OPTIMIZATION IN FREQUENCY DOMAIN DESIGN OF CONTROL SYSTEMS

A DISSERTATION

submitted in partial fulfilment
of the requirements for the award of the degree
of
MASTER OF ENGINEERING
in
ELECTRICAL ENGINEERING
(System Engineering and Operations Research)

By

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June, 1985

Gratis

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the dissertation entitled, "OPTIMIZATION IN FREQUENCY DOMAIN DESIGN OF CONTROL SYSTEMS" in partial fulfilment of the requirements for the award of the Degree of MASTER OF ENGINEERING IN ELECTRICAL ENGINEERING with specialisation in SYSTEM ENGINEERING AND OPERATIONS RESEARCH, submitted in the Department of Electrical Engineering, University of Roorkee is an authentic record of my own work carried out for a period of about eleven months, from July 1984 to June 1985, under the supervision of Dr. Jayant Pal, Reader, Department of Electrical Engineering, University of Roorkee, Roorkee, India.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree or diploma.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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Abstract

In this dissertation, we propose to use optimization techniques in the frequency domain design of control system. This is different from the optimal control techniques in which optimization is done in the time domain. The objective of this work is to test the suitability or otherwise of using optimization techniques to find the controller parameters so as to minimize the squared error of frequency response deviations of the controlled system and a specification model. The graphs have also been drawn for time response and frequency response of different cases. The results are attached at the end of each case.

CONTENTS

I. INTRODUCTION

Design of control systems represents an interesting and complex subject in control system studies. In a simplified manner the design problem of control systems can be described with the aid of the block diagram of Figure 1.

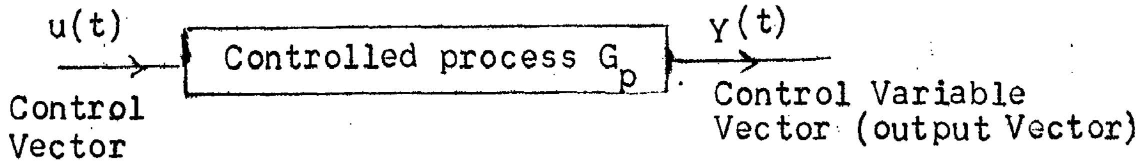


Fig.1: Block Diagram of a controlled Process.

The Figure 1 shows a controlled process whose output Vector Y(t) represents q controlled variables and the control vector u(t) represents p control signals. The problem is to find a set of 'appropriate' signals u(t), so that the controlled variable vector Y(t) behaves as desired. The description of the basic design problem is simplified by overlooking the possible existence of external disturbances.

Once the desired control vector u(t) for satisfactory control is determined, a controller is usually needed to generate this control from the reference inputs and the state vector x(t) or output Y(t).

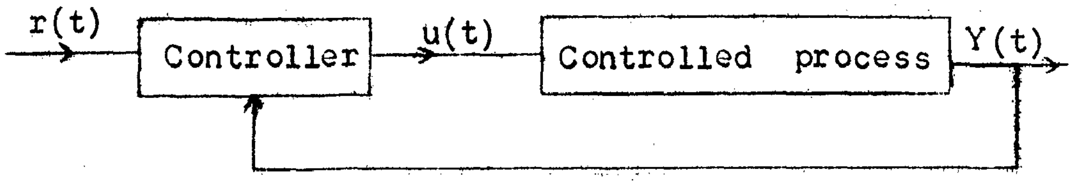


Fig.2: Block Diagram of a control system with output feedback.

Figure 2 illustrates the block diagram of a control system whose control vector is derived from the input vector, and the output vector. This type of system is referred to as an output feedback system. The block diagram is intended only for the purpose of illustrating the philosophy of designing control systems and no attempt is made to include all possible configurations.

The design and parameter adjustment of the open loop transfer function of the system for specified closed loop performance is carried out somewhat more easily in frequency domain (i.e. through frequency response) than in time domain (i.e. through time response). Further, the effects of noise disturbance and parameter variations are relatively easy to visualize and assess through frequency response. If necessary, the transient response of a system can be obtained from its frequency response through the Fourier integral.

The frequency response is easily evaluated from the sinusoidal transfer function which can be obtained simply by replacing s with jw in the system transfer function T(s). The transfer function T(jw) thus obtained, is a complex function of frequency and has both a magnitude and a phase angle. These characteristics are conveniently represented by graphical plots.

II. REVIEW OF CONTROL SYSTEM DESIGN THEORY

The early stage of the theoretical development of the design of control systems was characterized by the works of Nyquist, Nichols and Bode who developed such classical methods as the Nyquist plot, Bode diagram and Nichols Chart. A unique feature of these methods is that they are all graphical techniques which are conducted in the frequency domain. In the design of control systems, both the time and frequency responses are of importance. The use of the frequency domain techniques leads to graphical methods for the design of controllers.

The classical design of control systems involve a trial and error approach. The proper selection of the system configuration as well as the parameters of the controller depend to a great extent on the experience and judgement on the part of designer. In the frequency domain design, the design specifications usually are given in terms of such criteria as gain margin, phase margin, peak resonance and band width. These criteria, however, should be related to the time doma in specifications such as rise time, overshort and settling time which are more amenable to direct measurements. The distinct disadvantage of the classical design of control systems is that it does not indicate whether a solution actually exists for the design problem at the outset. It is entirely possible that design requirements are so stringent or may be contradictory so that they can not be satisfied by any system configuration or controllers that are physically realizable. Even when a solution does exist, the classical design may yield a system that may not be the best one.

The introduction of the root locus technique by Evans in 1950 made possible the design of control systems to be carried out in the S-plane. The main advantage of the root locus method is that information on frequency domain as well as time domain characteristics can be derived directly from the pole-zero configuration in the S-plane. With the knowledge of the closed loop transfer function poles and zeros, the time domain response is determined readily by means of inverse Laplace transform and the frequency response is obtained from the Bode plot. However, the root locus design still is basically a trial and error procedure and it relies on the reshaping of the root loci to obtain a satisfactory pole-zero configuration for the closed loop system.

The work by Norbert Wiener in the late 1940s opened a new horizon to the design of control systems. Wiener introduced not only statistical considerations in control system design, but also the idea of a performance index. For the first time, the design engineer was able to start from a set of design criteria and carry out the design by means of a completely analytical procedure. We are able to design a control system that is optimum or the best possible with respect to a given performance criterion. The principle of Wiener's optimization technique is demonstrated by the block diagram in Fig.1. The design objective is to determine the closed loop transfer function Y(s)/U(s) of the system such that the error between the desired output and the actual output is minimized. In Wiener's statistical design ttechnique, the mean-square value of the error e(t) is used as the performance index J i.e.

$$J = \lim_{T \to \infty} \frac{1}{T} \int_0^T e^2(t)\,dt \qquad \ldots (1)$$

The reason for using the mean square error as the performance index is that the minimization of this particular performance index induces an analytical design procedure.

State Variable approach is a direct time domain approach which provides a basis for the modern control theory using system optimization. It is a very powerful technique for the analysis and design of linear and non-linear, time-invariant or time-variant, multi-input multi output systems. The organisation of the state variable approach is such that it is easily amenable to solution through digital computers.

In the present work, we propose to use optimization techniques in the frequency domain design of control systems. This is different from the optimal control techniques in which optimization is done in the time domain. The objectives of this work is to test the suitability or otherwise of using optimization techniques to find the controller parameters so as to minimize the squared error of frequency response deviations of the controlled system and a specification model. The details of the proposed technique are given in the following chapter.

III. FREQUENCY DOMAIN DESIGN USING OPTIMIZATION

The design problem may be stated as follows. Given the plant transfer function G(s) as

$$G(s) = \frac{\sum_{i=o}^{m} a_i s^i}{\sum_{i=o}^{n} b_i s^i} \qquad \text{Where } m \leq n \qquad \text{.... (2)}$$

Let us choose a pre-compensator as

$$C(s) = \frac{\sum_{i=o}^{r-1} C_i s^i}{\sum_{i=o}^{r} d_i s^i} \qquad \text{.... (3)}$$

So that the closed loop system with unity feedback is given by

$$T(s) = \frac{G(s)\, C(s)}{1 + G(s)C(s)} \qquad \text{.... (4)}$$

approximates a given model transfer functi on M(s)

$$M(s) = \frac{\sum_{i=o}^{q} e_i s^i}{\sum_{i=o}^{p} f_i s^i} \qquad \text{Where } q \leq p \qquad \text{.... (5)}$$

in some sense. In other words, we seek to design C(s) so that T(s) approaches M(s) over a frequency range (ω_o, ω_1). It may be noted that the function T(s) involves the unknown parameters C_i, d_i, $i \in (O, r)$ of C(s) while e_i, f_i of M(s) are known. We define the unknown parameters of C(s) as

$$\underline{p} = [C_i, d_i ; i \in (0, r)] \quad \text{.... (6)}$$

Error Criteria :

We may choose any one of the several error criteria commonly used. The most popular one is the mean squared error function defined by

$$E = \frac{1}{2} \int_{\omega_0}^{\omega_1} |T(j\omega) - M(j\omega)|^2 \, d\omega \quad \text{.... (7)}$$

or more generally the weighted mean squared error function defined by

$$E = \frac{1}{2} \int_{\omega_0}^{\omega_1} W(\omega) \, |T(j\omega) - M(j\omega)|^2 \, d\omega \quad \text{.... (8)}$$

Where | | represents the absolute value of a complex function and $W(\omega)$ is a real non-negative weighting function.

Iteration algorithm :

STEP- 1: Make a reasonable guess of the controller parameters C_i, d_i. This initial guess need not be close to the optimal values. With this choice of parameters values $T(p, jw)$ can be computed.

STEP-2 : Use the element values of Step-1 and an analysis programme to compute the error function $E(p)$. If $E(p) \leq \epsilon$, where ϵ is a small preassigned positive number, the probelm is solved, the parameter values chosen in step-1 are satisfactory . Usually, we get $E(p) >> \epsilon$, in this case we must proceed to step-3.

STEP-3 : Introduce a small perturbation on the parameter values. That is replace C_i by $C_i + \delta C_i$, d_i by $d_i + \delta d_i$, where C_i and d_i represent the small change on the element values C_i, d_i respectively. This means that parameters vector $\underline{p}$ is replaced by $\underline{p} + \delta\underline{p}$. Using these adjusted parameter values, the corresponding transfer function $T(\underline{p}+ \delta\underline{p}, j\omega)$ and the error function $E(\underline{p} + \delta\underline{p})$ can be computed. We then choose $\underline{p}$ so that the following two conditions are satisfied :

1. $E(\underline{p} + \delta\underline{p}) < E(\underline{p})$
2. $|E(\underline{p} + \delta\underline{p}) - E(\underline{p})|$ is maximized.

The first condition guarantees that the adjustment of tth the parameter values is in the right direction in the sensee that the new system is one step closer to the desired one. The second condition assure that $\underline{p}$ is chosen in an optimal fashion in the sense that the difference between the original error function and the adjusted one is as large as possible.

STEP-4: Use the new parameterr values $\underline{p} + \underline{p}$ to compute $T(\underline{p} + \delta\underline{p}, j\omega)$ and $E(\underline{p} + \delta\underline{p})$. If $E(\underline{p} + \delta\underline{p}) \leq \epsilon$, stop the iterations; $p + \delta p$ is the optimal parameter vector. If $E(\underline{p} + \delta\underline{p}) > \epsilon$, use $\underline{p} + \delta\underline{p}$ as the new parameter values, go back to step-3 and continue the process until one of the following condi-tions is satisfied :

1. $E \leq \theta$ or

2. $|E_{i+1} - E_i| \leq \eta$

where η is a pre-assigned positive number and E_i denotes the error function at the ith iteration. The first condition implies that the error function has reached the desired limit and the iterations can be terminated. The second condition implies that the error function has reached a minimum point (or a saddle point) and further iterations will not reduce E appreciably. This minimum however, might be a local minimum rather than the global minimum. In the case where E has reached, a local minimum a new initial guess might be chosen and iterative process may be repeated until the global minimum is found and the optimum parameters values are obtained.

Mean Squared Error Optimization :

We use a perturbation technique to compute the optimum change $\delta \underline{p}$ on the parameter vector $\underline{p}$ that satisfies condition 1 and 2 of Step-3 of the previous algorithm.

Perturbation Analysis :

To introduce the basic idea behind the perturbation analysis, let us first consider the mean squared error function of equation (7). The generalization to any error criterion will then follow.

Changing the parameter vector $\underline{p}$ by the 'small' vector $\delta\underline{p}$ will cause a change δT on the transfer function $T(\underline{p}, jw)$, which in turn will result in a perturbation δE on the error function $E(\underline{p})$. Using equation (7), the change in $E(\underline{p})$ is

$$E(\underline{p}+\delta\underline{p})-E(\underline{p})= \frac{1}{2} \int_{w_o}^{w_1}[|T(\underline{p},jw)+\delta T(\underline{p},jw)-M(jw)|^2- T(p,jw)$$

$$- |T(\underline{p},jw)-M(\underline{p},jw)|^2]dw \qquad \ldots\ldots (9)$$

Equation (9) can be written as

$$E(\underline{p}+\delta\underline{p}) - E(\underline{p}) = \frac{1}{2} \int_{w_o}^{w_1}[(T+\delta T-M)(\overline{T}+\delta\overline{T}-\overline{M})-(T-M)(\overline{T}-\overline{M})]dw \qquad \ldots\ldots (10)$$

Where $\overline{T}$, $\delta\overline{T}$ and $\overline{M}$ denote the complex conjugates of T, δT and M respectively.

Simplifying (10) yields :

$$E(\underline{p}+\delta\underline{p}) - E(\underline{p}) = \frac{1}{2} \int_{w_o}^{w_1}[(T-M)\delta\overline{T}+(\overline{T}-\overline{M})\delta T+|\delta T|^2]dw \qquad \ldots\ldots (11)$$

Since by assumption $\delta\underline{p}$ is small and $T(\underline{p},jw)$ is considered to be a smooth continuous function of $\underline{p}$ then δT is small. Consequently, $|\delta T|^2$ is a second order term in comparison with the other terms of the integrand, and hence can be neglected in this equation. We then have

$$E(\underline{p}+\delta\underline{p}) - E(\underline{p}) = \delta E(\underline{p}) = \frac{1}{2}\int_{w_o}^{w_1} [(T-M)\delta\bar{T}+(\bar{T}-\bar{M})\delta T)]dw \quad .... (12)$$

Where $\delta E(\underline{p})$ is the approximate change in $E(\underline{p})$ after neglecting the second order term using the properties of complex functions, the equation simplifies to

$$\delta E(\underline{p}) = \int_{w_o}^{w_1} RR_e \{[\bar{T}(\underline{p},jw) - \bar{M}(jw)]\ \delta T(\underline{p},jw)\}\ dw \quad .... (13)$$

$\delta T(\underline{p},jw)$ can be expanded in terms of the perturbation on the parameter values as follows :

$$\delta T = \sum_{i=o}^{r-1} \frac{\delta T}{\delta C_i}\delta C_i + \sum_{i=o}^{r} \frac{\delta T}{\delta d_i}\delta d_i \quad .... (14)$$

Where the partial derivatives are taken with respect to adjustable parameters. If there are other parameters in the system that can be adjusted, the corresponding partial derivatives will be added to (13). Using a vector notation, this equation can be written as

$$\delta T(\underline{p},jw) = g^T(\underline{p},jw)\ \delta\underline{p} \quad .... (14)$$

Where we have used the following notations

$$g^T(\underline{p},jw) = [\frac{\delta T}{\delta C_1}, \frac{\delta T}{\delta C_2}, ..., \frac{\delta T}{\delta C_{r-1}}, \frac{\delta T}{\delta d_1}, \frac{\delta T}{\delta d_2} .... \frac{\delta T}{\delta d_r}] \quad .... (15)$$

The function $g(\underline{p},jw)$ as defined is commonly referred to as the gradient of T with respect to $\underline{p}$. Replacing $\delta T(\underline{p},jw)$ from (14) into (12) and observing that $\delta\underline{p}$ is independent of w, we get

$$\delta E = \left(\int_{w_o}^{w_1} R_e \left\{ [\bar{T}(\underline{p},jw)-\bar{M}(jw)] g^T(\underline{p},jw) \right\} dw \right) \delta\underline{p} \qquad \ldots. (16)$$

We now make the following important observation. Since $M(jw)$ is given at each iteration, the parameter vector is known (by choosing) then $\bar{T}(\underline{p},jw)$ and $g^T(\underline{p},jw)$ can be computed for each w. Consequently, the coefficient of $\delta\underline{p}$ in (16) can be computed in terms of the parameter values of the previous iterations. Let us, therefore rewrite (16) in compact form.

$$\delta E(\underline{p}) = \beta^T(\underline{p})\ \delta\underline{p} \qquad \ldots. (17)$$

Where $\beta(\underline{p})$ is a column vector called the gradient of $E(\underline{p})$ and is defined by

$$\beta^T(\underline{p}) = \int_{w_o}^{w_1} R_e \left\{ [T(p,jw)-M(jw)] g^T(p,jw) \right\} dw \qquad \ldots. (18)$$

The optimization problem now is reduced to obtaining $\delta\underline{p}$ such that, for a given $\beta^T(\underline{p})$, the perturbation on the error function δE satisfies the following two conditions:-

1. $\delta E < 0$

2. $|\delta E|$ is maximized.

To obtain an efficient and rapidly convergent algorithm, it is necessary to satisfy condition 2.

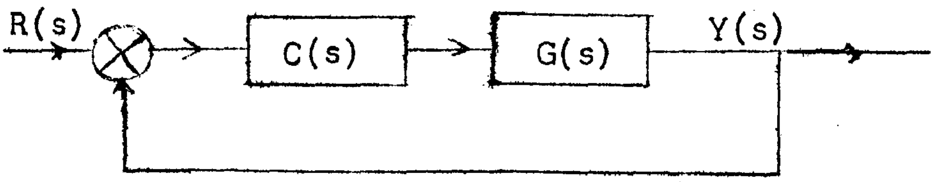
To find the solution to our optimization problem, we must make certain assumptions regarding the 'smallness' of the parameter perturbation.

<u>EXAMPLE 1</u>:

<u>CASE[I]</u>: Consider the design of a system whose model transfer function is given by

$$M(s) = \frac{25 + 4.242s}{25 + 7.07s + s^2}$$

and the actual topology of the system is given as



Where $G(s) = \dfrac{3}{s^2 + 4s + 3}$

and $C(s) = K_C[1 + \dfrac{1}{\tau_1 s}]$

$$\therefore \quad T(s) = \frac{1}{1 + \frac{1}{G(s)C(s)}}$$

$$= \frac{1}{1 + \frac{\tau_1 s(s^2 + 4s + 3)}{K_C(1 + \tau_1 s)3}}$$

$$T(s) = \frac{3K_C(1 + \tau_1 s)}{3K_C + 3\tau_1 s(1 + K_C) + 4\tau_1 s^2 + \tau_1 s^3}$$

$$T(\underline{p}, jw) = \frac{3K_C(1 + \tau_1 jw)}{3K_C + jw3\tau_1(1+K_C) - 4w^2\tau_1 - j\tau_1 w^3}$$

$$\frac{\partial T(p,jw)}{\partial K_C} = \frac{-3w^2\tau_1(w^2-7) + jw(9\tau_1-15w^2\tau_1)}{D^2}$$

Where $D = 3K_C - 4\,w^2\tau_1 + jw(3\tau_1 + 3K_C\tau_1 - \tau_1 w^2)$

$$\frac{\partial T(p,jw)}{\partial C_1} = \frac{-3K_C[-w^2(7-w^2+3K_C) + jw(3+K_C-w^2)]}{D^2}$$

AKC = 5.0

τ_1 = 1.0

On writing arithmetic expressions

```
  D=CMPLX(3.0xAKC-4.0*w**2*T1,3.0*T1+3.0*AKC*T1-T1*w**2)
N A=CMPLX(-3.0*w**2*T1*(w**2-7.0),w*(9.0*T1-15.0*w**2*T1)
N B=CMPLX(-3.0*AKC*(-w**2*(7.0-w**2+3.0*AKC),
          w*(3.0+AKC-5.0*w**2))

  DH1 = CMPLX(25.0- w**2, 7.07*w)
  DH2 = CMPLX(25.0, 4.242*w)
  DH3 = CMPLX(3.0*AKC, 3.0*w*AKC)
  H1  = DH2/DH1
  H2  = DH3/D
```

<u>CASE-II</u>: Again, we consider the same model transfer function as in the Case-I and with the same plant transfer function

$$G(s) = \frac{3}{s^2 + 4s + 3}$$

$$\text{but } C(s) = [K_P + \frac{K_I}{s} + K_D s]$$

$$= [\frac{K_I + K_P s + K_D s^2}{s}]$$

The closed loop transfer function is

$$T(s) = \frac{C(s)\ G(s)}{1 + C(s)\ G(s)}$$

$$= \frac{[\frac{K_I + sK_P + K_D s^2}{s}][\frac{3}{s^2 + 4s + 3}]}{1 + [\frac{K_I + K_P s + K_D s^2}{s}][\frac{3}{s^2 + 4s + 3}]}$$

$$T(\underline{p}, s) = \frac{3[K_I + K_P s + K_D s^2]}{s^3 + (4 + 3K_D)s^2 + 3(1 + K_P)s + 3K_I}$$

$$T(p, jw) = \frac{3[(K_I - K_D w^2) + jwK_P]}{3K_I - (4 + 3K_D)w^2 + jw(3 + 3K_P - w^2)}$$

$$\frac{\partial T}{\partial K_P} = \frac{-3w^2(3 - w^2) - j3w(9K_D w^2 + 4w^2)}{D^2}$$

$$\frac{\partial T}{\partial K_I} = \frac{3[-4w^2 + jw(3 - w^2)]}{D^2}$$

$$\frac{\partial T}{\partial K_D} = \frac{-3w^2[6K_I - 4w^2 - 15K_D w^2] - j3w^3[3 + 3K_P - w^2]}{D^2}$$

Arithmetic expressions will be

```
  D = CMPLX(3.0*AKI-(4.0+3.0*AKD)*w**2),w*(3.0+3.0*AKP-w**2))
 NB = CMPLX(3.0*(-4.0*w**2), 3.0*w*(3.0-w**2))
 NA = CMPLX(-3.0*w**2*(3.0-w**2), 3.0*w*(9.0*AKD*w**2-4.0*w**2))
 NC = CMPLX(-3.0*w**2(6.0*AKI-4.0*w**2-15.0*AKD*w**2),
           -3.0*w**3(3.0+3.0*AKP-w**2))
```

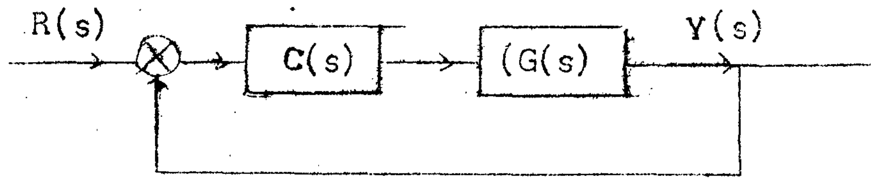
$$T(jw) = \frac{25 + j4.242\,w}{25 - w^2 + j7.07w}$$

```
DH2   = CMPLX(25.0, 4.242*w)

DH1   = CMPLX(25.0-w**2, 7.07*w)

H1    = DH 2/DH 1
DH3   = CMPLX(3.0*(AKI-AKD*w**2), 3.0*AKP*w)

H2    = DH3/D
```

CASE-III: Consider the design of a plant whose model transfer function is given by

$$H(s) = \frac{25 + 4.242s}{25 + 7.07s + s^2}$$

and the desired topology is shown below



Where $G(s) = \frac{3}{s^2 + 4s + 3}$

and $C(s) = [K_p + \frac{K_I}{s}] =][\frac{K_I + sK_P}{s}]$

Closed loop transfer function $= \frac{G(s)\ C(s)}{1 + G(s)\ C(s)}$

$$T(s) = \frac{[K_I + sK_p]/s\ [3/(s^2 + 4s + 3)]}{1 + [\frac{K_I + sK_P}{s}][\frac{3}{s^2+4s+3}]}$$

$$T(\underline{p}, s) = \frac{3[K_I + sK_p]}{3K_I + 3K_p s + s^3 + 4s^2 + 3s}$$

$$T(p,jw) = \frac{3K_I + j3wK_P}{3K_I - 4w^2 + jw(3K_P + 3 - w^2)}$$

$$\frac{\partial T}{\partial K_P} = \frac{-3w^2(3 + 12K_P - w^2) - j12w^3}{D^2}$$

$$\frac{\partial T}{\partial K_I} = \frac{9 - 15\,w^2}{D^2}$$

Arithmetic expressions will be

```
  D = CMPLX(3.0*AKI-4.0*w**2, w*(3.0*AKP+3.0-w**2))
 NA = CMPLX(-3.0*w**2*(3.0+12.0*AKP-w**2), -12.0*w**3)
NB  = CMPLX (9.0-15.0*w**2, 0)
DH2 = CMPLX(25.0, 4.242*w)
DH1 = CMPLX(25.0-w**2, 7.07*w)
H1  = DH2/DH1
DH3 = CMPLX(3.0*AKI, 3.0*w*AKP)
H2  = DH3/D
```

TO FIND CLOSED LOOP TRANSFER FUNCTIONS FROM THE TABLES OBTAINED FROM THE COMPUTER RESULTS:

EXAMPLE-I

CASE-I:

Sl. No.	Initial Guess K_C	Initial Guess τ_1	Final Values K_C	Final Values τ_1	w_o to w_1	Error
1.	5.00	1.00	2.4174	2.1653	0 to 5	0.2158
2.	5.00	1.00	5.0082	0.9972	0 to 0.25	0.0431
3.	5.00	1.00	5.0272	1.0047	0 to 0.5	0.0523
4.	5.00	1.00	5.3016	1.3252	0 to 1	0.1142

Closed loop transfer function will be

$$T_1(s) = \frac{3K_C(1 + \tau_1 s)}{3K_C + 3\tau_1 s(1 + K_C) + 4\tau_1 s^2 + \tau_1 s^3}$$

$$T_1(s) = \frac{3.3492 + 7.2522s}{3.3492 + 10.2521s + 4s^2 + s^3}$$

$$T_2(s) = \frac{15.0667 + 15.0245s}{15.0667 + 18.0245s + 4s^2 + s^3}$$

$$T_3(s) = \frac{15.0110 + 15.0815s}{15.0110 + 18.0815s + 4s^2 + s^3}$$

$$T_4(s) = \frac{12.0018 + 15.9047s}{12.0018 + 18.9047 + 4s^2 + s^3}$$

CASE-II:

Initial guess :

$K_P = 5.000$

$K_I = 1.000$

$K_D = 0.1000$

Final values $K_P = 0.7470$, $K_I = 1.0514$, $K_D = 0.2338$

Error = 0.306

Closed loop transfer function will be

$$T(s) = \frac{3[K_I + K_P s + K_D s^2]}{s^3 + (4 + 3K_D)s^2 + 3(1 + K_P)s + 3K_I}$$

$$T(s) = \frac{3.1542 + 2.241s + 0.7014s^2}{3.1542 + 5.241s + 4.2338s^2 + s^3}$$

CASE-III:

Sl. No.	Initial guess K_p	Initial guess K_I	Final Values K_p	Final Values K_I	w_o to w_1	Error
A.	5.000	1.000	4.1844	0.9717	0 to 5	1.2417
B.	5.000	1.000	4.9991	1.0014	0 to .25	0.0014
C.	5.000	1.000	4.9942	1.0027	0 to .5	0.0138
D.	5.000	1.000	4.9739	1.0029	0 to 1	0.0938

Closed loop transfer function will be

$$T_A(s) = \frac{2.9151 + 12.5532ss}{2.9151 + 15.5532s + 4s^2 + s^3}$$

$$T_B(s) = \frac{3.0042 + 14.9973s}{3.0042 + 17.9973s + 4s^2 + s^3}$$

$$T_C(s) = \frac{3.0081 + 14.9826s}{3.0081 + 17.9826s + 4s^2 + s^3}$$

$$T_D(s) = \frac{3.0087 + 14.9217s}{3.0087 + 17.9217s + 4s^2 + s^3}$$

From all these closed loop transfer functions, we shall determine the time and frequency responses of the systems.

```
      DIMENSION S1(100),S2(100),S3(100),E(100),SE(100),DATA(210,3)
      COMPLEX D,A,B,C,DD,H1,H2,HH,B1,B2,B3,DH1,DH2
      REAL W1,W2,W3
C     INITIAL GUESS
      AKC=5.
      T1=1.
      W=0.0
      N=51
      H=1./(N-1)
      PRINT 6,AKC,T1
      DO 2 ITER=1,30
      DO 4 I=1,N
      D=CMPLX(3.0*T1-4.0*W**2,W*(3.0*AKC+3.0-W**2))
      DD=D**2
      A=CMPLX(-3.0*W**2*(3.0+12.0*AKC-W**2),-12.0*W**3)
      B=CMPLX(9.0-15.0*W**2,0.0)
      DH1=CMPLX(3.0-W**2,4.0*W)
      DH2=CMPLX(3.0*T1,3.0*AKC*W)
C     DESIRED TRANSFER FUNCTION IS H1, ACTUAL TRANSFER FUNCTION IS H2
      H1=3./DH1
      H2=DH2/D
      DATA(I,1)=W
      DATA(I,2)=CABS(H1)
      DATA(I,3)=CABS(H2)
      HH=H2-H1
      B1=CONJG(HH)*(A/DD)/2.0
      B2=CONJG(HH)*(B/DD)/2.0
      B3=CONJG(HH)*(C/DD)/2.0
      S1(I)=REAL(B1)
      S2(I)=REAL(B2)
      S3(I)=REAL(B3)
      E(I)=((CABS(HH))**2)/2.0
      W=W+H
    4 CONTINUE
      CALL GRAPHX(DATA,N,1HW,5HH1,H2)
C     CHOOSE THE FOLLOWING STEP SIZES
      W1=.1
      W2=.1
      W3=.1
C     USE THE SIMPSONS RULE OF INTEGRATION TO COMPUTE THE GRADIENT
      CALL SIMPS (S1,H,N,ANS)
      AKC=-W1*ANS+AKC
      CALL SIMPS (S2,H,N,ANS)
      T1=-W2*ANS+T1
      CALL SIMPS (E,H,N,EP)
      SE(ITER)=EP
      PRINT 6,AKC,T1,EP
    6 FORMAT(/,5X,4F14.4)
C     STOP THE ITERATION IF THE ERROR EP IS LESS THAN 0.0001
      IF(EP.LE. .0001) GO TO 12
      W=0.
    2 CONTINUE
   12 DO 10 I=1,5
      DATA(I,1)=I
      DATA(I,2)=SE(I)
   10 DATA(I,3)=0.
      CALL GRAPHX(DATA,5,1HI,5HERROR)
      STOP
      END
      SUBROUTINE SIMPS(Y,H,N,ANS)
      DIMENSION Y(1)
      ODD=0.
      EVE=0.
      M=N-3
      DO 1 I=2,M,2
      EVE=EVE+Y(I)
    1 ODD=ODD+Y(I+1)
      ANS=(H/3.0)*(Y(1)+4.0*(EVE+Y(N-1))+2.0*ODD+Y(N))
      RETURN
      END
      SUBROUTINE GRAPHX (DATA,N,INDEP,VARDEP)
      DIMENSION DATA(210,3),A(121)
      PRINT 3,INDEP
    3 FORMAT(1H1,' THE INDEPENDENT VARIABLE IS ',2A10)
      PRINT 4,VARDEP
    4 FORMAT(1H ,' THE DEPENDENT VARIABLE IS ',2A10//)
      BIGEST=DATA(1,2)
      SMALL=DATA(1,2)
      DO 1 I=2,N
      IF(DATA(I,2).GT.BIGEST)BIGEST=DATA(I,2)
```

```
      IF(DATA(I,2).LT.SMAL)SMAL=DATA(I,2)
1     [illegible]
      DO 2 I=[illegible]
      IF(DATA(I,3).GT.BIGEST)BIGEST=DATA(I,3)
      IF(DATA(I,3).LT.SMAL)SMAL=DATA(I,3)
2     [illegible]
      PRINT [illegible], SMAL, BIGEST
      [illegible]I[illegible]S=BIGEST-SMAL
      DO 3 I=[illegible]
3     B(I)=[illegible]
      DO [illegible] I=[illegible]
      DATA(I,2)=(DATA(I,2)-SMAL)*[illegible]1.[illegible]/[illegible]I[illegible]S+1.[illegible]
      DATA(I,3)=(DATA(I,3)-SMAL)*[illegible]1.[illegible]/[illegible]I[illegible]S+1.[illegible]
      I[illegible]D[illegible]X=[illegible]TA(I,2)
      J[illegible]D[illegible]X=DATA(I,3)
      B(I[illegible]DEX)=1H+
      B(J[illegible]DEX)=1H*
      PRINT 1[illegible],DATA(I,1),(B([illegible]1),[illegible]1=1,61)
      B(I[illegible]DEX)=1H
4     B(J[illegible]DEX)=1H
2[illegible]  FORMAT(9X,[illegible],35X,1H,4X,[illegible]1.4,/10X,61(1H*))
1[illegible]  FORMAT(1H[illegible],[illegible]3.2,1X,61A1)
      RETURN
      END
```

5.0000	1.0000	
5.0001	1.0000	0.0433
5.0002	0.9999	0.0433
5.0003	0.9999	0.0433
5.0004	0.9999	0.0433
5.0005	0.9998	0.0433
5.0005	0.9998	0.0433
5.0006	0.9998	0.0433
5.0007	0.9997	0.0433
5.0008	0.9997	0.0433
5.0009	0.9997	0.0433
5.0010	0.9997	0.0433
5.0011	0.9996	0.0433
5.0012	0.9996	0.0433
5.0013	0.9996	0.0433
5.0014	0.9995	0.0432
5.0015	0.9995	0.0432
5.0016	0.9995	0.0432
5.0016	0.9994	0.0432
5.0017	0.9994	0.0432
5.0018	0.9994	0.0432
5.0019	0.9993	0.0432
5.0020	0.9993	0.0432
5.0021	0.9993	0.0432
5.0022	0.9992	0.0432
5.0023	0.9992	0.0432
5.0024	0.9992	0.0432
5.0025	0.9991	0.0432
5.0026	0.9991	0.0432
5.0026	0.9991	0.0432
5.0027	0.9990	0.0432
5.0028	0.9990	0.0432
5.0029	0.9990	0.0432
5.0030	0.9990	0.0432
5.0031	0.9989	0.0432
5.0032	0.9989	0.0432
5.0033	0.9989	0.0432
5.0034	0.9988	0.0432
5.0035	0.9988	0.0432
5.0036	0.9988	0.0432
5.0037	0.9987	0.0432
5.0037	0.9987	0.0432
5.0038	0.9987	0.0432

[illegible]	[illegible]	
5.0040	0.9986	0.0432
5.0041	0.9986	0.0432
5.0042	0.9985	0.0432
5.0043	0.9985	0.0432
5.0044	0.9985	0.0432
5.0045	0.9984	0.0432
5.0046	0.9984	0.0432
5.0047	0.9984	0.0432
5.0047	0.9984	0.0432
5.0048	0.9983	0.0432
5.0049	0.9983	0.0432
5.0050	0.9983	0.0432
5.0051	0.9982	0.0432
5.0052	0.9982	0.0432
5.0053	0.9982	0.0432
5.0054	0.9981	0.0432
5.0055	0.9981	0.0432
5.0056	0.9981	0.0432
5.0057	0.9980	0.0432
5.0058	0.9980	0.0432
5.0058	0.9980	0.0431
5.0059	0.9979	0.0431
5.0060	0.9979	0.0431
5.0061	0.9979	0.0431
5.0062	0.9978	0.0431
5.0063	0.9978	0.0431
5.0064	0.9978	0.0431
5.0065	0.9978	0.0431
5.0066	0.9977	0.0431
5.0067	0.9977	0.0431
5.0068	0.9977	0.0431
5.0068	0.9976	0.0431
5.0069	0.9976	0.0431
5.0070	0.9976	0.0431
5.0071	0.9975	0.0431
5.0072	0.9975	0.0431
5.0073	0.9975	0.0431
5.0074	0.9974	0.0431
5.0075	0.9974	0.0431
5.0076	0.9974	0.0431
5.0077	0.9973	0.0431
5.0078	0.9973	0.0431
5.0078	0.9973	0.0431

5.0079	0.9972	0.0431
5.0080	0.9972	0.0431
5.0081	0.9972	0.0431
5.0082	0.9972	0.0431

5.	1.	
5.	1.	.51
5.	1.	.519
5.	1. 2	.519
5.	1. 2	.52
5.	1. 3	.52
5.	1. 3	.52
5.	1. 4	.52
5.	1. 4	.52
5. 7	1. 5	.52
5.	1. 5	.52
5. 3	1. 6	.52
5.	1. 6	.52
5. 3	1. 7	.52
5.	1. 8	.52
5.	1.	.52
5.	1. 9	.52
5.	1. 9	.52
5.	1. 1	.52
5.	1. 1	.52
5.	1. 11	.52
5.	1. 11	.52
5. 7	1. 12	.52
5. 7	1. 12	.52
5. 7	1. 13	.52
5. 7	1. 13	.52
5. 7	1. 14	.52
5.	1. 14	.52
5.	1. 15	.52
5.	1. 16	.52
5.	1. 16	.52
5.	1. 17	.521
5. 7	1. 17	.521
5.	1. 18	.521
5.	1. 18	.521
5.	1. 19	.521
5.	1. 9	.521
5.	1. 2	.521
5.	1. 2	.521
5.	1. 21	.521
5.	1. 21	.521

5.[illegible]	[illegible]3	.521
5.[illegible]	[illegible]	.521
5.[illegible]	[illegible]24	.521
5.[illegible]	[illegible]25	.521
5.[illegible]	[illegible]26	.521
5.[illegible]	[illegible]26	.521
5.[illegible]	[illegible]27	.521
5.[illegible]	[illegible]27	.521
5.[illegible]7	[illegible]	.521
5.[illegible]	[illegible]	.521
5.[illegible]3	[illegible]29	.521
5.[illegible]	[illegible]	.521
5.[illegible]	[illegible]	.521
5.[illegible]7	[illegible]	.521
5.[illegible]	[illegible]31	.522
5.[illegible]	[illegible]31	.522
5.[illegible]	[illegible]32	.522
5.[illegible]	[illegible]32	.522
5.[illegible]7	[illegible]33	.522
5.[illegible]	[illegible]33	.522
5.[illegible]3	[illegible]34	.522
5.[illegible]	[illegible]	.522
5.[illegible]	[illegible]35	.522
5.[illegible]	[illegible]35	.522
5.[illegible]	[illegible]36	.522
5.	[illegible]37	.522
5.[illegible]2	[illegible]37	.522
5.[illegible]	[illegible]	.522
5.[illegible]7	[illegible]	.522
5.[illegible]	[illegible]	.522
5.[illegible]	[illegible]39	.522
5.[illegible]7	[illegible]	.522
5.[illegible]	[illegible]	.522
5.[illegible]	[illegible]41	.522
5.[illegible]	[illegible]41	.522
5.[illegible]	[illegible]42	.522
5.[illegible]	[illegible]42	.522
5.[illegible]	[illegible]43	.522
5.[illegible]	[illegible]	.522
5.[illegible]	[illegible]	.522
5.	[illegible]	[illegible]

5.	.	. 523
5.	. 7	. 523
5. 7	. 7	. 523

.527 5E-01

****

5.0000	1.0000	
5.0000	1.0000	0.0014
4.9999	1.0001	0.0014
4.9999	1.0001	0.0014
4.9999	1.0002	0.0014
4.9998	1.0002	0.0014
4.9998	1.0003	0.0014
4.9998	1.0003	0.0014
4.9998	1.0004	0.0014
4.9997	1.0004	0.0014
4.9997	1.0005	0.0014
4.9997	1.0005	0.0014
4.9996	1.0006	0.0014
4.9996	1.0006	0.0014
4.9996	1.0007	0.0014
4.9995	1.0007	0.0014
4.9995	1.0008	0.0014
4.9995	1.0008	0.0014
4.9995	1.0009	0.0014
4.9994	1.0009	0.0014
4.9994	1.0010	0.0014
4.9994	1.0010	0.0014
4.9993	1.0011	0.0014
4.9993	1.0011	0.0014
4.9993	1.0012	0.0014
4.9992	1.0012	0.0014
4.9992	1.0012	0.0014
4.9992	1.0013	0.0014
4.9992	1.0013	0.0014
4.9991	1.0014	0.0014
4.9991	1.0014	0.0014

5.	1.	
4.9[illegible]	1. [illegible]	.138
4.99[illegible]	1. 2	.13[illegible]
4.[illegible]	1. [illegible]3	.13[illegible]
4.[illegible]	1. [illegible]	.13[illegible]
4.9[illegible]	1. 5	.13[illegible]
4.99[illegible]	1. 5	.13[illegible]
4.9[illegible]7	1. 6	.13[illegible]
4.9[illegible]	1. 7	.138
4.9933	1. [illegible]6	.133
4.99[illegible]	1. 9	1.133
4.997[illegible]	1. 10	.133
4.9977	1. 11	.9138
4.9975	1. 12	.135
4.997[illegible]	1. 13	.133
4.997[illegible]	1. 14	.138
4.99[illegible]	1. 14	.136
4.9967	1. 15	.13[illegible]
4.9965	1. 16	.133
4.9963	1. 17	.138
4.9962	1. 18	.138
4.99[illegible]	1. 19	.138
4.995[illegible]	1. 2[illegible]	.133
4.995[illegible]	1. 21	.13[illegible]
4.995	1. 22	.133
4.995[illegible]	1. 23	.133
4.995	1. 23	.138
4.994[illegible]	1. 2[illegible]	.13[illegible]
4.99[illegible]	1. 25	.130
4.99[illegible]	1. 26	.138
4.99[illegible]	1. 27	.136

```
[illegible] =
[illegible] u(1) = [illegible]

[illegible] COEF[illegible] SYS[illegible]
[illegible]

[illegible] COEF[illegible] SYS[illegible]
.3 [illegible]

[illegible] COEF[illegible] SYST[illegible] ARE
.25[illegible] .7 [illegible]

DENOMINATOR COEF[illegible] SYST[illegible] ARE
.25[illegible] [illegible]
STEP SIZE [illegible]
[illegible] 1.0[illegible]E-06 5.[illegible]
[illegible] IYVSY IYVSY

PHI = [illegible]        OMEGA = 2.[illegible]
STARTING VALUES OF [illegible] VARIABLES
1 [illegible] 2 [illegible]E+00 3 [illegible]E+[illegible] 4 [illegible]E+[illegible] 5 0.0[illegible]E+0[illegible]
```

[illegible] INTERVAL 1

START AT [illegible] + [illegible] 1.00[illegible] E-01 AND FINISH AT 2.[illegible]

INDEPENDENT VARIABLE [illegible] VALUE

TIME	OUTPUT(1)	OUTPUT(2)	CUM.ERROR	ITG.ERROR
[illegible]	[illegible]	[illegible]	0.00[illegible]+00	0.0[illegible]+00
.1[illegible]	[illegible]	.3[illegible]5577[illegible]	0.105457140+00	0.1[illegible]54571[illegible]
.2[illegible]	[illegible]77763 +	[illegible]9546[illegible]	0.322397340+00	0.21694[illegible]21E+0[illegible]
.3[illegible]	[illegible]15[illegible]	0.89175[illegible]	0.54155[illegible]	0.2191[illegible]
[illegible]	[illegible]	[illegible]9265[illegible]+01	0.68991[illegible]	0.1[illegible]
.5[illegible]	.75[illegible]357[illegible]	0.1[illegible]65437[illegible]+01	0.7623[illegible]+00	0.72457[illegible]71E-01
.6[illegible]	[illegible]	0.1[illegible]8[illegible]	0.78689222[illegible]	0.2[illegible]51157[illegible]E-01
.7[illegible]	[illegible]	0.10752157[illegible]	0.7917[illegible]	0.[illegible]813[illegible]E-02
.8[illegible]	[illegible]31625[illegible]	0.1[illegible]59[illegible]	0.79195350[illegible]+00	0.25257722[illegible]E-03
.9[illegible]	[illegible]5[illegible]41[illegible]	0.1[illegible]	0.7919771[illegible]+00	0.2353363[illegible]
.1[illegible]	[illegible]	0.102475[illegible]+01	0.7919772[illegible]	0.1[illegible]1[illegible]9757E-0[illegible]
.11[illegible]	.[illegible]5215[illegible]	0.1[illegible]1255[illegible]+01	0.79247[illegible]	0.49262559[illegible]E-03
.12[illegible]	.5[illegible]519[illegible]	0.1[illegible]375[illegible]+01	0.795145[illegible]	0.2[illegible]7527[illegible]
.13[illegible]	[illegible]13575[illegible]	0.99598[illegible]	0.8017[illegible]117[illegible]	0.6[illegible]E-02
.14[illegible]	[illegible]07[illegible]77[illegible]	0.9732[illegible]	0.8133[illegible]	0.1135[illegible]E-01
.15[illegible]	[illegible]7[illegible]599[illegible]	0.99606[illegible]	0.8233[illegible]567[illegible]	0.1535[illegible]E-01
.16[illegible]	[illegible]	0.99093[illegible]13[illegible]	0.86[illegible]917[illegible]	0.17673[illegible]E-01
.17[illegible]	[illegible]71559[illegible]	0.9975929[illegible]	0.8642[illegible]7[illegible]	0.1[illegible]9189[illegible]E-01
.18[illegible]	[illegible]71123[illegible]	0.99833769[illegible]	0.88148[illegible]2[illegible]	0.17214[illegible]E-01
.19[illegible]9999[illegible]	[illegible]	0.9989[illegible]	0.89[illegible]79[illegible]	0.1[illegible]37[illegible]
[illegible]99999[illegible]	[illegible]335[illegible]	0.999[illegible]27[illegible]	0.91[illegible]1435[illegible]	0.1325[illegible]E-01
[illegible]999999[illegible]	[illegible]363550[illegible]	0.9993232[illegible]	0.9213[illegible]5[illegible]	0.1127[illegible]E-01
.2199999[illegible]	[illegible]17[illegible]	0.1[illegible]17[illegible]+01	0.931[illegible]	0.9[illegible]533337E-02
.2299999[illegible]	[illegible]	0.1[illegible]	0.939[illegible]	0.8[illegible]9577[illegible]E-02
.2399999[illegible]	.41275568[illegible]	0.1[illegible]13[illegible]	0.947128[illegible]	0.7[illegible]535[illegible]E-02
.2499999[illegible]	.216[illegible]3133[illegible]	0.1[illegible]1253[illegible]	0.9542[illegible]811[illegible]	0.71392[illegible]E-02
.2599999[illegible]	[illegible]7[illegible]737[illegible]	0.1[illegible]09810+01	0.9611[illegible]	0.[illegible]E-02
.2699999[illegible]	[illegible]777[illegible]	0.1[illegible]577[illegible]	0.96791[illegible]	0.677243[illegible]E-02
.2799999[illegible]	[illegible]	0.1[illegible]041[illegible]	0.974[illegible]	0.674[illegible]E-02
.2999999[illegible]	[illegible]7[illegible]	0.1[illegible]2273+01	0.98142223[illegible]	0.6753[illegible]E-02
.2999999[illegible]	[illegible]625[illegible]	0.1[illegible]71[illegible]+01	0.9881[illegible]311[illegible]	0.674[illegible]8172E-02
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.1[illegible]	.[illegible]95[illegible]+[illegible]	.1 [illegible]3[illegible]+[illegible]1	.118[illegible]1245[illegible]+[illegible]1	0.3[illegible]354[illegible]37[illegible]E-[illegible]
.1[illegible]	.[illegible]21[illegible]+	.99999[illegible]+[illegible]	.118[illegible]121[illegible]5[illegible]+ 1	0.32[illegible]32[illegible]E-[illegible]
.1[illegible]5[illegible]	.[illegible]137[illegible]+	.99999557[illegible]+[illegible]	.11842[illegible]7[illegible]+[illegible]1	0.3[illegible]12[illegible]E-[illegible]
.1[illegible]7[illegible]+[illegible]	.[illegible]2[illegible]+[illegible]	.99999[illegible]3[illegible]+[illegible]	.1182771[illegible]+ 1	0.2[illegible]772 [illegible]7[illegible]E-0[illegible]
.1[illegible]+[illegible]	.[illegible]9[illegible]+[illegible]	.99999[illegible]+[illegible]	.1184[illegible]59[illegible]+ 1	0.267[illegible]1715[illegible]E-[illegible]
.1[illegible]+[illegible]	.[illegible]7[illegible]+[illegible]	.99999[illegible]+[illegible]	.11843337[illegible]+ 1	0.2781583[illegible]E-[illegible]4
.1[illegible]+[illegible]	.[illegible]7[illegible]+[illegible]	.99999977[illegible]+[illegible]	.118[illegible]3[illegible]+[illegible]1	0.2[illegible]911[illegible]E-0[illegible]
.121[illegible]+[illegible]2	.[illegible]765[illegible]+[illegible]	.99999999[illegible]+[illegible]	.118[illegible]3807[illegible]+[illegible]1	0.2[illegible]33[illegible]E-[illegible]4
.192[illegible]+[illegible]2	.[illegible]+[illegible]	.1 [illegible]3[illegible]+[illegible]1	.118[illegible]118[illegible]+[illegible]1	0.2517[illegible]375[illegible]E-[illegible]
.1924999[illegible]+[illegible]	.[illegible]579[illegible]+[illegible]	.1 [illegible]2[illegible]+[illegible]1	.118[illegible]362[illegible]+[illegible]1	0.243[illegible]1[illegible]E-04
.1934999[illegible]+[illegible]2	.[illegible]33[illegible]+[illegible]	.1[illegible]28[illegible]+[illegible]1	.11844597[illegible]+[illegible]1	0.235[illegible]573[illegible]E-0[illegible]
.1945999[illegible]+[illegible]2	.[illegible]5[illegible]+[illegible]	.1[illegible]1[illegible]+[illegible]1	.118[illegible]82[illegible]+[illegible]1	0.227[illegible]9[illegible]75[illegible]E-0[illegible]
.1959999[illegible]+[illegible]2	.[illegible]5[illegible]+[illegible]	.1[illegible]27[illegible]+[illegible]1	.11[illegible]5[illegible]9[illegible]+[illegible]1	0.22[illegible]413[illegible]E-04
.1969999[illegible]+[illegible]2	.[illegible]5 +[illegible]	.1[illegible]11[illegible]+[illegible]1	.11[illegible]5205[illegible]+[illegible]1	0.21575516[illegible]E-04
.1979999[illegible]+[illegible]	.[illegible]652[illegible]+[illegible]	.1[illegible]+[illegible]1	.11[illegible]672[illegible]+[illegible]1	0.2[illegible]7[illegible]478[illegible]E-04
.1989999[illegible]+[illegible]2	.[illegible]2[illegible]+[illegible]	.99999817[illegible]+[illegible]	.11[illegible]4567[illegible]+[illegible]1	0.1[illegible]51865[illegible]E-04
.1999999[illegible]+[illegible]2	.[illegible]63[illegible]+[illegible]	.1[illegible]236[illegible]+[illegible]1	.1185658[illegible]3[illegible]+[illegible]1	0.1914[illegible]78[illegible]E-0[illegible]

[illegible].1 [illegible] E-01, [illegible]
DER OF [illegible] AT. [illegible] POLYNOMIAL IS =, 1

DER OF DENO[illegible] POLYNOMIAL IS =, 2

NIMUM VALU OF FREQUENCY IS = [illegible].1[illegible] E-01

XIMUM VALU OF FREQUENCY IS = [illegible].1 [illegible] E+ [illegible]

E NUMERATOR COEFFICIENTS ARE

.25[illegible] E+[illegible]2 .42[illegible]2[illegible] E+[illegible]1
E DENOMINATOR COEFFICIENTS ARE

.25[illegible] E+[illegible]2 .707[illegible] E+01 [illegible].1[illegible] E+01

S.NO	FREQUENCY	REAL MAGNITUDE	IMAGINARY MAGNITUDE	MAGNITUDE	PHASE ANGLE
0	0.0 [illegible] E+ [illegible]	.1 [illegible] E+ 1	. [illegible] E+0	0.100 [illegible] E+01	0.00 [illegible] E+00
1	0.100 [illegible] E-01	.1 [illegible] 6E+ 1	-.11312068E-02	0.10000014E+01	-0.64813317E-01
2	0.20 [illegible] E-01	.1 [illegible] 32E+ 1	-.22624543E-02	0.10000056E+01	-0.12962849E+00
3	0.30 [illegible] E-01	.1 [illegible] 72E+ 1	-.33937834E-02	0.10000130E+01	-0.19444738E+00
4	0.40 [illegible] E-01	.1 [illegible] 128E+ 1	-.45252346E-02	0.10000231E+01	-0.25927184E+00
5	0.50 [illegible] E-01	.1 [illegible] 2 [illegible] E+ 1	-.56568487E-02	0.10000362E+01	-0.32410372E+00
6	0.60 [illegible] 1E-01	.1 [illegible] 288E+ 1	-.67886662E-02	0.10000519E+01	-0.38894488E+00
7	0.70 [illegible] E-01	.1 [illegible] 392E+01	-.792 [illegible] 7286E-02	0.10000706E+01	-0.45379721E+00
8	0.80 [illegible] E-01	.1 [illegible] 512E+ 1	-.9 [illegible] 53 [illegible] 762E-02	0.10000922E+01	-0.51866251E+00
9	0.90 [illegible] E-01	.1 [illegible] 648E+01	-.10185749E-01	0.10001166E+01	-0.58354264E+00
10	0.100 [illegible] E+00	.1 [illegible] 799E+ 1	-.11318788E-01	0.10001440E+01	-0.64843949E+00
11	0.110 [illegible] E+00	.1 [illegible] 967E+01	-.12452234E-01	0.10001742E+01	-0.71335469E+00
12	0.120 [illegible] E+00	.1 [illegible] 115 [illegible] E+ 1	-.13586129E-01	0.10002073E+01	-0.77829071E+00
13	0.130 [illegible] E+00	.100 [illegible] 1349E+ 1	-.14720511E-01	0.10002432E+01	-0.84324881E+00
14	0.1400 [illegible] 0E+00	0.1 [illegible] 01564E+01	-.15855422E-01	0.10002821E+01	-0.90823095E+00
15	0.1500 [illegible] E+00	0.100 [illegible] 1794E+01	-.16990902E-01	0.10003237E+01	-0.97323906E+00
16	0.160 [illegible] E+00	0.10002 [illegible] 4 [illegible] E+01	-.18126993E-01	0.10003682E+01	-0.10382750E+01
17	0.1700 [illegible] E+00	0.1 [illegible] 023 [illegible] 1E+01	-.19263733E-01	0.10004156E+01	-0.11033406E+01
18	0.1800 [illegible] E+0	0.1 [illegible] 02578E+01	-.20401164E-01	0.10004659E+01	-0.11684377E+01
19	0.1900 [illegible] 0E+00	0.100 [illegible] 2871E+01	-.21539327E-01	0.10005189E+01	-0.12335681E+01
20	0.2000 [illegible] E+00	0.1 [illegible] 03178E+01	-.22678261E-01	0.10005749E+01	-0.12987338E+01
21	0.2100 [illegible] E+00	0.1 [illegible] 03501E+01	-.23818007E-01	0.10006336E+01	-0.13639364E+01
22	0.2200 [illegible] E+00	0.1 [illegible] 03839E+01	-.24958606E-01	0.10006952E+01	-0.14291780E+01
23	0.230 [illegible] E+00	0.100 [illegible] 4192E+01	-.26100096E-01	0.10007596E+01	-0.14944602E+01
24	0.2400 [illegible] E+00	0.1 [illegible] 04561E+01	-.27242520E-01	0.10008269E+01	-0.15597850E+01
25	0.2500 [illegible] E+00	0.1 [illegible] 04944E+01	-.28385915E-01	0.10008970E+01	-0.16251541E+01
26	0.260 [illegible] E+00	0.1 [illegible] 053 [illegible] 1E+01	-.29530325E-01	0.10009698E+01	-0.16905695E+01
27	0.270 [illegible] E+00	0.1 [illegible] 05754E+01	-.30675786E-01	0.10010455E+01	-0.17560329E+01
28	0.280 [illegible] E+0	0.100 [illegible] 6181E+01	-.31822340E-01	0.10011240E+01	-0.18215462E+01
29	0.290 [illegible] E+00	0.1 [illegible] 06623E+01	-.32970028E-01	0.10012053E+01	-0.18871111E+01
30	0.3000 [illegible] E+00	0.1 [illegible] 07079E+01	-.34118687E-01	0.10012894E+01	-0.19527296E+01
31	0.310 [illegible] 1E+00	.1 [illegible] 07549E+01	-.35268960E-01	0.10013762E+01	-0.20184035E+01
32	0.320 [illegible] 1E+00	.1 [illegible] 8034E+01	-.3642 [illegible] 284E-01	0.10014659E+01	-0.20841344E+01
33	0.330 [illegible] 1E+00	.1 [illegible] 08533E+01	-.37572898E-01	0.10015583E+01	-0.21499243E+01
34	0.340 [illegible] 1E+00	.1 [illegible] 9045E+01	-.38726346E-01	0.10016534E+01	-0.22157751E+01
35	0.350 [illegible] 1E+00	.1 [illegible] 09571E+01	-.39882163E-01	0.10017514E+01	-0.22816884E+01
36	0.360 [illegible] 1E+00	.1 [illegible] 0112E+01	-.410 [illegible] 892E-01	0.10018521E+01	-0.23476662E+01
37	0.370 [illegible] 2E+00	.1 [illegible] 1 665E+01	-.42197 [illegible] 68E-01	0.10019555E+01	-0.24137101E+01
38	0.380 [illegible] 2E+00	.1 [illegible] 11232E+01	-.4335 [illegible] 735E-01	0.10020618E+01	-0.24798221E+01
39	0.390 [illegible] 2E+00	.1 [illegible] 11812E+01	-.44517929E-01	0.100217 [illegible] 2E+01	-0.25460039E+01
40	0.400 [illegible] 2E+00	.1 [illegible] 124 [illegible] 6E+01	-.4568 [illegible] 9 [illegible] E-01	0.10022821E+01	-0.26122572E+01
41	0.410 [illegible] 2E+00	.1 [illegible] 13 [illegible] 12E+01	-.46845 [illegible] 56E-01	0.10023954E+01	-0.26785845E+01
42	.420 [illegible] 2E+00	.1 [illegible] 13631E+01	-.48 [illegible] 11 [illegible] 67E-01	0.10025133 [illegible] E+01	-0.27449860E+01
43	[illegible]	[illegible]	-.4917 [illegible] E-01	0.1 [illegible] 2633 [illegible] E+01	-0.2811 [illegible] E+01

44	0.4400 [illegible] 3E+ [illegible]	.1 [illegible] 19 0E+01	- .5 318173E-01	0.1 [illegible] 2755 E+01	-0.2079 225E+01
45	0.4500 [illegible] 3E+ [illegible]	0.1 [illegible] 155 3E+01	- .51519369E-01	0.1 [illegible] 246 [illegible] E+01	-0.2934 [illegible] 8E+01
46	0.4600 [illegible] 3E+00	0.1 [illegible] 16231E+01	- .52692330E-01	0.1 [illegible] 3 [illegible] 81E+01	-0.30113814E+01
47	0.4700 [illegible] 3E+ [illegible]	.1 [illegible] 1691 E+01	- .53867155E-01	0.1 [illegible] 31385E+01	-0.30781601E+01
48	0.4800 [illegible] 3E+00	0.1 [illegible] 176 3E+01	- .55 [illegible] 3845E-01	0.1 [illegible] 32715E+01	-0.3145 765E+01
49	0.4900 [illegible] 4E+00	.1 [illegible] 183 7E+01	- .56222153E-01	0.1 [illegible] 3 [illegible] 71E+01	-0.3212 5 16E+01
50	.1000 [illegible] E+00	0.1 [illegible] 799E+01	- .11318788E-01	0.1 [illegible] 141 E+01	-0.6 [illegible] 8439 7E+00
51	0.2000 [illegible] E+00	0.1 [illegible] 3 78E+01	- .22078261E-01	0.100 57 9E+01	-0.12987338E+01
52	0.3000 [illegible] E+00	0.1 [illegible] 7 79E+01	- .31118886E-01	0.10012 9 E+01	-0.19527295E+01
53	0.4000 [illegible] E+0 [illegible]	.1 [illegible] 12 6E+01	- .45660687E-01	0.1 [illegible] 22821E+01	-0.26122571E+01
54	0.500 [illegible] E+00	0.1 [illegible] 19 22E+01	- .574030 7E-01	0.10035453E+01	-0.32791218E+01
55	0.6000 [illegible] E+00	.1 [illegible] 2675 E+01	- .69324262E-01	0.10050692E+01	-0.39550959E+01
56	0.7000 [illegible] E+00	0.1 [illegible] 35393 E+01	- .81481674E-01	0.10068418E+01	-0.4619 59E+01
57	0.8000 [illegible] E+00	0.1 [illegible] 4468 E+01	- .93910955E-01	0.10088434E+01	-0.53412429E+01
58	0.9000 [illegible] 1E+00	.1 [illegible] 054325E+01	- .10664600E+00	0.1011 726E+01	-0.60547138E+01
59	0.1000 [illegible] E+01	0.1 [illegible] 63996E+01	- .11971854E+00	0.10134953E+01	-0.67838725E+01
60	0.1100 [illegible] E+01	0.1 [illegible] 73322E+01	- .13315773E+00	0.1016 95 E+01	-0.7530 877E+01
61	0.1200 [illegible] E+01	.1 [illegible] 81893E+01	- .14698972E+00	0.10188482E+01	-0.82950398E+01
62	0.1300 [illegible] E+01	0.1 [illegible] 89262E+01	- .16123724E+00	0.10217285E+01	-0.90797 71E+01
63	0.1400 [illegible] E+01	0.1 [illegible] 91945E+01	- .17591911E+00	0.10247 81E+01	-0.93853583E+01
64	0.1500 [illegible] E+01	0.1 [illegible] 98 20E+01	- .19104968E+00	0.10277558E+01	-0.10713039E+02
65	0.1600 [illegible] E+01	0.1 [illegible] 99156E+01	- .20663839E+00	0.1031 639 E+01	-0.11563609E+02
66	0.1700 [illegible] E+01	0.1 [illegible] 96562E+01	- .22268918E+00	0.10339227E+01	-0.12437992E+02
67	0.1800 [illegible] E+01	0.1 [illegible] 9 [illegible] 6E+01	- .2392 [illegible] 2E+00	0.103697 1E+01	-0.13330640E+02
68	0.18999999E+01	0.1 [illegible] 78995E+01	- .25616240E+00	0.10399426E+01	-0.14260073E+02
69	0.19999999E+01	0.1 [illegible] 62785E+01	- .2735 687E+00	0.10428 1E+01	-0.15208544E+02
70	0.20999999E+01	0.1 [illegible] 4 791E+01	- .29137260E+00	0.10455013E+01	-0.16182150E+02
71	0.21999999E+01	0.1 [illegible] 12395E+01	- .30950741E+00	0.104 8 41E+01	-0.1716 787E+02
72	0.22999999E+01	.99709929E+ [illegible]	- .32810694E+00	0.10502657E+01	-0.182 4158E+02
73	0.23999999E+01	.9934 89E+00	- .34694522E+	0.10522435E+01	-0.19251759E+02
74	0.24999999E+01	.98829 49E+ [illegible]	- .366 2847E+00	0.1053 951E+01	-0.20322887E+02
75	0.25999999E+01	.982319 6E+ [illegible]	- .38529542E+00	0.10551793E+01	-0.21116630E+02
76	0.26999999E+01	0.97543362E+00	- .40467774E+00	0.1050 5 E+01	-0.22531875E+02
77	0.27999999E+01	.96762828E+ [illegible]	- .42410075E+00	0.10564875E+01	-0.23667315E+02
78	0.28999999E+01	.95884524E+ [illegible]	- .44348422E+00	0.10564386E+01	-0.24821451E+02
79	0.29999999E+01	.949 7571E+ [illegible]	- .46270344E+00	0.10553 77 E+01	-0.25992610E+02
80	0.30999999E+01	.93831 62E+ [illegible]	- .48179035E+00	0.105 7743E+01	-0.27178954E+02
81	0.31999999E+01	.92655129E+ [illegible]	- .50053494E+00	0.10531061E+01	-0.28378499E+02
82	0.32999999E+01	.9138 963E+ [illegible]	- .51888672E+00	0.105 527E+01	-0.29589135E+02
83	0.33999999E+01	.9 1 831E+ [illegible]	- .53675614E+00	0.1047991E+01	-0.30808047E+02
84	0.34999999E+01	.88548 01E+	- .554 5625E+00	0.1044535 E+01	-0.3203 739E+02

88	0.38999998E+01	.6?71324E+00	-.61594379E+00	0.10256681E+01	-0.369575-5E+02
89	.39999199E+01	.[illegible]2819?E+	-.62933346E+00	0.10180938E+01	-0.38161026E+02
90	.40999996E+01	.7613 754?E+00	-.6417 ?0?6E+00	0.10310521E+01	-0.39397??7E+02
91	0.41999999E+01	.7616738?E+00	-.653.8171E+00	0.10034777E+01	-0.40603?3?E+02
92	0.42999999E+01	.742 ?688?E+00	-.6634360?8E+00	0.99539526E+00	-0.41797978E+02
93	0.43999999E+01	.72197314E+00	-.67275529E+00	0.98683580E+00	-0.42978972E+02
94	0.44999999E+01	.7?167851E+00	-.681?3182E+00	0.97785282E+00	-0.44146530E+02
95	0.46000000E+01	0.68126686E+00	-.68827050E+00	0.96842182E+00	-0.45293023E+02
96	0.47000000E+01	0.66818848E+00	-.69448426E+00	0.95863961E+00	-0.46422939E+02
97	0.48000000E+01	0.6? ?1132E+00	-.69969337E+00	0.94852383E+00	-0.47532952E+02
98	0.49000000E+01	0.62 1162?E+00	-.70392533E+00	0.93611245E+00	-0.48621892E+02
99	0.10000000E+01	0.10063996E+01	-0.1197185?E+00	0.10134953E+01	-0.67333725E+01
100	0.20000000E+01	0.1?62785E+01	-.27356?88E+00	0.1042???1E+01	-0.15208545E+02
101	0.30000000E+01	0.94907569E+00	-0.46274346E+00	0.1055677?E+01	-0.25992612E+02
102	0.40000000E+01	0.80028194E+00	-.62933036E+00	0.10180903E+01	-0.38181021E+02
103	0.50000000E+01	0.6[illegible]E+00	-.70721358E+00	0.927?4329E+00	-0.49688745E+02
104	0.60000000E+01	0.4190?136E+00	-.69799658E+00	0.81410156E+00	-0.59023990E+02
105	0.70000000E+01	0.28743184E+00	-.64454161E+00	0.70572726E+00	-0.65965652E+02
106	0.80000000E+01	0.20?87592E+00	-.57997553E+00	0.61351989E+00	-0.70965942E+02
107	0.90000000E+01	0.14325652E+00	-.51897477E+00	0.53838392E+00	-0.74568523E+02
108	0.10000000E+02	0.10581212E+00	-.46585444E+00	0.47772017E+00	-0.772?3235E+02
109	0.11000000E+02	0.8 5 ? ?26E-01	-.42084180E+00	0.42847348E+00	-0.79169929E+02
110	0.12000000E+02	0.6291?5?6E-01	-.38291319E+00	0.388?4671E+00	-0.80609997E+02
111	0.13000000E+02	0.5?318553E-01	-.35?84182E+00	0.354?3165E+00	-0.81938195E+02
112	0.14000000E+02	0.41?68256E-01	-.32352669E+00	0.32012200E+00	-0.82765635E+02
113	0.15000000E+02	0.3?1 8827E-01	-.30??6379E+00	0.30199615E+00	-0.83519946E+02
114	0.16000000E+02	0.2876? 21E-01	-.27973448E+00	0.281209?3E+00	-0.84129971E+02
115	0.17000000E+02	0.2457?257E-01	-.26197311E+00	0.26312280E+00	-0.84641977E+02
116	0.18000000E+02	0.21232455E-01	-.24633431E+00	0.24724767E+00	-0.85073574E+02
117	0.19000000E+02	0.18533?6?E-01	-.23246564E+00	0.23320323E+00	-0.85441631E+02
118	0.20000000E+02	0.1632 46?E-01	-.22??861?E+00	0.22009?39E+00	-0.85759?30E+02
119	0.21000000E+02	0.14?84951E-01	-.20896976E+00	0.20947118E+00	-0.86034659E+02
120	0.22000000E+02	0.12945744E-01	-.19693337E+00	0.19935416E+00	-0.86276714E+02
121	0.23000000E+02	0.1164241?E-01	-.18982704E+00	0.19016373E+00	-0.86490382E+02
122	0.24000000E+02	0.1 529?69E-01	-.181527?9E+00	0.18183219E+00	-0.86680439E+02
123	0.25000000E+02	0.957?4223E-02	-.17393?71E+00	0.17419382E+00	-0.86850546E+02
124	0.26000000E+02	0.87389771E-02	-.16695177E+00	0.16718033E+00	-0.87003658E+02
125	0.27000000E+02	0.8?13 721E-02	-.16051759E+00	0.16071747E+00	-0.87142187E+02
126	0.28000000E+02	0.7375?6?3E-02	-.15456647E+00	0.1547?231E+00	-0.87268115E+02
127	0.29000000E+02	.68129967E-02	-.149??556E+00	0.1492?126E+00	-0.8738??5?E+02
128	0.30000000E+02	.6312?29?E-02	-.1139 ?69E+00	0.1?[illegible]E+00	-0.874???4?E+02
129	.31000000E+02	0.5?663656E-02	-.1391199?E+00	0.1392?357E+00	-0.87585?32E+02
130	0.32000000E+02	0.5?66?333E-02	-.13?64?63E+00	0.1347?277E+00	-0.87?7??1E+02

132	0.3400 E+02	0.47829442E-02	-0.1280[illegible]E+00	[illegible]	[illegible]
133	0.35 E+ 2	0.4[illegible]5891559E- 2	- .12279035E+00	0.12280137E+00	-0.87903524E+02
134	0.36 E+ 2	.4221021IE- 2	- .1193[illegible]507E+00	0.11936034E+00	-0.87973471E+02
135	0.3700 E+02	.39778827E- 2	- .116[illegible]7.1E+00	0.11607519E+00	-0.88036129E+02
136	0.380 E+02	.375[illegible]9538E- 2	- .11295736E+00	0.11294981E+00	-0.88091910E+02
137	0.39 E+02	0.355 5967E-02	-0.1 99320E+00	0.10998981E+00	-0.88150141E+02
138	0.400 E+02	0.33626880E-02	-0.1071295E+00	0.10718231E+00	-0.88202166E+02
139	0.4100 E+02	0.31895327E-02	-0.10440706E+00	0.10451574E+00	-0.88251251E+02
140	0.4200 E+02	0.30296034E-02	-0.1 193467E+00	0.10197968E+00	-0.88297644E+02
141	0.4300 E+02	0.28515737E- 2	-0.99523011E-01	0.99561719E-01	-0.88341563E+02
142	0.4400 E+02	0.27442798E-02	- .97223604E-01	0.97262326E-01	-0.88383204E+02
143	0.4500 E+02	.26166983E-02	- .95028749E-01	0.95064769E-01	-0.88422742E+02
144	0.4600 E+02	.24973240E-2	-0.92931432E-01	0.92969998E-01	-0.88460336E+02
145	0.4700 E+02	.23871589E-2	-0.90925261E-01	0.90956593E-01	-0.88496130E+02
146	0.4800 E+02	.22836903E-2	-0.890 4391E-01	0.89033684E-01	-0.88530250E+02
147	0.4900 E+02	.21863855E-02	-0.87163467E-01	0.87190897E-01	-0.88562814E+02
148	0.1000 E+02	0.10581212E+00	-0.46585444E+00	0.47772017E+00	-0.77203235E+02
149	0.2000 E+02	0.1632 464E-01	-0.22 8610E+00	0.22069039E+00	-0.85759030E+02
150	0.3000 E+02	0.63123290E-02	-0.14390989E+00	0.14404326E+00	-0.87488474E+02
151	0.4000 E+02	0.33626888E-02	-0.10712954E+00	0.10718231E+00	-0.88202166E+02
152	0.5000 E+02	0.2096179 E-02	-0.85397576E-01	0.85423299E-01	-0.88593925E+02
153	0.6000 E+02	0.14365344E-02	- .71024187E-01	0.71038673E-01	-0.88842939E+02
154	0.7000 E+02	0.10345660E-02	-0.6 804727E-01	0.60813699E-01	-0.89015843E+02
155	0.8000 E+02	.795 3289E-03	-0.53152105E-01	0.53168345E-01	-0.89143196E+02
156	0.900 E+02	.62568065E-03	-0.47229954E-01	0.47234098E-01	-0.89241042E+02
157	0.1000 E+03	.50531159E-03	-0.4249 499E-01	0.42493504E-01	-0.89318644E+02
158	0.1100 E+03	0.41674193E-03	-0.38616637E-01	0.38618866E-01	-0.89381734E+02
159	0.1200 E+03	0.3496 645E-03	-0.35390845E-01	0.35392571E-01	-0.89434058E+02
160	0.1300 E+03	.2975 980E-03	-0.32662998E-01	0.32664263E-01	-0.89478169E+02
161	0.1400 E+03	.25620650E-03	-0.30325739E-01	0.30326822E-01	-0.89515868E+02
162	0.1500 E+03	.2230540E-03	-0.283 0932E-01	0.28301811E-01	-0.89548465E+02
163	0.1600 E+03	0.19591219E-03	-0.26529751E-01	0.26530474E-01	-0.89576933E+02
164	0.1700 E+03	0.17344516E-03	- .24967326E-01	0.24967929E-01	-0.89602012E+02
165	0.1800 E+03	0.15463672E-03	- .23578786E-01	0.23579293E-01	-0.89624275E+02
166	0.1900 E+03	.13873276E-03	- .22336622E-01	0.22337053E-01	-0.89644174E+02
167	0.2000 E+03	.12510412E-03	- .21216837E-01	0.21219207E-01	-0.89662065E+02
168	0.2100 E+03	.11349461E-03	- .2 2 7634E-01	0.20279535E-01	-0.89678239E+02
169	0.2200 E+03	0.1 3385 E- 3	-0.19238459E-01	0.19238736E-01	-0.89692932E+02
170	0.2300 E+03	.9157 30E-04	- .1843929 E-01	0.18439533E-01	-0.89706340E+02
171	.2400 E+03	0.80356649E-04	- .17680115E-01	0.17680329E-01	-0.89718624E+02
172	0.2500 E+03	0.6 15 46E-04	- .16972520E-01	0.16972715E-01	-0.89729920E+02
173	0.2600 E+03	.73967245E-04	- .16319409E-01	0.16319576E-01	-0.89740313E+02
174	0.2700 E+03	.0053 432E- 4	-0.157 47 5E-01	0.15714854E-01	-0.89749905E+02

176	.2900 E+03	.59133672E- 4	- .1 63 426E-01	0.1403.6 7E-01	-.89767281E+02
177	.3000 E+03	.55532.54E- 4	- .1414262 E-01	0.14142729E-01	-0.89775058E+02
178	.310 E+03	.52 25373E- 4	- .13636245E-01	0.13686344E-01	-.89782332E+02
179	.320 E+03	.48799257E- 4	- .1325849 9E-01	.13258499E-01	-.89789119E+02
180	.3300 E+03	.45883193E- 4	- .1285 514E-01	.1285 596E-01	-.89795553E+02
181	.3400 E+03	.4322 994E- 4	- .1247827 E-01	0.12478345E-01	-.89801578E+02
182	.350 E+03	.4 78 021E- 4	- .121216 E-01	0.12121719E-01	-.898 7259E+02
183	.360 E+03	.33547655E- 4	- .1178185 E-01	0.11784913E-01	-.89812622E+02
184	.37 E+03	.3649 179E- 4	-.11466262E-01	.1146632 E-01	-.89817696E+02
185	.3800 E+03	.31593274E- 4	-.11164447E-01	0.111645 E-01	-.89822501E+02
186	.390 E+03	.3234 561E- 4	- .1 876116E-01	0.10878165E-01	-.89827060E+02
187	.4000 E+03	.3121779 E- 4	-.106 6105E-01	0.10 6151E-01	-.89831389E+02
188	.410 E+03	.29712123E- 4	- .10347368E-01	0.10347411E-01	-.89835508E+02
189	.4200 E+03	.28313398E- 4	- .1 1 955E-01	0.101 995E-01	-.89839431E+02
190	.4300 E+03	.27 1 928E- 4	-.986 062E-02	0.9866 432E-02	-.89843170E+02
191	.440 E+03	.25796324E- 4	- .96417395E-02	0.964177 E-02	-0.89846739E+02
192	.450 E+03	.24661859E- 4	-.9427 431E-02	0.94278755E-02	-.89850149E+02
193	.4600 E+03	.236 631E- 4	- .92224659E-02	0.92224962E-02	-0.89853412E+02
194	.4700 E+03	.226 471E- 4	- .90262133E-02	0.90262417E-02	-.89856534E+02
195	.480 E+03	.2167384 1E- 4	- .88381397E-02	0.88381664E-02	-0.89859526E+02
196	.490 E+03	.2 79776E- 4	- .86577443E-02	0.86577693E-02	-0.89862396E+02
197	.100 E+03	0.5 534159E-03	-.42490499E-01	0.42493504E-01	-0.89318644E+02
198	.200 E+03	.12516412E-03	-.21218837E-01	0.2121927E-01	-0.89662065E+02
199	.300 E+03	0.55532 54E- 4	-.1414262 E-01	0.14142729E-01	-0.89775058E+02
200	0.4000 E+03	.3121779 E- 4	-.106 6105E-01	0.106 6151E-01	-0.89831389E+02
201	0.5000 E+03	.19973761E- 4	-.8481566 E-02	0.84845895E-02	-0.89865151E+02
202	0.600 E+03	.13966545E- 4	-.7 7 3275E-02	0.7 7 3411E-02	-0.89887647E+02
203	0.790 E+03	.1 138195E- 4	-.606 2063E-02	0.6 6 2148E-02	-0.89903709E+02
204	.800 E+03	.77998695E- 5	-.53026382E-02	0.5302 439E-02	-0.89915754E+02
205	.900 E+03	0.61525 68E- 5	-.47134304E-02	0.47134345E-02	-0.89925121E+02
206	0.1000 E+04	0.4991565 E- 5	-.42420707E-02	0.42420737E-02	-0.89932614E+02
207	0.110 E+04	0.412517 8E-05	-.38564168E-02	0.3856419 E-02	-0.89938745E+02

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
3	0.3	[illegible]	[illegible]	[illegible]	0.999973E35+ [illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	0.99995[illegible]	[illegible]
5	0.5[illegible]	[illegible]	[illegible]	[illegible]	0.9994277[illegible]	[illegible]
6	[illegible]	[illegible]	.9997 [illegible]	[illegible]	[illegible]	[illegible]
7	.7	[illegible]	.9997 [illegible]	- .171[illegible]	.99985995[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	0.9998142[illegible]	[illegible]
9	[illegible]	[illegible]	.99952 [illegible]	[illegible]	0.99977171[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	0.99972[illegible]	[illegible]
11	0.11[illegible]	[illegible]	[illegible]	- .27372[illegible]	0.99966[illegible]	[illegible]
12	0.12 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	0.13 [illegible]	[illegible]	[illegible]	-0.32293[illegible]	0.9995419[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]377E-01	0.999475[illegible]	-0.19921537 +01
15	[illegible]	[illegible]	[illegible]	-0.37133333E-01	[illegible]	-0.2132[illegible]57 +01
16	[illegible]	[illegible]	[illegible]	-0.3962[illegible]	0.99933258[illegible]	-0.2272[illegible] + 1
17	0.17[illegible]	[illegible]	[illegible]	-0.421[illegible]	0.99925763[illegible]	[illegible]
18	0.18 [illegible]	[illegible]	[illegible]	[illegible]	0.9991[illegible]	-0.25511[illegible] + 1
19	0.19[illegible]	[illegible]	[illegible]	[illegible]	0.999[illegible]23[illegible]	-0.26899[illegible] + 1
20	0.20[illegible]	[illegible]	[illegible]	[illegible]03E-01	0.999[illegible]	-0.2[illegible]2135 + 1
21	0.21[illegible]	[illegible]	[illegible]	[illegible]E-01	0.99[illegible]25[illegible]	-0.29[illegible]592 + 1
22	0.22[illegible]	[illegible]	[illegible]	-0.5[illegible]E-01	[illegible]	-0.31[illegible]458 +01
23	0.23[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.32[illegible] +01
24	0.24[illegible]	[illegible]	[illegible]	[illegible]	0.9987[illegible]	-0.33763[illegible] +01
25	.25	[illegible]	[illegible]	[illegible]	[illegible]	-0.351277[illegible] +01
26	.26[illegible]	[illegible]	[illegible]	[illegible]	0.99854[illegible]	[illegible] + 1
27	.27[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] +01
28	0.28 [illegible]	[illegible]	[illegible]	[illegible]	0.99839[illegible]	-0.39177[illegible] +01
29	0.29[illegible]	[illegible]	[illegible]	[illegible]	0.99832[illegible]	-0.405175[illegible] +01
30	0.30 [illegible]	[illegible]	[illegible]	[illegible]	0.99820[illegible]	-0.41[illegible] +01
31	0.31[illegible]	[illegible]	.99535525[illegible]	-0.751[illegible]	0.998[illegible]	-0.431831[illegible] +01
32	0.32[illegible]	[illegible]	[illegible]	- .77459[illegible]E-01	0.998[illegible]	-0.445[illegible] +01
33	.33 [illegible]	[illegible]	[illegible]	-0.797[illegible]E-01	0.998[illegible]	[illegible] +01
34	.34	[illegible]	[illegible]	[illegible]	0.998[illegible]	-0.471[illegible]395 +01
35	.35[illegible]	[illegible]	[illegible]	[illegible]	0.997991[illegible]	[illegible] +01
36	.36 [illegible]	[illegible]	[illegible]	[illegible]	0.99795[illegible]	-0.497[illegible] + 1
37	0.37[illegible]	[illegible]	[illegible]	[illegible]	0.9979[illegible]	-0.51[illegible]572 +01
38	0.38[illegible]	[illegible]	[illegible]	[illegible]17[illegible]E-01	0.9978[illegible]	-0.5236329[illegible] +01
39	0.39[illegible]	[illegible]	[illegible]	- .933[illegible]E-01	0.997[illegible]	- .53[illegible] + 1
40	0.40[illegible]	+	[illegible]	-0.955[illegible]E-01	0.997[illegible]	-0.5[illegible] +01
41	0.41	+	[illegible]	- .97773[illegible]E-01	0.997[illegible]	-0.5[illegible] +01

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible].45 [illegible]+	.[illegible]+	-.1[illegible]+	0.99791257[illegible]+	-[illegible].01331925 + 1
46	[illegible].46 [illegible]+	.[illegible]+	-.1[illegible]327[illegible]+	0.99794[illegible]+	-[illegible].0759[illegible] +.1
47	.47 [illegible]+	.[illegible]7[illegible]+	-.111[illegible]+	[illegible].99749237.+	-[illegible].[illegible]3[illegible]3 + 1
48	[illegible].48 [illegible]+	.[illegible]+	-.113[illegible]+	[illegible].999[illegible]+	-[illegible].[illegible]512[illegible] +.1
49	[illegible].49 [illegible]+	.[illegible]+	-.1[illegible]57[illegible]3[illegible]+	[illegible].999[illegible]+	-[illegible]37[illegible] + 1
50	[illegible].1[illegible]+	.99[illegible]+	-.2[illegible]-1	[illegible].99972[illegible]3[illegible]+	-.1[illegible]273[illegible] + 1
51	[illegible].2 [illegible]+	.997[illegible]+	-.[illegible]2[illegible]3[illegible]-1	0.999 22[illegible]+	-[illegible].2[illegible]2[illegible]7.+ 1
52	[illegible].3[illegible]+	.[illegible]+	-.7[illegible]65[illegible]-	[illegible].998[illegible]+	-[illegible].[illegible]1[illegible]52790.+ 1
53	[illegible].4[illegible]+	.[illegible]127[illegible]7 +	-.9[illegible]7[illegible]7[illegible]-	0.997[illegible] 77[illegible]+	-[illegible].5[illegible]825 + 1
54	[illegible].56[illegible]+	.[illegible]+	-.117[illegible]+	0.998[illegible]+	-[illegible].[illegible]703[illegible] +.1
55	[illegible].6[illegible]+	.[illegible]7[illegible]+	-.13[illegible]+	0.999-7[illegible]+	-[illegible] 1 + 1
56	[illegible].7[illegible]+	.[illegible]+	-.1[illegible]7[illegible]+	0.10[illegible]35[illegible]+ 1	-[illegible]2[illegible]0[illegible]23 + 1
57	[illegible].8[illegible]+	.9[illegible]7[illegible]+	-[illegible]1[illegible]7[illegible]+	0.10[illegible]+ 1	-[illegible].1[illegible]57[illegible]2 + 2
58	[illegible].9[illegible]1[illegible]+	.9[illegible]+	-.2[illegible]+	[illegible].1[illegible]+ 1	-[illegible].1[illegible]97[illegible] +.2
59	0.1[illegible]+	.9[illegible]+	-.2[illegible]+	0.1[illegible]+ 1	-[illegible].1295[illegible] +.2
60	[illegible].11[illegible]+ 1	.991[illegible]7 +	-[illegible].2[illegible]+	0.1022959[illegible]+ 1	-[illegible].142[illegible]93[illegible] +.2
61	[illegible].12[illegible]+ 1	.9[illegible]+	-[illegible].27[illegible]+	0.1[illegible]155[illegible]+ 1	-[illegible].15[illegible]22[illegible] +.2
62	[illegible].13[illegible]+ 1	.99[illegible]93[illegible]71[illegible]+	-.3[illegible]3[illegible]+	0.1[illegible]122[illegible]+ 1	-[illegible].16951105 +.2
63	[illegible].14[illegible]+ 1	.99[illegible]7 +	-[illegible].331[illegible]+	0.1[illegible]5 2[illegible]+ 1	-[illegible].1[illegible]374[illegible]5 + 2
64	[illegible].15[illegible]+ 1	.99[illegible]+	-.3[illegible]27[illegible]+	0.10613[illegible]+ 1	-[illegible].19[illegible]3955 + 2
65	[illegible].16[illegible]+ 1	.99[illegible]+	-[illegible].39[illegible]+	0.1[illegible]+ 1	-[illegible].21395821 + 2
66	[illegible].17[illegible]+ 1	.[illegible]+ 1	-.4[illegible]+	0.1[illegible]+ 1	-[illegible].23[illegible]+ 2
67	[illegible].18[illegible]+ 1	.9997 [illegible]+	-[illegible].459[illegible]+	0.11[illegible]29[illegible]+ 1	-[illegible].24[illegible]91[illegible]47 + 2
68	[illegible].1899999[illegible]+ 1	.99[illegible]+	-[illegible]90733 7[illegible]+	0.111[illegible]977[illegible]+ 1	-[illegible].26457111 + 2
69	[illegible].19999999[illegible]+ 1	.99[illegible]+	-.5[illegible]+	0.113[illegible]398[illegible]+ 1	-[illegible].2831[illegible]911 + 2
70	[illegible].20999999[illegible]+ 1	.99[illegible]7 +	-[illegible].577[illegible]+	0.114[illegible]667[illegible]+ 1	-[illegible].30459210 + 2
71	[illegible].21999999[illegible]+ 1	.9[illegible]+	-[illegible].6[illegible]+	[illegible].110[illegible]+ 1	-[illegible].323[illegible] +.2
72	[illegible].22999999[illegible]+ 1	.972[illegible]+	-[illegible].6[illegible]1113[illegible]+	0.118[illegible]359[illegible]+ 1	-[illegible].34460522 +.2
73	[illegible].2399999[illegible]+ 1	.959[illegible]+	-[illegible].71612733[illegible]+	0.119726113[illegible]+ 1	-[illegible].[illegible]073[illegible]611 + 2
74	[illegible].24999999[illegible]+ 1	.94195227 +	-.7[illegible]637[illegible]+	0.121[illegible]33[illegible]+ 1	-[illegible].391317[illegible] +.2
75	[illegible].25999999[illegible]+ 1	.91992[illegible]+	-[illegible].8182[illegible]+	0.123115[illegible]+ 1	-[illegible].[illegible]1050674 +.2
76	[illegible].26999999[illegible]+ 1	.89271[illegible]+	-[illegible].87115534[illegible]+	0.12473371[illegible]+ 1	-[illegible].44299703 + 2
77	[illegible].27999999[illegible]+ 1	.859715[illegible]+	-[illegible].924574[illegible]+	0.12625185[illegible]+ 1	-[illegible].4781721 + 2
78	[illegible].28999999[illegible]+ 1	.82[illegible]+	-[illegible].97[illegible]33[illegible]+	0.12702793[illegible]+ 1	-[illegible].49997205 +.2
79	[illegible].29999999[illegible]+ 1	.77[illegible]+	-.1 253[illegible]+ 1	0.128[illegible]+ 1	-[illegible].53[illegible]001 + 2
80	[illegible].3[illegible]+ 1	.72151[illegible]+	-.1 78[illegible]+ 1	0.12976[illegible]+ 1	-[illegible].562192[illegible]5 + 2
81	0.3199[illegible]+ 1	.[illegible]713[illegible]+	-[illegible].1123[illegible]+ 1	0.13[illegible]276[illegible]+ 1	-.59513923 + 2
82	[illegible].3299[illegible]+ 1	.[illegible]53[illegible]+	-.11[illegible]+ 1	[illegible].13 75712[illegible]+ 1	-[illegible].[illegible]14356 +.2
83	[illegible].3399[illegible]+ 1	.5231[illegible]+	-[illegible].1197[illegible]+ 1	0.1371[illegible]+ 1	-[illegible]73 +.2
84	[illegible].34[illegible]+ 1	.[illegible]2[illegible]+	-.12237[illegible]+ 1	0.13[illegible]25332[illegible]+ 1	-[illegible].[illegible]97[illegible]2[illegible] +.2
85	[illegible].35[illegible]+ 1	.[illegible]37[illegible]+	-.12[illegible]+ 1	[illegible].12933[illegible]+ 1	-[illegible].7359[illegible] +.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible].12[illegible]3[illegible]+ 1	-[illegible].772[illegible]5[illegible]+ 2
				[illegible]	-[illegible] 37[illegible] + 2

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
89	,3999[illegible]+	[illegible]	- ,1214[illegible]E+01	0,1215[illegible]977[illegible]+01	-[illegible]+2
9	,[illegible] 99[illegible]+	- ,[illegible]7[illegible]	- ,1185531[illegible]E+01	0,118[illegible]885[illegible]+01	-[illegible],91591215 +2
91	[illegible],41[illegible]+	[illegible]	- ,1149[illegible]711E+01	0,1154207[illegible]+01	-[illegible],95[illegible]2654 + 2
92	[illegible],4299[illegible]+[illegible]	[illegible]	-[illegible],11044[illegible]90E+01	0,112[illegible]2[illegible]3[illegible]+ 1	-[illegible],96303951 +2
93	[illegible],4399[illegible]+[illegible]	[illegible]	-[illegible],1[illegible]624[illegible]5[illegible]+01	0,10[illegible]5215[illegible]+01	- ,10148516 + 3
94	[illegible],4499[illegible]	- ,[illegible]	-[illegible],1[illegible]422[illegible]+01	0,10477182[illegible]+ 1	-[illegible],10453367 +3
95	[illegible],46[illegible]+[illegible]	-[illegible],3[illegible]29[illegible]+[illegible]	- ,95394[illegible]E+0	0,101[illegible]41[illegible]9E+ 1	-[illegible],10744431 +3
96	[illegible],47[illegible]+[illegible]	-[illegible],33[illegible]+[illegible]	-[illegible],913[illegible]5[illegible]78E+0	0,97297924E+[illegible]	-[illegible],11021415 +3
97	0,48[illegible]+[illegible]	- ,36329[illegible]	-[illegible],8024376[illegible]E+0	0,9356394[illegible]E+0	-[illegible],11264205 + 3
98	[illegible],49[illegible]+[illegible]	- ,384757[illegible]+[illegible]	- ,612317[illegible]E+0	0,8994675[illegible]E+	-[illegible],11533179 + 3
99	0,1[illegible]+[illegible]	[illegible]+[illegible]	-[illegible],22782316E+0	0,10159[illegible]6E+01	-0,1295[illegible] +2
100	0,2[illegible]	,3[illegible]+ 0	-[illegible],536[illegible]96[illegible]E+0	0,113[illegible]398E+01	-0,2831[illegible]913 +2
101	0,30[illegible]+	,77[illegible]227[illegible]	-[illegible],1[illegible]2[illegible]3[illegible]E+01	0,12801443E+01	-[illegible],53[illegible]654 +2
102	0,4[illegible]+[illegible]	[illegible]5659[illegible]-0	-[illegible],121[illegible]421[illegible]E+01	0,12150977E+01	-0,88[illegible]678[illegible] + 2
103	0,5[illegible]+	-[illegible]123777[illegible]+[illegible]	-[illegible],7[illegible]473356E+0	0,8030924[illegible]E+0	-[illegible],1176[illegible]499 +3
104	[illegible],6[illegible]+	- ,[illegible]+[illegible]	- ,4[illegible]67[illegible]99[illegible]E+0	0,57535571E+0	-[illegible],135016[illegible] +3
105	[illegible],7[illegible]+[illegible]	- ,32[illegible]+	-[illegible],22951937E+0	0,4[illegible]934623E+0	-[illegible],14501803 +3
106	0,8[illegible]+	- ,257[illegible]323[illegible]+[illegible]	-[illegible],140[illegible]402E+0	0,29344242E+0	-[illegible],15131601 +3
107	[illegible],9[illegible]+[illegible]	- ,2[illegible]1275[illegible]+[illegible]	-[illegible],92643045E-01	0,22442086E+[illegible]	-0,15561914 +3
108	0,1[illegible]+[illegible]	- ,16533[illegible]+	-[illegible],61313125E-01	0,17741995E+0	-[illegible],1587[illegible]631 +3
109	[illegible],11	[illegible]+ 2	-[illegible],13[illegible]21[illegible]+[illegible]	-[illegible],40561568E-01	0,14395294E+0	-[illegible],16112625 +3
110	[illegible],12[illegible]+[illegible]	- ,[illegible]	-[illegible],3[illegible]65332[illegible]E-01	0,11925271E+[illegible]	-[illegible],163006[illegible]9 + 3
111	[illegible],13[illegible]+[illegible]	-[illegible],9[illegible]- 1	-[illegible],268[illegible]427[illegible]E-01	0,10048365E+[illegible]	-[illegible],16452694 +3
112	[illegible],1[illegible]+[illegible]	-[illegible],3324[illegible]- 1	- ,21[illegible]9557E-01	0,85872545E-01	-[illegible],16579016 +3
113	[illegible],15[illegible]+[illegible]	-[illegible],7231[illegible]7[illegible]- 1	-[illegible],1089[illegible]94E-01	0,74266[illegible]54E-01	-[illegible],16685356 +3
114	[illegible],16[illegible]+[illegible]	- ,53[illegible]- 1	-[illegible],1375[illegible]E-01	0,64886634E-01	-[illegible],1677[illegible]356 +3
115	[illegible],17[illegible]+[illegible]	-[illegible],5[illegible]- 1	-[illegible],113527[illegible]E-01	0,57195[illegible]23E-01	-[illegible],16855132 +3
116	0,18[illegible]+[illegible]	- ,49912737[illegible]- 1	-[illegible],9[illegible]8[illegible]479[illegible]E-02	0,5[illegible]8[illegible]5672E-01	-[illegible],16924[illegible]52 +3
117	0,19[illegible]+ 2	-[illegible],44727[illegible]- 1	-[illegible],[illegible]767[illegible]E-02	0,45438972E-01	-[illegible],169849[illegible] + 3
118	[illegible],20[illegible]+ 2	-[illegible],[illegible]3123[illegible]- 1	-[illegible],[illegible]2[illegible]2979[illegible]E-02	0,40885[illegible]9E-01	-[illegible],170391[illegible]1 +3
119	[illegible],21[illegible]+ 2	-[illegible],3[illegible]- 1	-[illegible],5[illegible]E-02	0,3[illegible]9[illegible]9[illegible]72E-01	-[illegible],17067744 +3
120	[illegible],22[illegible]+ 2	-[illegible],33[illegible]- 1	-[illegible],5[illegible]7769[illegible]3E-02	0,33627433E-01	-[illegible],17131526 +3
121	0,23[illegible]+ 2	-[illegible],3[illegible]- 1	- ,4[illegible]26319[illegible]E-02	0,3[illegible]7[illegible]762E-01	-[illegible],17171212 +3
122	[illegible],24[illegible]+ 2	-[illegible],27[illegible]- 1	- ,3892347[illegible]E-02	0,2815278[illegible]E-01	-[illegible],172[illegible]73[illegible] +3
123	[illegible],25[illegible]+ 2	- ,25[illegible]7[illegible]- 1	-[illegible],3[illegible]24375[illegible]E-02	0,259[illegible]62952E-01	-[illegible],1724[illegible]429 +3
124	[illegible],26[illegible]+[illegible]	-[illegible],2377[illegible]- 1	-[illegible],303[illegible]731[illegible]E-02	0,23919628E-01	- ,1727[illegible]5 +3
125	[illegible],27[illegible]+ 2	- ,21984339 - 1	- ,27[illegible]5[illegible]3E-02	0,22154[illegible]38E-01	-[illegible],1729[illegible]6 +3
126	[illegible],28[illegible]+[illegible]	- ,2[illegible]- 1	-[illegible],2[illegible]147[illegible]E-02	0,2[illegible]577769E-01	-[illegible],1732[illegible]7 5 +3
127	[illegible],29[illegible]+[illegible]	-[illegible]- 1	- ,21737[illegible]71[illegible]E-02	0,1910[illegible]591E-01	-[illegible],[illegible]7[illegible] +3
128	[illegible],3[illegible]+[illegible]	- ,[illegible]77[illegible]- 1	- ,1[illegible]17[illegible]E-02	0,17892678E-01	-0,1737[illegible]90 +3
129	[illegible],31[illegible]+[illegible]	- ,[illegible]- 1	- ,1773[illegible]E-02	0,167[illegible]372[illegible]E-01	-[illegible],1739[illegible]9[illegible]6 + 3
130	[illegible],32[illegible]+[illegible]	- ,[illegible]- 1	- ,1[illegible]E-02	0,157[illegible]23[illegible]E-01	- ,174[illegible] + 3
131	[illegible],33[illegible]+[illegible]	-[illegible]- 1	-[illegible],1[illegible]E-02	0,1[illegible]755[illegible]3E-01	-[illegible],17[illegible]297[illegible] + 3

132	0.34	[illegible]	-.13 371 3 - 1	- .1339 76- 2	0.13342 77E- 1	- .174 + 3
133	.35	+	- .13 - 1	-.14261 7E-02	0.131 2453E-01	-0.17465 16.+03
134	.36	+ 2	-.1297 E- 1	-.1125 -02	0.1237 465E-01	-0.1747 239 +03
135	.37	+	- .1 - 1	-.1 3 9 -02	0.11713 17E-01	-0.17492615 +.3
136	.38	+	- .2 5 7 -01	-.955 -03	0.11 99 43E- 1	-0.1750 213 + 3
137	.39	+	- .1 7 - 1	-.1831 7 -03	0.1 533891E-01	-0.17519 56 + 3
138	.4	+ 2	- .997 7 - 2	- .11793 -03	0.1 1 149 -01	-0.1753131 + 3
139	.41	+ 2	- .9 - 2	- .759 1 -03	0.952 -02	-0.17542930 +03
140	.42	+	- .9 7 - 2	-.7 50 97E-03	0.94736 9E- 2	-0.17553976 + 3
141	0.43	+ 2	- .4 4772 - 2	- .5715 -03	0.865390 E- 2	-0.17564496 +.3
142	0.440	+	- .9 5 -02	- .613 57 -03	0.826 128 -02	- .17574532 +.3
143	0.4500	+ 2	-.7 7 7 - 2	- .5727 7E-03	0.7 976 83 - 2	-0.1758411 + 3
144	0.450	+ 2	- .7537 7 - 2	- .53 77E-03	0.75 229 -02	-0.1759 265 + 3
145	0.47	+ 2	- .7215 - 2	- .5 245 25 -03	0.723 45 - 2	-0.17602623 + 3
146	0.48	+ 2	-0.692 - 2	- .47 313 7 -03	0.693 71 E-02	-0.1761 4 9 +03
147	0.490	+ 2	- .6 3 37 - 2	- .442 07 -03	0.6055126 E-02	- .17616 8 +.3
148	0.1 00	+	- .165 3 +	- .64313125E-01	0.17741995E+	- .1567466 +03
149	0.2 00	+	- .31 3 - 1	-0.60 29 -02	0.1 8859 9E-01	-0.17 391 1 +03
150	0.3 0	+	- .177 3 - 1	- .19 74E-02	0.17 92 7 E-01	-0.17371 +03
151	0.4 0	+ 2	- .997 7 - 2	- .817 3 E-03	0.100101 49E-01	- .1753131 +03
152	0.5 0	+ 2	- .537 7 - 2	- .116 7 -03	0.639 4655E-02	-0.1702 1 +03
153	0.6	+ 2	- .125 92 - 2	-0.24 53E-03	0.4317212E-02	-0.1708 900 +03
154	.7 0	+ 2	-0.32 97 6 - 2	- .1 117 5 -03	0.325327 1E-02	-0.17733657 +03
155	0.8 0	+ 2	-0.2447 6 - 2	- .1 11 95 5-03	0.24894573E-02	-0.17767 57 +03
156	0.9	+ 2	-0.19 4 7 3 - 2	-0.71 22 2 -	0.1960257 E-02	-0.177933 5 +03
157	0.1 0	+ 3	- .15 - 2	- .51733 2 -	0.159225 E-02	-0.1781361 +03
158	0.11	+ 3	- .1315 3 - 2	- .3 83 1 -	0.131565 E-02	-0.1783 7 1 +.3
159	0.12 0	+ 3	- .11 - 2	- .2991767 - 4	0.11 5351 E-02	-0.17846 9 9 + 3
160	0.1300	+ 3	- .94 - 3	- .2352 -	0.9417297 E- 3	- .1785 9 +03
161	0.14 0	+ 3	- .8117 - 3	-0.1683 7 -	0.81927 E- 3	-0.17867 8 +03
162	0.15	+ 3	- .717 5 - 3	- .153 3 -	0.7 72271 E-03	- .178759 + 3
163	0.16	+ 3	- .62 - 3	- .1261 5 -	0.62154 95 -03	-0.1768373 +03
164	0.17	+ 3	-0.55 - 3	- .1 51439 -04	0.555467 E-03	-0.1769 576 +03
165	0.18	+ 3	- .49 975 9 - 3	- .35 2 -05	0.491 553 E-03	-0.17895661 +03
166	0.190	+ 3	- .4 5 5 -03	- .753 13 -05	0.445 999 -03	- .179 21 4 +03
167	0.2	+ 3	- .3 7 7 - 3	- .5 57 -05	0.39772 7 -03	-0.179 7 2 + 3
168	0.21	+ 3	- .3 - 3	- .557 3 -05	0.3 742310- 3	-0.17911 34 +03
169	0.22	+ 3	- .32 97 - 3	- .4 7 - 5	0.32 5 E-03	- .179154 2 +03
170	0.23	+ 3	- .3 -03	- .12 -05	0.3 7195 -03	- .179191 + 3
171	0.24	+ 3	- .27 5 - 3	-0.37353 7 -05	0.27617 91E- 3	-0.17922511 + 3
172	0.25	+ 3	- .25 4 - 3	- .33 677 -05	0.25 52 76 - 3	-0.1792 12 + 3
173	0.26	+ 3	- .23 7 3 - 3	- .24377 7 - 5	0.235 1557 -03	- .179 74 + 3
174	0.27	+ 3	- .1 - 3	- .2 23 -05	0.2182 49 -03	- .17931125 + 3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] + 3

176	0.29	-	- .[illegible]E- 3	-0.2[illegible]E- 5	0.1[illegible]E-03	-0.17535[illegible]+ 3
177	.3[illegible]	+	-0.17[illegible]E- 3	-0.19122[illegible]E-05	0.1707[illegible]E-03	-0.1793[illegible]5 + 3
178	.31[illegible]	+	-0.[illegible]E- 3	-0.173[illegible]E-05	0.10552[illegible]E-03	-0.1794[illegible]5 + 3
179	.32[illegible]	+	- .1553[illegible]E- 3	-0.1575572[illegible]E-05	0.15533631E-03	-0.17941[illegible] +03
180	.33[illegible]	+	- .14[illegible]E- 3	- .14366[illegible]E-05	0.14[illegible]E-03	- .1793052 +03
181	0.34	+	-0.137[illegible]E- 3	-0.13135317E-05	0.13759723E-03	-0.1794531[illegible]+ 3
182	0.35[illegible]	+	- .129[illegible]E- 3	- .1[illegible]62E-05	0.1296461[illegible]E-03	-0.1796573 +03
183	0.36[illegible]	+	-0.12272[illegible]E- 3	-0.11[illegible]523[illegible]E-05	0.122732[illegible]5E-03	-0.179483[illegible] + 3
184	0.37[illegible]	+	-0.11[illegible]253[illegible]E- 3	- .1[illegible]E-05	0.11o1o7[illegible]E-03	-0.17949746 +03
185	0.35[illegible]	+	- .1[illegible]E- 3	-0.9[illegible]E-06	0.11115189E-03	-0.1795[illegible] +03
186	0.39	+	- .1[illegible]571[illegible]E- 3	-0.87[illegible]28641E-06	0.104575[illegible]E-03	-0.1795232[illegible] + 3
187	0.4[illegible]	+	-0.99[illegible]E- 4	-0.8[illegible]5629[illegible]7E-06	0.99411327E-[illegible]	-0.1795351[illegible] + 3
188	.41[illegible]	+	-0.94[illegible]E- 4	-0.7[illegible]9[illegible]3[illegible]23E-06	0.9[illegible]621[illegible]81[illegible]E-04	-0.1795465[illegible] +03
189	0.42[illegible]	+	- .9[illegible]165725E- 4	-0.69676742E-06	0.9[illegible]166417E-04	-0.179557[illegible] + 3
190	0.43[illegible]	+	- .86[illegible]2[illegible]E- 4	- .[illegible]9242316E-06	0.86023[illegible]53E-04	-0.1795[illegible]7[illegible] +03
191	0.4[illegible]	+	-0.8215[illegible]88[illegible]E- 4	-0.6[illegible]517578E-06	0.82157125E-04	-0.1795774[illegible]3 +03
192	0.45	+	-0.7854[illegible]20[illegible]E- 4	- .5[illegible]65[illegible]07E-06	0.7[illegible]5[illegible]6[illegible]7[illegible]E-04	-0.1795[illegible]62 +03
193	0.46[illegible]	+	-0.7516[illegible]9[illegible]E- 4	-0.53[illegible]53536E-06	0.751o7[illegible]65E-04	-0.179595o1 + 3
194	0.47	+	-0.72[illegible]1479[illegible]E- 4	- .447[illegible]E-06	0.72[illegible]3195E-04	-0.179604[illegible]1 +03
195	.48[illegible]	+	-0.69[illegible]3259[illegible]E- 4	- .4o677[illegible]E-06	0.69[illegible]34169E-04	-0.1796126[illegible] +03
196	0.49	+	-0.6[illegible]43617[illegible]E- 4	-0.43377[illegible]39[illegible]E-06	0.6o245[illegible]70E-04	- .17962[illegible]5o +03
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199	0.3[illegible]	+	- .17[illegible]73[illegible]5[illegible]E- 3	- .191[illegible]2[illegible]E-05	0.1767[illegible]E-03	-0.17938[illegible]15 +03
200	0.4[illegible]	+	- .99[illegible]E- 4	- .8[illegible]5[illegible]E-06	0.99411327E-	-0.17953516 +03
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203	0.7[illegible]	+	- .32[illegible]5[illegible]E- 4	- .1[illegible]5[illegible]935[illegible]E-06	0.32459313E-04	-0.179734[illegible]7 +03
204	0.8[illegible]	+	- .2[illegible]E- 4	-0.1[illegible]E-06	0.2465152[illegible]E-04	-0.1797[illegible]7[illegible]3 +03
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206	.1[illegible]	+	- .159[illegible]79[illegible]E- 4	-0.51618163E-07	0.159[illegible]487[illegible]E-04	-0.17981[illegible]2 +03
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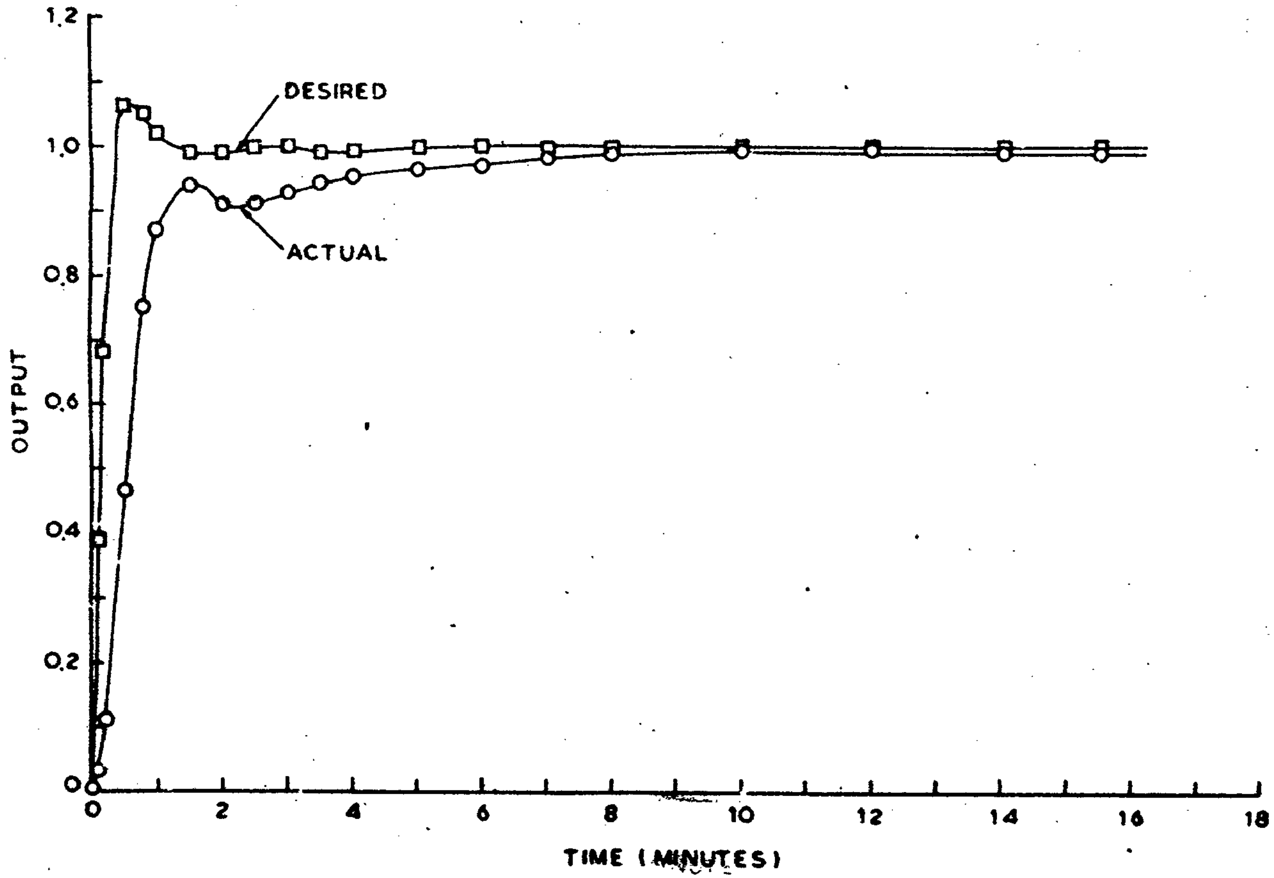

FIG TIME RESPONSE FOR EXAMPLE 1 CASE I (ω = 0 TO 5)

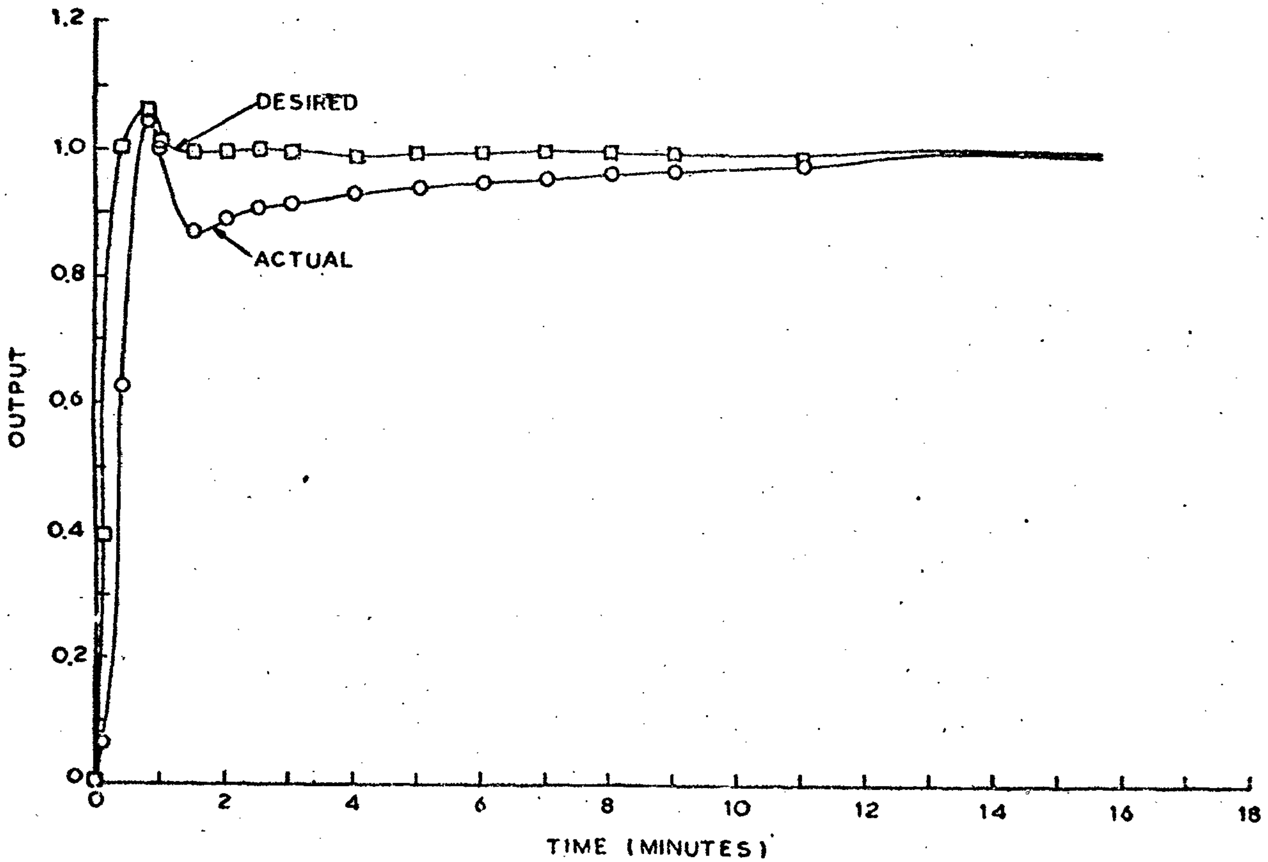

FIG TIME RESPONSE FOR EXAMPLE 1 CASE III ($\omega = 0$ TO 0.25)

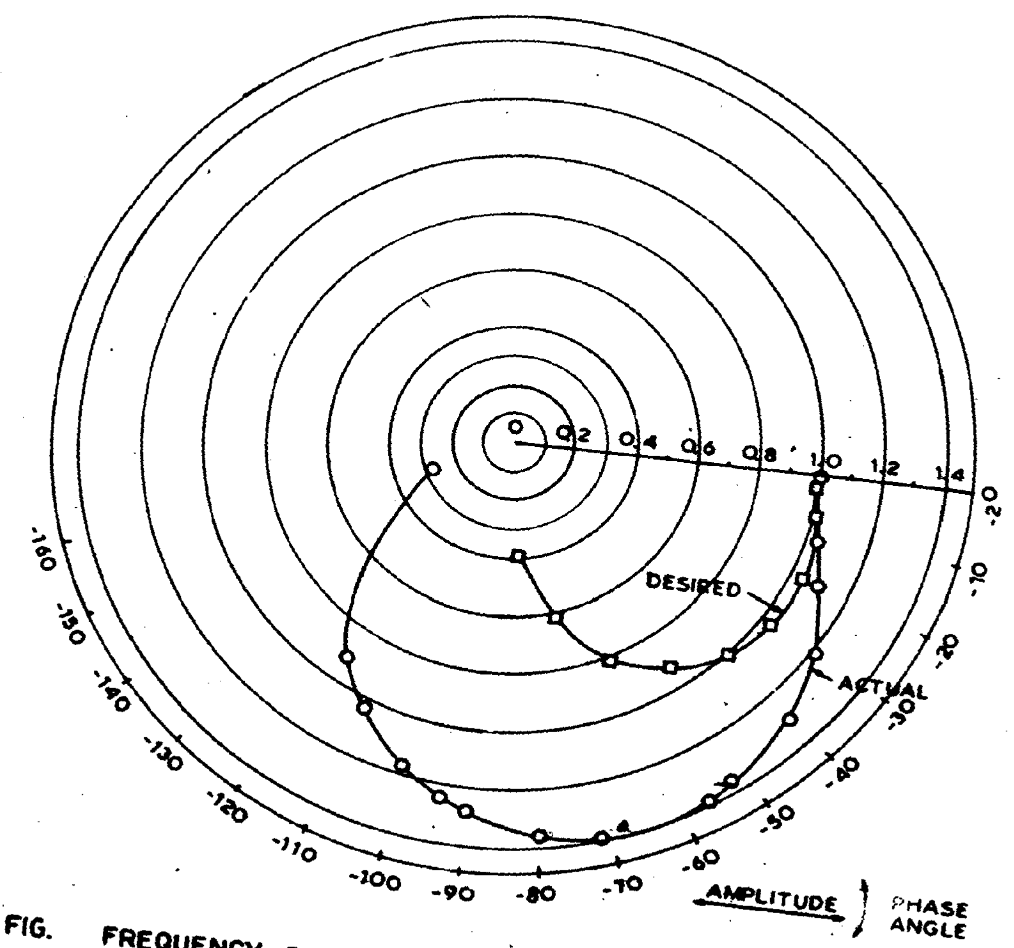

FIG. FREQUENCY RESPONSE FOR EXAMPLE 1 CASE 1 (ω=0 TO 0.25)

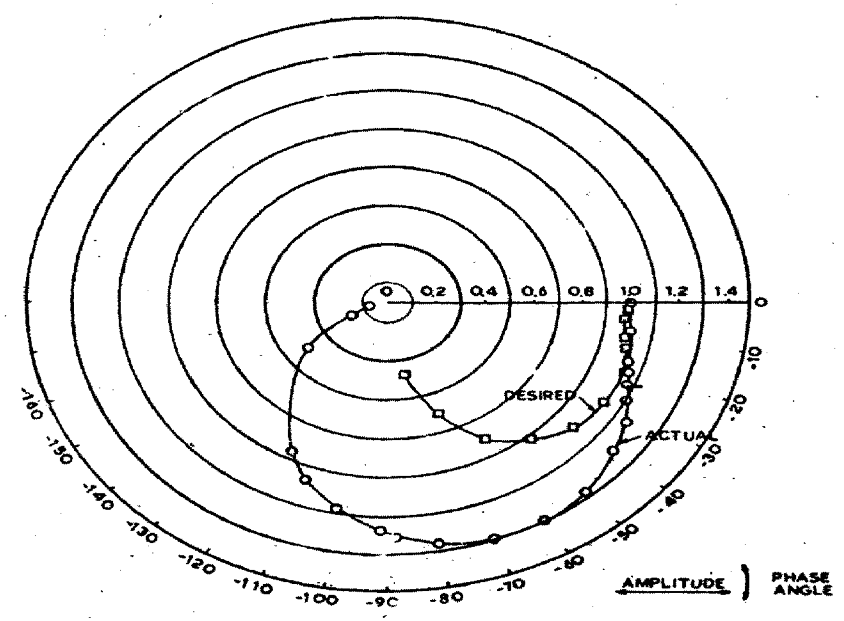

FIG FREQUENCY RESPONSE FOR EXAMPLE 1 CASE 1 (ω = 0 TO 1)

EXAMPLE 2:

Consider the control problem of a plant with time delay as given below : -

The Plant Transfer function $G(s) = \frac{2.08\ e^{-3.4s}}{13.2s + 1}$ and $C(s)=[K_p+K_I/s]$

Model transfer function $M(s)= e^{-3.4s}[\frac{4.04265 + 8.009}{s^2+ 4.4431s + 8.009}]$

The closed loop transfer function

$$T(s) = \frac{G(s)\ C(s)}{1 + G(s)\ C(s)}$$

$$T(\underline{p},s) = \frac{2.08\ e^{-3.4s}[K_I + K_p s]}{13.2s^2 + s + 2.08\ e^{-3.4s}[K_I + sK_p]}$$

$$T(\underline{p},s) = \frac{2.08[\text{Cos } 3.4w - s \text{ Sin } 3.4w][K_I + swK_p]}{-13.2w^2 + sw + 2.08(\text{Cos } 3.4w - s \text{ Sin } 3.4w)(K_I + swK_p)}$$

$$T(\underline{p},jw) = \frac{2.08[K_I \text{Cos}3.4w + wK_p \text{Sin}3.4w + j(wK_p \text{Cos}3.4w - K_I \text{Sin}3.4w)]}{-13.2w^2 + 2.08[K_I \text{Cos}3.4w + wK_p \text{Sin}3.4w] + j[w + 2.08(wK_p \text{Cos}3.4w - K_I \text{Sin } 3.4w)]}$$

$$\frac{\partial T(p,jw)}{\partial K_p} = \frac{2.08w}{D^2}[-13.2w^2 \text{Sin}3.4w - w\text{Cos}3.4w + jw(\text{Sin}3.4w - 13.2w\text{Cost}3.4w)]$$

Where $D = -13.2w^2 + 2.08[K_I \text{Cos } 3.4w + wK_p \text{Sin } 3.4w] + j[w + 2.08(wK_p \text{Cos } 3.4w - K_I \text{Sin } 3.4w)]$

$$\frac{\partial T(p,jw)}{\partial K_I} = \frac{2.08}{D^2}[-13.2\ w^2 \text{Cos}3.4w + w \text{ Sin } 3.4w + jw(\text{Cos } 3.4w + 13.2\ w \text{ Sin } 3.4w)]$$

On writing arithmetic expressions:

```
  D  = CMPLX(-13.2*w**2+ 2.08*(AKI*Cos(3.4*w)+w*AKP*SIN(3.4*w)),
             w+2.08*(w*AKP*COS(3.4*w )-AKI*SIN(3.4*w)))

 NA  = CMPLX(2.08*w*(-13.2*w**2*SIN(3.4*w)-w*COS(3.4*w)),
             2.08*w**2*(SIN(3.4*w)-13.2*w*COS*(3.4*w)))

 NB  = CMPLX(2.08*(-13.2*w**2*COS(3.4*w)+w*SIN(3.4*w)),
             2.08*w*COS(3.4xw)+13.2*w*SIN(3.4*w))).

DH1  = CMPLX(-w**2+8.009, 4.443*w)

DH2  = CMPLX(8.009*COS(3.4*w)+4.04265*w*SIN(3.4*w),
            4.04265*w*COS*(3.4*w)-8.009*SIN(3.4*w)))

H1   = DH 2/DH 1

DH3  = CMPLX(2.08*(AKI*COS(3.4*w)+w*AKP*SIN(3.4*w)),
            2.08*(w*AKP*COS*(3.4*w)-AKI*SIN(3.4*w)))
```

TO FIND CLOSED LOOP TRANSFER FUNCTIONS FOR THE SYSTEM

Sl. No.	Guess Values K_P	Guess Values K_I	Final Values K_P	Final Values K_I	w_0 to w_1	Error
A1	2.0	0.1	2.0004	0.1135	0 to 0.5	0.0002
A2	2.0	0.1	2.0512	0.0744	0 to 0.2	0.0084
A3	2.0	0.1	2.0046	0.1349	0 to 0.1	0.0009

Closed loop transfer functions will be

$$T_{A1}(s) = \frac{0.0185 + 0.2956s - 0.5385s^2 + 0.3152s^3}{0.0185 + 0.3744s + 0.6334s^2 + 2.1558s^3 + s^4}$$

In this example $e^{-3.4s}$ has been approximated as

$$e^{-3.4s} = \left[\frac{1 - 3.4s/2 + (3.4s)^2/12}{1 + 3.4s/2 + (3.4s)^2/12}\right]$$

$$e^{-3.4s} = \frac{1 - 1.7s + 0.9633s^2}{1 + 1.7s + 0.9633s^2}$$

$$T_{A2}(s) = \frac{0.0126 + 0.3148s - 0.5587s^2 + 0.3232s^3}{0.0126 + 0.3935s + 0.6131s^2 + 2.163s^3 + s^4}$$

$$T_{A3}(s) = \frac{0.0220 + 0.2903s - 0.5362s^2 + 0.1522s^3}{0.0220 + 0.3690s + 0.6356s^2 + 1.9928s^3 + s^4}$$

The model transfer functions can also be simplified as

$$M(s) = e^{-3.4s}\left[\frac{4.04265s + 8.009}{s^2 + 4.4431s + 8.009}\right]$$

Approximating $e^{-3.4s} = \dfrac{1 - 1.7s + 0.9633s^2}{1 + 1.7s + 0.9633s^2}$

$$\therefore M(s) = \frac{8.3141 - 9.9265s + 0.8745s^2 + 4.0425s^3}{8.3141 + 18.7463s + 16.8879s^2 + 6.2078s^3 + s^4}$$

With the help of all these closed loop transfer functions and the model transfer function, time and frequency responses have been determined.

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[illegible].3[illegible]	[illegible]+	- .[illegible]77[illegible] +	- .213[illegible]E+[illegible]	.2[illegible]3[illegible] +[illegible]	- .[illegible]72[illegible] + 3
[illegible].3[illegible]	[illegible]+	- .7[illegible]73[illegible] 5 +	- .[illegible]E+[illegible]	[illegible].2[illegible]77 +[illegible]	- .[illegible]1[illegible] + 3
[illegible].[illegible]	+	- .[illegible]2 7 + [illegible]	- .[illegible]E+[illegible]	[illegible].2[illegible]E+ 1	-[illegible].11[illegible]5135 +[illegible]3
[illegible].[illegible]	+	- .[illegible]3[illegible]2[illegible] + [illegible]	- .[illegible]77[illegible]E+[illegible]	.2[illegible]79[illegible]7[illegible] + 1	- .1[illegible]777[illegible] +[illegible]3

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	.?5	.+	- .? [illegible] +	- .1 [illegible] 3055 E+	0.229 [illegible] 235E+	- .1521353 +03
46	0.[illegible]	+	- .[illegible] 47[illegible] +	- .71 [illegible] 756+	.221[illegible] 476+ 1	- .1012926 +03
47	0.7	+	- .? 7[illegible] + 1	- .[illegible] 2661E+	0.2115[illegible] 35E+01	- .1[illegible] 914 +03
48	0.[illegible]	+	- .1[illegible] + 1	- .1447134[illegible] E+	0.2[illegible] 1[illegible] E+	- .1766[illegible] +03
49	0.[illegible]	+	- .1[illegible] + 1	.1[illegible] 556[illegible] E-1	0.1[illegible] 31[illegible] E+	.179[illegible] +03
5	0.1	+	.[illegible] 92[illegible] +	- .33[illegible] 7[illegible] E+	0.955[illegible] 15E+	- .2025[illegible] 357 +02
51	0.2	+	.[illegible] 234[illegible] +	- .71[illegible] 3793[illegible] E+	0.1[illegible] 2 [illegible] 962E+0	- .39[illegible] +02
52	0.3	+	.[illegible] 2 33 [illegible] +	- .1[illegible] 1271778E+01	0.15[illegible] 2[illegible] 773E+	- .[illegible] 29[illegible] 563 +02
53	.[illegible]	+	- .[illegible] 19[illegible] 2[illegible] +01	- .2 [illegible] 92[illegible] 9E+01	0.233[illegible] 5[illegible] E+01	- .11055154[illegible] +03
5	0.5	+	- .17757[illegible] + 1	.179[illegible] 475[illegible] E+	0.17[illegible] 0253[illegible] E+ 1	0.17[illegible] 25307 +03
55	0.6	+	- .74357[illegible] +	0.672[illegible] 933[illegible] E+	0.1[illegible] 2373[illegible] E+01	0.137[illegible] 65[illegible] +03
56	0.7	+	- .39[illegible] 73[illegible] +	0.5[illegible] 375[illegible] 37E+	0.653[illegible] E+	0.11[illegible] 7[illegible] 7[illegible] +03
57	0.8	+	- .[illegible] 125[illegible] 16[illegible] -01	0.[illegible] 7[illegible] 29[illegible] E+	0.4791552[illegible] E+00	0.1[illegible] 57[illegible] 2[illegible] +03
58	0.9	+	.1[illegible] 2[illegible] E-01	0.37[illegible] 2[illegible] 1E+	0.37[illegible] 9[illegible] E+00	0.07[illegible] 359 +02
59	0.1	+	.73[illegible] 7361[illegible] -01	0.3[illegible] 1[illegible] 12E+	0.3[illegible] E+0	0.764352[illegible] 3 +02
60	0.1[illegible]	+	.1[illegible] 217[illegible] +	0.2[illegible] 7[illegible] E+	0.2716[illegible] E+00	0.5[illegible] 324[illegible] 1 +02
61	0.12	+	.1[illegible] 9157[illegible] +	.2 235[illegible] E+	0.2[illegible] 7294E+00	0.5[illegible] 29926[illegible] +02
62	0.13	+	0.1[illegible] 193[illegible] +	0.10[illegible] 2[illegible] 79E+0	0.2[illegible] 711[illegible] E+0	0.[illegible] 917[illegible] 27 +02
63	0.1[illegible]	+	.[illegible] 22[illegible] +	.152[illegible] 397E+	0.1[illegible] 9453[illegible] E+0	0.[illegible] 1[illegible] 975 +02
6	0.15	+	.15[illegible] 5[illegible] +	0.1 [illegible] 22[illegible] 27[illegible] E+	0.1[illegible] 3752[illegible] E+00	0.[illegible] 51795[illegible] +02
65	0.16	+	.1[illegible] 5862[illegible] +	0.[illegible] 22[illegible] E-01	0.1723782[illegible] E+0	0.29122566 +02
66	0.17	+	.1[illegible] 7191[illegible] +0	0.[illegible] 91981[illegible] E-01	0.1[illegible] 27832[illegible] E+0	0.23592254 +02
67	0.1[illegible]	+	.[illegible] 5[illegible] 3[illegible] +	.4[illegible] 12[illegible] E-01	0.153[illegible] 257[illegible] E+0	0.1[illegible] 52[illegible] +02
68	0.1[illegible] 99[illegible]	+	.1[illegible] 192132[illegible] +	0.35[illegible] 2[illegible] E-01	0.1[illegible] 125[illegible] E+0	0.1307 [illegible] +02
69	0.1[illegible] 99[illegible]	+	.137[illegible] 72 [illegible] +	0.232[illegible] 2[illegible] E-01	0.139[illegible] 17[illegible] E+00	0.956[illegible] 2195 +01
70	0.2[illegible] 99[illegible]	+	.132[illegible] +	0.13[illegible] 57523E-01	0.133[illegible] 2655E+00	.5614[illegible] 36 +01
71	0.2199[illegible]	+	.12[illegible] 17[illegible] +	0.433[illegible] E-02	0.128 [illegible] E+0	0.15595511 +01
72	0.229[illegible]	+	.1231[illegible] 3 9 +	- .317[illegible] 79[illegible] E-02	0.123[illegible] 5[illegible] E+0	- .1[illegible] 7[illegible] 31[illegible] +01
73	0.239[illegible]	+	.1[illegible] 33[illegible] +	- .9534[illegible] 5[illegible] E-02	0.11[illegible] 7275[illegible] E+0	- .[illegible] +01
74	0.249[illegible]	+	.1135[illegible] +	- .152 [illegible] 523E-01	0.11[illegible] 2072E+00	- .7[illegible] 2[illegible] 79[illegible] +01
75	0.259[illegible]	+	.1 [illegible] +	- .1[illegible] E-01	0.11[illegible] 7025[illegible] E+0	- .1[illegible] 395[illegible] +02
76	0.269[illegible]	+	.1 [illegible] 32[illegible] +	- .2[illegible] 12[illegible] E-01	0.1 7[illegible] 2[illegible] 67E+	- .13 [illegible] 158 +02
77	0.279[illegible]	+	.1[illegible] 1583[illegible] +	- .2700936 [illegible] E-01	0.1[illegible] 3[illegible] 1[illegible] E+0	- .15[illegible] 31[illegible] +02
78	0.28[illegible]	+	0.[illegible] E-01	- .3[illegible] 715[illegible] 25E-01	0.1[illegible] 71E+0	- .177[illegible] 11 7 +02
79	0.299[illegible]	+	.9[illegible] 3 [illegible] E-01	- .333[illegible] 71E-01	0.97879 55E-01	- .199[illegible] 321 +02
80	0.3 [illegible] 99[illegible]	+	.[illegible] 3[illegible] E-01	- .3555[illegible] 3[illegible] E-01	0.951[illegible] 37E-01	- .21[illegible] 718 +02
81	0.3199[illegible]	+	.[illegible] E-01	- .37[illegible] 5[illegible] E-01	0.9[illegible] 527[illegible] E-01	- .23[illegible] 1 7[illegible] +02
82	0.3299[illegible]	+	.511[illegible] E-01	- .39[illegible] 72 [illegible] E-01	0.9 [illegible] E-01	- .257[illegible] +02
83	0.3399[illegible]	+	.77[illegible] E-01	- .[illegible] 33[illegible] E-01	0.877[illegible] 7[illegible] E-01	- .27[illegible] +02
8	0.3 99[illegible]	+	.7[illegible] 73[illegible] E-01	- .[illegible] 157[illegible] E-01	0.[illegible] 3[illegible] E-01	- .[illegible] 773 +02
85	0.3599[illegible]	+	.717[illegible] E-01	- .[illegible] 25[illegible] E-01	0.[illegible] E-01	- .3 [illegible] 7[illegible] +02
86	0.36[illegible]	+	.[illegible] E-01	- .33[illegible] 9 [illegible] E-01	.[illegible] 31[illegible] E-01	- .3213[illegible] +02
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

88	0.38[illegible] +	.[illegible]27[illegible] - [illegible]	- .[illegible]32E-01	[illegible].775771[illegible] -01	- .[illegible] +02
89	0.39[illegible] +	.[illegible]2[illegible] -01	- .[illegible]335[illegible]-01	0.75932[illegible]47[illegible] -01	- .3[illegible]1 +02
90	[illegible] +	.5[illegible]7[illegible] -01	- .[illegible]5127[illegible]27[illegible]-01	0.7[illegible]2[illegible]33[illegible] -01	- .37[illegible]211[illegible] +02
91	[illegible] +	.5[illegible]7[illegible]5[illegible]7 -01	- .[illegible]5332[illegible]5[illegible]-01	[illegible].72[illegible] -01	- .[illegible] +02
92	[illegible].42[illegible] +	.517 7[illegible] -01	- .[illegible]5238E-01	[illegible].71[illegible]972[illegible]-01	- .[illegible]4725313 +02
93	[illegible].43[illegible] +	.[illegible]27[illegible] -01	- .[illegible]552[illegible] 338E-01	0.[illegible]9[illegible]59[illegible] -01	- .[illegible]5238 +02
94	[illegible].44[illegible] +	.3[illegible] -01	- .[illegible]5[illegible]+91[illegible]-01	0.6[illegible]2[illegible]7[illegible]33[illegible]-01	- .[illegible]1[illegible]5[illegible]2 +02
95	[illegible].46 +	.[illegible]5[illegible] -01	- .[illegible]17[illegible]-01	[illegible].6[illegible]922[illegible]-01	- .[illegible]2[illegible]3[illegible]2 +02
96	[illegible].47 +	.[illegible]73[illegible]528 -01	- .[illegible]53[illegible]3[illegible]-01	0.[illegible]5[illegible]3[illegible]-01	- .[illegible]37[illegible]2[illegible]3 +02
97	[illegible].48 +	.57[illegible]5 -01	- .[illegible]5[illegible]-01	[illegible].6[illegible]3257[illegible]18E-01	- .[illegible]147[illegible] +02
98	[illegible].49[illegible] +	.[illegible]+[illegible]38[illegible]7 -01	- .[illegible]-01	[illegible].631[illegible]3[illegible]-01	- .[illegible]5[illegible]7522 +02
99	[illegible].1[illegible] + 1	.73[illegible]73[illegible]2 -01	.3[illegible]5[illegible]2[illegible]+ [illegible]	0.31[illegible]9[illegible]+[illegible]	[illegible].76[illegible]352[illegible]3 +02
100	[illegible].2[illegible] + 1	.137[illegible]7[illegible]9 +	.[illegible]2[illegible]3[illegible]-01	[illegible].139[illegible]17[illegible]+[illegible]	[illegible].95[illegible]21[illegible]3 +01
101	0.3[illegible] + 1	.99[illegible]3[illegible] -01	- .[illegible]3[illegible]175[illegible]-01	[illegible].57[illegible]79[illegible]53[illegible]-01	- .[illegible]9[illegible]32[illegible] +02
102	0.4[illegible] + 1	[illegible].[illegible]12[illegible]23[illegible] -01	- .[illegible]57[illegible]-01	0.75932[illegible]77[illegible]-01	- .[illegible]14 +02
103	0.5 + 1	.[illegible]259[illegible]7 -01	- .[illegible]7[illegible]356[illegible]-01	0.[illegible]9[illegible]7[illegible]2[illegible]-01	- .[illegible]3[illegible]9 +02
104	[illegible].6 + 1	.[illegible]111[illegible]573[illegible] -01	- .[illegible]5[illegible]-01	0.52259[illegible]32[illegible]-01	- .53[illegible]5[illegible]1 +02
105	[illegible].7[illegible] + 1	.235[illegible] -01	- .3[illegible]5[illegible]17[illegible]-01	0.45118[illegible]39[illegible]-01	- .53537[illegible]2 +02
106	0.8[illegible] + 1	.[illegible]639[illegible]3[illegible] -01	- .35[illegible]-01	0.3[illegible]21[illegible]9[illegible]-01	- .[illegible]2[illegible]2333 +02
107	0.9[illegible] + 1	.[illegible]173[illegible]2 -01	- .3[illegible]7[illegible]-01	0.35[illegible]7[illegible]1E-01	- .[illegible]5[illegible]1[illegible] +02
108	0.1[illegible] + 2	.1[illegible]97[illegible]2 -01	- .295[illegible]-01	0.31[illegible]7[illegible]28E-01	- .67[illegible]393[illegible]2 +02
109	0.11[illegible] + 2	.1[illegible]3[illegible]1[illegible] -01	- .2731[illegible]-01	[illegible].29[illegible]7[illegible]-01	- .[illegible]327[illegible]9 +02
110	0.12[illegible] + 2	.8477[illegible]9 -02	- .25[illegible]3[illegible]-01	[illegible].2[illegible]713[illegible]3[illegible]-01	- .71[illegible] +02
111	0.13 + 2	.725[illegible]22 -02	- .[illegible]25[illegible]-01	0.24[illegible]69E-01	- .72[illegible]17 +02
112	[illegible].1[illegible] + 2	.[illegible]277[illegible] -02	- .[illegible]-01	0.229[illegible]395[illegible]-01	- .74[illegible]2[illegible]19 +02
113	[illegible].15 + 2	.5[illegible]3[illegible]7[illegible] -02	- .2[illegible]7[illegible]7[illegible]-01	[illegible].2[illegible]33112[illegible]-01	- .7517[illegible]3 +02
114	[illegible].16 + 2	.[illegible]3[illegible] -02	- .[illegible]5[illegible]7[illegible]-01	[illegible].2[illegible]1[illegible]2[illegible]-01	- .7[illegible]97[illegible]2 +02
115	0.17[illegible] + 2	.[illegible]7[illegible]5 -02	- .[illegible]3E-01	[illegible].1[illegible]3[illegible]5[illegible]-01	- .7[illegible]1[illegible] +02
116	0.18 + 2	.[illegible]3[illegible]71 -02	- .17[illegible]7[illegible]-01	[illegible].176[illegible]-01	- .77[illegible]3[illegible] +02
117	[illegible].19 + 2	.3[illegible]425[illegible] -02	- .1[illegible]15[illegible]-01	0.1[illegible]29[illegible]-01	- .7[illegible]2[illegible]75[illegible] +02
118	0.2[illegible] + 2	.31[illegible]5[illegible] -02	- .1[illegible]3[illegible]29[illegible]-01	[illegible].1[illegible]1117[illegible]-01	- .7[illegible]5 +02
119	0.21[illegible] + 2	.2[illegible]172[illegible] -02	- .15[illegible]6[illegible]-01	0.153[illegible]7[illegible]9[illegible]-01	- .7[illegible]57[illegible] +02
120	0.22[illegible] + 2	.2575[illegible] -02	- .1[illegible]2[illegible]94[illegible]-01	0.1[illegible]65[illegible]5[illegible]9[illegible]-01	- .79[illegible]7[illegible] +02
121	[illegible].23[illegible] + 2	.23[illegible]3[illegible] -02	- .13[illegible]15[illegible]-01	0.1[illegible]2[illegible]7[illegible]-01	- .[illegible]5 +02
122	0.2[illegible] + 2	.2[illegible]7[illegible] -02	- .1[illegible]27[illegible]1[illegible]-01	0.1[illegible]3[illegible]5[illegible]-01	- .[illegible]71[illegible]71 +02
123	[illegible].25 + 2	.1[illegible]5 -02	- .[illegible]7[illegible]7[illegible]97[illegible]-01	0.129 32[illegible]-01	- .[illegible]1 8[illegible] +02
124	0.26 + 2	.[illegible]75 -02	- .1[illegible]27[illegible]23[illegible]-01	0.12[illegible]71[illegible]-01	- .[illegible]1[illegible]31[illegible] +02
125	[illegible].27 + 2	.[illegible]71[illegible] -02	- .1[illegible]26[illegible]-01	[illegible].1[illegible]5[illegible]7[illegible]-01	- .[illegible]771 +02
126	0.28 + 2	.1[illegible]5[illegible] -02	- .[illegible]223[illegible]-01	[illegible].11525[illegible]-01	- .[illegible]2[illegible]1 +02
127	[illegible].29 + 2	.[illegible]7[illegible]7 -02	- .[illegible]29[illegible]1[illegible]-01	0.1[illegible]12[illegible]17[illegible]-01	- .[illegible]2[illegible]1[illegible] +02
128	[illegible].3 + 2	.[illegible]7[illegible]75 -02	- .1[illegible]-01	[illegible].1 75[illegible]957[illegible]-01	- .[illegible]257[illegible] +02
129	[illegible].31[illegible] + 2	.[illegible] -02	- .1 3[illegible]3[illegible]-01	[illegible].1[illegible]1277[illegible]-01	- .[illegible] +02
130	[illegible].32[illegible] + 2	.[illegible] -02	- .1[illegible]372[illegible]-01	[illegible].1[illegible]-01	- .[illegible]3 3[illegible]3 +02
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] +02

[illegible]	.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] + 2
[illegible]	.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] + 2
[illegible]	.36	+	[illegible]	[illegible]	[illegible]	[illegible] + 2
[illegible]	.37	+	[illegible]	[illegible]	[illegible]	[illegible] +2
36	.38	+	[illegible] − 3	[illegible] − 2	[illegible]	[illegible] + 2
37	.39	+	[illegible] − 3	[illegible] − 2	[illegible]	[illegible] +2
38	[illegible]	[illegible]	[illegible] − 3	[illegible] − 2	[illegible]	[illegible] +2
39	[illegible]	+	.746209[illegible] − 3	−.71[illegible]8519[illegible] − 2	0.7077[illegible] − 2	−[illegible] +2
40	0.42	+	.74127[illegible] − 3	.7057[illegible]237E−2	[illegible] − 02	−[illegible] + 2
41	0.43	+	[illegible] − 3	−.7[illegible] − 2	0.731[illegible] − 2	−[illegible]319 +2
42	0.44	+	[illegible] − 3	−.731[illegible] − 2	[illegible] − 02	−[illegible] +2
43	0.45	+	[illegible]1974274 − 3	−.71[illegible] − 2	0.7177[illegible]27E−02	−[illegible] +2
44	0.46	+	[illegible]19293 − 3	−[illegible] − 2	[illegible] − 02	−[illegible]515[illegible] +2
45	0.47	+	[illegible] − 3	−[illegible] − 2	[illegible] − 2	−[illegible] +2
46	0.48	+	[illegible] − 3	−[illegible] − 02	[illegible] − 02	−[illegible] +2
47	0.49	+	.5229[illegible] − 3	−.0571639[illegible] − 2	[illegible] − 02	−[illegible] +2
148	0.1	+	[illegible] − 1	−.295[illegible] − 1	0.31[illegible] − 01	−[illegible] + 2
149	0.20	+	[illegible] − 2	−.15[illegible] − 1	0.1011173[illegible]E−01	−[illegible] +2
150	0.3	+	.135[illegible]7975[illegible] − 2	−.1[illegible] − 1	0.1[illegible] − 01	−[illegible]2572[illegible] +2
151	0.4	+	.7839778[illegible] − 3	−.8[illegible]771[illegible] − 2	0.[illegible]7392[illegible] − 02	−[illegible]27[illegible]3 +2
152	0.5	+	.5[illegible]2237[illegible] − 3	−[illegible]336[illegible] − 2	[illegible] − 02	−[illegible] +2
153	0.6	+	[illegible] − 3	−.5373[illegible] − 2	0.[illegible] − 02	−[illegible] +2
154	0.7	+	[illegible] − 3	−[illegible] − 2	[illegible]738E−02	−[illegible] +2
155	0.8	+	[illegible] − 3	−[illegible] − 2	[illegible]3918E−02	−[illegible]7213116 +2
156	0.9	+	.15519819[illegible] − 3	−.358722[illegible] − 2	0.3[illegible]7672E−02	−[illegible]22722 +2
157	0.1	+ 3	.12572336[illegible] − 3	−.322[illegible] − 2	0.323[illegible] − 02	−.0777[illegible] +2
158	0.11	+	[illegible] − 3	−.29[illegible] − 2	0.2937[illegible]91E−02	−[illegible] +2
159	0.12	+ 3	.973195230 − 4	−.269[illegible] − 2	0.26[illegible]76E−02	−[illegible]141967 +2
160	0.13	+ 3	.7[illegible] − 4	−[illegible]027[illegible] − 2	0.2[illegible] − 02	−[illegible]3 +2
161	0.14	+ 3	.6415[illegible]205[illegible] − 4	−.23[illegible]7537[illegible] − 2	0.23[illegible]293E−02	−[illegible]74[illegible]3 +2
162	0.15	+ 3	.5569[illegible]581[illegible] − 4	−.2153[illegible] − 2	0.215[illegible]12E−02	−[illegible]513573 +2
163	0.16	+ 3	.491237338 − 4	−.2[illegible] − 02	0.2[illegible] − 02	−[illegible]72 +2
164	0.17	+ 3	.43515293[illegible] − 4	−.19[illegible]599[illegible] − 02	0.19[illegible]971[illegible] − 02	−[illegible]2 +2
165	0.18	+ 3	.388151998 − 4	−.1795[illegible]691E−02	0.179[illegible]7F−02	−[illegible]013[illegible] +2
166	0.19	+ 3	.3[illegible]373913 − 4	−.17[illegible]639[illegible] − 02	0.170[illegible]55[illegible] − 02	−[illegible] +2
167	.2	+ 3	.31[illegible]115 − 4	−.1515[illegible] − 02	0.1615951[illegible]E−02	−[illegible]17[illegible] +2
168	0.21	+ 3	.2[illegible]513 7 − 4	−.1535[illegible]33E−2	0.153[illegible]55E−02	−[illegible]2[illegible]1 +2
169	0.22	+ 3	[illegible] − 4	−.1[illegible]2458 − 2	0.1[illegible]638E−02	−[illegible]3 +2
170	0.23	+	.2377[illegible] − 4	−.1[illegible]2E−2	0.1[illegible]538E−02	−[illegible] +2
171	0.24	+ 3	[illegible] − 4	−.13[illegible] − 2	0.13[illegible] − 02	−[illegible]7[illegible] +2
172	0.25	+ 3	.2[illegible]251 3[illegible] − 4	−.12[illegible]261[illegible] − 2	0.12[illegible]77[illegible] − 02	−[illegible] +2
173	0.26	+	.1[illegible]5[illegible]37 − 4	−.1[illegible]29155[illegible] − 2	0.12[illegible]479E−02	−[illegible] + 2
174	0.27	+	.7[illegible] − 4	−.11[illegible] − 2	0.1[illegible]7[illegible]172[illegible] − 2	−[illegible] + 2
175	0.28	+ 3	[illegible] − 4	−.1[illegible]15[illegible] − 2	0.11[illegible] − 2	−[illegible] + 2

176	0.29	+0	[illegible]	-.[illegible]E-02	.1[illegible]E-02	-.[illegible]31[illegible] +2
177	0.3	+0	.[illegible]7 375[illegible]	-.1 772[illegible]E-2	0.1 77315[illegible]E-02	-.[illegible]2[illegible]7[illegible] +2
178	0.31	+0	.[illegible]7[illegible]5	-.1[illegible]E-02	0.1[illegible]7[illegible]E-02	-.[illegible]7[illegible]3 +02
179	0.32	+0	.[illegible]	-.1[illegible]9913[illegible] 2	.1[illegible]E-02	-.[illegible] +02
180	0.33	+0	.[illegible]415[illegible]	-.0793149[illegible]E-03	0.979[illegible]E-03	-.[illegible]32[illegible] +2
181	0.34	+0	.[illegible]	-.95[illegible]51[illegible]E-03	0.95[illegible]7[illegible]31E-03	-.[illegible]3[illegible]227 +2
182	0.35	+0	.1[illegible]672[illegible]	-.92336235[illegible]E-03	0.923[illegible]E-03	-.[illegible]5 +02
183	0.36	+0	.[illegible]7 [illegible]77[illegible]E-5	-.[illegible]771657[illegible]E-03	0.[illegible]77[illegible]E-03	-.[illegible] +02
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185	0.38	+0	0.971[illegible]1359[illegible]E-5	-.[illegible]5[illegible]7[illegible]E-03	0.[illegible]192[illegible]E-03	-.[illegible]132[illegible] +2
186	0.39	+0	.82[illegible]92[illegible]15[illegible]E-5	-.[illegible]7[illegible]E-03	0.[illegible]267113[illegible]E-03	-.[illegible]2[illegible]3[illegible]4 +02
187	0.4	+0	.7[illegible]21[illegible]E-5	-.[illegible]7955[illegible]E-03	0.[illegible]79[illegible]E-03	-.[illegible]25[illegible] +02
188	0.41	+0	.7[illegible]21[illegible]73[illegible]E-5	-.7[illegible]825[illegible]E-03	0.76[illegible]7[illegible]E-03	-.[illegible]5[illegible]3 +02
189	0.42	+0	.71[illegible]51[illegible]E-5	-.7[illegible]E-03	0.7[illegible]5[illegible]5[illegible]E-03	-.[illegible]1 +2
190	0.43	+0	.[illegible]23352[illegible]E-5	-.7515[illegible]E-03	0.751[illegible]23[illegible]E-03	-.[illegible]9[illegible]7 +02
191	0.44	+0	.[illegible]596[illegible]E-5	-.7[illegible]1[illegible]E-03	0.73[illegible]E-03	-.[illegible]93273 +02
192	0.45	+0	0.62111337[illegible]E-5	-.713191[illegible]E-03	0.7162179[illegible]E-03	-.[illegible]95[illegible]3[illegible] +02
193	0.46	+0	.59[illegible]251[illegible]E-5	-.7 257[illegible]E-03	0.7[illegible]2[illegible]69E-03	-.[illegible]95133[illegible] +02
194	0.47	+0	0.55[illegible]37[illegible]37[illegible]E-05	-.[illegible]7[illegible]3[illegible]27[illegible]E-03	0.[illegible]735[illegible]E-03	-.[illegible]952[illegible]19[illegible] +02
195	0.48	+0	0.5[illegible]59[illegible]1[illegible]31[illegible]E-5	-.[illegible]73[illegible]7[illegible]E-03	0.[illegible]7332[illegible]E-03	-.[illegible]365[illegible]2 +02
196	0.49	+0	0.52[illegible]3[illegible]749[illegible]E-05	-.[illegible]59[illegible]773[illegible]E-03	0.[illegible]59[illegible]E-03	-.[illegible]95[illegible]3 +02
197	0.1	+0	0.1257[illegible]233[illegible]E-3	-.3229[illegible]E-02	0.3231[illegible]E-02	-.[illegible]777[illegible] +02
198	0.2	+0	0.31[illegible]1115[illegible]	-.1[illegible]15[illegible]5[illegible]E-02	0.1[illegible]595132E-02	-.[illegible]85175 +02
199	0.3	+0	0.1397[illegible]675[illegible]	-.1[illegible]772[illegible]E-02	0.1[illegible]773139[illegible]E-02	-.[illegible]39[illegible]5[illegible]7[illegible]7 +02
200	0.4	+0	.7[illegible]E-05	-.[illegible]7955[illegible]E-03	0.[illegible]799389[illegible]E-03	-.[illegible]59[illegible]259[illegible] +02
201	0.5	+0	0.5[illegible]31 3[illegible]7[illegible]E-5	-.[illegible]63773[illegible]E-03	0.[illegible]39[illegible]7[illegible]E-03	-.[illegible]9554[illegible]3 +02
202	0.6	+0	0.3[illegible]37935[illegible]E-5	-.53[illegible]535[illegible]E-03	0.53[illegible]E-03	-.[illegible]39[illegible]2[illegible]7 +02
203	0.7	+0	0.25[illegible]7[illegible]E-05	-.[illegible]517[illegible]E-03	0.461713[illegible]E-03	-.[illegible]1497 +02
204	0.8	+0	.19[illegible]527[illegible]3[illegible]E-5	-.[illegible]399[illegible]E-03	0.[illegible]399923[illegible]E-03	-.[illegible]721313 +02
205	0.9	+0	0.15[illegible]2[illegible]5[illegible]E-5	-.3591[illegible]72[illegible]E-03	0.3591[illegible]5[illegible]E-03	-.[illegible]975[illegible]2[illegible]2 +02
206	0.1	+0	0.125777[illegible]E-5	-.3231971[illegible]E-03	0.3231995[illegible]E-03	-.[illegible]777[illegible] +02
207	0.11	+0	0.1[illegible]394852[illegible]E-5	-.293[illegible]16[illegible]E-03	0.293[illegible]178[illegible]E-03	-.[illegible]797329 +02

DER OF N M ATOR POLYNOMIAL IS =, 3

DER OF DENO I ATOR POLYNOMIAL IS =, 4

NIMUM VALU OF FREQUENCY IS = .E-01

XIMUM VALU OF FREQUENCY IS = .1 E+04

E NUMERATOR COEFFICIENTS ARE

.83141000E+01 -0.39265000E+01 .8745 E+00 0.4 42 E+ 1

E DENOMINATOR COEFFICIENTS ARE

.83141000E+01 0.1874630 E+02 .168879 E+02 0.62 78 E+01 0.1

S.[illegible]	FREQ[illegible]CY	REAL MAG I[illegible]	I[illegible] GI[illegible]	[illegible]	[illegible]
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35	[illegible].35[illegible]1E+[illegible]	[illegible].3[illegible]52834[illegible]E+	- .[illegible]51769[illegible]E+0	[illegible].1[illegible]116[illegible]6[illegible]E+[illegible]1	-[illegible].69121211E+[illegible]2
36	0.36[illegible]1E+[illegible]	[illegible].3[illegible]81[illegible]E+	-[illegible].95759[illegible]8[illegible]E+[illegible]	[illegible].1[illegible]122616E+[illegible]1	-[illegible].7108377[illegible]E+[illegible]2
37	[illegible].37[illegible]2E+[illegible]	[illegible].2[illegible]5[illegible] 6[illegible]E+	-[illegible].9[illegible]3[illegible]31[illegible]E+[illegible]	[illegible].1[illegible]129354[illegible]E+ 1	- .73[illegible]23[illegible]E+[illegible]2
38	[illegible].38[illegible]2E+[illegible]	[illegible].2[illegible]3 49[illegible]E+	- .[illegible]79[illegible]81[illegible]E+[illegible]	[illegible].1 13[illegible]257[illegible]E+[illegible]1	- .75[illegible]241[illegible]E+ 2
39	[illegible].39[illegible]2E+[illegible]	[illegible].[illegible]26[illegible]826[illegible]E+	-[illegible].[illegible]E+[illegible]	[illegible].1[illegible]1[illegible]3325[illegible]E+[illegible]1	- .7[illegible]95[illegible]E+ 2
4[illegible]	[illegible].4[illegible]2E+[illegible]	.1[illegible]52[illegible]755[illegible]E+	- .[illegible]7E+[illegible]	[illegible].1[illegible]15 55[illegible]E+ 1	- .7[illegible]911127[illegible]E+ 2
41	[illegible].41[illegible]2E+[illegible]	.[illegible]2[illegible]3[illegible]E+	-[illegible].1[illegible]29[illegible]1 E+01	[illegible].1[illegible]1579[illegible]E+ 1	- .[illegible]271[illegible]E+ 2
42	[illegible].42[illegible]2E+[illegible]	.1[illegible]72[illegible]E+[illegible]	- .1[illegible]5527E+[illegible]1	[illegible].1[illegible]1[illegible]55[illegible]1[illegible]E+[illegible]1	-[illegible].[illegible]2[illegible]3[illegible]E+ 2

44	0.44[illegible]E+[illegible]	0.587[illegible]23[illegible]E-[illegible]	-0.1[illegible]16[illegible]11[illegible]E+[illegible]	0.1[illegible]E+[illegible]	-0.[illegible]E+[illegible]2
45	0.451[illegible]E+[illegible]	.243826[illegible]E-[illegible]	-0.1[illegible]16618[illegible]E+[illegible]	.1[illegible]E+[illegible]	-0.[illegible]E+[illegible]2
46	0.46[illegible]E+[illegible]	-0.9969957[illegible]E-[illegible]2	-0.1[illegible]1967[illegible]E+01	0.1[illegible]197275E+[illegible]	-0.[illegible]50132[illegible]E+[illegible]2
47	0.47[illegible]E+[illegible]	-0.[illegible]33138[illegible]E-[illegible]1	-0.1[illegible]1959[illegible]E+01	0.1[illegible]2[illegible]5[illegible]1E+[illegible]1	-0.92[illegible]E+[illegible]2
48	0.48[illegible]E+[illegible]	-0.786[illegible]1751[illegible]E-1	-0.1[illegible]18375[illegible]E+01	0.1[illegible]214[illegible]77E+01	-0.[illegible]1352[illegible]E+[illegible]2
49	0.49[illegible]E+[illegible]	-0.112758[illegible]1E+	-0.1[illegible]160323E+01	0.112227[illegible]E+[illegible]1	-0.96332735E+[illegible]2
50	0.10[illegible]E+[illegible]	0.942[illegible]121[illegible]E+[illegible]	-.33844816E+0[illegible]	0.1[illegible]9[illegible]E+01	-0.19762[illegible]E+[illegible]2
51	0.2[illegible]E+[illegible]	0.77[illegible]215[illegible]E+[illegible]	-.6389[illegible]22E+0[illegible]	0.10[illegible]3[illegible]E+[illegible]1	-0.39532752E+[illegible]2
52	0.30[illegible]E+0[illegible]	0.5[illegible]51[illegible]1[illegible]12E+[illegible]	-0.867[illegible]7137E+0[illegible]	0.10[illegible]57556E+[illegible]1	-0.59282[illegible]33E+[illegible]2
53	0.40[illegible]E+0[illegible]	0.1[illegible]522761[illegible]E+[illegible]	-.9961[illegible]447E+0[illegible]	0.1015[illegible]55[illegible]E+[illegible]1	-0.7891[illegible]1[illegible]E+[illegible]2
54	0.5000[illegible]E+0[illegible]	-0.1[illegible]67[illegible]82[illegible]E+[illegible]	-0.1[illegible]125665E+01	0.10231[illegible]59E+01	-0.96247[illegible]24E+[illegible]2
55	0.600[illegible]0E+0[illegible]	-0.4[illegible]989[illegible]38[illegible]E+[illegible]	-.91957439E+0[illegible]	0.10326732E+01	-0.117[illegible]E+03
56	0.7000[illegible]0E+0[illegible]	-0.7395217[illegible]E+[illegible]	-0.735[illegible]9732E+0[illegible]	0.1[illegible]43423[illegible]E+01	-0.135133[illegible]E+03
57	0.80[illegible]0E+0[illegible]	-0.93372534[illegible]E+[illegible]	-0.49142827E+0[illegible]	0.1[illegible]551515E+[illegible]1	-0.15224[illegible]1[illegible]E+03
58	0.900[illegible]1E+0[illegible]	-0.1[illegible]452198E+[illegible]1	-0.21738[illegible]19E+0[illegible]	0.10675854E+01	-0.1[illegible]9751[illegible]2E+03
59	0.10[illegible]0E+01	-0.1[illegible]788527E+[illegible]1	0.58333[illegible]7[illegible]E-01	0.10842856E+01	0.17[illegible]9[illegible]51[illegible]E+[illegible]3
60	0.110[illegible]0E+01	-0.1[illegible]468514E+[illegible]1	0.31553241E+00	0.1[illegible]9337[illegible]2E+01	0.1632[illegible]E+03
61	0.120[illegible]0E+01	-0.96[illegible]23325[illegible]E+[illegible]	0.5[illegible]193853E+0[illegible]	0.11[illegible]69368E+01	0.15[illegible]66229E+03
62	0.130[illegible]0E+01	-0.84563959E+[illegible]	0.73174752E+0[illegible]	0.11182847E+01	0.13912981E+03
63	0.140[illegible]0E+01	-0.70372282E+[illegible]	0.8[illegible]366512E+0[illegible]	0.11296[illegible]15E+01	0.12853275E+03
64	0.150[illegible]0E+01	-0.5[illegible]66554[illegible]E+	.99915445E+0[illegible]	0.11398826E+01	0.11[illegible]7721[illegible]E+03
65	0.1600[illegible]0E+01	-0.38825393E+[illegible]	0.1[illegible]811563E+01	0.11487559E+01	0.1097537[illegible]E+03
66	0.170[illegible]0E+01	-.22635[illegible]16E+0[illegible]	0.11332686E+01	0.1156[illegible]456E+01	0.1[illegible]1392[illegible]2E+03
67	0.180[illegible]0E+01	-0.732[illegible]848E-[illegible]1	.11592692E+01	0.1161578[illegible]E+01	0.93613118E+02
68	0.18999999E+01	0.7[illegible]15413[illegible]E-[illegible]1	.1162864[illegible]E+01	0.11652259E+[illegible]1	0.863513[illegible]4E+02
69	0.19999999E+01	0.2[illegible]161[illegible]E+[illegible]	.11475627E+01	0.116691[illegible]1E+01	0.79552062E+02
70	0.2[illegible]999999E+01	0.3377[illegible]8[illegible]2E+[illegible]	.11166257E+01	0.1166599[illegible]E+[illegible]1	0.73169[illegible]12E+02
71	0.21999999E+01	0.[illegible]518[illegible]2[illegible]E+[illegible]	0.1[illegible]73[illegible]41[illegible]E+[illegible]1	0.116[illegible]3[illegible]8[illegible]E+[illegible]1	0.67163[illegible]43E+02
72	0.22999999E+01	0.55352[illegible]E+[illegible]	0.1[illegible]1951[illegible]2E+01	0.116[illegible]921E+[illegible]1	0.615[illegible]11[illegible]2E+02
73	0.23999999E+01	0.64274[illegible]51E+[illegible]	0.9594872[illegible]E+[illegible]	0.115[illegible]421E+[illegible]	0.56155[illegible]2E+02
74	0.24999999E+01	0.7198[illegible]716E+[illegible]	0.892[illegible]9376E+[illegible]	0.114627[illegible]2E+01	0.511[illegible]E+02
75	0.25999999E+01	0.7852422[illegible]E+[illegible]	0.8222116[illegible]E+0[illegible]	0.1136942[illegible]E+01	0.4631751[illegible]E+02
76	0.26999999E+01	0.8397231[illegible]E+[illegible]	0.75[illegible]446[illegible]E+[illegible]	0.112[illegible]1[illegible]5E+[illegible]1	0.41765[illegible]9[illegible]E+02
77	0.27999999E+01	0.86[illegible]4159[illegible]E+[illegible]	0.6781[illegible]5[illegible]E+0[illegible]	0.1114[illegible]E+[illegible]1	0.37[illegible]91[illegible]3[illegible]E+02
78	0.28999999E+01	0.91[illegible]58[illegible]9[illegible]E+[illegible]	0.6[illegible]642911E+0[illegible]	0.1[illegible]2[illegible]E+01	0.3341[illegible]319[illegible]E+02
79	0.29999999E+01	0.9[illegible]560946[illegible]E+[illegible]	0.53618653E+0[illegible]	.1[illegible]7[illegible]72E+[illegible]1	0.29552[illegible]3[illegible]E+02
80	0.30999999E+01	0.96[illegible]769[illegible]E+[illegible]	0.46[illegible]976[illegible]E+0[illegible]	0.1[illegible]72332[illegible]E+[illegible]1	0.25882257E+02
81	0.31999999E+01	0.977234[illegible]2E+	0.4[illegible]27[illegible]2[illegible]3E+[illegible]	0.1[illegible]5[illegible]562[illegible]E+01	0.223957[illegible]7[illegible]E+02
82	0.32999999E+01	0.9838[illegible]857E+	0.3[illegible]365[illegible]7E+0[illegible]	0.1[illegible]411[illegible]75[illegible]E+[illegible]1	.19[illegible]23[illegible]7[illegible]E+[illegible]2
83	0.33999999E+01	.9855[illegible]3[illegible]7[illegible]E+	0.2813317[illegible]E+[illegible]	0.1[illegible]2[illegible]11[illegible]E+[illegible]1	0.15931[illegible]E+[illegible]2
84	0.34999999E+01	.9826[illegible]2[illegible]7[illegible]E+	0.2257[illegible]18[illegible]E+[illegible]	0.1[illegible]8[illegible]021[illegible]E+[illegible]1	.129[illegible]E+[illegible]2
85	0.35999999E+01	0.9756[illegible]2[illegible]E+	0.1735[illegible]27E+[illegible]	.991[illegible]35[illegible]E+	.10[illegible]E+[illegible]2
86	0.369[illegible]E+[illegible]1	.96725877[illegible]E+	.125[illegible]E+	0.9755[illegible]797E+	.73[illegible]E+[illegible]1
87	[illegible]	[illegible]E+	.[illegible]E+[illegible]	0.95[illegible]E+	[illegible]E+[illegible]

88	0.38999998E+01	0.96167249E+	.37942317E-01	0.94223475E+	.231 98E+01
89	0.39999996E+01	0.92589865E+	- .66994494E-03	.92589865E+	-0.42661230E-01
90	0.40999996E+01	0.9 0631E+	- .36330206E-01	0.90702256E+	- .72 51 E+01
91	0.41999998E+01	0.8911 E+	-0.69110917E-01	0.89323522E+	- . 6345 2E+01
92	0.42999998E+01	0.87256192E+	-0.99137145E-01	0.87616 76E+	- .00 351 E+01
93	0.43999998E+01	0.85345323E+	- .12672042E+00	0.8626 96 E+	-0.64 3554E+01
94	0.44999998E+01	0.83 2237E+	-0.15189455E+00	0.84774128E+	-0.10321763E+02
95	0.46 E+01	0.81442725E+	-0.17466911E+00	0.83296927E+00	-0.12111323E+02
96	0.470 0E+01	0.79 6 E+	- .19560279E+00	0.81850327E+	-0.13334510E+02
97	0.480 E+01	.77527950E+	- .214847 2E+00	0.80346943E+	- .15 7 7 E+02
98	0.490 E+01	0.75586572E+	-0.23214539E+	0.79071137E+	- .17 73 08E+02
99	0.100 0E+01	-0.19784527E+01	0.58333476E-01	0.1 0 4265E+01	0.17 9 510E+03
100	0.200 0E+01	0.21161 8 E+	.11475027E+01	0.11669170E+01	0.79552 50E+02
101	0.300 0E+01	0.97566946E+	0.5361604 E+00	0.10870972E+01	0.29552590E+02
102	0.400 E+01	0.92589655E+	-0.66947119E-03	0.92569881E+00	-0.42665301E-01
103	0.500 E+01	0.73672132E+	- .24703337E+00	0.77728986E+00	-0.18542947E+02
104	0.600 E+01	0.56655686E+	-0.34302561E+00	0.66076013E+00	-0.30970586E+02
105	0.700 0E+01	0.43956221E+	-0.36527539E+	0.57152519E+00	-0.39726534E+02
106	0.800 0E+01	0.34754439E+	-0.36271363E+00	0.50234279E+00	-0.46223517E+02
107	0.900 E+01	0.28026877E+	-0.34897710E+00	0.44760117E+00	-0.51229559E+02
108	0.10 E+02	0.23013811E+	- .33125631E+00	0.40338004E+00	-0.55203039E+02
109	0.11 E+02	0.19211750E+	- .31271037E+00	0.36701078E+00	-0.58435 8E+02
110	0.12 E+02	0.16259545E+	-0.29472527E+00	0.3365923 E+00	-0.611143 7E+02
111	0.13 E+02	0.13929691 E+	-0.27783341E+00	0.31879741E+00	-0.63372261E+02
112	0.140 E+02	0.12 61427E+	-0.26224677E+00	0.28865509E+00	-0.65301229E+02
113	0.150 E+02	0.10541862E+	-0.24797 1 E+00	0.26941869E+00	-0.66968470E+02
114	0.160 E+02	0.92901649E-01	- .23492825E+00	0.25263016E+00	-0.68423059E+02
115	0.17 E+02	0.82473915E-01	-0.223 2299E+0	0.2377839 E+00	-0.69705022E+02
116	0.180 E+02	0.73095311E-01	-0.21214633E+	0.22450296E+00	-0.70843119E+02
117	0.19 0E+02	0.66245379E-01	-0.20219321E+00	0.21276870E+	-0.71859106E+02
118	0.200 E+02	0.59863446E-01	-0.19306625E+00	0.20213414E+	-0.72773956E+02
119	0.210 E+02	0.54357630E-01	-0.18467751E+00	0.19251113E+	-0.73598650E+02
120	0.220 00E+02	0.49575256E-01	-0.17694861E+	0.18376212E+	-0.74348606E+02
121	0.230 0E+02	0.4539535 E-01	-0.16961028E+00	0.17577331E+	-0.75033144E+02
122	0.24 E+02	0.41721129E-01	-0.16320140E+0	0.16844992E+	-0.75659951E+02
123	0.250 E+02	0.38471429E-01	-0.15706855E+	0.16171212E+	-0.76236201E+02
124	0.260 E+02	0.35591579E-01	-0.15136425E+	0.15549243E+	-0.76767992E+02
125	0.270 0E+02	0.33 2 3 E-01	-0.14604703E+0	0.14973335E+	-0.7726 17E+02
126	0.280 E+02	0.30717365E-01	-0.141 8022E+0	0.14438505E+	-0.77716738E+02
127	0.290 E+02	0.28 457 E-01	-0.13643146E+	0.1394 65 E+	-0.7814173 E+02
128	0.3 E+02	.26770316E-01	-0.132 7198E+	0.13475 37E+	-0.78539374E+02
129	0.31 E+02	.2 3659 E-01	-0.12797610E+	0.13041 2 E+	-0.789 2 6E+02
130	0.32 E+02	.2335 15 E-01	-0.124122 E+0	0.1263363 E+	-0.79256 E+02

132	0.34[illegible]E+02	[illegible].2[illegible]671439[illegible]- 1	- .117[illegible]581[illegible]E+[illegible]	-.116[illegible]E+[illegible]	- .79[illegible]
133	0.35[illegible]E+02	.19[illegible]15[illegible]- 1	- .11381442E+[illegible]	0.1155[illegible]679E+[illegible]	-0.8[illegible]1799[illegible]E+02
134	0.36[illegible]E+02	[illegible].18524055[illegible]- 1	- .11[illegible]74281E+[illegible]	0.112296[illegible]3E+[illegible]	-0.80653[illegible]1E+02
135	0.37[illegible]E+02	[illegible].17834786[illegible]- 1	- .1[illegible]783[illegible]23E+0	0.1[illegible]92[illegible]2736+[illegible]	-0.80711979E+02
136	0.38[illegible]E+02	.167217[illegible]2E- 1	-0.1[illegible]5[illegible]6[illegible]02E+0[illegible]	0.1[illegible]63871[illegible]E+[illegible]	-[illegible].809569[illegible]6E+02
137	0.39[illegible]E+02	[illegible].15[illegible]77672E-[illegible]1	-[illegible].1[illegible]243568E+0[illegible]	0.1[illegible]365911E+[illegible]	-[illegible].81169237E+02
138	[illegible].40[illegible]E+02	[illegible].15[illegible]959[illegible]4E- 1	-[illegible].99933682E-[illegible]1	0.10[illegible]6744E+0[illegible]	-0.81409917E+02
139	0.41[illegible]E+02	[illegible].1[illegible]37[illegible]441[illegible]-[illegible]1	- .97549398E-[illegible]1	0.986[illegible]22[illegible]3E-01	-0.816196[illegible]4E+02
140	0.42[illegible]E+02	.13695997[illegible]- 1	- .95274989E-[illegible]1	0.9625[illegible]37[illegible]E-01	-[illegible].81[illegible]19672E+02
141	[illegible].430[illegible]E+02	[illegible].13[illegible]679[illegible]4[illegible]-[illegible]1	-[illegible].93103115E-[illegible]1	0.94015743E- 1	-[illegible].820[illegible]2216+02
142	[illegible].44[illegible]E+02	.12482[illegible]14[illegible]- 1	- .91[illegible]270722E-[illegible]1	0.9107087[illegible]8E- 1	-[illegible].82192[illegible]872E+02
143	0.45[illegible]E+02	[illegible].119346312E- 1	-[illegible].89040717E-[illegible]1	0.8983699[illegible]E-[illegible]1	-[illegible].82365053E+02
144	0.460[illegible]E+02	[illegible].11422457E-[illegible]1	-[illegible].87138427E-01	[illegible].87[illegible]389[illegible]E-[illegible]1	-[illegible].825320[illegible]8E+02
145	0.470[illegible]E+02	[illegible].1[illegible]9425367E-[illegible]1	- .85315017E-01	0.860139[illegible]1E-01	-[illegible].82691156E+02
146	0.480[illegible]E+02	[illegible].10492219E-[illegible]1	-[illegible].83565727E-01	0.84271634E-01	-[illegible].82843672E+02
147	0.49[illegible]E+02	0.10069122E-[illegible]1	- .81886168E-01	0.82502919E-01	-[illegible].82969653E+02
148	0.10[illegible]E+02	0.23619811E+[illegible]	- .33125631E+0[illegible]	0.403368[illegible]4E+0[illegible]	-[illegible].55203639E+02
149	0.200[illegible]E+02	0.59863446E- 1	-0.19306625E+0[illegible]	0.2021341E+0[illegible]	-[illegible].72773[illegible]962E+02
150	0.300[illegible]E+02	[illegible].26778316E- 1	- .132[illegible]7196E+0[illegible]	0.13475937E+0[illegible]	-[illegible].78536372E+02
151	0.400[illegible]E+02	0.15095949E- 1	-0.99933682E-01	0.10106744E+0[illegible]	-[illegible].81409917E+02
152	0.500[illegible]E+02	0.9671[illegible]944E- 2	-0.80272284E-01	0.80852766E-01	-0.83130225E+02
153	0.600[illegible]E+02	0.6719684[illegible]2E- 2	-0.67040751E-01	0.67376758E-01	-0.84276230E+02
154	0.700[illegible]E+02	0.49385218E- 2	- .57539539E-01	0.57751083E-01	-0.85094538E+02
155	0.800[illegible]E+02	[illegible].37618549E- 2	- .50[illegible]3927[illegible]E-[illegible]1	0.50531988E-01	- .857[illegible]7955E+02
156	0.900[illegible]E+02	0.29685646E- 2	- .44817656E-01	0.4491719[illegible]E-01	- .8616504[illegible]E+02
157	0.10[illegible]E+03	0.242[illegible]9878E- 2	- .40352826E-[illegible]1	0.40425386E-01	-0.86566058E+02
158	0.11[illegible]E+03	0.2[illegible]09693E- 2	-0.36695777E-[illegible]1	0.3675[illegible]291E-01	-0.86678664[illegible]E+02
159	0.120[illegible]E+03	0.16814678E- 2	-[illegible].3364573[illegible]E- 1	0.3368772E-01	-0.87139018E+02
160	0.130[illegible]E+03	[illegible].14327940E- 2	-[illegible].310633[illegible]6E-[illegible]1	0.31096332E-01	-[illegible].87359137E+02
161	0.140[illegible]E+03	0.12354613E- 2	-[illegible].288487[illegible]E-01	0.28675143E-01	-0.87547[illegible]2E+02
162	0.150[illegible]E+03	0.1[illegible]762578E- 2	-0.26928617E-01	0.2695[illegible]116E-01	-0.87711327E+02
163	0.160[illegible]E+03	0.94595210E- 3	-0.25248007E-01	0.25265721E-01	-0.87851309E+02
164	0.170[illegible]E+03	0.83795324E- 3	-0.23764723E-01	0.23779492[illegible]E-01	-0.87980[illegible]7E+02
165	0.180[illegible]E+03	0.74744587E- 3	-0.22445[illegible]96[illegible]E-01	0.2245[illegible]1E-01	-0.88092799E+02
166	0.190[illegible]E+03	.67[illegible]84716E- 3	-[illegible].21265798E-01	0.21270373E-01	-0.88193186E+02
167	0.200[illegible]E+03	0.60564677E- 3	- .202[illegible]3479E-01	0.20212549E-01	-0.88263536E+02
168	0.210[illegible]E+03	0.54916367E- 3	-0.19242288E-01	0.1925[illegible]93E-01	-0.88365241E+02
169	0.220[illegible]E+03	0.50037676E- 3	-0.18368223E-01	0.18375[illegible]37E-01	-0.88[illegible]3959E+02
170	0.230[illegible]E+03	0.457817[illegible]E- 3	- .1757[illegible]15E-01	0.1757[illegible]12[illegible]E-01	-0.88507[illegible]E+02
171	0.240[illegible]E+03	0.42046326E- 3	- .1683[illegible]53[illegible]E-01	0.16843776E- 1	-0.8856958[illegible]E+02
172	0.250[illegible]E+03	0.3875[illegible]126E- 3	- .16165367E-01	0.1617[illegible]E-01	-0.8862[illegible]E+02
173	0.260[illegible]E+03	.358260[illegible]9E- 3	-0.15543971E-01	0.1554[illegible]8[illegible]9E-01	-[illegible].88[illegible]7972E+02
174	0.270[illegible]E+03	0.3322232[illegible]E- 3	- .14966556E-01	0.14972242E-01	-0.8872[illegible]57[illegible]E+02

176	0.290 E+03	0.2879 177E- 3	- .1393669E-01	.1353 72E-01	-0.83 162 5E+02
177	0.300 E+03	.2691 38E- 3	-0.13 72327E-01	0.13475 15E-01	-0.88557250E+02
178	0.310 E+03	0.252 231 E- 3	-0.13 379 E-01	0.13 3E-01	-0.88926 1E+02
179	0.320 E+03	.236518 E- 3	- .1263 61 E-01	0.12632 25E-01	-0. 8272 E+02
180	0.330 E+03	0.2224 179E- 3	-0.1224799E-01	0.1225 11E-01	-0.88 597 E+02
181	0.340 E+03	0.20951221E- 3	-0.118678 E-01	0.116 971 E-01	-0.889 35 E+02
182	0.350 E+03	0.19771153E- 3	-0.1154 317E-01	0.1155 97E-01	-0.89019 3E+02
183	0.360 E+03	0.16688 48E- 3	-0.1122762 E-01	0.11229175E-01	-0.89 464 9E+02
184	0.370 E+03	0.17691566E- 3	-0.10924251E-01	0.1092 6 8E-01	-0.8972222E+02
185	0.380 E+03	0.16772711E- 3	-0.10636843E-01	0.1063 165E-01	-0.89096639E+02
186	0.390 E+03	0.15923624E- 3	-0.10364168E-01	0.10365392E-01	-0.891196 3E+02
187	0.400 E+03	0.15137417E- 3	-0.10105123E-01	0.101 6256E-01	-0.89141 9E+02
188	0.410 E+03	0.144 8 3 E- 3	-0.98587091E-02	0.98597 1 E-02	-0.891627 3E+02
189	0.420 E+03	0.1373 11 E- 3	-0.96240261E-02	0.96250054E-02	-0.8918267 E+02
190	0.430 E+03	0.13 98949E- 3	-0.94 255 E-02	0.9401166 E-02	-0.89201686E+02
191	0.440 E+03	0.1251 321E- 3	-0.9186653 E-02	0.91875 46E-02	-0.89219831E+02
192	0.450 E+03	0.1196 497E- 3	- .898254 E-02	0.89833379E-02	-0.892371 9E+02
193	0.460 E+03	0.11446138E- 3	-0.87873 21E-02	0.8786 475E-02	-0.89253753E+02
194	0.470 E+03	0.10964260E- 3	-0.86 3689E-02	0.8601 677E-02	-0.89269631E+02
195	0.480 E+03	0.10512183E- 3	-0.84212227E-02	0.84218787E-02	-0.8926 648E+02
196	0.490 E+03	0.1 0875 E- 3	-0.82493868E-02	0.8250 36E-02	-0.892994 E+02
197	0.1 E+03	0.242 9878E- 2	-0.4 352826E-01	0.40425386E-01	-0.86566658E+02
198	0.2 E+03	0.60544677E- 3	-0.2 2 3473E-01	0.20212549E-01	-0.88263538E+02
199	0.300 E+03	0.2691 388E- 3	-0.13472327E-01	0.13475 15E-01	-0.88 55726E+02
200	0.400 E+03	0.15137417E- 3	-0.1 1 5123E-01	0.10116256E-01	-0.891418 9E+02
201	0.500 E+03	0.9688 42 E- 4	- .8 844228E-02	0.8 85 32E-02	-0.89313457E+02
202	0.600 E+03	0.67278433E- 4	- .67371859E-02	0.67375 1 E-02	-0. 9427 7 E+02
203	0.700 E+03	0.49 29212E- 4	- .57747895E-02	0.5775 11E-02	-0. 95 9 23E+02
204	0.800 E+03	0.37 4321 E- 4	- .5 529841E-02	0.50531258E-02	-0. 957 2 E+02
205	0.900 E+03	.29 1729E- 4	-0. 91507 E-02	0.44916073E-02	- . 95 3E+02
206	0.1000 E+04	0.2422 42 E- 4	-0. 4242792E-02	0.4 425 5E-02	-0. 9 56 6E+02
207	0.1100 E+04	0.2 16895E- 4	- .3674945 E-02	0.3675 3E-02	-0. 0 795 E+02

VALU OF ... CY IS =

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RATOR CO...

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[illegible]	+	[illegible]	[illegible]	0.1[illegible]E+ 1	[illegible] + [illegible]
0.1	-	.[illegible] +	- .35[illegible]E- [illegible]	0.90[illegible]742[illegible]E+[illegible]	- .2[illegible]469[illegible] + 1
0.2	-	.[illegible]75[illegible] +	- .7[illegible]473573[illegible]E- [illegible]	0.10[illegible]5E+ 1	-0.[illegible]035[illegible]58 + 1
0.3	-	.[illegible] +	-.1[illegible]53[illegible]263E+	0.1[illegible]5[illegible]E+01	-0.[illegible]139[illegible] + 1
0.4	-	.3[illegible]7 +	- .13[illegible]17[illegible]3[illegible]E+[illegible]	0.1[illegible]19780E+01	- .7775[illegible]9[illegible]1 + 1
0.5	-	.[illegible]2 +	- .17[illegible]2[illegible]7E+	0.1[illegible]81790E+01	-.5[illegible]7754[illegible]1 + 1
0.6	-	.3[illegible]7[illegible] +	- .2[illegible]5[illegible]5[illegible]E+ [illegible]	0.1[illegible]6[illegible]E+01	-0.117[illegible]4[illegible] + 2
0.7	-	.9[illegible] +	- .23[illegible]7[illegible]E+ [illegible]	0.1[illegible]137[illegible]20[illegible]E+01	-0.130[illegible]2655 + 2
0.8	-	.3[illegible]3[illegible] +	- .271[illegible]E+[illegible]	0.1[illegible]2[illegible]59[illegible]2E+01	-0.15[illegible]5[illegible]53[illegible] + 2
0.9	-	0.99[illegible]3[illegible]7 +	- .3[illegible]62[illegible]E+	0.1[illegible]2[illegible]3[illegible]E+01	-0.[illegible]731[illegible]5[illegible]4 + 2
0.10	+	.9[illegible] +	- .3[illegible]1[illegible]77E+[illegible]	0.1[illegible]3[illegible]720[illegible]E+01	-0.[illegible]917[illegible]5[illegible]1 + 2
0.11	+	.9[illegible] +	- .377[illegible]E+[illegible]	0.1[illegible]5[illegible]35[illegible]E+01	-0.21[illegible]59242 + 2
0.12	+	.97[illegible]73[illegible] +	-0.[illegible]1477[illegible]7[illegible]E+[illegible]	0.1[illegible]6[illegible]395E+01	-0.22[illegible]5[illegible]3[illegible] + 2
0.13	+	.97[illegible]1[illegible] +	- .[illegible]3[illegible]E+[illegible]	0.1[illegible]7[illegible]94[illegible]E+01	-0.2[illegible]7[illegible]57[illegible] + 2
0.14	+	.97[illegible]3[illegible]78 +	- .[illegible]3[illegible]5[illegible]E+[illegible]	0.1[illegible]9[illegible]07[illegible]7E+01	-0.2[illegible]3[illegible]716[illegible] + 2
0.15	+	.97[illegible] +	- .5[illegible]E+[illegible]	0.111[illegible]9[illegible]E+01	-0.2[illegible]7[illegible]7579 + 2
0.16	+	.[illegible]73[illegible]5 +	- .5[illegible]617[illegible]E+[illegible]	0.1133[illegible]812E+01	-0.3[illegible]59465 + 2
0.17	+	.97[illegible]37[illegible]1 +	- .[illegible]263[illegible]E+[illegible]	0.1155[illegible]76[illegible]E+01	-0.32[illegible]20[illegible]7 + 2
0.18	+	.9[illegible]7[illegible] +	- .[illegible]7[illegible]13[illegible]1[illegible]E+[illegible]	0.1179[illegible]7[illegible]E+01	-0.3[illegible]4 + 2
0.19	+	.9[illegible]3357[illegible] +	- .72[illegible]27[illegible]E+[illegible]	0.12[illegible]6673[illegible]E+01	-0.37[illegible]2[illegible]9 + 2
0.20	+	.[illegible]57[illegible]27 +	- .7[illegible]329[illegible]E+[illegible]	0.123[illegible]9[illegible]35E+01	-0.[illegible]919[illegible]517 + 2
0.21	+	.9[illegible]7[illegible] +	- .[illegible]3[illegible]E+[illegible]	0.1267[illegible]59[illegible]E+01	-0.[illegible]1[illegible]27[illegible]9 + 2
0.22	+	.9[illegible]7[illegible] +	- .9[illegible]29E+[illegible]	0.13[illegible]2[illegible]7[illegible]E+01	-0.43721497 + 2
0.23	+	.9[illegible]7[illegible] +	- .9[illegible]E+	0.1341173[illegible]E+01	-0.4[illegible]877[illegible]9 + 2
0.24	+	.9[illegible] +	-0.1[illegible]2[illegible]E+01	0.13[illegible]2[illegible]3[illegible]E+01	-0.[illegible]53[illegible]4[illegible] + 2
0.25	+	.[illegible]72[illegible]7[illegible] +	- .1[illegible]7[illegible]E+01	0.1[illegible]2[illegible]E+01	-0.51[illegible]7[illegible]1[illegible] + 2
0.26	+	.9[illegible]7[illegible] +	-0.1[illegible]3[illegible]E+ 1	0.1[illegible]77[illegible]1[illegible]E+01	-0.5372773[illegible] + 2
0.27	+	.9[illegible] +	-0.1277[illegible]E+01	0.1532[illegible]3[illegible]E+ 1	-0.5[illegible]49[illegible]2[illegible]2 + 2
0.28	+	.9[illegible]7[illegible] +	-0.13[illegible]E+01	0.1591159[illegible]2E+01	-0.59[illegible]77[illegible]3 + 2
0.29	+	.7[illegible]1 +	- .1[illegible]5[illegible]E+ 1	0.165[illegible]2[illegible]7[illegible]E+01	-0.[illegible]2[illegible]7[illegible]1[illegible]2 + 2
0.30	+	.7[illegible]9[illegible]28 +	- .1[illegible]7[illegible]7[illegible]E+ 1	0.1725[illegible]2[illegible]E+01	-0.[illegible]572[illegible] + 2
0.31	+	.[illegible]39[illegible] +	-0.1[illegible]E+ 1	0.1[illegible]1[illegible]311E+ 1	-0.[illegible]91[illegible]5[illegible] + 2
0.32	+	.5[illegible] +	-0.175[illegible]E+ 1	0.1[illegible]2[illegible]E+01	-0.72[illegible]27[illegible]2 + 2
0.33	+	.[illegible] +	- .1[illegible]E+01	.1[illegible]7[illegible]E+01	-0.7[illegible]514[illegible]7 + 2
0.34	+	.[illegible]3[illegible] +	- .2[illegible]3[illegible]E+[illegible]	.2[illegible]5[illegible]375E+01	-0.[illegible]1127942 + 2
0.35	+	.[illegible]2[illegible]1 +	-0.21[illegible]E+ [illegible]	.21[illegible]1[illegible]E+01	-0.8575[illegible]67 + 2
0.36	+	- .[illegible]	- .22[illegible]E+	0.22[illegible]12[illegible]E+ 1	- .9[illegible]75[illegible]727 + 2
0.37	+	- .[illegible]5[illegible] +	- .23[illegible]E+ 1	.23[illegible]3[illegible]E+ 1	-0.[illegible]517[illegible] + 2
0.38	+	- .[illegible]1[illegible] +	- .2[illegible]75717 + [illegible]	.24[illegible]1[illegible]E+01	- .1[illegible]2[illegible]29[illegible] + 3
0.39	+	- .[illegible]1[illegible] +	- .2[illegible]7[illegible]373E+ [illegible]	0.255[illegible]E+ 1	- .1[illegible]832377 + 3
0.40	+	- .[illegible] +	-0.257[illegible]E+[illegible]	0.26[illegible]E+ 1	-0.[illegible]15[illegible]3136 + 3
0.41	+	- .[illegible]77 +	-0.22[illegible]3[illegible]E+ [illegible]	0.2[illegible]77[illegible]23[illegible]E+01	- .122[illegible]2[illegible] + 3
0.42	+	- .[illegible] +	- .2[illegible]7[illegible]7[illegible]E+ [illegible]	.27[illegible]E+01	- .12[illegible]7[illegible] + 3

.[illegible]	[illegible]	-.[illegible]7[illegible]	-[illegible].15[illegible] +	.7[illegible]15[illegible]+[illegible]1	- .1[illegible]7[illegible] + 3
.45	[illegible]	[illegible]	- .12[illegible]7[illegible]	.7[illegible] + 1	- .1[illegible]7[illegible] + 3
[illegible].46	[illegible]	- .[illegible]21[illegible] + 1	- .41[illegible]7[illegible] +	.25[illegible]567 +[illegible]1	- .15[illegible]559[illegible] + 3
[illegible].47	[illegible]	- .[illegible]7[illegible] + 1	- .[illegible]197[illegible] +	.2557[illegible]51[illegible]+[illegible]1	- .16[illegible]7[illegible] + 3
[illegible].48	[illegible]	- .[illegible]7[illegible] + 1	- .3[illegible] +	.2275[illegible] + 1	- .[illegible]71[illegible] + 3
.49	[illegible]	- .[illegible]921 + [illegible]	- .12[illegible] +	[illegible].2157[illegible]41[illegible]+ 1	-[illegible].17[illegible]7.+[illegible]3
[illegible].1	[illegible]	.1[illegible] +	-[illegible].3[illegible]77 +	[illegible].1[illegible]3[illegible]726[illegible]+[illegible]1	- .1[illegible]17[illegible]2 +[illegible]2
[illegible].2	[illegible]	.[illegible]7[illegible]27[illegible]+	- .7[illegible] + [illegible]	[illegible].1235[illegible]5[illegible]+[illegible]1	- .[illegible]91[illegible]51[illegible] +[illegible]2
[illegible].3	+	.7[illegible]41 +	- .157[illegible]7[illegible] + [illegible]	[illegible].1725[illegible]1[illegible]+[illegible]1	-[illegible].657[illegible] + 2
[illegible].4	+	- .[illegible]755[illegible]+[illegible]1	-[illegible].237[illegible]35[illegible] + 1	.26[illegible]53[illegible]+[illegible]1	- .115 3135. +[illegible]3
[illegible].5	+	- .[illegible]2[illegible] + 1	[illegible].71[illegible] [illegible]- 1	[illegible].2[illegible]3[illegible]+[illegible]1	[illegible].[illegible]7797[illegible] +[illegible]3
[illegible].6	+	- .[illegible]13[illegible]12[illegible] +	[illegible].6[illegible]5[illegible] +	.1[illegible]12[illegible]+[illegible]1	[illegible].1[illegible]35[illegible]3[illegible] +[illegible]3
[illegible].7	+	- .[illegible]7[illegible]655 +	[illegible].[illegible]2[illegible] +	[illegible].752[illegible]+[illegible]	[illegible].12[illegible]557[illegible]7.+[illegible]3
[illegible].8	+	- .[illegible]3[illegible]915 +	.[illegible]1[illegible]+[illegible]	[illegible].5[illegible]716+[illegible]	[illegible].1[illegible]48[illegible]+[illegible]3
[illegible].9	+	- .7[illegible]55[illegible]- 1	.[illegible]17[illegible]+	[illegible].[illegible]2[illegible]+[illegible]	[illegible].[illegible]943421[illegible]+[illegible]2
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.11	+ .[illegible]23[illegible]	= [illegible]	.1[illegible]- 1	= .[illegible]197 + 2
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.15	+ .3[illegible]	= .9[illegible]	.1[illegible]777[illegible]- 1	= .[illegible]7[illegible]5 + 2
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.22	+ .[illegible]2 - 2	= .[illegible]7[illegible] - 2	.69[illegible]- 2	= .75[illegible]3[illegible] + 2
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.31	+ .[illegible]7[illegible]	= .[illegible]	.[illegible]- 2	= .7[illegible]3552 + 2
.32	+ .[illegible]	= .[illegible]	.7[illegible]17[illegible]- 2	= .[illegible] + 2

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[illegible]	+	[illegible]	-.3[illegible]	0.38[illegible]5[illegible]7 1[illegible]E-03	-0.[illegible]92[illegible]9961 +
.41	+	[illegible]	-.37[illegible]	0.37[illegible]E-03	-0.[illegible]9229231 +
[illegible]	+	.75[illegible]	-.3[illegible]77[illegible]	0.3[illegible]23[illegible]7[illegible]E-03	-0.[illegible]92[illegible]7583 +
.43	+	[illegible]	-.353[illegible]	0.35[illegible]13[illegible]E-03	-0.[illegible]926[illegible]1 +
.44	+	[illegible]	-.3[illegible]	0.3459[illegible]E-03	-0.[illegible]92[illegible]1785 +
.45	+	[illegible]	-.33[illegible]	0.336227[illegible]E-03	-0.[illegible]929774[illegible] +
.46	+	[illegible]	-.33[illegible]	0.33[illegible]74[illegible]E-03	-0.[illegible]9313[illegible]12 +
.47	+	[illegible]	-.32[illegible]	0.323[illegible]3[illegible]E-03	-0.[illegible]932763[illegible] +
[illegible]	+	[illegible]	-.317[illegible]	0.317 [illegible]739E-03	-0.[illegible]9341638 +
[illegible]	+	[illegible]	-.31[illegible]	0.31[illegible]E-03	-0.89355075 +
.1	+	.3[illegible]	-.152[illegible] E- 2	0.1522[illegible]E-02	-0.[illegible]684[illegible]255 +
.2	+	[illegible]	-.76[illegible]7 [illegible]	0.76[illegible]5[illegible]E-03	-0.[illegible]8[illegible]19941 +
0.3	+	[illegible]	-.5 7[illegible]	0.5[illegible]73[illegible]E-03	-0.[illegible]8[illegible]4[illegible]613 +
.4	+	[illegible]	-.3[illegible]	0.38[illegible]7 1[illegible]E-03	-0.[illegible]92[illegible]9961 +
.5	+	[illegible]	-.3[illegible]	0.364[illegible]35[illegible]E-03	-0.[illegible]9367973 +
.6	+	[illegible]	-.253[illegible]	0.2536[illegible]75[illegible]E-03	-0.[illegible]9473315 +
.7	+	.[illegible]713[illegible]	-.217[illegible]	0.2174298[illegible]E-03	-0.89548560 +
.8	+	.1311717[illegible]	-.1[illegible]	0.19[illegible]5[illegible]E-03	-0.[illegible]960[illegible]994 +
.9	+	.[illegible]	-.16[illegible]	0.16[illegible]1173E-03	-0.[illegible]964[illegible]888 +
0.10	+	[illegible]	-.1521[illegible]	0.1522[illegible]E-03	-0.[illegible]96[illegible]01 +
.11	+	[illegible]	-.1383[illegible]	0.13836396[illegible]E-03	-0.[illegible]9712731 +

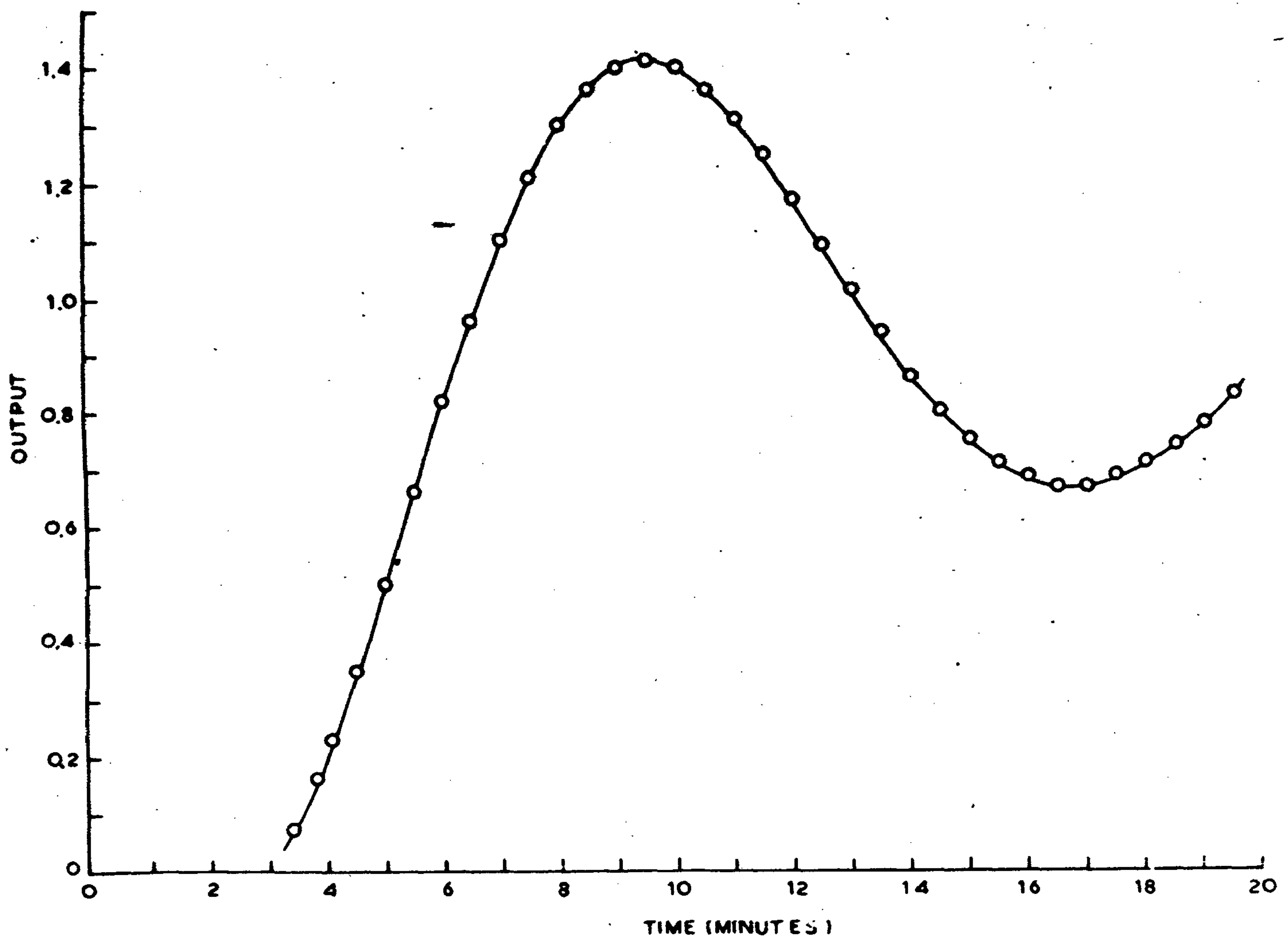

FIG TIME RESPONSE FOR EXAMPLE 2 CASE A2 (ω = 0 TO 0.2)

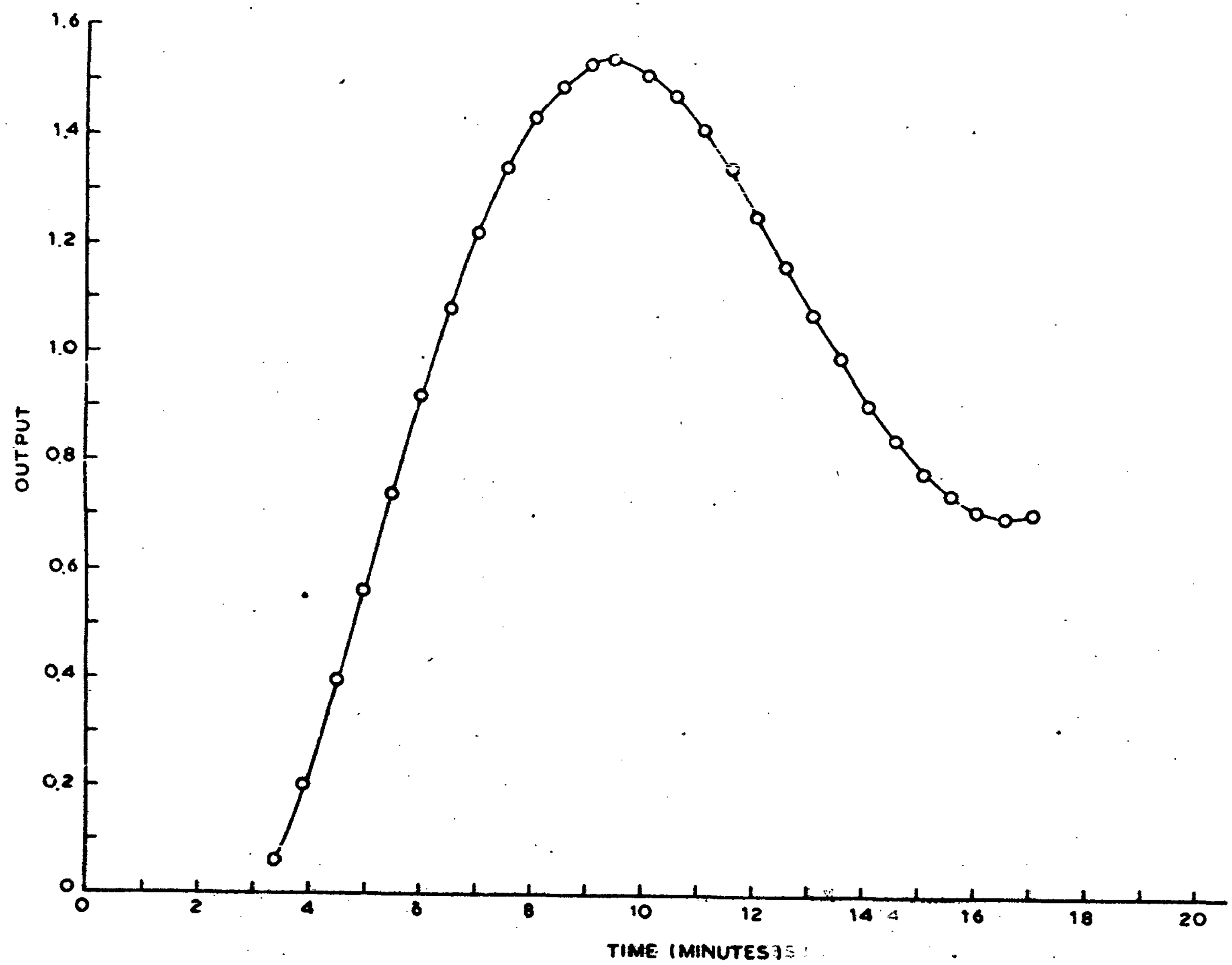

FIG TIME RESPONSE FOR EXAMPLE 2 CASE A 3 (ω = 0 TO 0.1)

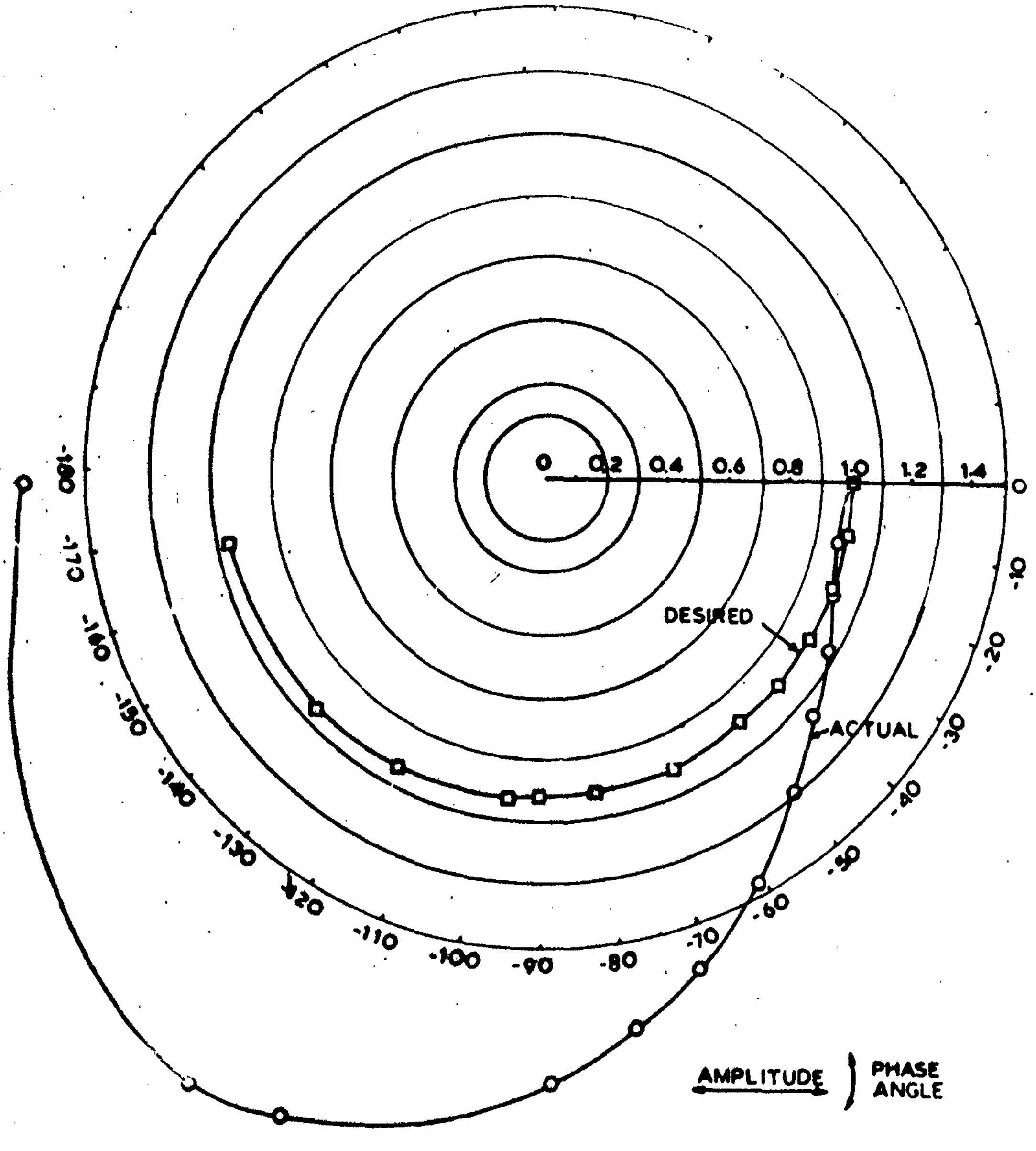

FIG FREQUENCY RESPONSE FOR EXAMPLE 2 CASE A1 (ω = 0 TO 0.5)

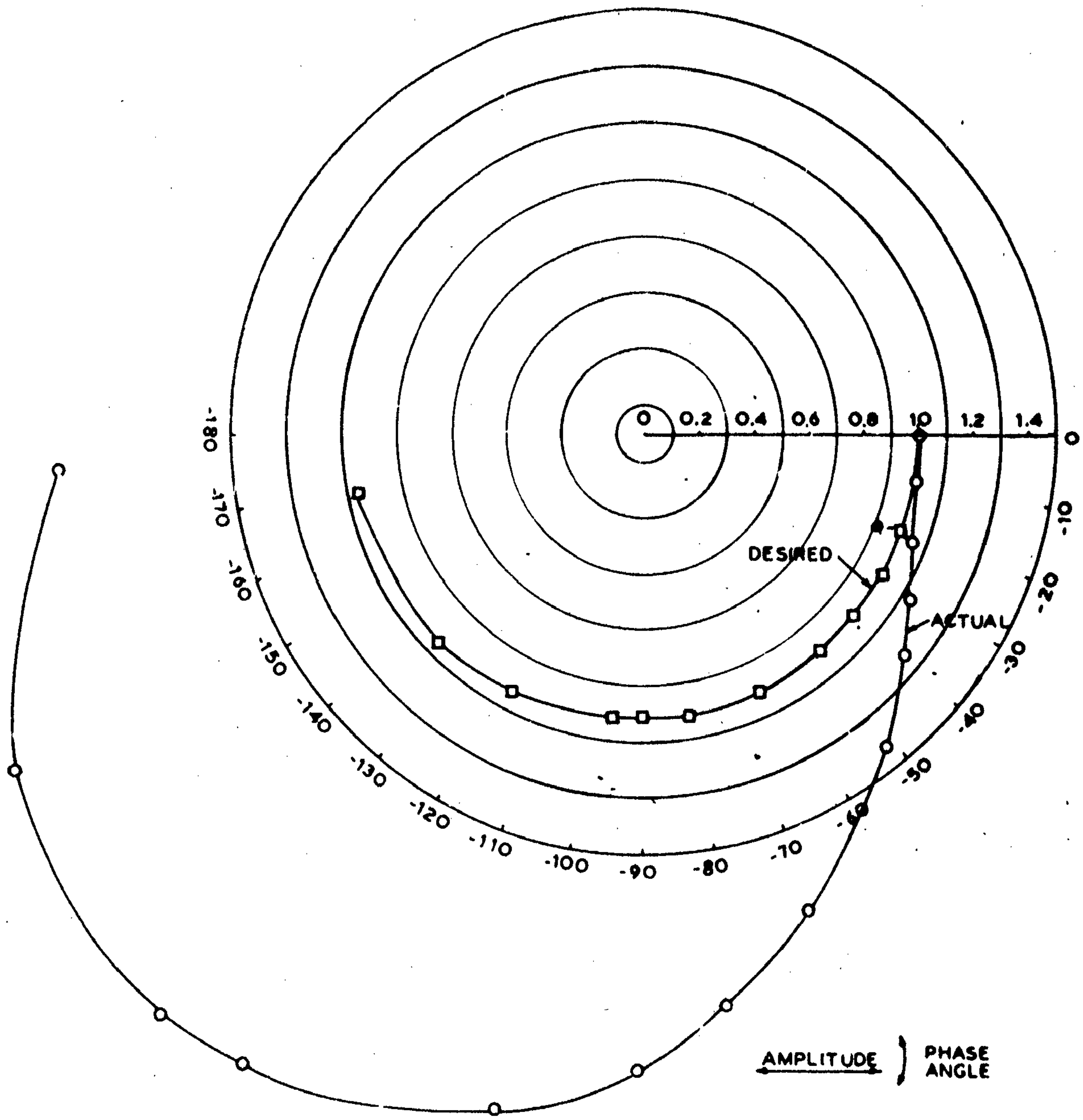

FIG FREQUENCY RESPONSE FOR EXAMPLE 2 CASE A3 ($\omega = 0$ TO 0.1)

V. CONCLUSIONS

In this work, optimization techniques have been used in the frequency domain design of single-input-single-output control systems. The suitability of using gradient methods for optimization to get the unknown controller parameters have been tested in this work. It is felt that other powerful parameter optimization techniques may be used to get better and quicker convergence.

It has been shown that this is a viable method for control system design for processes with/without time delay. The convergence of the results are dependent on a prior good choice of the controller parameters as well as on the range of frequency-interval (w_o, w_1) chosen in the performance index. It is found that a small value of w_1(say 1 radian/sec.) normally leads to a good controller with quick convergence.

The ultimate effectiveness of this method may be found by testing on a range of real life process models and this work is relegated to future workers. It is felt that this is a new addition to the several methods of control system design available in the literature.

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