Design Project Grading Rubric

Code (20 points)

Note: There is only one score for all of the codes submitted. The main consideration is organization and proper use of structure. Points not taken off points for inefficient code.

Commenting (5 points)

- -0: for providing descriptive comments (at least for the significant lines of code) and defining all variables when appropriate
- -1: for missing a statement at the beginning of the code that describes the purpose of the code
- -2: for providing the minimum number of comments, and/or comments that are only somewhat descriptive, and/or defining most (but not all) variables
- -3: for providing only a few comments, and/or comments that are somewhat descriptive, and/or defining some variables
- -4: for providing only a few comments if any, and/or comments that are cryptic, and/or defining very few variables
- -5: no comments provided whatsoever

Programming structure (15 points)

- -0: for having the basic organization: physics, objective function, driver, and optimization are there own standalone procedures.
- -2: if organization should be improved, or some minor problems with programming structure
- -6: if codes are not organized well and have some significant problems with programming structure
- -10: if codes are completely disorganized with significant problems with programming structure

Memo (70 points)

Summary (4 points)

- -0: at least three sentences that provide the problem statement, approach used to solve the problem, and main findings
- -1: missing problem statement
- -1: missing approach statement
- -1: missing statement of main findings
- -1: poor writing

Methods (16 points)

Description of methods (4 points)

-0: for describing Runge-Kutta and optimization procedure

-1: missing Runge-Kutta description

-1: missing description of optimization procedure

-1: poor writing

Equations with variables described in body (4 points)

-0: at least two equations provided for the acceleration and coasting stages of motion AND all variables/parameters described in text

-1: missing one of the equations

-1: not stating initial conditions

-1: not describing some of the variables

-2: not describing any variables

Table 1: Values of design parameters (4 points)

-0: for including table with realistic ranges given for ALLl parameters

-1: for including table with ranges given for most parameters

-2: for including table with ranges given for some parameters

-2: for including table but ranges are not realistic

-3: for including table but not providing ranges for any of the design parameters

-1: for not including table caption

-1: for not referencing table in text

Constraints Provided (4 points)

-0: for providing description of the four main constraints: train height (less than tunnel height) and width (less than tunnel width), train length (less than length of setup track), wheel slippage (initial tank pressure less than criterion given in handout), and gear radius (less than wheel radius)

-1: missing train dimension constraints

-1: missing wheel slippage constraint

-1: missing gear radius constraint

Numerical Results (40 points)

Table 2: Summary of code output (5 points)

-0: for providing a summary that shows the computational time, maximum distance traveled, time to reach finish line, and a list of the optimum physical parameters

-1: missing computational time

-1: missing maximum distance traveled and time to reach finish line

-3: missing list of optimum physical parameters (list should include at least those parameters that have to be specified for the design, i.e., $L_t, r_o, \rho_t, P_0, r_p, L_r, r_p, m$)

-2: if table is not descriptive, i.e., if numbers are simply provided without any indication of the corresponding variable

-1: missing table caption

Figure 1: Plot of x and v versus t for optimal solution (8 points)

-0: for providing figure that exhibits correct trend, meaning there is an acceleration regime and coasting regime, and the maximum distance traveled is less than 12.5 m but greater than 10 m.

-10: for providing figure but maximum distance is either less than 10 m or greater than 12.5 m or trend is incorrect (does not exhibit the expected shape).

-2: missing axis labels

-1: missing figure caption

Table 3: Physical parameters of optimal solution (15 points)

-0: for providing a completed table with values for all of the parameters listed (see original memo for required parameters)

-5: for providing a table, but the optimal values of some of the parameters are unrealistic

-10: for providing a table, but the optimal values of most of the parameters are unrealistic

-2: for providing a table with most of the parameters given (some parameters missing, but the ones given are realistic)

-5: for providing a table with some of the parameters given (most of the parameters are missing, but the one given are realistic)

-1: missing table caption

Text describing results (5 points)

-0: for referencing both figures and table AND for providing a statement on the maximum distance traveled and time to reach the finish line by the "optimum" train

-1: for each missing reference in the text

-1: not including a statement about the optimum train performance

-5: not providing any text

Realistic Train Design (10 points)

Table 4: Parts list (5 points)

- -0: for providing a complete parts list including size, model number, vendor, and estimated price for each of the major components: pipe/tube, end caps, rack, pinion gear, wheels/axles, and pneumatic piston.

- -3: for missing manufacturer/vendor and/or model number

- -1: for missing end caps

- -1: for missing rack

- -1: for missing pinion gear

- -1: for missing wheels/axles

- -1: for missing prices on one or more items

- -2: for missing sizes on one or more items

- -1: missing table caption

Text describing design (5 points)

- -0: for referencing both the figure and table AND for providing a statement on how the realistic components were chosen. If the realistic design parameters differ from the values in the optimum solution, then the student needs to mention this and state that the simulation was run on the realistic train. The time to cross the finish line and total distance traveled for realistic train should also be included if these are different from the optimum train.

- -1: for each missing reference

- -2: not including a statement about the realistic train components were selected

- -3: not providing details about the performance of the *realistic* train compared to the *optimum* train