Control Systems LAB Digital Assignment 8

Submitted by:

Swarup Tripathy — 19BEE0167

School of Electrical Engineering

Faculty: **Professor Dhanamjayalu C**

Course: **EEE-3001**

Course Name: **Control Systems Lab**

Lab Slot: **L45 + L46**

Study of PID controller using MATLAB

Exp No: 8

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AIM

1. To study the characteristics of the each of proportional (P), the integral (I), and the derivative (D) controls using M-file Editor in MATLAB.

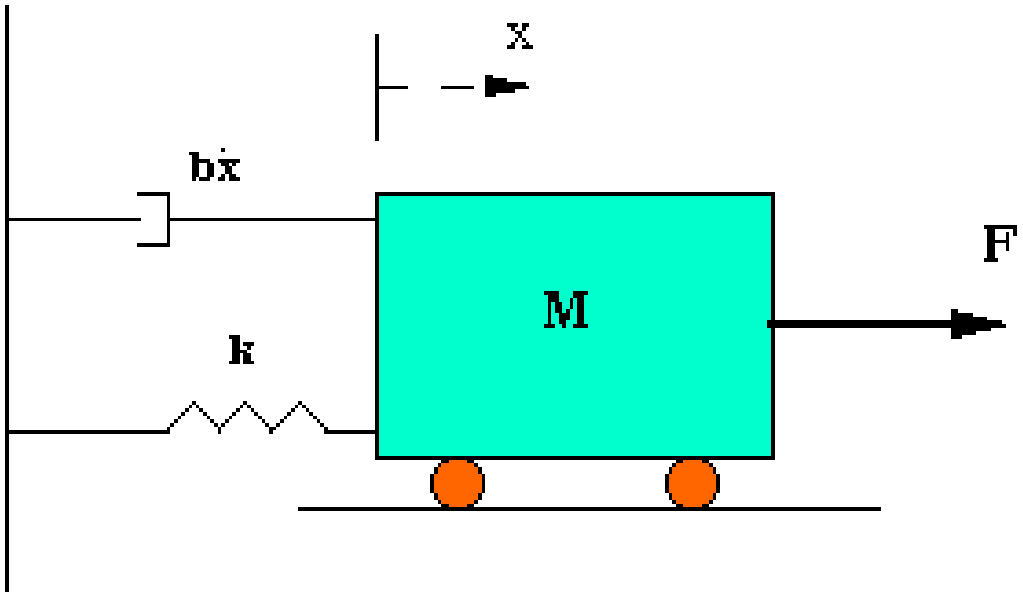
APPARATUS REQUIRED

1. Personal Computer with MATLAB

PROCEDURE

1. Enter the commend window of the MATLAB
2. Create a new M – file by selecting File – New – M – File.
3. Type and save the program.
4. Execute the program by either pressing F5 or Debug – Run.
5. View the results.

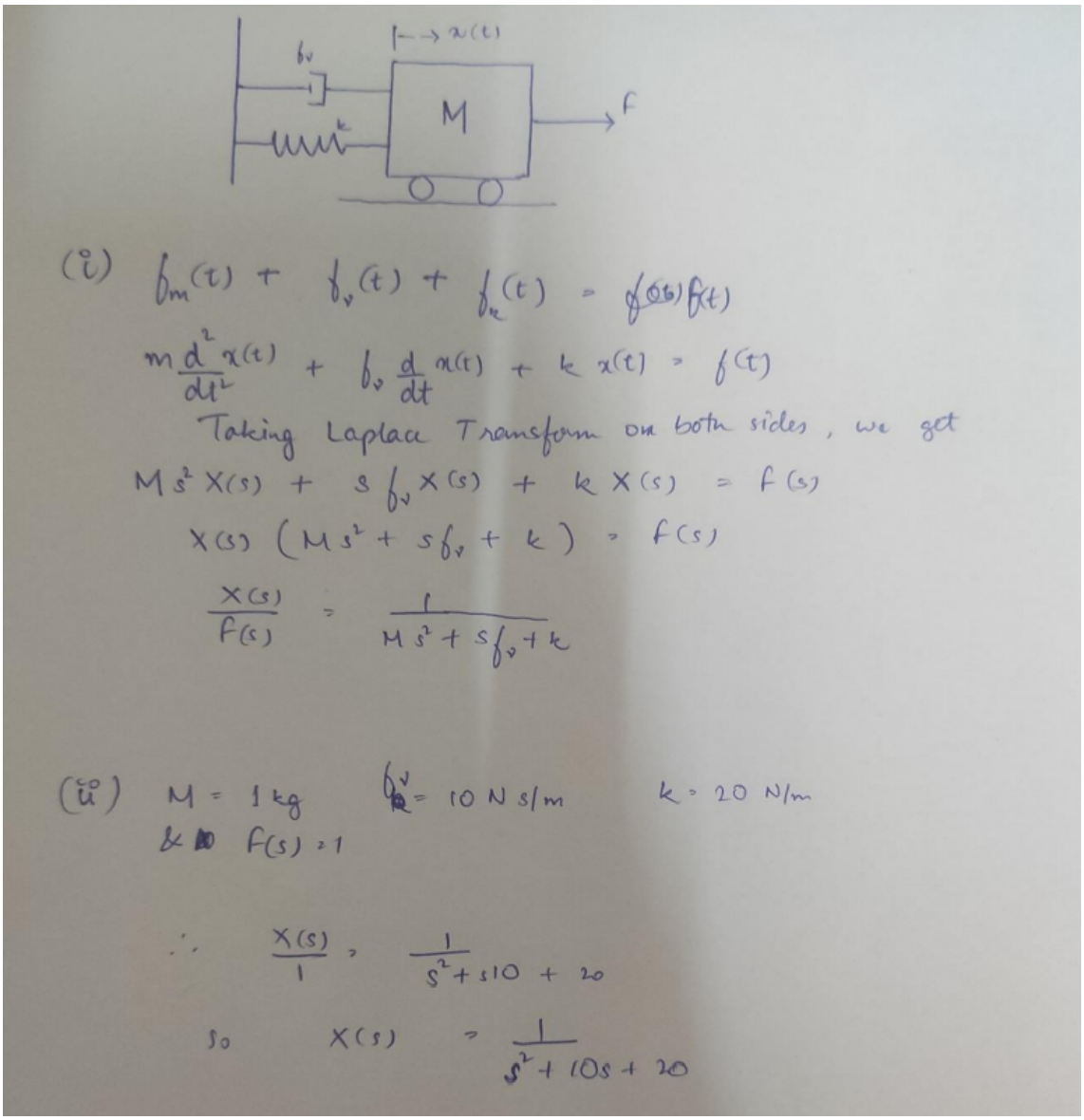
PROBLEM STATEMENT



Find

1. Transfer function of the system given above
2. If M = 1kg , b = 10 N.s/m , k = 20 N/m F(s) = 1
   (a) Obtain the open loop step response.
   (b) Obtain the closed loop step response with proportional Control (Proportional gain (Kp) = 300)
   (c) Obtain the closed loop step response with proportional-Derivative Control (Kp) = 300 Kd = 10
   (d) Obtain the closed loop step response with proportional-Integral- Control [(Kp) = 30 Ki = 70]
   (e) Obtain the closed loop step response with proportional-Integral- Derivative Control [(Kp) = 300 , Ki = 300 Kd =50]

SOLUTION



(i) $f_m(t) + f_v(t) + f_k(t) = f(t)$

$$m\frac{d^2x(t)}{dt^2} + f_v\frac{d}{dt}x(t) + k\,x(t) = f(t)$$

Taking Laplace Transform on both sides, we get

$$Ms^2X(s) + sf_vX(s) + kX(s) = F(s)$$

$$X(s)(Ms^2 + sf_v + k) = F(s)$$

$$\frac{X(s)}{F(s)} = \frac{1}{Ms^2 + sf_v + k}$$

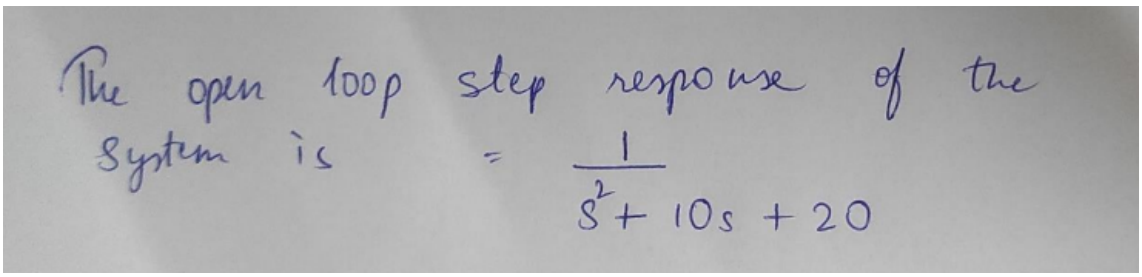
(ii) $M = 1\text{ kg}$ $f_v = 10\text{ N s/m}$ $k = 20\text{ N/m}$

& $F(s) = 1$

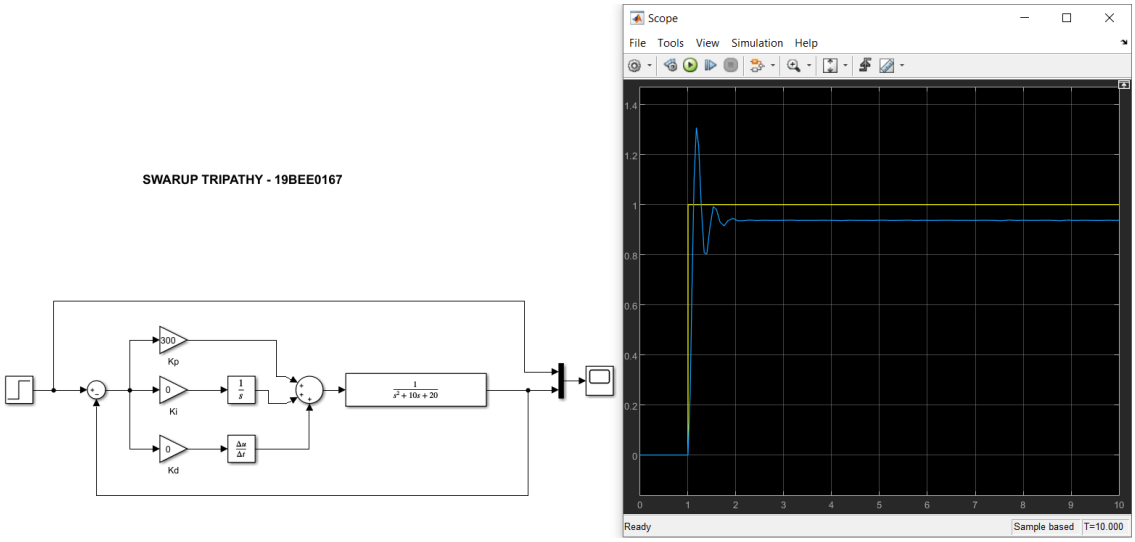
$$\therefore \frac{X(s)}{1} = \frac{1}{s^2 + s10 + 20}$$

So $$X(s) = \frac{1}{s^2 + 10s + 20}$$

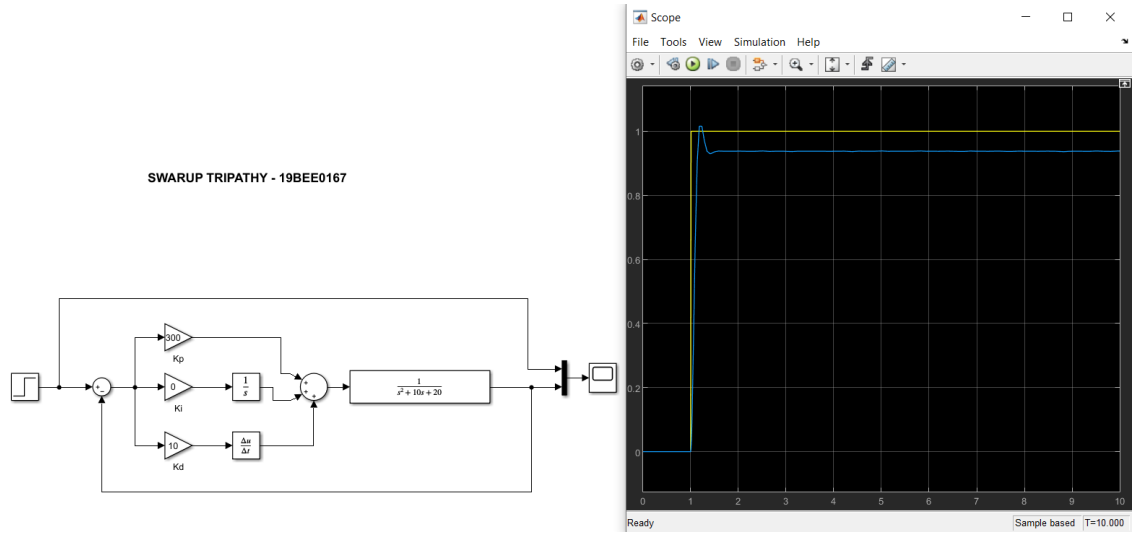
1. Open loop Step response



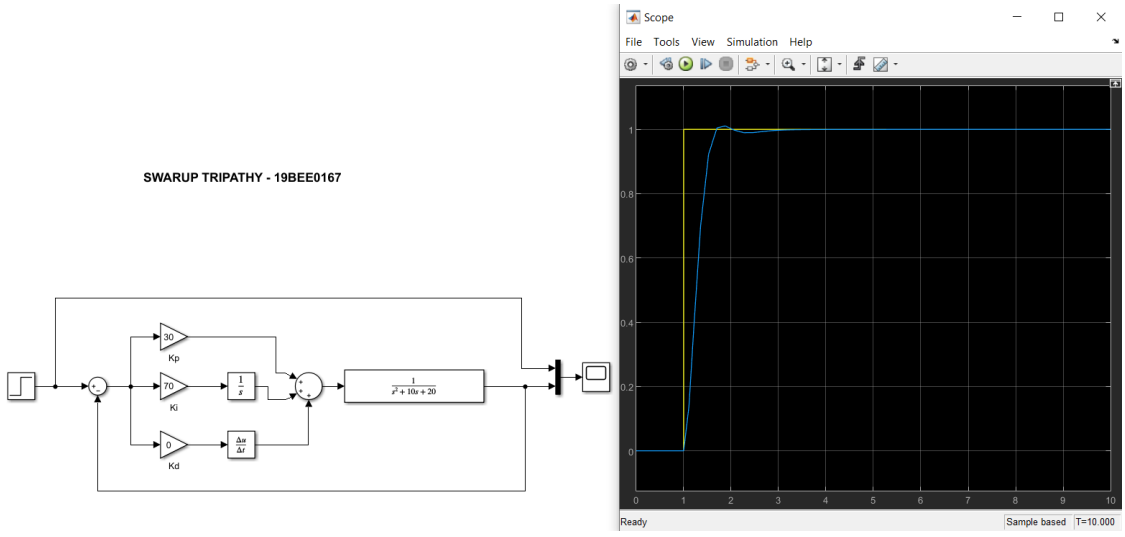
2. Proportional Control



3. Proportional-Derivative Control



4. Proportional-Integral Control



5. Proportional-Integral-Derivative Control