**COMPUTATION OF STABILITY REGIONS**

To identify the boundary of the stability region in the parameter space of PI controller, ( )-plane for a given time delay τ, s = j and the crossing frequency > 0 is substituted into (2). The PI controller gains are then separated to obtain a new equation as follows

P(s) = + + + +

+

[- ] +j [}

Q(s) = ++++

] +j []

=

] +j[] \*

]] j[] \*+ j[]=

-[ R + j

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][] =

][] =

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[] - ] =- [].

**REAL PART**

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() ()]

= [- .

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= -

**IMAGINARY PART**

() + ( () + ()]

=-[

() + () + () + () +() - ()]

=[ ]

= -

+ = 0

From 6 and 7 we get

From 7 and 6 we get

A1()+ B1()+ C1 ()=0

A2()+ B2()+ C2 ()=0

The coefficients are

A1 () = -pי2 2 + qי44cos(t) – qי22cos(t) – qי33sin(t) + qי1ωcsin(t)

B1() = -pיי2 2 + pיי0 – qיי22cos(t)+qיי0cos(t) – qיי3ωc3sin(t) + qיי1ωcsin(t)

C1 () = -p6 + p4 – p22

A2() = -pי33 + pי1 – qי33cos(t) + qי44sin(t) + qי22sin(t)

B2() = pיי1 – qיי33cos(t) + qיי1cos(t) + qיי22sin(t) – qיי0sin(t)

C2() = p5 5 – p3 3 + p1