Midterm Evaluation Criteria

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- Midterm Problem
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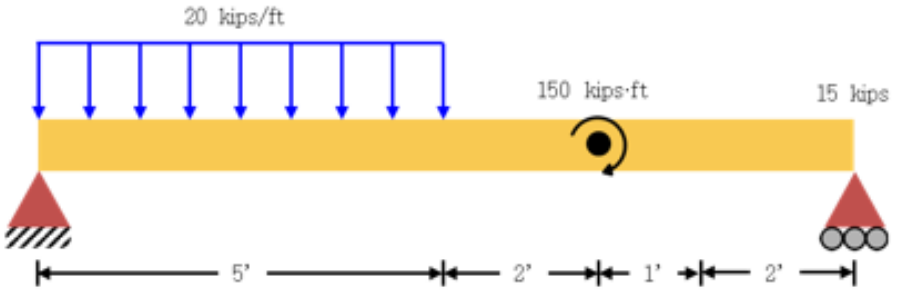
MIDTERM PROBLEM

1. [MATLAB] A simply supported beam is loaded as shown in the following.



Using singularity function the displacement along the beam can be expressed by the equation.

$$u_y(x) = \frac{-5}{6}\left[\langle x-0\rangle^4 - \langle x-5\rangle^4\right] + \frac{15}{6}\langle x-8\rangle^3 + 75\langle x-7\rangle^2 + \frac{57}{6}x^3 - 238.25x$$

By definition, the singularity function can be expressed as follows:

$$\langle x-a\rangle^n = \begin{cases} (x-a)^n & \text{when } x > a \\ 0 & \text{when } x \le a \end{cases}$$

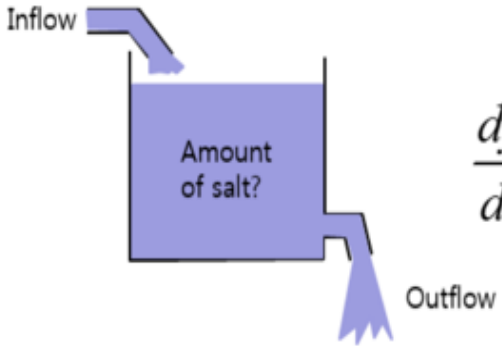
(1) Develop an M-file that creates a plot of displacement versus distance along the beam, x. Note that $x = 0$ at the left end of the beam. (10 pts)

(2) Edit the singularity function in the M-file by using the sub-function (5 pts)

MIDTERM PROBLEM

2. [MATLAB] Mixing problems with water and salt in a single tank can be modelled as the following ODE.

$y(t)$ denotes the amount of salt in the tank at time t. The salt inflow rate is 10 and the salt outflow rate is $0.025y$.



$$\frac{dy}{dt} = 10 - 0.025y$$

(1) Develop a single function script that covers various methods (Euler's method, Heun's method with out update and Ralston's method) up to the 2nd order Runge-Kutta method by taking parameters as in the equation below. (5 pts)

(2) Solve the following initial value problem over the interval from t=0 to 200 with the Euler's method, Heun's method (w/o update), Midpoint method, Ralston's method using the MATLAB function developed in problem. Compare the three different results with the analytic solution by using graphical method (include legend).

where $y(0)=40$ and step size $\Delta t=20$. When the analytic solution of the above initial value problem is given as

(10 pts)

MIDTERM PROBLEM

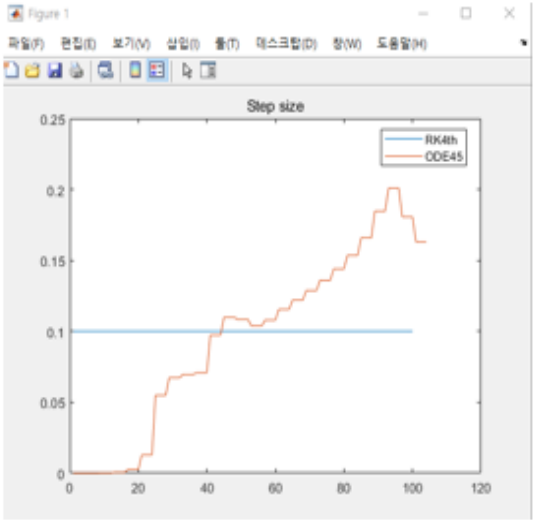
3. [MATLAB] Solve the following initial value problem over the interval from t=0 to 10 where $y(0)=1$, $y'(0)=0$, $\Delta t=0.1$ s.

$$y''+3y'+2.25y=-10e^{-1.5x}$$

(1) Develop a single function script that covers Euler's method and fourth-order RK method for second order ODE and Obtain solutions from Euler's method and fourth-order RK method. Compare the two results with the exact solution by using graphical method (15 pts)

Exact solution $y''+3y'+2.25y=-10e^{-1.5x}$

(2) Obtain solution using MATLAB Built-in function (ode45). Compare the result with the step size by using graphical method and number of the solution. (5 pts)



MIDTERM PROBLEM

4. [AMESim/Simulink] Consider half car model by AMESim. The parameter values in the model are as follows.

(1) [AMESim] Construct this AMESim model for this system. Show the result of vehicle pitch angle(Simulation time: 20 s, print interval: 0.01 s) (10 pts)

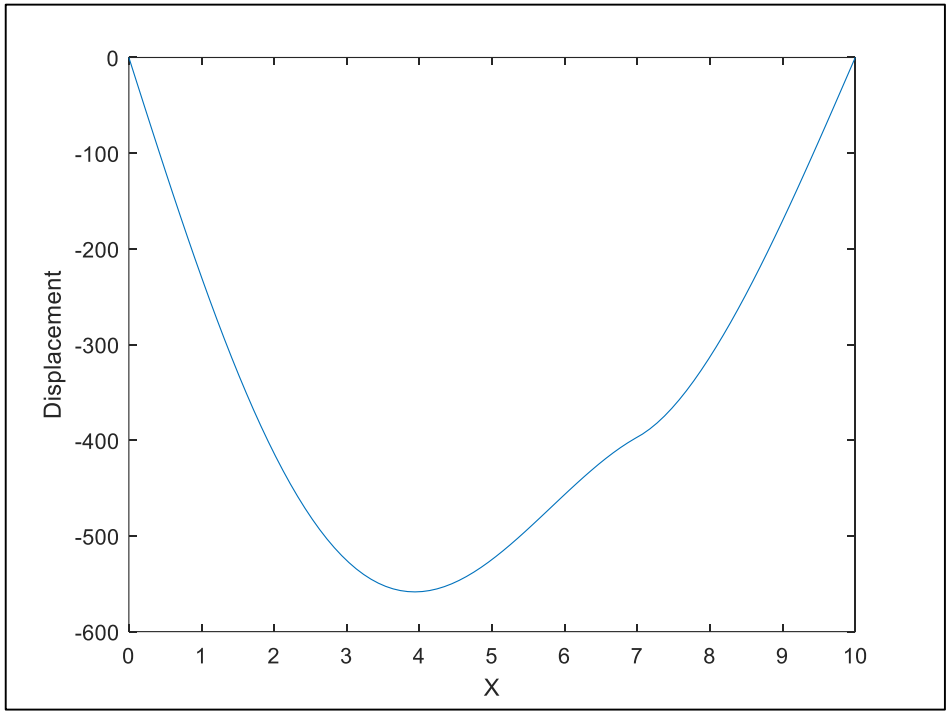
(2) [Simulink] Construct a Simulink model for this system. Show the result of vehicle pitch angle by using scope block (Simulation time: 20 s, solver – ode23tb) (15 pts)

5. [AMESim/Simulink] Consider the Following 2-speed transmission. The parameter values in the model are as follows.

(1) [AMESim] Construct this AMESim model. Compare the engine(J_eng component) and vehicle side(J_out component) side RPM. (Simulation time: 20 s, interval: 0.01 s) (10 pts)

(2) [Simulink] Construct a Simulink model for this system. (Simulation time: 20 s). Show the engine(J_eng) and vehicle side(J_out) side RPM. (15 pts)

PROBLEM.1 EVALUATION CRITERIA

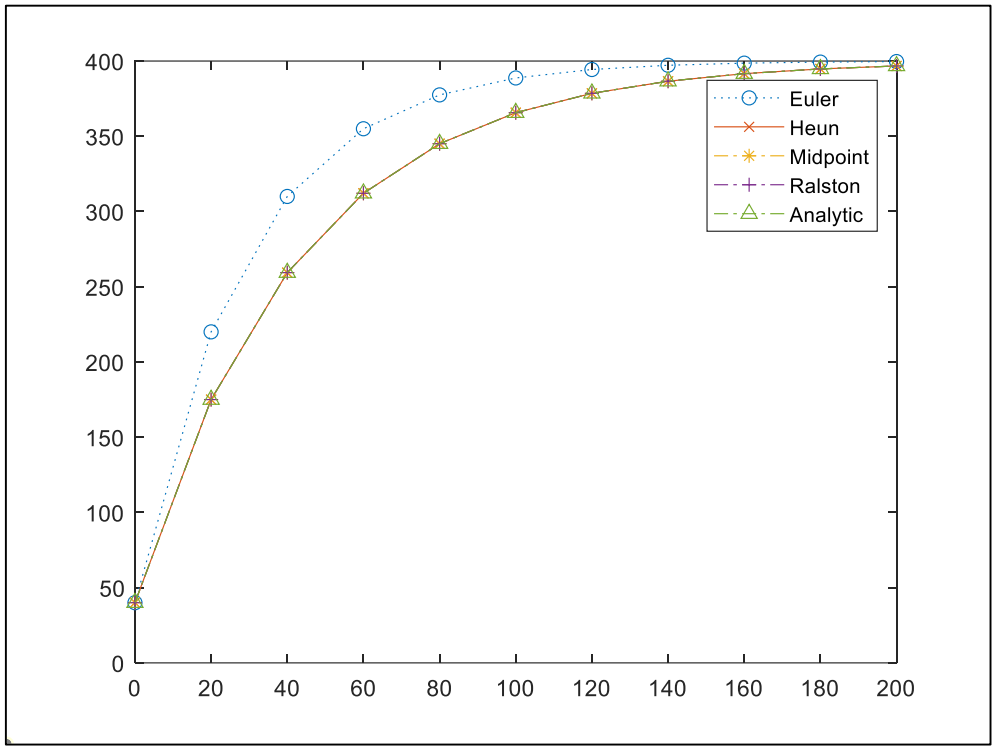


채점 기준

1.(1) 코드작성 완성 – 8 점
/ plot – 2 점 (수식작성 6)

1.(2) 코드작성 완성 – 5 점

PROBLEM.2 EVALUATION CRITERIA

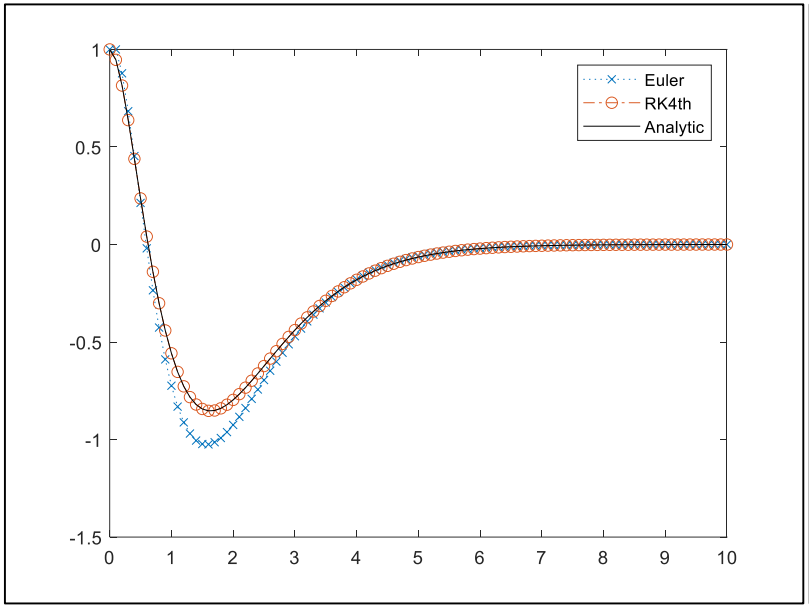


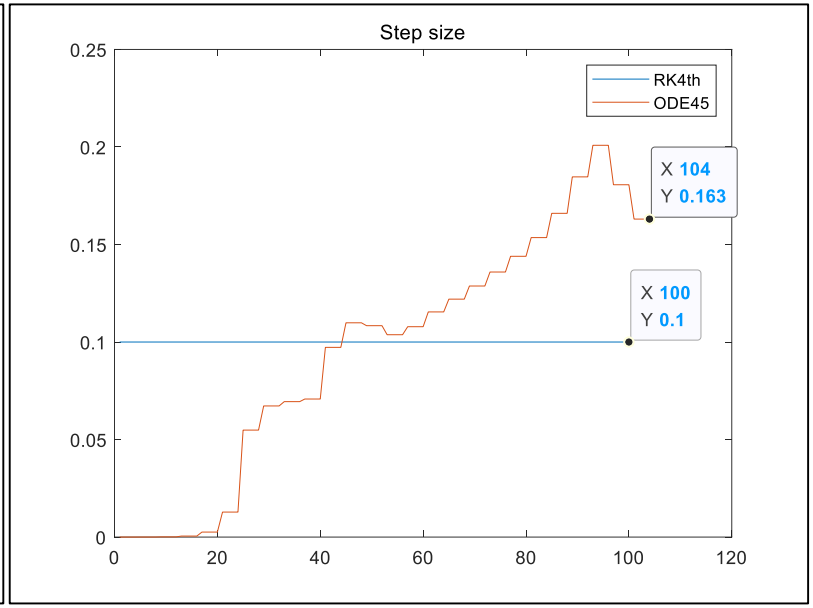
채점 기준

2.(1) 코드작성 완성 – 5점
(general form이 아닐경우 2점)

2.(2) 코드작성 완성 – 8점 각 2점
(Euler/Heun/Mid/Ralston)
/ 도식화 2점

PROBLEM.3 EVALUATION CRITERIA



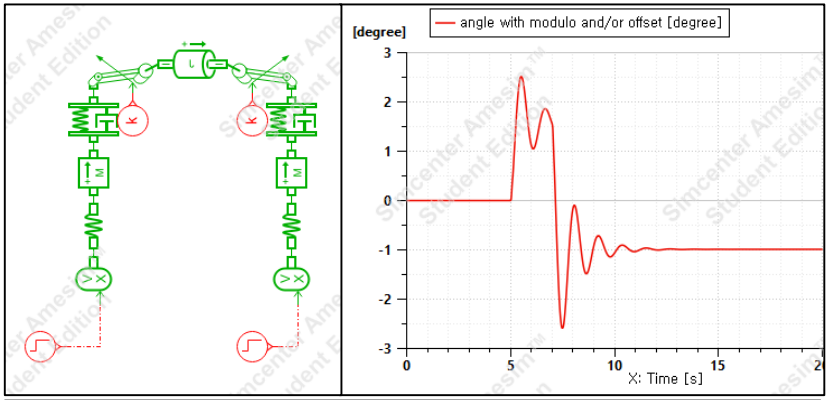


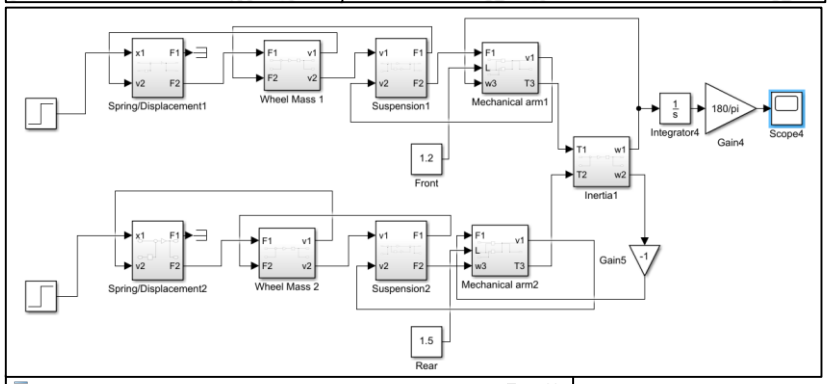
채점 기준

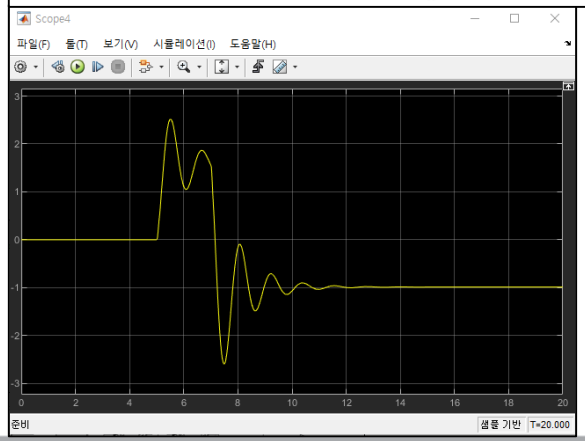
3.(1) 오일러 7 점 / RK45코딩 7점 (linear ODE solver 일 경우 2점) / 도식화 1점

3.(2) 솔루션 수 3점(RK45 1점/ ODE45 2점) 도식화 2점

PROBLEM.4 EVALUATION CRITERIA





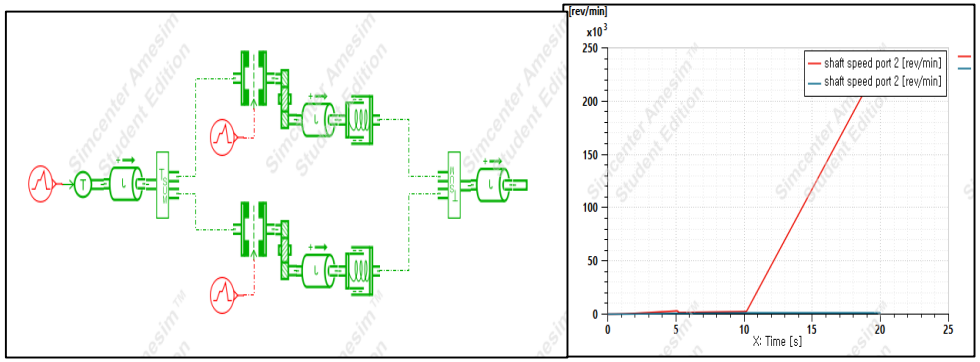


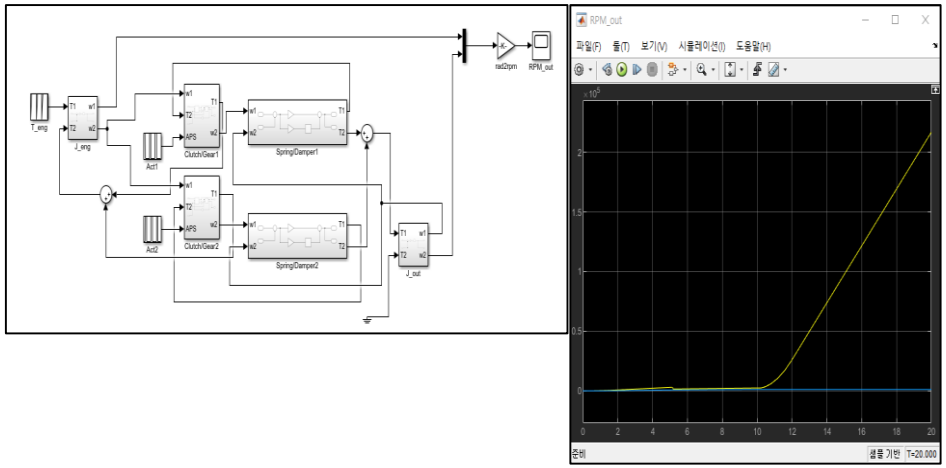
채점 기준

4.(1) 모델 구성 완성 5점
(블록다이어그램 4 파라미터 1)
시뮬레이션 시간 설정 1점
/ 올바른 결과 4점

4.(2) 모델 구성 완성 10점 점
(블록다이어그램 8파라미터 2)
시뮬레이션 솔버 설정 1점
/ 올바른 결과 4점
Sub-system SD - 1 Mass - 1 Suspension - 1 Mechanical arm -1

PROBLEM.5 EVALUATION CRITERIA





채점 기준

5.(1) 모델 구성 완성 5점
(블록다이어그램 4 파라미터 1)
/시뮬레이션 시간 설정 1점 /
올바른 결과 4점

5.(2) 모델 구성 완성 10점 점
(블록다이어그램 8파라미터 2)
/시뮬레이션 솔버 설정 1점 /
올바른 결과 4점
Sub-system Mass – 1 Spring
damper – 1 Clutch -1