Sub: Soft Computing Tech Roll no: MT22MCS010.

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Assignment no: 2

Q. Design a fuzzy control system for Automatic AC tempreture controller.

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Here, in automatic AC tempreture controller system, let the output is given in terms of tempreture.

ie Input given to controller be

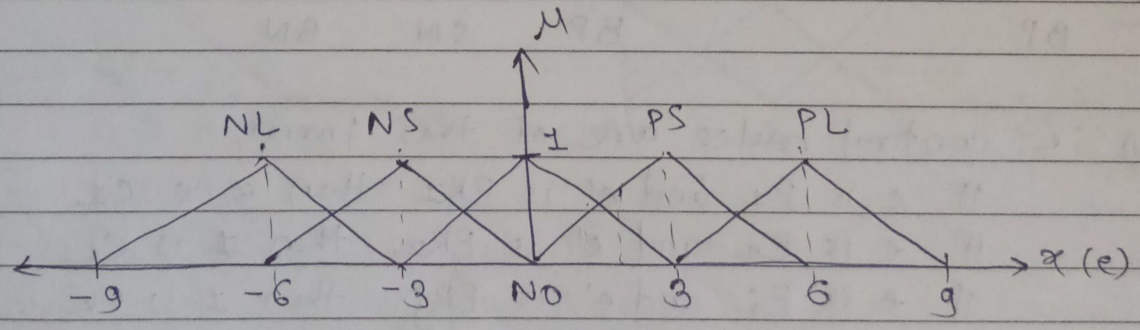
i) tempreture error (e) → difference between desired tempreture & output tempreture.

ii) tempreture error rate (e') → difference between desired rate of change of tempreture, & actual ~~pressure~~ tempreture rate.

Input variables:

i) let error (e) be defined as 5 linguistic terms: labelled $E_1, E_2, \ldots E_5$.

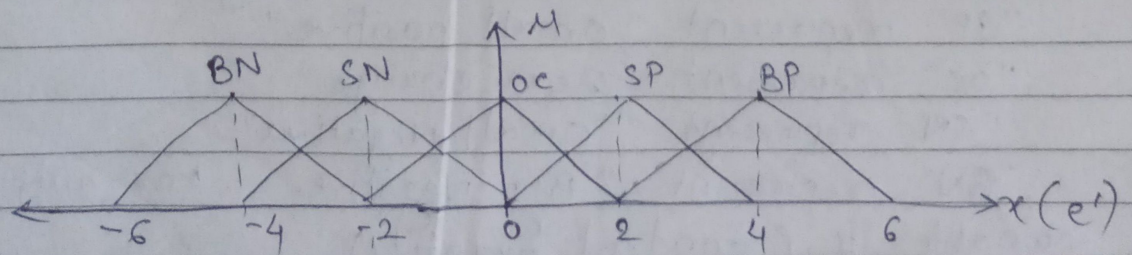
They will conform linguistic variables NL, NS, NO, PS, PL.



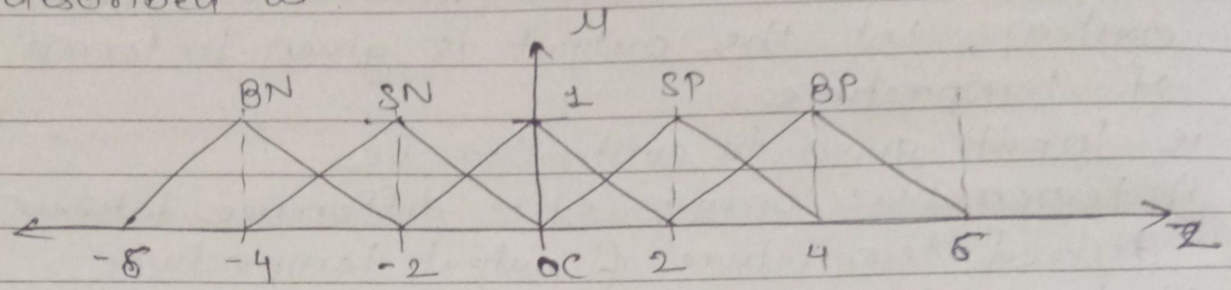
~~ii) let Expressed~~

ii) for error rate (e') the ~~seve~~ 5 fuzzy variables labelled ER1, ... ER5.

~~with~~ They will conform linguistic variables BN, SN, OE, SP, BP



iii) The fuzzy output variable control quantity (z), will also use 5 fuzzy variables on normalized universe, $z = \{-5, -4, \ldots +5\}$ described as:



iv) Control rules for the given controller are expressed as:

(change rate) ERi \ Ei (error)	NL	NS	NO	PS	PL
BN	BP	SP	BN	[illegible]	[illegible]
SN	BP	SP	SN	[illegible]	[illegible]
OC	BP	SP	OC	SN	BN
SP			PS	SN	BN
BP			BP	SN	BN

v) i.e. control rules are of the form,
If e is E_1 and e' is ER_1 then z is C_1
If e is E_2 and e' is ER_2 then z is C_2
If e is E_i and e' is ER_j then z is C_k.

e.g. If tempreture error (e) is "~~Big~~ Negative large" and tempreture error rate (e') is "Big Negative (BN)" then tempreture change is "Big Positive".

where the terms "BP" represent "Big positive",
"SP" represent "Small positive"
"OC" represent "Zero change"
"SN" represent "Small Negative"
"BN" represent "Big Negative" for output variable z (control quantity).

Test case :-

i) IF tempreture error (e) = 2,
error rate (e') = 2.

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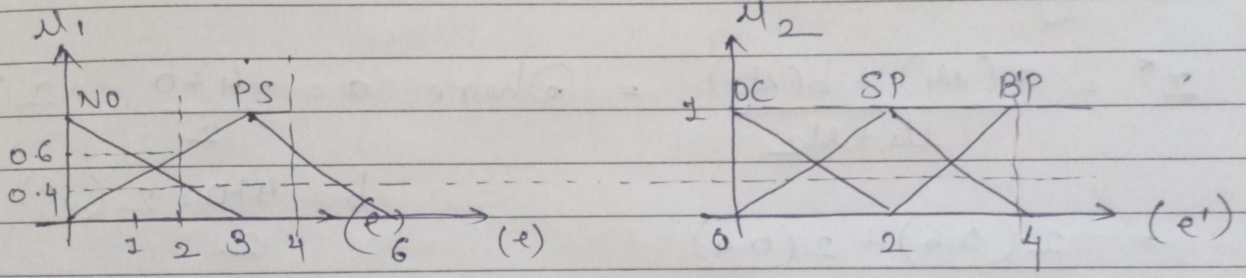
1] Converting crips value to appropriate linguistic terms, then

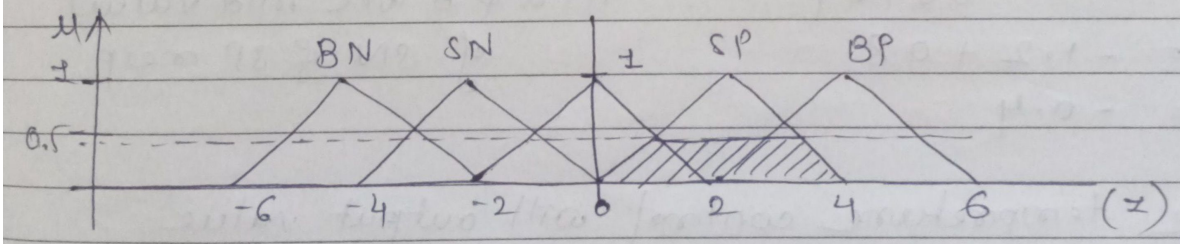
Tempreture error = $\{\frac{0.4}{NO}, \frac{0.6}{PS}\}$

error rate = $\{\frac{1}{SP}\}$

2] Based on linguistic term and control rules fired rules shown as :

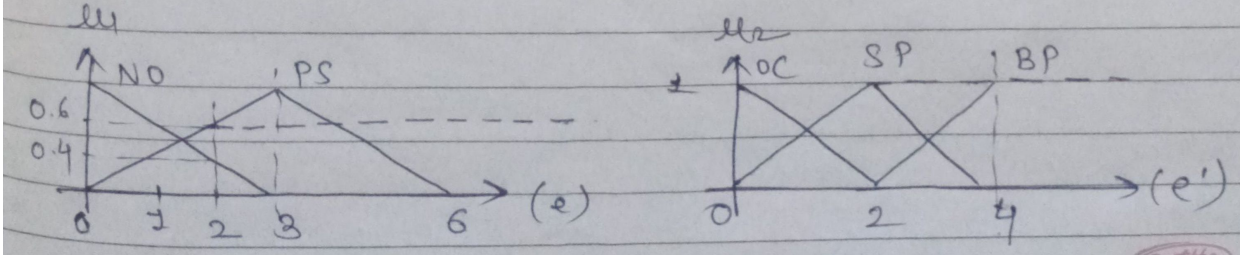
Rule 1] If error E = "NO" and ER = "SP"
then control change = "PS".

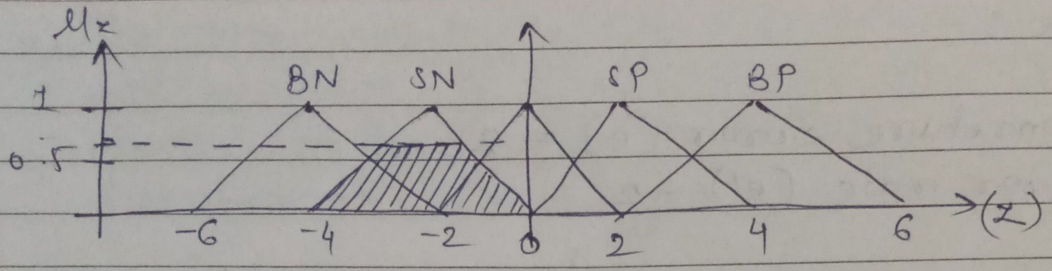




$\therefore \mu(z) = \min(\mu_1, \mu_2) = \min(0.4, 1) = 0.4$.

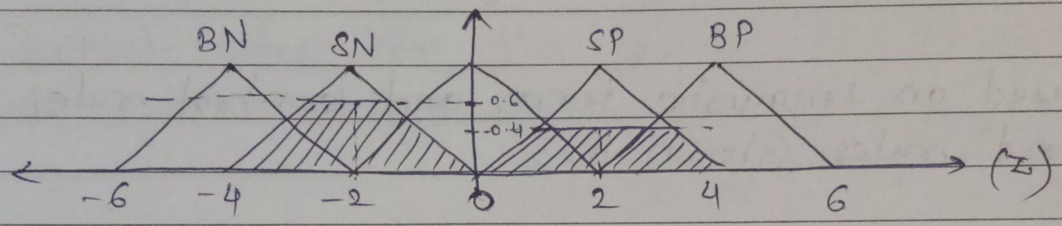
Rule 2] If error E = "PS" and ER = "SP"
then tempreture control change = "SN".





$\because \mu_z = \min(\mu_1, \mu_2) = \min(0.6, 1) = 0.6$.

Hence, overall consequent of PC can be shown as:



now, applying defuzzification using Weighted average method,

$$z^* = \frac{a(\mu_1) + b(\mu_2)}{\mu_1 + \mu_2}$$

$$= \frac{-2(0.6) + 2(0.4)}{0.6 + 0.4}$$

$$= -1.2 + 0.8$$

$$z^* = -0.4$$

where, $a = \frac{-4+0}{2} = -2$ (SN)

$b = \frac{4+0}{2} = 2$ (SP)

ie. a & b are mid values of SN & SP resp.

Hence, temprature control will output value as $-0.4°C$.