Classical Mechanics : Minor 2 (Open Book Exam) Total Marks 20 Time 1 hr.

Answer all the questions

1) A particle of mass "m" is moving under the influence of a central force, $\vec{F} = \frac{-C}{r^3}\hat{r}$. Sketch the potential corresponding to this central force. Determine the different kinds of orbits which are possible for a particle moving in this potential. Is it possible to have a circular orbit for this potential? If so what is the condition that is required to get this circular orbit. (6)

2) If instead of a Coulomb potential, the scattering potential between two particles is given by $V = -kr^2$ where "k" is a constant, what would be the impact parameter and the scattering cross-section for the two particles (6)

3) A uniform cone of height "h" and density "d" and subtending angle "α" is mounted so as to rotate freely round a vertical axis. On the outside, there is a rigidly fixed uniform spiral track though which a mass "m" can slide down. The track is frictionless. Find the Hamiltonian of the mass sliding down the track as the cone spins about the vertical axis. Is there any conserved quantity associated with the motion? (8)