Homework Assignment #7

(due: Wednesday, October 24, 11:30 pm)

1. Splitting of $\mathcal{L}$: Taylor problem (8.2) (6P)
Redo the steps (8.9) – (8.13) but include the additional potential energy.

2. Molecule in Gravitational Field: Taylor problem (8.3) (7P)
Hint: First rewrite your Lagrangian in coordinates of the center of mass and the relative distance. Then solve the two resulting Lagrange equations. Finish by rewriting your result in cartesian coordinates.

3. Effective Potential: Taylor problem (8.13) (7P)
Hint: For part (c) First write the Taylor series for $U_{\text{eff}}(r_0 + \epsilon)$, then use equation (8.29) to get an DE for ϵ.

4. Kepler's First Law: Taylor problem (8.16) (7P)
Hint: Start with Eq. (8.49), rearrange so that you can replace $r\cos\phi$ with x. Then make sure to use $r^2 = x^2 + y^2$ and complete the square for the x-term.

5. Satellite: Taylor problem (8.18) (7P)
Hint: You may assume that the mass m of the satellite is small enough to approximate $\mu \approx m$.

6. Non-Kepler Orbit: Taylor problem (8.23) (8P)
You answer to b) should include a sketch of the orbit $r(\phi)$. **d) In Addition:** Sketch $U_{\text{eff}}(r)$ and conclude if the possible solutions include bound and/or unbound orbits. Compare with your result $r(\phi)$ in a).
Hint: Do a) and b) together by using the same approach as Taylor for Eq. (8.45) through (8.49).

7. Changes of Orbit: Taylor problem (8.35) (8P)

Schedule: Wednesday: 1.–3., Friday 4. – 6., Monday: 7.