IC200 : Introduction to Astronomy & Astrophysics **Instructor : Dr. Mahavir Sharma**
Tutorial-4

1. Calculate the upper limit of the distance from the centre of a black hole from which even the light can not escape. What is its value for a solar mass black hole. What is its values for the mass of the earth (imagine hypothetically if the entire mass of earth is confined to a point).

2. Calculate and plot the mass distribution corresponding to the density profile for the dark matter of a galaxy given by

$$\rho = \frac{\rho_0}{x(1+x^2)}; \qquad x = \frac{r}{r_s}$$

   where ρ_0 and r_s are constants. How would you derive the potential corresponding to this?

3. Show that if the Universe is composed only of matter then the expansion factor $a(t) \propto t^{2/3}$, where t is the time since the beginning of the Universe. If it is composed of only photons then show that $a(t) \propto \sqrt{t}$.

4. The light we receive from a far-away galaxy is redshifted such that redshift, $z = 6$. Think and then try to derive/explain how far the galaxy is from us? How fast the galaxy is moving away from us?

5. Think and describe on the basis of what you learned in the lecture whether the Hubble constant H changes with time?

6. The light we receive from Andromeda is redshifted or blueshifted. How much do you think is the shift? How would you calculate?