

PHY 620 - Graduate General Relativity

Welcome to the home page for "Modern General Relativity" (PHY 620) in Fall 2026.

Lecturer: Neelima Sehgal
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Class Times: Mondays and Wednesdays 11:00am - 12:20pm ESS 450
Office Hours: Wednesdays 3:30 - 4:30pm 454 ESS
Course grade: Attendance and Participation in Class Discussion (10%)
Homework Problem Sets (10%)
2 Midterm Exams (25% each)
Final Exam (30%)

Course Text Book: A First Course in General Relativity by Bernard Schutz, Cambridge University Press, 2022

Class Structure:

- Homework problem sets for each chapter are due on Mondays at 10am, submitted via Brightspace.
- The first midterm exam will be on Wednesday September 30th in class.
- The second midterm exam will be on Wednesday November 4th in class.
- The final exam is scheduled for Wednesday December 9th.
- We will aim to cover roughly one chapter of the textbook per week.

Topics to be Covered:

Vector and Tensor Analysis in Special Relativity
Perfect Fluids in Special Relativity
Curvature and Curved Manifolds
Physics in Curved Spacetime
Einstein Field Equations
Gravitational Waves
Spherical Stars
Black Holes
Gravitational Lensing
Cosmology

Americans with Disabilities Act:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Academic Integrity:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at <http://www.stonybrook.edu/uaa/academicjudiciary/>

Critical Incident Management:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

Detailed syllabus for PHY 620 - Modern General Relativity

Week 1

Chapter 1 - Special relativity

Week 2

Chapter 2 - Vector analysis in special relativity

HW 1 due: Chapter 1, problems 3, 17, and 21.

Week 3 - Labor Day; Wed class missed

Week 4

Chapter 3 - Tensor analysis in special relativity

HW 2 due: Chapter 2, problems 24, 25, and 33.

Week 5

Chapter 4 - Perfect fluids in special relativity

HW 3 due: Chapter 3, problems 17, 27, and 31.

Week 6

Chapter 5 - Preface to curvature

HW 4 due: Chapter 4, problems 20, 24, and 25. For problem 25 just do parts a, b, c, and h.

Midterm 1 on Wednesday (Chapters 1 - 4)

Week 7

Chapter 5 - Preface to curvature

Week 8

Chapter 6 - Curved manifolds

HW 5: Chapter 5, problems 5.11, 5.17, and 5.21. (no class Monday)

Week 9

Chapter 6 - Curved manifolds

Week 10

Chapter 7 - Physics in a curved spacetime

HW 6: Chapter 6, problems 6.3, 6.36, 6.39.

Week 11

Chapter 8 - The Einstein field equations

HW 7: Chapter 7, problem 10 (for part e for iv, you can assume $k=0$). Chapter 8, problem 19.

Midterm 2 on Wednesday (Chapters 5 - 7)

Week 12

Chapter 9 - Fundamentals of gravitational radiation

Week 13

Chapter 10 - Spherical solutions for stars

HW 8: Chapter 9, problems 5, 9, 14.

Week 14

Chapter 11 - Schwarzschild geometry and black holes

HW 9: Chapter 10, problems 3, 13, and 19.

Week 15

Chapter 13 - Cosmology

HW 10: Chapter 11, problems 8, 17, and 40.

Week 16

Chapter 13 - Cosmology

HW 11: Chapter 13, problems 19, 23, 25.

Note: for problem 19 you want to show the present age is $2/(3 H_0)$, i.e. $(2/3)(1/H_0)$.

Final Exam on Wednesday (Chapters 1-13 with more emphasis on Chapters 8-13)