EXAM 1 MATH 499
Special Topics Course in General Relativity
Semester 172

Time Allowed 2 Hours **Maximum Points: 100**

Q1. Solve the equation for which the Lie derivative of the metric tensor is zero, i.e., $L_\xi g = 0$. Solve the resulting equation in plane polar coordinates.

Q2. A metric admits a time-like Killing's vector $\partial / \partial t$. What conservation law this vector admits?

Q3. Write down the geodesic equations. Solve them for the surface of a unit sphere with metric $(1, \sin^2 \vartheta)$.

Q4. Find an expression for the Riemann Christoffel curvature tensor $R^a{}_{bcd}$. Using the metric tensor, write it in a totally covariant form R_{abcd}. Using this covariant form, give all the symmetry properties of this tensor.

Q5. Give the expression for Einstein tensor. From this tensor construct vacuum Einstein field equations.

Q6. In a static, spherically symmetric metric express all the independent Einstein field equations in terms of the metric tensor. Without solving these equations, give solutions of these equations in vacuum.