General Relativity

Institute of Physics Bhubaneshwar

Homework 6

Textbook: Sean Carroll's *Spacetime and Geometry*

Remember each homework carries weight.

Late submissions will not be accepted.

1. Let us say you are engrossed in music listening to your favourite song on the 98.5 MHz Red FM radio station far away from a black hole. A very evil alien pushes you in the black hole. You start to fall radially inward from infinity towards the $r = 2M$ surface. Now, since you have no escape, you decided to enjoy your last free fall by continuing listening to the radio station. Calculate how you must tune your radio set so that you can continue to listen to the radio station during the infall.

   [Hint: You are falling on an ingoing radial timelike geodesic. There are two effect you need to take into account. The red shift because of your motion – you are speeding away from the radio station. The blueshift because you are moving towards stronger and stronger gravitational field. These two effects do not cancel each other. The problem has many steps. Think, calculate, discuss.]

2. Chapter 5, problem 4.