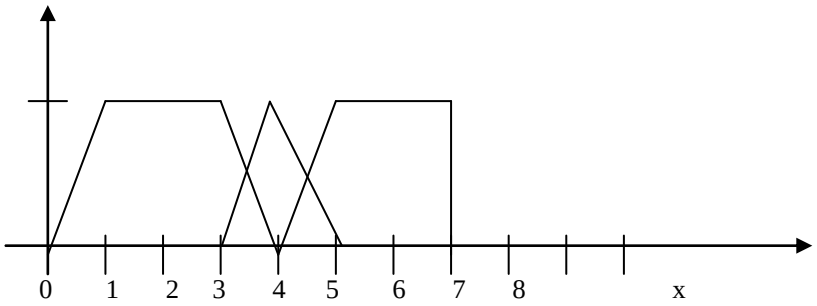
Tut 4

Q1. Three output fuzzy sets are given as follows:

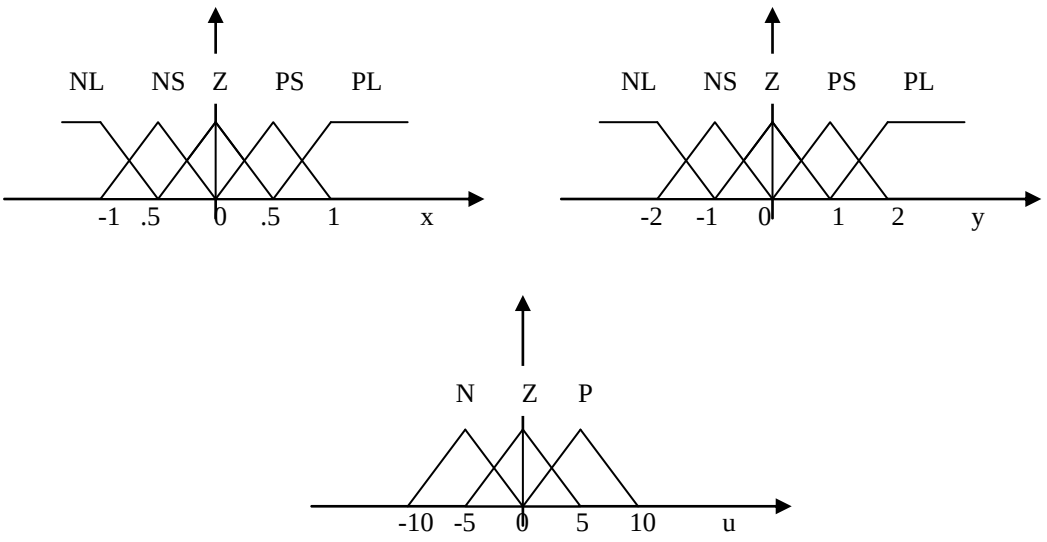


Find the defuzzified output of the union of the three output fuzzy sets using COG.

Q2. A two-input (x,y) and single output (u) fuzzy controller uses the following rule table for controlling a plant:

y-input \ x-input	NL	NS	Z	PS	PL
NL	P	P	P	P	Z
NS	P	P	P	Z	N
Z	P	P	Z	N	N
PS	P	Z	N	N	N
PL	Z	N	N	N	N

The linguistic terms are defined as follows:



(i) Find the output fuzzy set when the inputs are x = -0.25, and y = 1.
(ii) Assuming COG defuzzification find the crisp control output corresponding to the inputs x = 0.5/3 (fraction), and y = 0.5.

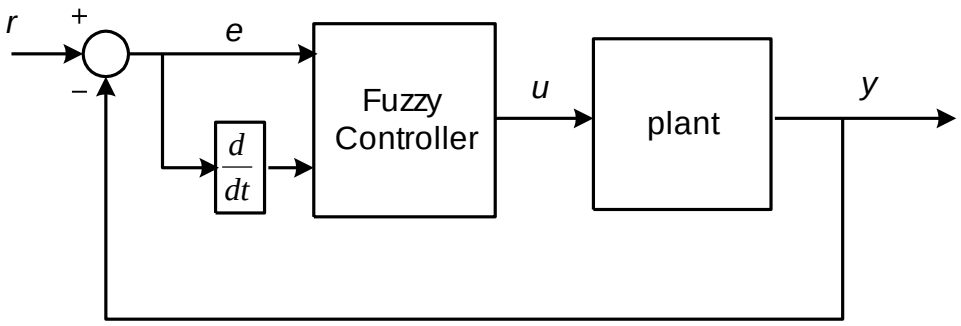
Q3. Repeat Q2 assuming min operator for premise product for implication.

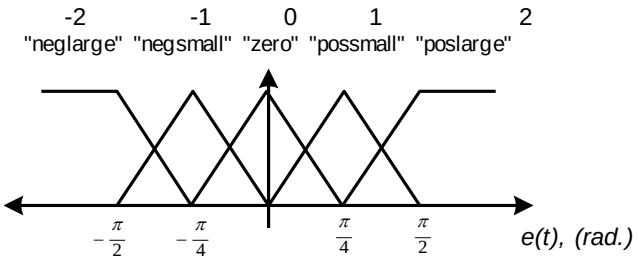
Q4. A fuzzy controller is used to control a non-linear plant. r and y represent the reference input and the output of the plant respectively. The fuzzy controller's inputs are the error signal e =(r-y) and the first derivative of e with respect to time t or $\dot{e}$, and it's output is u, which is the control input signal to the plant. The fuzzy rule base of the controller is given in table 1 and the membership functions of the controller inputs e, $\dot{e}$ and the controller output u are defined as shown below.

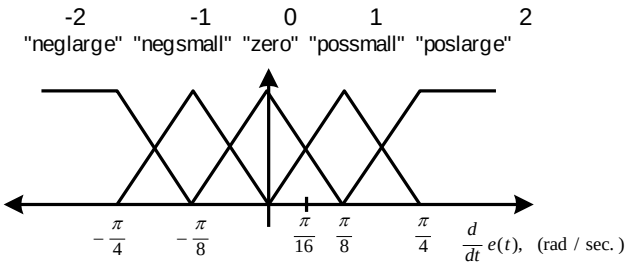
(i) Is the rule base of the controller consistent? Explain your answer.

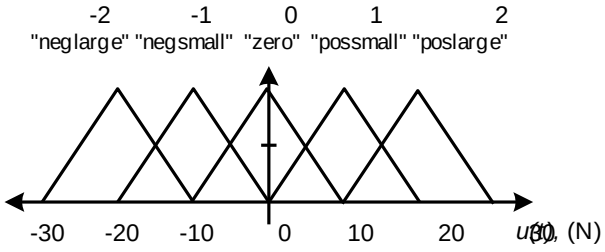
(ii) Write down the rules that fire (or turned on) when the two controller inputs (e, $\dot{e}$) is $(3\pi/8,\ \pi/16)$.

(iii) Graphically depict the operation of the controller for the control inputs given in (ii) and hence determine the crisp control output. Use minimum for the premise and implication and COG defuzzification.









u		$\dot{e}$				
		-2	-1	0	1	2
e	-2	2	2	2	1	0
	-1	2	2	1	0	-1
	0	2	1	0	-1	-2
	1	1	0	-1	-2	-2
	2	0	-1	-2	-2	-2