PHYS 507 A Sp 17: Physical Applications Of Group Theory

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Prof. **Steve Sharpe**   **(http://faculty.washington.edu/srsharpe/)** (**srsharpe@uw.edu (mailto:srsharpe@uw.edu)**)

W F 1:30-2:50 PAB: A110

Office hour: W 3-3:30 & 5:15-6, PAB B406

TA: Brandon Robinson (**robinb22@uw.edu (mailto:robinb22@uw.edu)**)

Office hours: Th 3:00-4:30, PAB B418 (move to B405 if needed)

Welcome to PHYS 507 (Spring 2017). This course is aims to provide an understanding of finite and continuous groups and the tools needed to apply them. (The split between finite and continuous groups will be about 1:1) This is a topic that is important in most branches of physics, most notably solid state, nuclear and particle physics. I assume no prior instruction in group theory, but a strong background in linear algebra is required. I assume some knowledge of QM. Based on past experience, the course should be accessible to all physics graduate students (including those in their first year) and also to advanced undergraduates with a strong math background. Last time I taught the class about 10 undergraduates took it successfully.

I am happy to try and answer questions by email if you cannot make any of the office hours.

All the information about texts, howeworks and grading see the **COURSE INFORMATION** page (also available from the "Pages" link). There will be no exams.

Useful links are collected **here**---please email suggestions for further content.

Here is the tentative schedule, which is based on what I covered in this course in 2015 so is likely quite accurate.

Course Summary:

Date	Details	
Wed Mar 29, 2017	📅 **Lecture 1: Basic definitions and examples of finite groups (https://canvas.uw.edu/calendar?event_id=986975& include_contexts=course_1153120)**	1:30pm to 2:50pm
Fri Mar 31, 2017	📅 **Lecture 2: Subgroups, cosets and conjugacy classes. Begin representation theory. (https://canvas.uw.edu/calendar?event_id=986985& include_contexts=course_1153120)**	1:30pm to 2:50pm
Wed Apr 5, 2017	📅 **Lecture 3: Equivalence and (ir)reducibility of representations; characters and character table, general properties and examples (https://canvas.uw.edu/calendar?event_id=986976& include_contexts=course_1153120)**	1:30pm to 2:50pm

Date	Details	
Fri Apr 7, 2017	📅 **Lecture 4: Character properties. Schur's lemmas.** (https://canvas.uw.edu/calendar?event_id=986986&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW1---due in class Friday, April 7** (https://canvas.uw.edu/courses/1153120/assignments/3679618)	due by 2:50pm
Wed Apr 12, 2017	📅 **Lecture 5: Regular Representation, Class algebra, Permutation group in more detail** (https://canvas.uw.edu/calendar?event_id=986977&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri Apr 14, 2017	📅 **Lecture 6: Irreps of symmetric group in detail. Young Tableaux. Tensor products or irreps.** (https://canvas.uw.edu/calendar?event_id=986987&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW2: due in class Friday, April 14** (https://canvas.uw.edu/courses/1153120/assignments/3702416)	due by 2:50pm
Wed Apr 19, 2017	📅 **Lecture 7: Decomposing irreps into those of subgroups; Direct Product groups.** (https://canvas.uw.edu/calendar?event_id=986978&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri Apr 21, 2017	📅 **Lecture 8: Wigner-Eckart theorem for finite groups. Clebsch-Gordon coefficients in D3.** (https://canvas.uw.edu/calendar?event_id=986988&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW3 due in class Friday April 21st** (https://canvas.uw.edu/courses/1153120/assignments/3713797)	due by 3pm
Wed Apr 26, 2017	📅 **Lecture 9: Crystal point groups. Applications of group theory to materials and normal modes.** (https://canvas.uw.edu/calendar?event_id=986979&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri Apr 28, 2017	📅 **Lecture 10: Intro to continuous groups; generators of compact, simple Lie groups** (https://canvas.uw.edu/calendar?event_id=986989&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW4 due in class 4/28/17** (https://canvas.uw.edu/courses/1153120/assignments/3719640)	due by 3pm
Wed May 3, 2017	📅 **Lecture 11: Introduction to Lie Algebras and their representations; irreps of su(2)** (https://canvas.uw.edu/calendar?event_id=986980&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri May 5, 2017	📅 **Lecture 12: SU(3) Lie algebra, Cartan subalgebra, roots and weights of su(3) and su(2)** (https://canvas.uw.edu/calendar?event_id=986990&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW5 due in class Friday, May 5th** (https://canvas.uw.edu/courses/1153120/assignments/3720051)	due by 11:59pm
Wed May 10, 2017	📅 **Lecture 13: General structure of Lie algebras. Roots raise weights. su(2) subalgebras and their implications.** (https://canvas.uw.edu/calendar?event_id=986981&include_contexts=course_1153120)	1:30pm to 2:50pm

Date	Details	
Fri May 12, 2017	📅 **Lecture 14: Georgi's master formula. Simple roots. Cartan matrix. Root diagram for g(2)** (https://canvas.uw.edu/calendar?event_id=986991&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW6 due in class May 12** (https://canvas.uw.edu/courses/1153120/assignments/3734149)	due by 11:59pm
Wed May 17, 2017	📅 **Lecture 15: Full Lie algebra from root diagram. Begin classification of semi-simple Lie algebras.** (https://canvas.uw.edu/calendar?event_id=986982&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri May 19, 2017	📅 **Lecture 16: Finish classification of semi-simple Lie algebras; Explicit algebras for su(N) and so(2N)** (https://canvas.uw.edu/calendar?event_id=986992&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW7 due in class 5/19** (https://canvas.uw.edu/courses/1153120/assignments/3735651)	due by 3pm
Wed May 24, 2017	📅 **Lecture 17: Explicit algebras for An, Bn, Cn and Dn. Roots of E6.** (https://canvas.uw.edu/calendar?event_id=986983&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri May 26, 2017	📅 **Lecture 18: Irreps of Lie algebras. Weyl reflections and Weyl group.** (https://canvas.uw.edu/calendar?event_id=986993&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW8 due in class May 26th** (https://canvas.uw.edu/courses/1153120/assignments/3741126)	due by 3pm
Wed May 31, 2017	📅 **Lecture 19: Decomposing tensor products of irreps using Dynkin indices. Real/pseudoreal/complex irreps. Tensors for SU(3).** (https://canvas.uw.edu/calendar?event_id=986984&include_contexts=course_1153120)	1:30pm to 2:50pm
Fri Jun 2, 2017	📅 **Lecture 20: Young Tableaux as a tool for SU(3). Decomposing irreps into subalgebras.** (https://canvas.uw.edu/calendar?event_id=986994&include_contexts=course_1153120)	1:30pm to 2:50pm
	📝 **HW9 due in class 6/2/17** (https://canvas.uw.edu/courses/1153120/assignments/3746611)	due by 3pm
Thu Jun 8, 2017	📝 **HW10: due noon Thursday 6/8/17---turn into me, my mailbox or to Brandon** (https://canvas.uw.edu/courses/1153120/assignments/3746708)	due by 11:59am
Sun Jun 11, 2017	📝 **Final Grade** (https://canvas.uw.edu/courses/1153120/assignments/3763817)	due by 11:59pm