	4	Hall Effect	W	-	9-Oct
			M	Lab 3	14-Oct
9	4	Hall Effect	W	-	16-Oct
			M	-	21-Oct
10	4	Hall Effect	W	-	23-Oct
			M	-	28-Oct
11	5	Spontaneous Parametric Downconversion Set-up and Alignment	W	-	30-Oct
			M	Lab 4	4-Nov
12	5	Spontaneous Parametric Downconversion Set-up and Alignment	W	-	6-Nov
			M	-	11-Nov
13	5	Spontaneous Parametric Downconversion Set-up and Alignment	W	-	13-Nov
			M	-	18-Nov
14	6	(Proof of the Existence of Photons (the Grangier Experiment))	W	-	20-Nov
			M	-	25-Nov
15	Thanksgiving Break		W	-	27-Nov
	6	(Proof of the Existence of Photons (the Grangier Experiment))	M	Lab 5	2-Dec
W			-	4-Dec	
Finals Week	-	Final Project Due	M	Project	7-Dec
			W	-	11-Dec
		Lab report 6 Due	F	Lab 6	13-Dec