Duke University
Department of Physics

Physics 361 Spring Term 2020

WUN2K FOR LECTURE 15

These are notes summarizing the main concepts you need to understand and be able to apply.

- If there are n coordinates q_j and m **equations of constraint**, or auxiliary conditions, $f_k(x_i, t) = 0$, the problem may be solved by introducing **Lagrange undetermined multipliers** $\lambda_k(t)$: the equations to solve are then $\frac{\partial \mathcal{L}}{\partial q_i} - \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{q}_i} + \sum_k \lambda_k(t)\frac{\partial f_k}{\partial q_i} = 0$, where $k = 1, 2, ..m$, and $i = 1, 2, ...n$. This gives $m + n$ equations in $m + n$ unknowns, including the n equations of constraint. The forces of constraint are then given by $F_i = \sum_k \lambda_k \frac{\partial f_k}{\partial q_i}$.