

# Physics 130 General Relativity Seminar

## Assignment 4 February 10, 2011

### Part 1: Readings

**Cheng:** Chapters 13(Tensors in General relativity)

**Amanda Peet GR Lectures** - Appropriate pages.

**Other sources** among references on website or books in my office.

### Part 2: Review Questions from Text

You must do the readings BEFORE attempting the problems in order to get a good grasp of the overall content of the week's material to be understood. A problem should then make you look more carefully at specific parts of the readings that are necessary for the solution of that particular problem!

Suggested answers in textbook.

Will be discussed first in seminar.

Participation in discussion = 10% Seminar grade.

Any other questions about readings.

1. Review Questions Cheng: 13-1, 13-2, 13-3, 13-6, 13-7, 13-8, 13-9

### Part 3: Everyone Problems

Everyone must understand these solutions.

Most solved in back of textbook.

Only look at solutions if completely stumped!

Will be discussed second in seminar.

Random choice of presenter.

Quality/correctness of presentation = 40% Seminar grade.

1. Cheng: 13-1 Covariant derivative for covariant components
2. Cheng: 13-2 Christoffel symbols in polar coordinates for a flat plane
3. Cheng: 13-6 Parallel transport and the angular excess

4. Cheng: 13-7 Riemann curvature as the commutator of covariant derivatives
5. Cheng: 13-11 Reducing the Riemann tensor to Gaussian curvature
6. Cheng: 13-14 Contraction of Christoffel symbols

**Part 4: Extra Problems**

One seminar member has overall responsibility for each problem.

Solve as many as you can.

Attempting zero beyond your responsibility is NOT an option!

You will not understand solutions without attempting a problem.

Volunteer presenters OK. Never volunteering is NOT an option!

1. EP #27 Riemann Tensor \_\_\_\_\_
2. EP #29 On a Paraboloid \_\_\_\_\_
3. EP #33 Parallel Transport on a Sphere \_\_\_\_\_
4. EP #34 Curvature on a Sphere \_\_\_\_\_
5. EP #35 Riemann Tensor for 1+1 Spacetimes \_\_\_\_\_
6. EP #36 About Vectors Tangent to Geodesics \_\_\_\_\_
7. EP #82 Does It Transform Correctly? \_\_\_\_\_
8. EP #91 Rotating Frames \_\_\_\_\_