PHYSICS 341

ELEMENTARY NUCLEAR PHYSICS

Prof. Yuri Efremenko
Nielsen M103
yefremen@utk.edu

General Information

Class Hours: 12:40 – 1:30 P.M. Monday/ Wednesday/ Friday at P415
Office Hours: after class and by appointment.

Text: "Introductory Nuclear Physics" Kenneth Krane, Wiley, ISBN 047180553X
Supplementary texts (optional):
"Quantum physics of atoms, molecules, solids, nuclei and particles" Robert Eisberg and Robert Resnick, Wiley, ISBN 0-471-87373-X.
"Quantum Mechanics" Paul C.W. Davies and David S. Betts, Chapman and Hall, ISBN 0-412-57900-6.

General Course Description

The course will start with refreshing of nuclear properties. After we will recall basic properties of quantum mechanics learned in 232. After that we will study nuclear structure, nuclear decay and reactions based on the nuclear shell model. We will cover some topics of astrophysics, big bang, and primordial nuclear synthesis.

Prerequisites

Knowledge of basic calculus and physics up to the level of Physics 232 or 250 is required for success in this course.

Course Objectives

The course is aimed toward junior level nuclear engineers and physics majors; however other engineering and science majors with the correct preparation are very welcome. The objectives are:
1) To cover the basics of nuclear structure, i.e. how neutrons and protons collect together to form a nucleus.

2) To give students a basic understanding of nuclear reactions and the energetics involved.
3) To introduce some of the current regions of research in nuclear physics.
4) To give students the opportunity of working on a small project as part of a team.

Lecture Notes and Communication

Lecture notes will be posted online. My main modes of communication are:
1) Through the lectures, and the times before and after classes.
2) In my office during office hours or by appointment (you can try to drop in without an appointment, but I'm sometimes at ORNL or elsewhere). Best way to make appointment is to send me e-mail with request.

My preferred method of communicating about material in the course, and homework problems in particular, is in person and over email.

Reading Assignments

Reading the relevant chapter or sections for each week's lectures is a compulsory and vital part of the course. The course is structured in such a way that reading prior to the lecture is essential. Much of the class time will be devoted to discussing the material.

ACADEMIC HONESTY

All work submitted by a student is expected to represent their own work. Students are expected to submit their own homework. Students are expected to perform all work in conformance with the University policies regarding Academic Honesty.

Classroom Environment

I firmly believe that the classroom atmosphere should be comfortable and open, allowing students and teachers to ***discuss the material***. This requires a great deal of ***respect*** and listening to one another as well as reducing side conversations to a minimum. I request that laptops not be used in the classroom, as they can easily become a distraction e.g. email, facebook etc, believe me, I know! This does mean that I expect you to take any notes on paper with a pen.

Grading Policy

If, for any reason, there is a concern about a grade given on an exam or exam question, an appeal will be entertained if it is raised **no later than one week** after the date on which the graded exams are made available for return to the class. After this "appeal period" of one week, exam grades will be considered final and will not be altered.

MISSING THE FINAL EXAM IS VERY SERIOUS AND MAY WELL RESULT IN FAILURE OF THE COURSE

Grading Scale

Final Grades are determined from the weighted average, where the weights are:
25% - Homework (10% quizzes, 15% homework sets)
15% - Group Project
30% - Three in class tests
30% - Final Exam

The final grade will be assigned from the weighted average based on the following *provisional* grading scale.

A	90 and above
A-	87 and above
B+	83 and above
B	80 and above
B-	77 and above
C+	73 and above
C	70 and above
C-	67 and above
D+	63 and above
D	60 and above
D-	57 and above
F	Below 57

Homework Assignments

There will be ten quizzes that you can access through Canvas and will require numerical, true/false, or multiple answer (click **ALL** the correct answers). Additionally there will be three homework sets that will have longer answers and need to be handed in on paper before the in class test. For the homework sets there will be a penalty of 5% per day that the homework is handed in late up to a maximum of 50%. That is, if you hand in your homework two days late you can obtain up to a maximum of 90%. If you hand your homework in ten or more days late you can obtain up to a maximum of 50% for that homework set.

Exams

There will be three in class tests during the semester and the final. The final will be comprehensive. Date of the final exam is December 14, 1:00 p.m.

Preliminary Course Schedule:

Date		Topc	Quizes
24-Aug	L-1	Introduction 1.1-1.4	
26-Aug	L-2	Nuclear Properties 3.2	
29-Aug	L-3	Nuclear Properties 3.3	Q1
31-Aug	L-4	Radioactive decays, 6.1,6.3	
2-Sep	L-5	Radioactive decay, 6.4	
5-Sep	Labor day		
7-Sep	L-6	Radioactive decay, 6.5-6.8	Q2
9-Sep	L-7	QM-Wave Function 2.1	
12-Sep	L-8	QM-Operators 2.2	
14-Sep	L-9	QM-Free Particle. Step Barier. 2.3	
16-Sep	L-10	QM-Potential Barrier. 2.3	
19-Sep	L-11	QM- Potential Well. 2.3	Q3
21-Sep	L-12	QM-Harmonic Oscillator, 3D. 2.3 - 2.4	
23-Sep	Test 1		T1, HW1
26-Sep	L-13	QM 3_d. 2.5-2.6	
28-Sep	L-14	The Nuclear Radius 3.1	
30-Sep	L-15	The Nuclear Radius 3.1	Q4

3-Oct	L-16	Nuclear EM moments. 3.5	
5-Oct	L-17	Nuclear EM moments. 3.4 - 3.5	
7-Oct	Fall brake		
10-Oct	L-18	Excited states. 3.6, Deuteron. Forces 4.1	
12-Oct	L-19	Nuclear scattering, 4.2,4.4. the Shell model 5.1	
14-Oct	L-20	The Shell model 5.1	
17-Oct	L-21	The Shell model 5.1	Q5
19-Oct	L-22	Collective motion, decay width 5.2	
21-Oct	T-2		T2, HW2
24-Oct	L-23	Q.T. of radioactivity 6.2 Alpha Decay 8.1	
26-Oct	L-24	Alpha Decay 8.2-8.6	Q6
28-Oct	L-25	Beta decay 9.1-9.3	
31-Oct	L-26	Beta decay 9.4-9.5	Q7
2-Nov	L-27	Beta decay 9.6-9.10	
4-Nov	L-28	Gamma Decay 10.1-10.5	
7-Nov	L-29	Gamma Decay 10.5-10.9	Q8
9-Nov	L-30	Relativity, Nuclear Reactions. Chapter 11	
11-Nov	L-31	Nuclear Reactions. Chapter 11	
14-Nov	L-32	Nuclear Reactions. Chapter 11, Astro. Chapter 19	
16-Nov	L-33	Astro, chapter 19. Fusion 13.1-13.2	
18-Nov	T-3		T3, HW3
21-Nov	L-34	Astro. Chapter 19.	Q9
23-Nov	Th.G.	Off	
25-Nov	Th.G.	Off	
28-Nov	L-35	Particle Interactions with Matter. From Lecture.	Q10
30-Nov	L-36	Reports	
2-Dec	L-37	Reports	
5-Dec	L-38	Reports	
7-Dec	L-39	Review	
14-Dec	Final	1:00 PM - 3:15 pm.	Final

Group Project
Students will work in teams of about 7-9 to research a topic of current interest in nuclear physics. Each group will present their findings to the class and will write a short report. Each student in the group will receive the same grade for the project and will need to sign off that **ALL** the students in the group contributed. A list of topics will be posted with primary source references.

Disability Accommodations
"The University of Tennessee, Knoxville, is committed to providing an inclusive learning environment for all students. If you anticipate or experience a barrier in this course due to a chronic health condition, a learning, hearing, neurological, mental health, vision, physical, or other kind of disability, or a temporary injury, you are encouraged to contact Student Disability Services (SDS) at 865-974-6087 or sds@utk.edu. An SDS Coordinator will meet with you to develop a plan to ensure you have equitable access to this course. If you are already registered with SDS, please contact your instructor to discuss implementing accommodations included in your course access letter."

COVID-19 adjustments.
Situation is still fluid. Expect that some classes could be online. However, I expect most lectures will be F2F. If you have Covid related symptoms, please stay at home.