Particles and Nuclei
01:750:418
Fall 2020

Instructor: Professor Sunil Somalwar

Summary: Nuclei and Particles is an advanced course covering the nature of nuclear forces and nuclear models and classification and interactions of elementary particles. Topics include the deuteron and the nature of nuclear force, nuclear phenomenology, stability, nuclear models including the shell model, fission, fusion, and radioactive decays. Classification and interactions of elementary particles, conservation laws, continuous symmetries, C, P, and T discrete symmetries, neutral kaons, gauge (Yang Mills) theories in a non-relativistic toy formulation, Standard Model and the Higgs boson.

This course is intended for students majoring in physics and astrophysics, and is highly recommended for students intending to go to graduate school.

Pre-requisites: 01:750:361, 01:750:417 strongly recommended

Co-requisites: None

Meeting times: Two 80 minute lectures per week.
Lecture: T-Th 5 (3:20-4:40 pm)
Recitations: None

Text: Introduction to Nuclear and Particle Physics, Das and Ferbel

LMS: Canvas

Provisional Plans for Remote Instruction: Webex lectures delivered during class periods followed by the lecture video being made available online within a day along with the pdf of (handwritten) "blackboard" notes. No Powerpoint! Instructor will be available online for Q/A after each class, as well as on most afternoons by appointment for individual Webex meetings. Students are encouraged to have an individual "meet the professor" videoconference with the instructor early in the semester. Email interaction is also encouraged.

Evaluation:
Class participation: Encouraged, but no attendance or evaluation during class.
Homework: 30%, weekly assignments.
Mid-term: 30%, unproctored at-home open book/notes limited time, during class period.
Final Exam: 40%, unproctored at-home open book/notes limited time, during the exam slot.

Schedule (provisional):

Week	Topic
1	Deuteron
2	Nuclear phenomenology, masses, spins, dipole moments, stability of nuclei
3	Nuclear models, liquid drop, Fermi gas, Shell model
4	Nuclear radiation, alpha, beta, gamma decay
5	Applications of nuclear physics, nuclear fission, fusion, radioactive dating
6	Interactions of elementary particles, symmetries, gauge principle
7	Electromagnetism and U(1), QED
8	Quarks, leptons, weak interaction and SU(2)
9	Quark model, Strong and weak interactions
10	Discrete transformations, parity, time reversal, charge conjugation, kaons
11	SU(3), QCD, color factors, mesons and baryons
12	Running of the coupling constants, asymptotic freedom
13	Gauge bosons, Standard Model
14	Higgs mechanism, Beyond Standard Model

Academic Integrity:

Students are expected to maintain the highest level of academic integrity. You should be familiar with the university policy on academic integrity: http://academicintegrity.rutgers.edu/academic-integrity-policy/ Violations will be reported and enforced according to this policy.

Use of external sources to obtain solutions to homework assignments or exams is cheating and a violation of the University Academic Integrity policy. Cheating in the course may result in penalties ranging from a zero on an assignment to an F for the course, or expulsion from the University. Posting of homework assignments, exams, recorded lectures, or other lecture materials to external sites without the permission of the instructor is a violation of copyright and constitutes a facilitation of dishonesty, which may result in the same penalties as explicit cheating.

Not only does the use of such sites violate the University's policy on Academic Integrity, using such sites interferes with your achievement of the learning you are paying tuition for. Assignments, quizzes, and exams are given not simply to assign grades, but to promote the active learning that occurs through completing assignments on your own. Getting the right answer is much less important than learning how to get the right answer. This learning is critical to your success in subsequent courses and your careers.

Student wellness Services
Student Counseling, ADAP & Psychiatric Services (CAPS) wellness for non-emergency psychological health issues services (848) 932-7884, 17 Senior Street, New Brunswick, NJ

08901 http://health.rutgers.edu/medical-counseling-services/counseling/

Violence Prevention & Victim Assistance (VPVA), (848) 932-1181, 3 Bartlett Street, New Brunswick, NJ 08901, http://www.vpva.rutgers.edu/

Office of Disability Services (848) 445-6800, Lucy Stone Hall, Suite A145, Livingston, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854, https://ods.rutgers.edu/

Scarlet Listeners for confidential peer counseling and referral hotline, (732) 247-5555, http://www.scarletlisteners.com