**clear ALL**

**M= 8.8;**

**D= 1;**

**Tg= 0.2;**

**Tc= 0.3;**

**Tr= 12;**

**Fp= 1/6;**

**R= 1/11;**

**Beta= 21;**

**Kev= 1;**

**Tev= 0.1;**

**alpha0= 0.8;**

**alpha1= 0.2;**

**Ki = 0.6;**

**Kp = 0.2;**

**p6= (M\*R\*Tg\*Tr\*Tc\*Tev);**

**p5= (D\*R\*Tg\*Tr\*Tc\*Tev) + (M\*R) \*(Tg\*Tr\*Tc + Tr\*Tc\*Tev + Tg\*Tc\*Tev + Tg\*Tr\*Tev);**

**p4= (D\*R) \*(Tg\*Tr\*Tc + Tr\*Tc\*Tev + Tg\*Tc\*Tev + Tg\*Tr\*Tev) + (M\*R) \*(Tr\*Tc + Tg\*Tc + Tg\*Tr + Tc\*Tev + Tg\*Tev+ Tr\*Tev);**

**p3= (D\*R) \*(Tc\*Tr+ Tg\*Tc + Tg\*Tc + Tg\*Tr + Tc\*Tev + Tr\*Tev + Tg\*Tev) + (M\*R) \*(Tc+Tr+Tg+Tev) +(Fp\*Tr\*Tev) + (alpha0\*Beta\*R\*Kp\*Fp\*Tr\*Tev);**

**p2= (D\*R) \*(Tc+Tr+Tg+Tev) +(M\*R) +(Fp\*Tr) +Tev+(alpha0\*Beta\*R) \*(Kp\*Tev + Kp\*Fp\*Tr + Ki\*Fp\*Tr\*Tev);**

**p1= (D\*R) + 1 + (alpha0\*Beta\*R) \*(Kp+ Ki\*Tev + Ki\*Fp\*Tr);**

**p0= (alpha0\*Beta\*R\*Ki);**

**q4= (alpha1\*Beta\*R\*Kev\*Kp\*Tg\*Tr\*Tc);**

**q3= (alpha1\*Beta\*R\*Kev) \*(Kp\*Tr\*Tc + Kp\*Tg\*Tc + Kp\*Tg\*Tr + Ki\*Tg\*Tc\*Tr);**

**q2= (alpha1\*Beta\*R\*Kev) \*(Kp\*Tc + Kp\*Tr + Kp\*Tg + Ki\*Tr\*Tc + Ki\*Tg\*Tc +Ki\*Tg\*Tr);**

**q1= (alpha1\*Beta\*R\*Kev) \*(Kp + Ki\*Tc + Ki\*Tr + Ki\*Tg);**

**q0= alpha1\*Beta\*R\*Kev\*Ki;**

**t12= p6^2;**

**t10= p5^2 - 2\*p6\*p4;**

**t8 = p4^2 + 2\*p6\*p2 - 2\*p5\*p3 - q4^2;**

**t6 = p3^2 - 2\*p6\*p0 - 2\*p4\*p2 + 2\*p5\*p1 + 2\*q4\*q2 - q3^2;**

**t4 = p2^2 + 2\*p4\*p0 - 2\*p3\*p1 - 2\*q4\*q0 + 2\*q3\*q1 - q2^2;**

**t2 = p1^2 - 2\*p2\*p0 + 2\*q2\*q0 - q1^2;**

**t0 = p0^2 - q0^2;**

**k=1;**

**r = roots ([t12 t10 t8 t6 t4 t2 t0]);**

**for i=1: size(r,1)**

**an(i)=angle(r(i)) \*(180/pi);**

**if (an(i)==0)**

**w1(k)=r(i);**

**k=k+1;**

**end**

**end**

**m = 0;**

**for n = 1: size(w1,2)**

**wa (: n) = sqrt (w1(: n));**

**wc = wa (: n);**

**derWc = 6\*t12\*wc^10 + 5\*t10\*wc^8 + 4\*t8\*wc^6 + 3\*t6\*wc^4 + 2\*t4\*wc^2 + t2;**

**RT = sign(derWc);**

**if(RT==1)**

**m = m+1;**

**P = p6\*(j\*wc) ^6 + p5\*(j\*wc) ^5 + p4\*(j\*wc) ^4 + p3\*(j\*wc) ^3 + p2\*(j\*wc) ^2 + p1\*(j\*wc) ^1 + p0;**

**Q = q4\*(j\*wc) ^4 + q3\*(j\*wc) ^3 + q2\*(j\*wc) ^2 + q1\*(j\*wc) ^1 + q0;**

**SIN = imag(P/Q);**

**COS = real(-P/Q);**

**theta = atan(SIN/COS);**

**if COS<0**

**tau1(:m) = ((theta+pi)/wc);**

**else**

**tau1(:m) = (theta/wc);**

**end**

**RT;**

**wc;**

**tau1;**

**else**

**RT;**

**wc;**

**end**

**end**

**Kp**

**Ki**

**format long g**

**tau = min(tau1)**

**format**