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LINEAR SYSTEMS DYNAMICS

(LSD) PROGRAM

HC003C

VOLUME I - USER'S MANUAL

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Prepared by C.A. Argila
C.A. Argila
Electrical and
Electronics Group

Approved by W.P. Bennett
W.P. Bennett, Head
Sybsystems Analysis Section

Approved by D.A. Schnebly
D.A. Schnebly
Group Leader
Electrical and
Electronics Group

Approved by D.L. Ball
D.L. Ball, Manager
Computational Simulations
Department

TRW
SYSTEMS GROUP

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ABSTRACT

The Linear Systems Dynamics (LSD) Program performs a root locus, frequency response, or time response analysis of a system when given either the poles and zeros of the transfer function of the system or a matrix array of equations that defines the system. For the time response analysis, a piece-wise quadratic driving function of up to one hundred segments may be specified. A data tape is generated by the LSD Program that may be used by the TRWPLT General Plotting Program to obtain root locus, frequency response, or time response plots.

The LSD Program is written in FORTRAN V for use on the SRU 1108 EXEC II computing system.

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1. PROBLEM DESCRIPTION

The LSD program performs root locus, frequency response, and time response analyses of systems. Following is a description of the types of systems to which the LSD program may be applied. Section 1.5 contains an example that is further explained in Sections 2 and 4 where a computer solution is found.

1.1 INTRODUCTION

For any integer, n, the integro-differential operator of order n, P^n, is defined as follows: Given a function, f, defined on the interval (a;b) which is both integrable and differentiable on (a;b),

$$P^n[f(t)] = \begin{cases} \dfrac{d^n f(t)}{dt^n}, & n > 0 \\ f(t), & n = 0 \\ \displaystyle\int_0^t \int_0^{t_{-n}} \cdots \int_0^{t_2} f(t_1)\, dt_1 \cdots dt_{-(n+1)}\, dt_{-n}, & n < 0 \end{cases} \qquad (1\text{-}1)$$

for all $t \in (a;b)$.

An integro-differential equation of order n means any equation that explicitly involves the operator P^n or P^{-n} and does not involve the operator P^m where $|m| > |n|$.

Theorem I

The integro-differential operator of order n is a linear operator.

Proof:

The differential operator, the identity operator, and the integral operator are linear operators; therefore, the integro-differential operator is linear.

Theorem II

For any Laplace transformable function, f,

$$\mathcal{L}\left[P^n\left[f(t)\right]\right] = \begin{cases} S^n F(S) - \sum_{i=1}^{n} S^{n-i} \lim_{t\to 0+} P^{i-1}\left[f(t)\right], & n > 0 \\ F(S), & n = 0 \\ S^n F(S) + \sum_{i=n}^{-1} S^i \lim_{t\to 0+} P^{i-n-1}\left[f(t)\right], & n < 0 \end{cases} \tag{1-2}$$

where

$$F(S) = \mathcal{L}\left[f(t)\right].$$

Proof:

This theorem also follows immediately from the analogous result for the differential and integral operators.

1.2 DETERMINING TRANSFER FUNCTION OF A SYSTEM

Consider a system that has associated with it various parameters described by the functions $i_0, i_1, \ldots i_{n-1}$, e one of which is thought of as being input (for example, e) and one of which is thought of as being output (for example i_0). Suppose that the functions $i_0, i_1, \ldots, i_{n-1}$, e satisfy the set of integro-differential equations

$$\left.\begin{aligned} Q_{11}(P)[i_0] + \ldots + Q_{1n}(P)[i_{n-1}] &= Q_{1n+1}(P)[e] \\ \vdots \qquad\qquad \vdots \qquad\qquad & \vdots \\ Q_{n1}(P)[i_0] + \ldots + Q_{nn}(P)[i_{n-1}] &= Q_{nn+1}(P)[e] \end{aligned}\right\} \tag{1-3}$$

where

$$Q_{ij}(P)[f] = a_m P^m[f] + \ldots + a_k P^k[f], \quad m, \ldots, k \text{ are integers,}$$

$i = 1, \ldots, n$, $j = 1, \ldots, n+1$.

If there exist polynomials of the form

$$r_{ij}(s) = a_m(1/s)^m + \ldots + a_1(1/s) + a_o + b_1 s + \ldots + b_k s^k, \quad (1\text{-}4)$$

for natural numbers m and k and for integers i = 1, . . ., n, j = 1, . . ., n+1, so that

$$\left.\begin{aligned} r_{11}(s)\, I_o(s) + \ldots + r_{1n}(s)\, I_{n-1}(s) &= r_{1n+1}(s)\, E(s) \\ &\vdots \\ r_{ni}(s)\, I_o(s) + \ldots + r_{nn}(s)\, I_{n-1}(s) &= r_{nn-1}(s)\, E(s) \end{aligned}\right\} \quad (1\text{-}5)$$

the system under investigation is said to be a realizable system and the set of equations (1-5) is the Laplace transform of the set of integro-differential equations (1-3).

The LSD Program is restricted to the analysis of realizable systems; however, the following theorem proves that the only systems that may exist in nature are realizable systems.

Theorem III

Given a system whose parameters are described by the functions $i_0, i_1, \ldots, i_{n-1}$, e that satisfy the set of integro-differential equations (1-3), a sufficient condition that the system be a realizable system is that each of the functions $i_0, i_1, \ldots, i_{n-1}$, e satisfy the equation

$$\lim_{t \to 0+} P^{-1}[f(t)] = 0 . \quad (1\text{-}6)$$

Proof:

The following lemma must be proved:

Lemma

If a function f satisfies the equation

$$\lim_{t \to 0+} P^{-1}[f(t)] = 0 ,$$

then, for any natural number k it is true that

$$\lim_{t\to 0+} P^{-k}\,[f(t)] = 0\ .$$

Proof of Lemma:

The lemma shall be proved by mathematical induction. The result is true for k = 1 by hypothesis. Now, if

$$\lim_{t\to 0+} P^{-(k-1)}\,[f(t)] = 0$$

is true. It must be shown that this implies

$$\lim_{t\to 0+} P^{-k}\,[f(t)] = 0.$$

By definition (1-1),

$$\lim_{t\to 0+} P^{-k}\,[f(t)] = \lim_{t\to 0+} \int_0^t P^{-(k-1)}\,[f(t_k)]\,dt_k$$

As $t\to 0+$, $t_k\to 0+$ and $P^{-(k-1)}\,[f(t)]\to 0$, i.e. $P^{-(k-1)}[f(t)]$ becomes bounded, and, hence

$$\lim_{t\to 0+} \int_0^t P^{-(k-1)}\,[f(t_k)]\,d\,t_k = 0\ ,$$

which proves the lemma.

Now, continuing with the proof of the theorem, polynomials must be constructed of the form (1-4) so that (1-5) is satisfied. It is sufficient to find, for some i = 1, . . ., n, polynomials $r_{i1}(s)$, . . . , $r_{in+1}(s)$ such that

$$r_{i1}(s)\,I_0(s) + \ldots + r_{in}(s)\,I_{n-1}(s) = r_{in+1}(s)\,E(s)\ . \qquad (1\text{-}7)$$

In the integro-differential equation

$$Q_{i1}(P)[i_0] + \ldots + Q_{in}(P)[i_{n-1}] = Q_{in+1}(P)[e]\ , \qquad (1\text{-}8)$$

it may be assumed, without loss of generality, that each Q_{ij} is of the form

$$Q_{ij}(P)[f] = a_{m_j} P^{m_j}[f] + \ldots + a_{k_j} P^{k_j}[f], \quad j = 1, \ldots, n+1$$

where the integers $m_j \ldots, k_j$ are all negative. This assumption may be made because the operator P is linear (Theorem I); hence, both sides of equation (1-8) could be "multiplied" by the operator P^q, where q is a sufficiently small negative integer, so that only terms of the form P^m $(m < 0)$ obtain.

Now, from the Laplace transform of both sides of equation (1-8) equation (1-7) is derived with

$$r_{ij}(s) = a_{m_j} s^{m_j} + \ldots + a_{k_j} s^{k_j}, \quad j = 1, \ldots, n+1 \qquad (1\text{-}9)$$

The initial conditions

$$\sum_{i=n_j}^{-1} S^i \lim_{t \to 0+} P^{i-n_j-1}[f(t)], \quad j = 1, \ldots, n+1$$

are neglected since by the above lemma they are all zero.

The condition (1-6) of Theorem III means physically that the functions representing the various parameters within a system must be initially bounded, i.e., impulses (or other distributions) are not allowed at the origin. This is the case with systems occurring in nature and is not a severe restriction to place on the type of systems which the LSD program can analyze.

1.2.1 Matrix Associated with a Realizable System

Given a realizable system from which the set of equations (1-5) can be obtained, the $n \times n+1$ matrix may be formed

$$\begin{bmatrix} r_{11}(s) & \ldots & r_{1n}(s) & r_{1n+1}(s) \\ \vdots & & \vdots & \vdots \\ r_{n1}(s) & \ldots & r_{nn}(s) & r_{nn+1}(s) \end{bmatrix} \qquad (1\text{-}10)$$

which is defined as the matrix associated with the realizable system being considered. Matrix (1-10) can be extended to a square matrix with the addition of a last row. The matrix

$$\begin{bmatrix} r_{11}(s) & \cdots & r_{1n}(s) & r_{1n+1}(s) \\ \vdots & & \vdots & \vdots \\ r_{n1}(s) & \cdots & r_{nn}(s) & r_{nn+1}(s) \\ C_0 & \cdots & C_{n-1} & C_n \end{bmatrix} \tag{1-11}$$

is called the last row extension of the matrix (1-10).

Theorem IV

The transfer function of a realizable system defined by the set of integro-differential equations (1-3), with input e and output i_0, is given by

$$T(s) = \frac{\text{DET}\begin{bmatrix} r_{1n+1}(s) & r_{12}(s) & \cdots & r_{1n}(s) \\ \vdots & \vdots & & \vdots \\ r_{nn+1}(s) & r_{n2}(s) & \cdots & r_{nn}(s) \end{bmatrix}}{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{nn}(s) \\ \vdots & & \vdots \\ r_{n1}(s) & \cdots & r_{nn}(s) \end{bmatrix} E(s)} . \tag{1-12}$$

Proof:

By definition, the transfer function of the system is $I_0(s)/E(s)$. Now, by the theorem of linear algebra known as Crammer's Rule

$$I_0(s) = \frac{\text{DET}\begin{bmatrix} r_{1n+1}(s) & r_{12}(s) & \cdots & r_{1n}(s) \\ \vdots & \vdots & & \vdots \\ r_{nn+1}(s) & r_{n2}(s) & \cdots & r_{nn}(s) \end{bmatrix}}{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1n}(s) \\ \vdots & & \vdots \\ r_{n1}(s) & \cdots & r_{nn}(s) \end{bmatrix}} .$$

Corollary I

The transfer function of a realizable system defined by the set of integro-differential equations (1-3), with input e and output i_0 may be expressed as the ratio of two determinants of the last row extension of the matrix associated with the system, namely

$$T(s) = \frac{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1n}(s) & r_{1n+1}(s) \\ \vdots & & \vdots & \vdots \\ r_{n1}(s) & \cdots & r_{nn}(s) & r_{nn+1}(s) \\ -1 & 0 \cdots & 0 & 0 \end{bmatrix}}{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1n}(s) & r_{1n+1}(s) \\ \vdots & & \vdots & \vdots \\ r_{n1}(s) & \cdots & r_{nn}(s) & r_{nn+1}(s) \\ 0 & \cdots & 0 & 1 \end{bmatrix}} \cdot \qquad (1\text{-}13)$$

Proof:

This corollary follows immediately from the above theorem and the rules for expanding and interchanging the columns of determinants.

1.2.2 Method Used by LSD Program

The above corollary is the crux of the method used by the LSD Program to determine the transfer function of a given system.

The LSD user supplies the matrix associated with the given system (1-10) and the last row elements for the numerator and denominator determinants of (1-13). The LSD Program then determines the eigenvalues and eigenvectors of the numerator and denominator matrices. Next, the LSD Program determines the characteristic polynomials of the numerator and denominator matrices. These polynomials are factored so that the poles ($P_1, \ldots, P_n$) and zeros ($Z_1, \ldots, Z_m$) of the transfer function are determined. The transfer function may then be written as

$$T(s) = K_b \frac{\prod_{i=1}^{m} (s-Z_i)}{\prod_{i=1}^{n} (s-P_i)} \cdot \qquad (1\text{-}14)$$

1.2.3 Summary

Thus far in this section, a description of the type of systems for which the LSD Program may be used has been presented. A realizable system has been defined carefully, since this is the only type of system which can be analyzed by the LSD Program. It has been proved that a system is realizable if all of the parameters within the system start out bounded. This is true of physical systems; hence, the LSD Program has a wide range of applications.

Finally, a corollary has been proved which shows that two determinants, that are last row extensions of the matrix associated with a given system, are sufficient to completely define the transfer function of that system. How the LSD Program uses this corollary and certain results from linear algebra to express the transfer function of the system as a ratio of two factored polynomials is also presented.

1.3 ALTERING TRANSFER FUNCTION

When the system described by the set of integro-differential equations (1-3) was introduced, the functions i_0 and e were arbitrarily selected as output and input, respectively. Any other pair of functions could have adopted these roles, or it might be desirable to consider as output for the system the sum of two of these functions. Obtaining these altered transfer functions from the matrix associated with the system may still be done quite easily as is shown in the following two corollaries to Theorem IV.

Corollary II

The transfer function of a realizable system defined by the set of integro-differential equations (1-3) with input i_i and output i_j, where $i, j = 0, 1, \ldots, n, (i_n = e)$ is given by $T(s) = \Delta_1/\Delta_2 \, I_i(s)$ where Δ_1 is the determinant of the matrix (1-11) with $C_0, \ldots, \hat{C}_j, \ldots, C_n = 0, C_j = -1$ and Δ_2 is the determinant of the matrix (1-11) with $C_0, \ldots, \hat{C}_i, \ldots, C_n = 0, C_i = 1$.

Proof:

This corollary follows immediately from Theorem IV and the rules for expanding and interchanging the columns of determinants.

Corollary III

The transfer function of a realizable system defined by the set of integro-differential equations (1-3) with input i_i and output $i_j + i_k$, where i, j, k = 0, 1, . . . , n is given by $T(s) = \Delta_1/\Delta_2 I_i(s)$ where Δ_1 is the determinant of the matrix (1-11) with $C_0, \ldots, \hat{C}_j, \ldots, \hat{C}_k, \ldots, C_n = 0$, $C_j = C_k = -1$ and Δ_2 is the determinant of the matrix (1-11) with $C_0, \ldots, \hat{C}_i, \ldots, C_n = 0$, $C_i = 1$.

Proof:

By definition, the desired transfer function is $T(s) = (I_j(s) + I_k(s))/I_i(s)$. It follows that

$$T(s) = \frac{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1j-1}(s) & r_{1i}(s) & \cdots & r_{1n}(s) \\ \vdots & & \vdots & \vdots & & \vdots \\ r_{n1}(s) & \cdots & r_{nj-1}(s) & r_{ni}(s) & \cdots & r_{nn}(s) \end{bmatrix} + \text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1k-1}(s) & r_{1i}(s) & \cdots & r_{1n}(s) \\ \vdots & & \vdots & \vdots & & \vdots \\ r_{n1}(s) & \cdots & r_{nk-1}(s) & r_{ni}(s) & \cdots & r_{nn}(s) \end{bmatrix}}{\text{DET}\begin{bmatrix} r_{11}(s) & \cdots & r_{1i-1}(s) & r_{1i+1}(s) & \cdots & r_{1n}(s) \\ \vdots & & \vdots & \vdots & & \vdots \\ r_{n1}(s) & \cdots & r_{ni-1}(s) & r_{ni+1}(s) & \cdots & r_{nn}(s) \end{bmatrix} I_i(s)}$$

by Crammer's rule. The desired result follows immediately.

The above corollaries show how versatile the LSD Program input is. Once the matrix associated with a given realizable system has been found, proper selection of the last row elements in the last row extended matrix enable the user to specify the system transfer function with any parameter (or the sum of any parameters) as input and any parameter as output.

1.4 ROOT LOCUS, FREQUENCY RESPONSE, AND TIME RESPONSE ANALYSES

The majority of the discussion thus far has been concerned with determining the transfer function for a realizable system. However, the end product from the LSD Program is usually a root locus, frequency response, or time response analysis. Once the transfer function has

been determined in the form of (1-14), these three analyses can be done quite simply.

The root locus for a given system is simply the collection of points in the complex plane

$$\mathcal{R} = \{s \in C \mid P(s) + L\,Q(s) = 0,\ L \in I\} \tag{1-15}$$

where

$$P(s) = \prod_{i=1}^{n} (s - P_i)$$

$$Q(s) = \prod_{i=1}^{m} (s - Z_i)$$

and I is some set of complex numbers over which L ranges. The choice of I determines if the root locus is a "gain locus" or a "phase locus".

The frequency response for a given system is simply the set of real points

$$f = \{P \mid P = |T(j\omega)|,\ \omega \in I\} \tag{1-16}$$

where T is the transfer function of the system, j is the complex unit (0, 1), and I is an interval along the real axis.

The time response for the given system is the function defined by

$$X(t) = \int_0^t h(t-\tau)\, e(\tau)\, d\tau \tag{1-17}$$

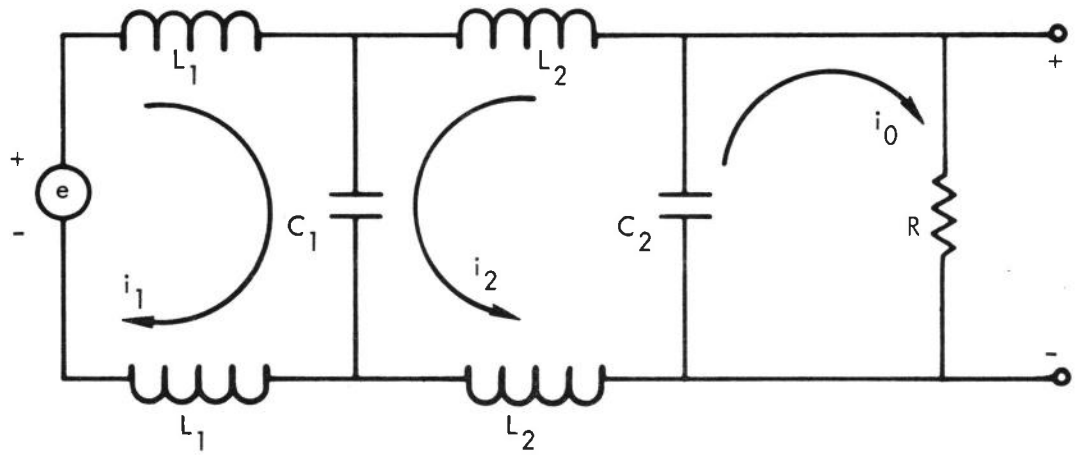
where h is the inverse Laplace transform of the transfer function and e is simply the input function for the system.

The nature of these three very important topics in systems theory has been oversimplified; however, it is assumed that the user is already quite familiar with these topics.

1.5 EXAMPLE

To illustrate the discussion up to this point, a simple electrical network is considered. This example will be continued in Sections 2 and 4 where a complete computer solution will be found.

The network below models an ideal (i.e., loss-less) transmission line:



Voltage e is input and current i_0 is output. From Kirchoff's Voltage Law, the loop equations are written

$$\left.\begin{aligned} i_0 R + \frac{1}{C_2} \int_0^t (i_2 + i_0)\, dt &= 0 \\ 2 L_1 \frac{d i_1}{dt} + \frac{1}{C_1} \int_0^t (i_1 + i_2)\, dt &= e \\ 2 L_2 \frac{d i_2}{dt} + \frac{1}{C_2} \int_0^t (i_2 + i_0)\, dt + \frac{1}{C_1} \int_0^t (i_1 + i_2)\, dt &= 0 \end{aligned}\right\} \quad (1\text{-}18)$$

Using the definition (1-1), the set of equations can be rewritten as

$$\left.\begin{aligned} \left(R + \frac{1}{C_2} P^{-1}\right)[i_0] + \frac{1}{C_2} P^{-1}[i_2] &= 0 \\ \left(2L_1 P + \frac{1}{C_1} P^{-1}\right)[i_1] + \frac{1}{C_1} P^{-1}[i_2] &= e \\ \frac{1}{C_2} P^{-1}[i_0] + \frac{1}{C_1} P^{-1}[i_1] + \left(2L_2 P + \left(\frac{1}{C_2} + \frac{1}{C_1}\right) P^{-1}\right)[i_2] &= 0 \end{aligned}\right\} \quad (1\text{-}19)$$

which corresponds in the discussion to the set of integro-differential equations (1-3). All initial conditions assumed to be zero (except possibly e(0+), which is assumed to be bounded) and the Laplace transform of each side of this set of equations is taken.

$$\left.\begin{aligned} \left(R + \frac{1}{C_2}\frac{1}{s}\right) I_0(s) + \frac{1}{C_2}\frac{1}{s} I_2(s) &= 0 \\ \left(2L_1 s + \frac{1}{C_1}\frac{1}{s}\right) I_1(s) + \frac{1}{C_1}\frac{1}{s} I_2(s) &= E(s) \\ \frac{1}{C_2}\frac{1}{s} I_0(s) + \frac{1}{C_1}\frac{1}{s} I_1(s) + \left(2L_2 s + \left(\frac{1}{C_2} + \frac{1}{C_1}\right)\frac{1}{s}\right) I_2(s) &= 0 \end{aligned}\right\} \quad (1\text{-}20)$$

Each side of the above equations is multiplied by s and the order of the equations is rearranged to obtain the equivalent set

$$\left.\begin{aligned} \left(Rs + \frac{1}{C_2}\right) I_0(s) + \frac{1}{C_2} I_2(s) &= 0 \\ \frac{1}{C_2} I_0(s) + \frac{1}{C_1} I_1(s) + \left(2L_2 s^2 + \frac{1}{C_1} + \frac{1}{C_2}\right) I_2(s) &= 0 \\ \left(2L_1 s^2 + \frac{1}{C_1}\right) I_1(s) + \frac{1}{C_1} I_2(s) &= sE(s) \end{aligned}\right\} \quad (1\text{-}21)$$

Polynomials in the form (1-4) have been constructed, and the set of equations specified in (1-5) have been established; hence, the network is a realizable system. Theorem III could have been used to determine that

the network was a realizable system since it was given that all initial conditions were zero and that e(0+) is bounded; however, by constructing the set of equations, (1-21) it is possible to immediately write down the matrix associated with the network,

$$\begin{bmatrix} Rs + \frac{1}{C_2} & 0 & \frac{1}{C_2} & 0 \\ \frac{1}{C_2} & \frac{1}{C_1} & 2L_2 s^2 + \left(\frac{1}{C_1} + \frac{1}{C_2}\right) & 0 \\ 0 & 2L_1 s^2 + \frac{1}{C_1} & \frac{1}{C_1} & s \end{bmatrix} \quad (1\text{-}22)$$

This example will be continued in Sections 2 and 4 where the LSD Program will be used to find the frequency response of the network and the time response of the network with step function and ramp function inputs.

2. INPUT

A data deck is defined as all of the Hollerith cards, in their proper sequence, that the user is required to submit for any particular computer run, exclusive of machine control cards. The LSD data deck is simple and is divided into successive data cases, with each data case being in the same form.

Data for each data case are entered (all at one time) via the FORTRAN namelist $DATA. The symbols "$DATA" must appear in columns two through six of the first data card. Input parameters may then be entered in any order, beginning in any column (except column one), in the form PARAM1 = xxxxx, PARAM2 = xxxxx, . . . The only restrictions are that no punch ever appear in column one and that no entry be split between two Hollerith cards. The latter restriction is imposed because a comma is automatically assumed at the end of each Hollerith card.

After all the desired input parameters have been entered (not every parameter need be entered), a card containing the symbols "$END" in columns two through five must appear immediately after the last data card; this signifies the end of input data for this particular data case. Following the "$END" card, from one to five comment/description cards may appear. These cards will be printed as headings to the output listing for this particular data case. After the last comment/description card, another data case may appear.

Each of the LSD parameters listed below is initialized to zero unless otherwise specified. The value of each LSD parameter remains unchanged from one data case to the next unless it is explicitly changed by the user. LSD parameters are unaffected by program calculations; each parameter has the value to which it was initialized or the value to which it was last set by the user.

2.1 DETAILED DESCRIPTION OF GENERAL INPUT OPTIONS

Mnemonic	Description
CLEAR	= 0, no effect = 1, input matrix cleared of any values left over from this data case before the next data case is processed.

Mnemonic	Description
COMENT	= 0, no effect = N (N = 1,...,5), number of comment/ description cards that must follow the "$END" card terminating the data input for this data case
INPUT	= 1, matrix is input for transfer function = 2, S-plane poles, zeros, and gain are input for transfer function = 3, option not currently used = 4, matrix is input; however, only eigenvalues and eigenvectors are to be determined INPUT is initialized to 2.
NOVFLS	Number of overflow messages to be printed. NOVFLS is initialized to 100.
NUNFLS	Number of underflow messages to be printed.*
PLOT	= 0, no effect = 1, data generated during this data case will be output on a data tape mounted on unit "F" (FORTRAN ID number 8) for use by the TRWPLT general plotting program
SFREQR(J)	= 0, no effect = 1, frequency response will be calculated for the J-th determinant ratio (J = 1,...,7)
SROOTL(J)	= 0, no effect = 1, root locus will be calculated for the J-th ratio
STIMER(J)	= 0, no effect = 1, time response will be calculated for the J-th ratio

2.2 DETAILED DESCRIPTION OF S-PLANE INPUT PARAMETERS

Mnemonic	Description
SNP	Total number of poles being input. This parameter is interrogated only if INPUT = 2. A maximum of 100 poles is allowed.

*Because of the manner in which UNIVAC 1108 arithmetic is performed and the very small imaginary parts that may be generated in complex arithmetic operations, it is quite normal to encounter underflows during program execution. These underflows do not affect the accuracy of the results; therefore, NUNFLS is initialized to zero.

Mnemonic	Description
SNZ	Total number of zeros being input. This parameter is interrogated only if INPUT = 2. A maximum of 100 zeros is allowed.
SP(I)	The I-th pole in complex form (I = 1, . . . , 50). Only one member of a conjugate pair is input. These parameters are interrogated only if INPUT = 2.
SZ(I)	The I-th zero in complex form. Only one member of a conjugate pair is input. These parameters are interrogated only if INPUT = 2.
SKRL	Root locus gain.* This parameter is interrogated only if INPUT = 2.
SKB	Bode gain.* This parameter is interrogated only if INPUT = 2.
ASNP(J)	Number of additional poles for the J-th ratio
ASNZ(J)	Number of additional zeros for the J-th ratio
ASP(I, J)	Additional poles for the J-th ratio**
ASZ(I, J)	Additional zeros for the J-th ratio**
ASKRL(J)	Additional root locus gain for the J-th ratio***
ASKB(J)	Additional bode gain for the J-th ratio***

2.3 DETAILED DESCRIPTION OF MATRIX INPUT PARAMETERS

Mnemonic	Description
D(I, K)	Contains a last row element for the K-th determinant, if I is even; D(I-1, K) contains the number of the column to which this element belongs (I = 2, . . . , 20).

*When INPUT = 2, either root locus gain or bode gain must be zero, but not both.

**These are poles and zeros in addition to those calculated from the matrix input. In this manner, poles and zeros which are known (as for compensation) may be input directly, thus simplifying the matrix input. Additional poles and zeros may also be input when INPUT = 2.

***Additional gain means that the existing gain is multiplied by the additional gain. Additional gains may be either root locus or bode, regardless of which type of gain was originally input.

Mnemonic	Description
RATIO (1, J)	Number of the determinant to be used for the numerator of the J-th (transfer function) ratio
RATIO(2, J)	Number of the determinant to be used for the denominator of the J-th ratio
NROOTS(J)	Is the maximum number of roots to be found for the characteristic polynomial of the J-th determinant. If NROOTS(J) = 0, ORDER × DEGREE will be used as the maximum number of roots to be found.
NFAKES(J)	Number of roots already known for the characteristic polynomial of the J-th determinant. These roots are to be input and not calculated.
EST(I, J)	Estimate for the I-th root of the characteristic polynomial of the J-th determinant, entered in complex form. The NFAKES(J) number of roots which are already known must be the first "estimates" for the J-th determinant. Only one member of a conjugate pair is entered (I = 1, . . . , 50).
LEADCO(J)	Leading coefficient of the characteristic polynomial for the J-th determinate. LEADCO(J) is entered if and only if all roots for the characteristic polynomial of the J-th determinate are input.
LASTCO(J)	Last non-zero coefficient of the characteristic polynomial for the J-th determinant. LASTCO(J) is entered if and only if LEADCO(J) is entered.
SCALE1	Scale factor to prevent overflows and underflows while triangularizing the matrix. SCALE1 is initialized to 1.*
SCALE2	Scale factor to prevent overflows and underflows while triangularizing the matrix. SCALE2 is initialized to 1.*
ORDER	Order of the input matrix; i. e., the number of columns in the input matrix. A maximum order of 40 is the standard option.
DEGREE	Highest degree of the polynomial terms in the input matrix. A maximum degree of 5 is the standard option.

*The LSD user should never have occasion to use SCALE1 or SCALE2.

Mnemonic	Description
AMAT(L, M)	Matrix for the highest, K-th, degree terms in the input matrix (M = 1, . . . , 40, L = 1, . . . , M-1).
BMAT(L, M)	Matrix for the (K-1)-th degree terms of the input matrix
CMAT(L, M)	Matrix for the (K-2)-th degree terms of the input matrix
DMAT(L, M)	Matrix for the (K-3)-th degree terms of the input matrix
EMAT(L, M)	Matrix for the (K-4)-th degree terms of the input matrix
FMAT(L, M)	Matrix for the (K-5)-th degree terms of the input matrix
SELECT	Enables the user to input matrices of orders greater than 40 (up to 60) and degree greater than 5 (up to 107), but not both = 0, no effect (matrix is input as above) = 10, ORDER ≤ 10, DEGREE ≤ 107. = 20, ORDER ≤ 20, DEGREE ≤ 24. = 30, ORDER ≤ 30, DEGREE ≤ 11. = 40, ORDER ≤ 40, DEGREE ≤ 5. = 50, ORDER ≤ 50, DEGREE ≤ 3. = 60, ORDER ≤ 60, DEGREE ≤ 2.
M10(L, M, N)	Matrix input for SELECT = 10. N = 1 for highest degree terms, N = 2 for next highest degree terms, etc.
M20(L, M, N)	Matrix input for SELECT = 20
M30(L, M, N)	Matrix input for SELECT = 30
M40(L, M, N)	Matrix input for SELECT = 40
M50(L, M, N)	Matrix input for SELECT = 50
M60(L, M, N)	Matrix input for SELECT = 60

2.4 DETAILED DESCRIPTION OF FREQUENCY RESPONSE INPUT PARAMETER

Mnemonic	Description
FREQ(I)	FREQ is a table of 543 entries containing 143 standard frequencies ranging from 0.628 radians to 2513 radians, preceded by 200 zero entries

Mnemonic	Description
	and followed by 200 zero entries. Additional frequencies may be added to this table by the user. Additional frequencies are automatically generated by the LSD program near resonance points.

2.5 DETAILED DESCRIPTION OF ROOT LOCUS INPUT PARAMETERS

Mnemonic	Description
PHASE(J)	= 0, root locus for the J-th ratio will be zero degree phase = 1, root locus for the J-th ratio will be 180 degree phase
DBUP(J)	= 0, increasing gain locus will not be performed for the J-th ratio ≠ 0, increasing gain locus will be performed for the J-th ratio up to DBUP(J) decibels from the nominal gain
DBDOWN(J)	= 0, decreasing gain locus will not be performed for the J-th ratio ≠ 0, decreasing gain locus will be performed for the J-th ratio down to DBDOWN(J) decibels from the nominal gain
PHUP(J)	= 0, increasing phase locus will not be performed for the J-th ratio ≠ 0, increasing phase locus will be performed for the J-th ratio up to PHUP(J) degrees from the nominal phase
PHDOWN(J)	= 0, decreasing phase locus will not be performed for the J-th ratio ≠ 0, decreasing phase locus will be performed for the J-th ratio down to PHDOWN(J) degrees from the nominal phase
STEPDU(J)	Maximum step size (in decibels) for the increasing gain locus, for the J-th ratio
STEPDD(J)	Maximum step size (in decibels) for the decreasing gain locus, for the J-th ratio
STEPPU(J)	Maximum step size (in degrees) for the increasing phase locus, for the J-th ratio
STEPPD(J)	Maximum step size (in degrees) for the decreasing phase locus, for the J-th ratio

Mnemonic	Description
NCLPOL(J)	Total number of closed-loop poles, for the J-th ratio, for which the root locus is desired. If this entry is zero, the number of open loop poles will be used.
CLPOLE(I)	Estimates for the closed loop poles, in complex form. Only one member of a conjugate pair is entered (I = 1, . . . , 50). If these entries are zero, the open loop poles will be used.

2.6 DETAILED DESCRIPTION OF TIME RESPONSE INPUT PARAMETERS

Mnemonic	Description
STARTT	Start time for computing the output response
FINALT	Maximum time for computing output response
DELTAT	Time increment
POLYN(J)	Number of polynomial segments in the input function for the J-th ratio. POLYN(J) must be less than 100.
POLYT(I, J)	The I-th discrete time for the input function for the J-th ratio (I = 1, . . . , 100).
POLYC(I, J)	The I-th coefficient for the input polynomial for the J-th ratio (I = 1, . . . , 300). The coefficients must be in the order: constant, linear, and quadratic for segment one; constant, linear, and quadratic for segment two; etc.

2.7 EXAMPLE

In Section 1.4, the matrix associated with a network representing an ideal transmission line was shown to be

$$\begin{bmatrix} Rs + \frac{1}{C_2} & 0 & \frac{1}{C_2} & 0 \\ \frac{1}{C_2} & \frac{1}{C_1} & 2L_2 s^2 + \left(\frac{1}{C_1} + \frac{1}{C_2}\right) & 0 \\ 0 & 2L_1 s^2 + \frac{1}{C_1} & \frac{1}{C_1} & s \end{bmatrix} \qquad (1\text{-}22)$$

To find the frequency response and time response (with specified input voltage) of this network, general input options might be:

```
COMENT = 2
INPUT = 1
PLOT = 1
SFREQR = 1
STIMER = 1, 1
```

No S-plane input parameters are needed since no additional poles, zeros, or gains are to be added. Matrix input parameters might be:

```
D(1, 1) = 1, -1, D(1, 4) = 4, 1
RATIO(1, 1) = 1, 4, RATIO(1, 2) = 1, 4
ORDER = 4
DEGREE = 2
AMAT(3, 2) = 2L1, AMAT(2, 3) = 2L2
BMAT(1, 1) = R, BMAT(3, 4) = 1
CMAT(1, 1) = 1/C2, 1/C2, CMAT(2, 2) = 1/C1, 1/C1
CMAT(1, 3) = 1/C2, 1/C1 + 1/C2, 1/C1
```

The standard form of matrix input was used, since the order of the input matrix was less than 41 and the degree of the polynomials was less than 6. If the input matrix has order greater than 40 (this would be the case if the ideal transmission line had more than 38 "segments" rather than just two), the following option could be used:

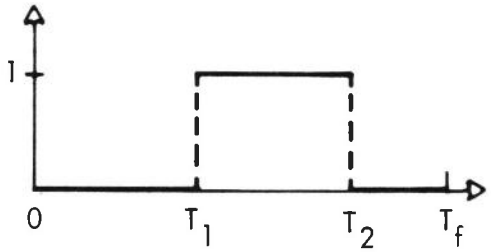
```
SELECT = 60
```

and then input the matrix as

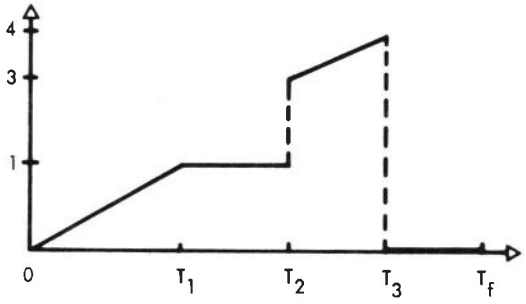
```
M60(3, 2, 1) = 2L1, M60(2, 3, 1) = 2L2
M60(1, 1, 2) = R, M60(3, 4, 2) = 1
M60(1, 1, 3) = 1/C2, 1/C2, M60(2, 2, 3) = 1/C1, 1/C1
M60(1, 3, 3) = 1/C2, 1/C1 + 1/C2, 1/C1
```

This would produce the same input matrix as the former entries produced.

No frequency response input is required since the standard frequency response table will be used. No root locus input is required as this option is not used. Two time response analyses, with the following two different driving functions will be executed.



DRIVING FUNCTION FOR RATIO 1



DRIVING FUNCTION FOR RATIO 2

Possible time response inputs are:

FINALT = T_f
DELTAT = Δ_t
POLYN = 3, 4
POLYT(1, 1) = 0, T_1, T_2, T_f, POLYT(1, 2) = 0, T_1, T_2, T_3, T_f
POLYC(4, 1) = 1
POLYC(1, 2) = 0, $1/T_1$, 0, 1, 0, 0, 3, $1/(T_3-T_2)$

This example will be continued in Section 4 where the computer solution will be found.

3. OUTPUT

Output for the LSD Program is in the form of printed output and data tape output. Described here are the output formats; refer to Section 4 for the actual printed output from a computer run.

3.1 DETAILED DESCRIPTION OF STANDARD PRINTED OUTPUT

The printed output that the LSD user may always expect is described below. In the following section, error and warning messages that may be output by the LSD Program are described.

3.1.1 Detailed Description of General LSD Output

Certain output is always obtained when the LSD Program is executed and allowed to terminate normally. This general output consists of a heading page for each data case input (provided no input errors have occurred) listing the various LSD options and a summary page printed immediately after the end of the last data case processed. The summary page includes the number of data cases that the LSD Program attempted to process and the current date and time (on a 24 hour clock) at which LSD execution was terminated.

3.1.2 Detailed Description of Matrix Output

If INPUT = 1 or INPUT = 4, the input matrix will be printed out, highest degree terms first, followed by successive printouts, one for each determinant considered. For each such matrix, the last row elements are listed, followed by the eigenvalues (and their iterants) and eigenvectors, for this matrix. The output is concluded by a listing of the leading, last non-zero and last coefficients of the characteristic polynomial of this matrix.

3.1.3 Detailed Description of Transfer Function Output

Following the matrix output (or the heading page, if INPUT = 2), the resultant transfer function is printed for this ratio. The poles, zeros, bode gain, root locus gain, and ratio of root locus gain to bode gain are printed out.

3. 1. 4 Detailed Description of Root Locus Output

The root locus output follows the transfer function output or the output from a previous analysis.

The root locus header page prints all pertinent root locus information, including the centroid of the locus, the initial phase and gain, and the nominal closed-loop poles as well as the estimates that were input for the nominal closed-loop poles.

Following the root locus header page, the root locus branches are printed in the order: increasing gain (for each of the closed-loop poles), decreasing gain (for each of the closed-loop poles), increasing phase (for each of the closed-loop poles) and decreasing phase (for each of the closed-loop poles).

3. 1. 5 Detailed Description of Frequency Response Output

No frequency response header page is printed. The frequency response analysis is printed in eight columns immediately following the transfer function output or a previous analysis. These columns are: frequency (radians per second), frequency (Hz), real part of the transfer function, imaginary part of the transfer function, gain (ratio), gain (dB), phase (degrees) and phase margin (degrees).

3. 1. 6 Detailed Description of Time Response Output

The time-response output follows the transfer function output or the output from a previous analysis.

The time response header page prints all pertinent information on the time response analysis, including the residues of each non-zero pole and all of the coefficients in the Laurent expansion of the transfer function about the origin if a pole exists at the origin; these are referred to in the output as the "LAMBDA'S".

Following the time response header page, the time response analysis is printed in four columns: time (seconds), response function, inverse Laplace transform of the transfer function, and driving function.

3.2 DETAILED DESCRIPTION OF NON-STANDARD PRINTED OUTPUT

A number of error and warning messages may occasionally be generated by the LSD Program; these are listed below.

Message	Remarks
********* OVERFLOW OCCURRED AT LOCATION _____	
********* UNDERFLOW OCCURRED AT LOCATION _____	
********* THIS IS THE LAST OVERFLOW MESSAGE	
********* THIS THE LAST UNDERFLOW MESSAGE	
AN ERROR IN THE NAME LIST '$DATA' WAS ENCOUNTERED CAUSING ONE DATA CASE TO BE LOST.	This message might be generated by a tape read error, but more likely by an error in one of the namelist cards. Suggestion: examine each card carefully for this data case and, if no error can be found, rerun the case. This error may cause errors to result with successive data cases, causing the entire run to terminate.
CASE ABORTED BECAUSE INPUT = ___ IS NOT ALLOWED.	
CASE ABORTED BECAUSE NUMBER OF ZEROS EXCEEDS NUMBER OF POLES.	This message can be encountered only if INPUT = 2.
CASE ABORTED BECAUSE NEITHER BODE GAIN NOR ROOT LOCUS GAIN WERE INPUT.	This message can be encountered only if INPUT = 2.
CASE ABORTED BECAUSE BOTH BODE GAIN AND ROOT LOCUS GAIN WERE INPUT.	This message can be encountered only if INPUT = 2.
RATIO __ CANNOT BE SOLVED-- DETERMINANT ___ .	One cause for this message is contradictory specification of matrix input parameters.

Message	Remarks
AN ERROR OCCURRED IN DETERMINING THE EIGENVALUES AND/OR EIGENVECTORS. THIS CASE WILL BE ABORTED.	Either ORDER or DEGREE was input as zero.
UNSUCCESSFUL DETERMINATION OF EIGENVALUES FOR DETERMINANT ___ .	
EITHER LEADCO OR LASTCO OF DETERMINANT __, A DETERMINANT WITH KNOWN ROOTS, INPUT AS ZERO - DETERMINANT NOT PROCESSED.	
AN ERROR OCCURRED IN THE ABOVE CALCULATIONS.	If this message follows a root locus analysis, either bode and root locus gain are zero or number of zeros exceeds number of poles. If this message follows a frequency response analysis, all elements of the table FREQ are zero. If this message follows a time response analysis, either the number of zeros exceeds the number of poles or the number of polynomial segments is greater than 100.
AN ERROR OCCURRED IN CALCULATING THE RESIDUES AND/OR LAMBDA'S. CALCULATION OF THE TIME RESPONSE WILL BE ABORTED.	This message may be generated during the time response analysis because of improper input. The input should satisfy the following conditions: • Total number of zeros must be less than the sum of the number of non-zero poles and the number of poles at the origin. • If the number of zeros exceeds the number of non-zero poles, there must be two or three poles at the origin. • Multiple poles are allowed only at the origin.
********* ERROR OCCURRED IN TIME RESPONSE CALCULATION.	

Message	Remarks
********* COUNTER HAS BEEN EXCEEDED.	During the Eigenvalue determination, the number of iterants became too large for the allotted storage.
AN ERROR OCCURRED IN CALCULATING THE NOMINAL CLOSED-LOOP POLES. CALCULATION OF THE ROOT LOCUS BRANCHES WILL BE ABORTED.	Error termination in the subroutine ROOT that solves the root locus function.
BODE GAIN ATTAINED A VALUE OF ZERO. THIS CASE WILL BE ABORTED.	May occur during root locus analysis.
********* AN ERROR OCCURRED IN ROOT LOCUS CALCULATION.	

3.3 DETAILED DESCRIPTION OF DATA TAPE OUTPUT

One or more files is generated on the data tape for each data case that has PLOT = 1. One file is generated for each root locus, frequency response, or time response analysis that is performed during such a data case.

For the frequency response and time response files, one record is generated for each line of output in the response table. The first word of each record corresponds to the value in the first column of any given line, the second word corresponds to the second column, etc. There are eight columns in the frequency response table and four columns in the time response table; hence, records in the frequency response files are eight words long, and records in the time response files are four words long.

For the root locus files, N + 4 record types are generated within the file. Records of type 1 contain all abscissa points; records of types 2, 3, and 4 contain, respectively, the ordinate points of the zeros, open-loop poles and nominal closed-loop poles; records of types 5, . . . , N + 4 contain the ordinate points of the N root locus branches in the order they are printed out.

The above formats are as required by the TRWPLT general plotting program.

4. SAMPLE CASE

A sample computer run is included to demonstrate program capabilities and options. The first data case considered is a continuation of the example started in Sections 1 and 2. Since this program is designed to be used with the TRWPLT General Plotting Program, the plot input and output are included with this sample case.

DATE 9 Dec 68 | PRIORITY | TRW SYSTEMS HOUSTON COMPUTING CENTER | CARD STOCK: ✖ YELLOW | PAGE 1 OF 11
NAME C. ARGILA | PROBLEM NO H38301 | 80 COLUMN FREE KEY PUNCH FORM | ☐ NORTHERN BLUE | KEYPUNCHED BY:
EXT 2503 | SPECIAL CHARACTERS | ☐ | VERIFIED BY:
NO. OF CARDS 208

```
$DATA
INPUT = 1
CØMENT = 2
CLEAR = 1
PLØT = 1
ØRDER = 4
DEGREE = 2
RATIØ(1,1) = 1, 4, RATIØ(1,2) = 1, 4
D(1,1) = 1, -1.0, D(1,4) = 4, +1.0
AMAT(2,3) = 2, AMAT(3,2) = 1
BMAT(1,1) = 1, BMAT(3,4) = 1
CMAT(1,1) = 2, 2, CMAT(2,2) = 4, 4, CMAT(1,3) = 2, 6, 4
SFREQR = 1
STIMER = 1, 1, DELTAT = 0.1, FINALT = 20.0, PØLYN = 3, 4
PØLYT(1,1) = 0.0, 1.0, 12.0, 20.0, PØLYT(1,2) = 0.0, 5.0, 10.0, 15.0, 20.0
PØLYC(1,1) = 0, 0, 0, 1, 0, 0, 0, 0, 0, PØLYC(1,2) = 0, 0.2, 0, 1, 0, 0, 3,
0.2, 0, 0, 0, 0
$END
SAMPLE CASE -- DELAY LINE NETWØRK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0
```

STL FORM 708 REV. 5 69

DATE _____ PRIOR TY _____

NAME _____ PROBLEM NO _____

EXT _____

NO OF CARDS _____

TRW SYSTEMS
HOUSTON COMPUTING CENTER

80 COLUMN FREE KEY PUNCH FORM

CARD STOCK

PAGE 2 OF _____

KEYPUNCHED BY _____

VERIFIED BY _____

```
$DATA
INPUT = 4
CØMENT = 1
PLØT = 0
SFRERR = 0
STIMER = 0, 0
ØRDER = 24
DEGREE = 2
NRØØTS = 25
DX(1,1) = 23, -1.0, RATIØ(1,2) = 0, 0
NFAKES = 1
EST(1,1) = (0.0,0.0), (-6.6,31.08), (-10.7,40.07), (-8.1,42.2), (-.47,9.0),
(14.4,0.0), (-.31,38.5)
AMAT(1,1) = 1.0, AMAT(2,2) = 1.0, AMAT(3,3) = 1.0, AMAT(4,4) = 1.0,
AMAT(5,1) = 0.0308768, AMAT(5,2) = -.626025E-2, AMAT(5,3) = .905084,
AMAT(5,4) = -.870069E-2, AMAT(6,1) = -.0308927, AMAT(6,2) = .159747E-1,
AMAT(6,3) = 4.83398, AMAT(6,4) = -.0380289, AMAT(9,1) = .928642E-2,
AMAT(9,2) = -.287587E-2, AMAT(9,3) = -.297798, AMAT(9,4) = .002008,
AMAT(10,1) = -.657993E-2, AMAT(10,2) = .159819E-2, AMAT(10,3) = .0657256,
AMAT(10,4) = -.35147E-3, AMAT(14,1) = .0308768, AMAT(14,2) = -.626025E-2,
```

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DATE _____ PRIORITY _____ TRW SYSTEMS CARD STOCK PAGE 3 OF _____

NAME _____ PROBLEM NO _____ HOUSTON COMPUTING CENTER ☐ PLAIN _____ KEYPUNCHED BY _____

EXT _____ SPECIAL CHARACTERS ☐ FORTRAN SOURCE

NO. OF CARDS _____ **80 COLUMN FREE KEY PUNCH FORM** ☐ 7094 SYMBOLIC VERIFIED BY _____

```
AMAT(14,3) = .905084, AMAT(14,4) = -.870069E-2, AMAT(15,1) = -.018219,
AMAT(15,2) = .0121385, AMAT(15,3) = 4.45684, AMAT(15,4) = -.0355044,
AMAT(18,1) = .928642E-2, AMAT(18,2) = -.287587E-2, AMAT(18,3) = -.297798,
AMAT(18,4) = .002008, AMAT(19,1) = .162103E-2, AMAT(19,2) = -.884201E-3,
AMAT(19,3) = -.178314, AMAT(19,4) = .128209E-2, AMAT(12,10) = .620577E-4,
AMAT(21,19) = .620577E-4
BMAT(1,1) = .756, BMAT(2,2) = .808, BMAT(3,3) = .1106E1, BMAT(4,4) = .1137E1,
BMAT(6,1) = -.968424E1, BMAT(6,2) = .500775E1, BMAT(6,3) = .151535E4,
BMAT(6,4) = -.119213E2, BMAT(10,1) = -.318762E1, BMAT(10,2) = .774239,
BMAT(10,3) = .318405E2, BMAT(10,4) = -.170268, BMAT(15,1) = -.571131E1,
BMAT(15,2) = .380516E1, BMAT(15,3) = .139713E4, BMAT(15,4) = -.111299E2,
BMAT(19,1) = .785305, BMAT(19,2) = -.428348, BMAT(19,3) = -.863836E2,
BMAT(19,4) = .621105, BMAT(6,7) = -1.0, BMAT(10,11) = -1.0, BMAT(15,16) = -1.9,
BMAT(19,20) = -1.0, BMAT(5,5) = .67E-2, BMAT(9,9) = .1815E-2,
BMAT(14,14) = .65E-2, BMAT(18,18) = .1815E-2, BMAT(6,5) = .22E-1,
BMAT(6,6) = -.22E-1, BMAT(10,9) = .22E-1, BMAT(10,10) = -.22E-1,
BMAT(8,6) = .281E-2, BMAT(12,10) = .273207E-1, BMAT(12,12) = -.124614E-1,
BMAT(12,13) = .1426BE-1, BMAT(15,14) = .22E-1, BMAT(15,15) = -.22E-1,
BMAT(19,18) = .22E-1, BMAT(19,19) = -.22E-1, BMAT(17,15) = .281E-2,
BMAT(21,19) = .273207E-1, BMAT(21,21) = -.124614E-1, BMAT(21,22) = .142683E-1,
```

STL FORM 706 REV. 8-65

DATE _____ PRIORITY _____ TRW SYSTEMS HOUSTON COMPUTING CENTER CARD STOCK PAGE 4 OF _____

NAME _____ PROBLEM NO _____ ☐ PLAN _____ KEYPUNCHED BY _____

EXT _____ SPECIAL CHARACTERS ☐ FORTRAN SOURCE

NO. OF CARDS _____ **80 COLUMN FREE KEY PUNCH FORM** ☐ JOBS SYMBOLIC VERIFIED BY _____

```
BMAT(13,13) = -.2E-1, BMAT(22,22) = -.2E-1,
CMAT(1,1) = .9468E3, CMAT(2,2) = .1632E4, CMAT(3,3) = .3060E4,
CMAT(4,4) = .3235E4, CMAT(1,24) = -.243598E-3, CMAT(2,24) = .125615E-3,
CMAT(3,24) = .211494E-4, CMAT(4,24) = -.123579E-4, CMAT(5,7) = 1.0,
CMAT(7,8) = -1.0, CMAT(8,8) = -1.0, CMAT(9,11) = 1.0, CMAT(11,12) = -1.0,
CMAT(13,13) = -1.0, CMAT(14,16) = 1.0, CMAT(16,17) = -1.0, CMAT(17,17) = -1.0,
CMAT(18,20) = 1.0, CMAT(20,21) = -1.0, CMAT(22,22) = -1.0, CMAT(23,23) = -1.0,
CMAT(5,5) = .296292E-2, CMAT(9,9) = .290066E-2, CMAT(14,14) = .296292E-2,
CMAT(18,18) = .290066E-2, CMAT(6,5) = .689655E1, CMAT(6,6) = -.689655E1,
CMAT(15,14) = .689655E1, CMAT(15,15) = -.689655E1, CMAT(10,9) = .3367E1,
CMAT(10,10) = -.3367E1, CMAT(19,18) = .3367E1, CMAT(19,19) = -.3367E1,
CMAT(7,6) = -.216, CMAT(16,15) = -.216, CMAT(11,10) = -.405,
CMAT(20,19) = -.405, CMAT(7,7) = 1.0325, CMAT(16,16) = 1.0325,
CMAT(11,11) = 1.124, CMAT(20,20) = 1.124, CMAT(8,6) = .37, CMAT(12,10) = 1.52636
CMAT(12,12) = -1.6138, CMAT(12,13) = 1.8478, CMAT(17,15) = .37,
CMAT(21,19) = 1.52636, CMAT(21,21) = -1.6138, CMAT(21,22) = 1.8478,
CMAT(13,6) = .1806, CMAT(13,10) = .1806, CMAT(22,15) = .1806,
CMAT(22,19) = .1806, CMAT(8,13) = 1.145, CMAT(17,22) = 1.145,
CMAT(23,7) = -.29095E3, CMAT(23,11) = -.2668E3, CMAT(23,13) = .1987E4,
CMAT(23,16) = -.1020E4, CMAT(23,20) = -.928E3, CMAT(23,22) = .69115E4
```

STL FORM 708 REV. 5 65

DATE _____ PRIORITY _____ TRW SYSTEMS HOUSTON COMPUTING CENTER CARD STOCK PAGE 5 OF _____

NAME _____ PROBLEM NO _____ ☐ PLAN _____ KEYPUNCHED BY _____

EXT _____ SPECIAL CHARACTERS ☐ FORTRAN SOURCE

NO. OF CARDS _____ **80 COLUMN FREE KEY PUNCH FORM** ☐ 7094 SYMBOLIC VERIFIED BY _____

```
$END
                    EIGENVALUE TEST CASE
$DATA
INPUT = 2
PLOT = 1
COMENT = 1
SROOTL = 1
SNP = 2, SP = (-1.5,1.0)
SNZ = 1, SZ = (-1.0,0.0)
SKRL = 1.0
DBUP = 10.0, DBDOWN = 40.0, PHUP = 60.0, PHDOWN = 60.0
STEPDU = 0.5, STEPDD = 0.5, STEPPU = 2.0, STEPPD = 2.0
$END
                ROOT LOCUS TEST CASE NO. 1 (D'AZZO & HOUPIS, P. 234)
$DATA
PHASE = 1
DBUP = 2.0
STEPDU = 0.1
$END
                    ROOT LOCUS TEST CASE NO. 2
```

STL FORM 700 REV. 8-65

DATE _____ PRIORITY _____ TRW SYSTEMS PAGE 6 OF _____

NAME _____ PROBLEM NO _____ HOUSTON COMPUTING CENTER CARD STOCK

EXT _____ SPECIAL CHARACTERS

NO OF CARDS _____ 80 COLUMN FREE KEY PUNCH FORM

☐ PLAIN _____ KEYPUNCHED BY _____

☐ FORTRAN SOURCE

☐ 7094 SYMBOLIC VERIFIED BY _____

```
$DATA
SRØØTL = 0
SFREQR = 1
SKB = 4.0, SKRL = 0.0
SNZ = 1, SZ = (-2.0,0.0)
SNP = 4, SP = (0.0,0.0), (-0.5,0.0), (-1.6,7.84)
$END
        FREQUENCY RESPØNSE TEST CASE (D'AZZØ & HØUPIS, P. 298)
$DATA
SFREQR = 0
STIMER = 1
SNP = 3, SP = (-2.0,1.0), (0.0,0.0)
SNZ = 2, SZ = (-5.0,0.0), (-1.0,0.0)
SKRL = 1.0, SKB = 0.0
DELTAT = 0.05, FINALT = 5.0, PØLYT = 0.0, 10.0, PØLYN = 1, PØLYC = 1.0, 0, 0
$END
        TIME RESPØNSE TEST CASE (VAN VALKENBURG P. 144)
```

STL FORM 708 REV. 5-65

DATE _____ PRIORITY _____

NAME _____ PROBLEM NO _____

EXT _____ SPECIAL CHARACTERS

NO OF CARDS _____

TRW SYSTEMS
HOUSTON COMPUTING CENTER

80 COLUMN FREE KEY PUNCH FORM

CARD STOCK
☐ PLAIN _____
☐ FORTRAN SOURCE
☐ 1394 SYMBOLIC

PAGE 1 OF _____

KEYPUNCHED BY _____

VERIFIED BY _____

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
V XQT TRWPLT
N@IREC = 1
NTYPE=2
TITLE=ID=SAMPLE CASE -- DELAY LINE NETW@RK
XLABEL=ID=FREQUENCY(RAD/SEC)
YLABEL=ID=GAIN -- PHASE
CADD = 0.0, 0.0, -180.0
PL@T = 1,6,8,ENDLST
ENDPLT
ENDFIL
NTYPE = 0
CADD=0.0,0.0,0.0
XLABEL=ID=TIME(SEC)
YLABEL=ID=RESP@NSE -- DRIVING FUNCTI@N
PL@T=1,2,4,ENDLST
ENDPLT
ENDFIL
REPEAT
N@IREC=0
XLABEL=ID=
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
```

STL FORM 700 REV. 8-65

DATE _____ PRIORITY _____ PAGE 8 OF _____

NAME _____ PROBLEM NO _____ TRW SYSTEMS

EXT _____ SPECIAL CHARACTERS HOUSTON COMPUTING CENTER

NO. OF CARDS _____ 80 COLUMN FREE KEY PUNCH FORM

CARD STOCK ☐ PLAIN _____ ☐ ORIGINAL SOURCE ☐ _____

KEYPUNCHED BY _____ VERIFIED BY _____

```
YLABEL=ID=
TITLE=ID=SAMPLE RΦΦT LΦCUS PLΦT (GAIN)
XHI = +0.1
XLΦ = -2.3
YHI = 1.12
YLΦ = -0.05
PLΦT = 1,1, 1,5, 1,6, ENDLST
ENDPLT
NΦADV=1
NCHAR=-20
PLΦT = 1,1, 1,2, ENDLST
ENDPLT
NΦADV=1
NCHAR=-29
PLΦT = 1,1, 1,3, ENDLST
ENDPLT
NΦADV=1
NCHAR=-4
PLΦT = 1,1, 1,4, ENDLST
ENDPLT
```

STL FORM 708 REV. 5-65

DATE _____ PRIOR ID _____

NAME _____ PROBLEM NO _____

EXT _____ SPECIAL CHARACTERS

NO. OF CARDS _____

TRW SYSTEMS
HOUSTON COMPUTING CENTER

80 COLUMN FREE KEY PUNCH FORM

CARD STOCK
☐ PLAIN _____
☐ FORTRAN SOURCE
☐ [illegible] SYMBOLIC

PAGE 9 OF _____

KEYPUNCHED BY _____

VERIFIED BY _____

```
NCHAR=5
TITLE=ID=SAMPLE ROOT LOCUS PLOT (PHASE)
XHI = -0.95
XLO = -2.25
YHI = 1.65
YLO = -0.05
PLOT = 1,1, 1,7, 1,8, ENDLST
ENDPLT
NOADV = 1
NCHAR=-20
PLOT = 1,1, 1,2, ENDLST
ENDPLT
NOADV=1
NCHAR=-29
PLOT = 1,1, 1,3, ENDLST
ENDPLT
NOADV=1
NCHAR=-4
PLOT = 1,1, 1,4, ENDLST
ENDPLT
```

STL FORM 708 REV. 8-65

DATE _____ NAME _____ EXT _____ NO. OF CARDS _____

PROGRAMMER _____ PROBLEM NO. _____ SPECIAL CHARACTERS

TRW SYSTEMS
HOUSTON COMPUTING CENTER

80 COLUMN FREE KEY PUNCH FORM

CARD STOCK
☐ PLAIN _____
☐ PROGRAM SOURCE
☐ USER SYMBOLIC

KEYPUNCHED BY _____

VERIFIED BY _____

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

```
ENDFIL
REPEAT
NCHAR=5
NØIREC=1
NTYPE=2
XHI=0.0
XLØ=0.0
YHI=0.0
YLØ=0.0
TITLE=ID=SAMPLE BØDE PLØT
XLABEL=ID=FREQUENCY (RAD/SEC)
YLABEL=ID=GAIN -- PHASE
CADD=0.0, 0.0, -180.0
PLØT=1,6,8,ENDLST
ENDPLT
NTYPE=0
TITLE=ID=SAMPLE NICHØLS CHART
XLABEL=ID=PHASE
YLABEL=ID=GAIN
CADD=-180.0,0.0
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

STL FORM 708 REV. 5 67

DATE _____ PRIORITY _____ PAGE 11 OF 11

NAME _____ PROBLEM NO _____ TRW SYSTEMS

EXT _____ SPECIAL CHARACTERS HOUSTON COMPUTING CENTER

NO. OF CARDS _____ **80 COLUMN FREE KEY PUNCH FORM** CARD STOCK

☐ PLAIN _____

☐ FORTRAN SOURCE

☐ IBM SYMBOLIC

KEYPUNCHED BY _____

VERIFIED BY _____

```
PLOT=8,6,ENDLST
ENDPLT
ENDFIL
CADD = 0.0, 0.0, 0.0
TITLE=ID=SAMPLE TRANSIENT RESPONSE
XLABEL=ID=TIME (SEC)
YLABEL=ID=RESPONSE -- DRIVING FUNCTION
PLOT=1,2,4,ENDLST
ENDPLT
ENDFIL
ENDRUN
```

BTL FORM 700 REV. 8-65

4.2 SAMPLE OUTPUT

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 1

SAMPLE CASE -- DELAY LINE NETWORK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0

OPTIONS

```
CLEAR  =  1
COMENT =  2
INPUT  =  1
NUNFLS =  0
NUVFLS =100
PLOT   =  1
SFREQR =  1, 0, 0, 0, 0, 0, 0
SROOTL =  0, 0, 0, 0, 0, 0, 0
STIMER =  1, 1, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 1

SAMPLE CASE -- DELAY LINE NETWORK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0

INPUT MATRIX

DEGREE OF MATRIX = 2

	1	2	3	4
1	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	2.0000+00	0.0000
3	0.0000	1.0000+00	0.0000	0.0000

DEGREE OF MATRIX = 1

	1	2	3	4
1	1.0000+00	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	1.0000+00

DEGREE OF MATRIX = 0

	1	2	3	4
1	2.0000+00	0.0000	2.0000+00	0.0000
2	2.0000+00	4.0000+00	6.0000+00	0.0000
3	0.0000	4.0000+00	4.0000+00	0.0000

DETERMINANT NUMBER 4

LAST ROW ELEMENTS
COLUMN 4 HAS THE VALUE 1.0000+00

ITERANTS FOR EIGENVALUE 1

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.1000-01, 0.0000)	(6.0768-01, 0.0000)	(6.0768-01, 0.0000)
(-9.0000-02, 0.0000)	(5.3556-01, 0.0000)	(5.3556-01, 0.0000)
(-1.0000-01, 0.0000)	(5.7362-01, 0.0000)	(5.7362-01, 0.0000)
(1.6816-03, 0.0000)	(-1.3520-02, 0.0000)	(-1.3520-02, 0.0000)
(-2.5430-05, 0.0000)	(2.0349-04, 0.0000)	(2.0349-04, 0.0000)
(2.2751-09, 0.0000)	(0.0000 , 0.0000)	(0.0000 , 0.0000)

EIGENVECTOR
(-1.0000+00, 0.0000)
(-1.0000+00, 0.0000)
(1.0000+00, 0.0000)
(0.0000 , 0.0000)

ITERANTS FOR EIGENVALUE 2

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-9.0000-02, 0.0000)	(-5.9506+00, 0.0000)	(5.3556-01, 0.0000)
(-1.0000-01, 0.0000)	(-5.7362+00, 0.0000)	(5.7362-01, 0.0000)
(-1.1000-01, 0.0000)	(-5.5244+00, 0.0000)	(6.0768-01, 0.0000)
(-4.3925-01, 0.0000)	(1.0532-01, 0.0000)	(-4.6262-02, 0.0000)
(-4.3129-01, 0.0000)	(-1.5519-03, 0.0000)	(6.6933-04, 0.0000)
(-4.3140-01, 0.0000)	(7.2264-07, 0.0000)	(-3.1175-07, 0.0000)
(-4.3140-01, 0.0000)	(-2.3135-06, 0.0000)	(9.9805-07, 0.0000)

EIGENVECTOR
(1.0000+00, 0.0000)
(7.4943-01, 0.0000)
(-7.8430-01, 0.0000)
(0.0000 , 0.0000)

ITERANTS FOR EIGENVALUE 3

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-9.0000-02, 0.0000)	(-1.7430+01, 0.0000)	(5.3556-01, 0.0000)
(-1.0000-01, 0.0000)	(-1.7309+01, 0.0000)	(5.7362-01, 0.0000)
(-1.1000-01, 0.0000)	(-1.7188+01, 0.0000)	(6.0768-01, 0.0000)
(-2.3173+00, 1.1993+00)	(3.3174+00,-3.2918+01)	(-1.5620+02,-1.1323+02)
(-1.2489+00,-1.8582-01)	(-3.8980+00, 2.6201+00)	(-4.8510+00, 1.0876+00)
(-1.4841+00,-6.5706-02)	(-1.7322-01, 1.0868+00)	(-4.5100-01, 1.6643+00)
(-1.4965+00,-5.2259-04)	(5.9039-02, 8.7244-03)	(9.4097-02, 1.3986-02)
(-1.4930+00,-8.1404-06)	(5.2947-05, 1.3556-04)	(8.3915-05, 2.1486-04)
(-1.4930+00, 1.8872-11)	(-1.5526-07,-3.1428-10)	(-2.4608-07,-4.9812-10)
(-1.4930+00,-1.4663-11)	(5.8563-08, 2.4419-10)	(9.2820-08, 3.8703-10)

EIGENVECTOR

(1.0000+00, 0.0000)
(1.6279-01,-3.3237-12)
(-2.5350-01, 3.3939-12)
(0.0000 , 0.0000)

ITERANTS FOR EIGENVALUE 4

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.1000-01, 0.0000)	(-1.2428+01, 1.3177-10)	(6.0768-01, 0.0000)
(-1.0000-01, 0.0000)	(-1.2426+01, 1.3080-10)	(5.7362-01, 0.0000)
(-9.0000-02, 0.0000)	(-1.2423+01, 1.2984-10)	(5.3556-01, 0.0000)
(-4.1694-02,-2.4118+00)	(-7.8409-01,-3.7534-02)	(8.7075+00,-9.6823+00)
(-3.7794-02,-2.4918+00)	(-4.8896-06, 9.5151-05)	(-1.2978-03,-1.1415-03)
(-3.7803-02,-2.4918+00)	(-7.0870-08, 2.9947-09)	(7.5584-07,-1.0414-06)
(-3.7803-02,-2.4918+00)	(-7.5773-08, 3.2019-09)	(8.0814-07,-1.1134-06)

EIGENVECTOR

(-2.3864-01,-2.5505-01)
(1.0000+00, 0.0000)
(5.5189-01,-4.7099-02)
(-2.6266-09,-2.3960-08)

ACCURACY CHECK

(-1.1000-01, 0.0000)	(-2.0000+00, 0.0000)	(6.0768-01, 0.0000)
(1.0000+04, 0.0000)	(-2.0000+00, 0.0000)	(-2.0004+20, 0.0000)

CHARACTERISTIC POLYNOMIAL OF DETERMINANT NO. 4

LEADING COEFFICIENT	LAST NON-ZERO COEFFICIENT	LAST COEFFICIENT
-2.0000+00	-8.0000+00	0.0000

DETERMINANT NUMBER 1

LAST ROW ELEMENTS
COLUMN 1 HAS THE VALUE -1.0000+00

ITERANTS FOR EIGENVALUE 1

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.1000-01, 0.0000)	(8.8000-01, 0.0000)	(8.8000-01, 0.0000)
(-9.0000-02, 0.0000)	(7.2000-01, 0.0000)	(7.2000-01, 0.0000)
(-1.0000-01, 0.0000)	(8.0000-01, 0.0000)	(8.0000-01, 0.0000)
(-1.3970-08, 0.0000)	(1.1176-07, 0.0000)	(1.1176-07, 0.0000)

EIGENVECTOR

(0.0000 , 0.0000)
(0.0000 , 0.0000)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ACCURACY CHECK

(-1.0000-01, 0.0000)	(-8.0000+00, 0.0000)	(8.0000-01, 0.0000)
(1.0000+04, 0.0000)	(-8.0000+00, 0.0000)	(-8.0000+04, 0.0000)

CHARACTERISTIC POLYNOMIAL OF DETERMINANT NO. 1

LEADING COEFFICIENT	LAST NON-ZERO COEFFICIENT	LAST COEFFICIENT
-8.0000+00	-8.0000+00	0.0000

RATIO 1 (DET 1/DET 4)

INPUT TRANSFER FUNCTION

BODE GAIN
1.0000+00

ROOT LOCUS GAIN
4.0000+00

ZEROS (1)
(-1.3970-08, 0.0000)

POLES (5)
(2.2751-09, 0.0000)
(-4.3140-01, 0.0000)
(-1.4930+00,-1.4663-11)
(-3.7803-02,-2.4918+00)
(-3.7803-02, 2.4918+00)

RESULTANT TRANSFER FUNCTION

BODE GAIN
1.0000+00

ROOT LOCUS GAIN
4.0000+00

GAMMA
4.0000+00

ZEROS (0)

POLES (4)
(-4.3140-01, 0.0000)
(-1.4930+00, 0.0000)
(-3.7803-02,-2.4918+00)
(-3.7803-02, 2.4918+00)

**** FREQUENCY RESPONSE ****

SAMPLE CASE -- DELAY LINE NETWORK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0

RATIO 1

FREQUENCY (RAD/SEC)	FREQUENCY (HZ)	TRANSFER FUNCTION (REAL)	TRANSFER FUNCTION (IMAGINARY)	GAIN (RATIO)	GAIN (DB)	PHASE (DEG)	PHASE MARGIN
6.2832-03	1.0000-03	9.9971-01	-1.8845-02	9.9989-01	-9.4186-04	-1.0799+00	1.7892+02
1.0000-02	1.5915-03	9.9928-01	-2.9983-02	9.9973-01	-2.3869-03	-1.7186+00	1.7828+02
1.2566-02	2.0000-03	9.9886-01	-3.7665-02	9.9957-01	-3.7694-03	-2.1595+00	1.7784+02
1.5000-02	2.3873-03	9.9837-01	-4.4943-02	9.9938-01	-5.3702-03	-2.5775+00	1.7742+02
1.8850-02	3.0000-03	9.9743-01	-5.6435-02	9.9902-01	-8.4778-03	-3.2384+00	1.7676+02
2.0000-02	3.1831-03	9.9711-01	-5.9864-02	9.9890-01	-9.5433-03	-3.4358+00	1.7656+02
2.5000-02	3.9789-03	9.9548-01	-7.4735-02	9.9829-01	-1.4903-02	-4.2934+00	1.7571+02
2.5133-02	4.0000-03	9.9544-01	-7.5129-02	9.9827-01	-1.5062-02	-4.3161+00	1.7568+02
3.0000-02	4.7746-03	9.9351-01	-8.9543-02	9.9753-01	-2.1445-02	-5.1501+00	1.7485+02
3.1416-02	5.0000-03	9.9288-01	-9.3723-02	9.9730-01	-2.3512-02	-5.3925+00	1.7461+02
3.7699-02	6.0000-03	9.8978-01	-1.1219-01	9.9611-01	-3.3819-02	-6.4670+00	1.7353+02
4.0000-02	6.3662-03	9.8850-01	-1.1892-01	9.9563-01	-3.8056-02	-6.8600+00	1.7314+02
4.3982-02	7.0000-03	9.8612-01	-1.3052-01	9.9472-01	-4.5970-02	-7.5394+00	1.7246+02
5.0000-02	7.9577-03	9.8212-01	-1.4790-01	9.9319-01	-5.9323-02	-8.5642+00	1.7144+02
5.0265-02	8.0000-03	9.8193-01	-1.4867-01	9.9312-01	-5.9950-02	-8.6093+00	1.7139+02
6.0000-02	9.5493-03	9.7440-01	-1.7640-01	9.9024-01	-8.5180-02	-1.0261+01	1.6974+02
6.2832-02	1.0000-02	9.7198-01	-1.8437-01	9.8931-01	-9.3326-02	-1.0740+01	1.6926+02
7.0000-02	1.1141-02	9.6540-01	-2.0432-01	9.8679-01	-1.1555-01	-1.1950+01	1.6805+02
8.0000-02	1.2732-02	9.5517-01	-2.3159-01	9.8284-01	-1.5034-01	-1.3629+01	1.6637+02
9.0000-02	1.4324-02	9.4376-01	-2.5813-01	9.7843-01	-1.8944-01	-1.5297+01	1.6470+02
1.0000-01	1.5915-02	9.3125-01	-2.8387-01	9.7356-01	-2.3275-01	-1.6953+01	1.6305+02
1.2566-01	2.0000-02	8.9461-01	-3.4591-01	9.5915-01	-3.6226-01	-2.1139+01	1.5886+02
1.5000-01	2.3873-02	8.5474-01	-3.9884-01	9.4322-01	-5.0777-01	-2.5015+01	1.5498+02
1.8850-01	3.0000-02	7.8433-01	-4.6998-01	9.1436-01	-7.7768-01	-3.0930+01	1.4907+02
2.0000-01	3.1831-02	7.6209-01	-4.8818-01	9.0504-01	-8.6666-01	-3.2643+01	1.4736+02
2.5000-01	3.9789-02	6.6251-01	-5.5149-01	8.6201-01	-1.2898+00	-3.9775+01	1.4023+02
2.5133-01	4.0000-02	6.5984-01	-5.5283-01	8.6082-01	-1.3017+00	-3.9957+01	1.4004+02
3.0000-01	4.7746-02	5.6335-01	-5.9135-01	8.1674-01	-1.7583+00	-4.6389+01	1.3361+02
3.1416-01	5.0000-02	5.3609-01	-5.9893-01	8.0381-01	-1.8969+00	-4.8169+01	1.3183+02
3.7699-01	6.0000-02	4.2224-01	-6.1643-01	7.4717-01	-2.5316+00	-5.5590+01	1.2441+02
4.0000-01	6.3662-02	3.8396-01	-6.1738-01	7.2703-01	-2.7689+00	-5.8122+01	1.2188+02
4.3982-01	7.0000-02	3.2243-01	-6.1374-01	6.9328-01	-3.1818+00	-6.2285+01	1.1771+02
5.0000-01	7.9577-02	2.4082-01	-5.9880-01	6.4541-01	-3.8033+00	-6.8091+01	1.1191+02

5.0265-01	8.0000-02	2.3753-01	-5.9794-01	6.4339-01	-3.8305+00	-6.8335+01	1.1167+02
5.6549-01	9.0000-02	1.6662-01	-5.7431-01	5.9799-01	-4.4661+00	-7.3821+01	1.0618+02
6.0000-01	9.5493-02	1.3303-01	-5.5938-01	5.7498-01	-4.8070+00	-7.6622+01	1.0338+02
6.2832-01	1.0000-01	1.0803-01	-5.4653-01	5.5710-01	-5.0813+00	-7.8818+01	1.0118+02
7.0000-01	1.1141-01	5.3861-02	-5.1288-01	5.1570-01	-5.7520+00	-8.4005+01	9.5995+01
8.0000-01	1.2732-01	-3.8286-03	-4.6639-01	4.6640-01	-6.6248+00	-9.0470+01	8.9530+01
9.0000-01	1.4324-01	-4.5929-02	-4.2319-01	4.2567-01	-7.4185+00	-9.6194+01	8.3806+01
1.0000+00	1.5915-01	-7.6923-02	-3.8462-01	3.9223-01	-8.1291+00	-1.0131+02	7.8690+01
1.2566+00	2.0000-01	-1.2646-01	-3.0811-01	3.3305-01	-9.5499+00	-1.1231+02	6.7685+01
1.5000+00	2.3873-01	-1.5617-01	-2.6272-01	3.0563-01	-1.0296+01	-1.2073+02	5.9271+01
1.8850+00	3.0000-01	-2.1545-01	-2.4099-01	3.2326-01	-9.8089+00	-1.3180+02	4.8202+01
2.0000+00	3.1831-01	-2.5000-01	-2.5000-01	3.5355-01	-9.0309+00	-1.3500+02	4.5000+01
2.4011+00	3.8214-01	-1.1340+00	-4.1010-01	1.2058+00	1.6258+00	-1.6012+02	1.9883+01
2.4162+00	3.8455-01	-1.3321+00	-3.7436-01	1.3837+00	2.8206+00	-1.6430+02	1.5697+01
2.4314+00	3.8697-01	-1.5939+00	-2.8126-01	1.6185+00	4.1824+00	-1.6999+02	1.0008+01
2.4466+00	3.8938-01	-1.9288+00	-6.5259-02	1.9299+00	5.7109+00	-1.7806+02	1.9378+00
2.4617+00	3.9180-01	-2.2891+00	3.9967-01	2.3237+00	7.3237+00	1.7010+02	-9.9038+00
2.4769+00	3.9421-01	-2.4256+00	1.2420+00	2.7251+00	8.7076+00	1.5289+02	-2.7115+01
2.4921+00	3.9663-01	-1.8860+00	2.1890+00	2.8894+00	9.2162+00	1.3075+02	-4.9253+01
2.5072+00	3.9904-01	-8.4745-01	2.4992+00	2.6390+00	8.4287+00	1.0873+02	-7.1269+01
2.5224+00	4.0145-01	-6.6607-02	2.1849+00	2.1859+00	6.7927+00	9.1746+01	-8.8254+01
2.5376+00	4.0387-01	3.0418-01	1.7409+00	1.7673+00	4.9461+00	8.0089+01	-9.9911+01
2.5527+00	4.0628-01	4.4265-01	1.3742+00	1.4437+00	3.1897+00	7.2145+01	-1.0785+02
2.5679+00	4.0870-01	4.7861-01	1.1031+00	1.2024+00	1.6011+00	6.6544+01	-1.1346+02
2.5831+00	4.1111-01	4.7250-01	9.0486-01	1.0208+00	1.7876-01	6.2427+01	-1.1757+02
2.5133+00	4.0000-01	-4.8182-01	2.4179+00	2.4655+00	7.8379+00	1.0127+02	-7.8730+01
3.0000+00	4.7746-01	1.0891-01	8.9109-02	1.4072-01	-1.7033+01	3.9289+01	-1.4071+02
3.1416+00	5.0000-01	7.9034-02	5.9452-02	9.8898-02	-2.0096+01	3.6952+01	-1.4305+02
3.5000+00	5.5704-01	4.1523-02	2.6593-02	4.9309-02	-2.6141+01	3.2637+01	-1.4736+02
3.7699+00	6.0000-01	2.8070-02	1.6320-02	3.2469-02	-2.9771+01	3.0173+01	-1.4983+02
4.0000+00	6.3662-01	2.0916-02	1.1306-02	2.3776-02	-3.2477+01	2.8393+01	-1.5161+02
4.3982+00	7.0000-01	1.3354-02	6.4560-03	1.4832-02	-3.6576+01	2.5802+01	-1.5420+02
4.5000+00	7.1620-01	1.2022-02	5.6621-03	1.3289-02	-3.7530+01	2.5219+01	-1.5478+02
5.0000+00	7.9577-01	7.4974-03	3.1377-03	8.1275-03	-4.1801+01	2.2709+01	-1.5729+02
5.0265+00	8.0000-01	7.3246-03	3.0475-03	7.9333-03	-4.2011+01	2.2590+01	-1.5741+02
5.5000+00	8.7535-01	4.9510-03	1.8672-03	5.2914-03	-4.5529+01	2.0663+01	-1.5934+02
5.6549+00	9.0000-01	4.3944-03	1.6084-03	4.6795-03	-4.6596+01	2.0103+01	-1.5990+02
6.0000+00	9.5493-01	3.4139-03	1.1727-03	3.6098-03	-4.8850+01	1.8958+01	-1.6104+02
6.2832+00	1.0000+00	2.8094-03	9.1892-04	2.9558-03	-5.0586+01	1.8112+01	-1.6189+02
6.5000+00	1.0345+00	2.4360-03	7.6874-04	2.5544-03	-5.1854+01	1.7514+01	-1.6249+02
7.0000+00	1.1141+00	1.7875-03	5.2186-04	1.8621-03	-5.4600+01	1.6275+01	-1.6372+02

7.5000+00	1.1937+00	1.3427-03	3.6479-04	1.3914-03	-5.7131+01	1.5200+01	-1.6480+02
8.0000+00	1.2732+00	1.0289-03	2.6144-04	1.0616-03	-5.9481+01	1.4258+01	-1.6574+02
8.5000+00	1.3528+00	8.0206-04	1.9145-04	8.2459-04	-6.1675+01	1.3425+01	-1.6657+02
9.0000+00	1.4324+00	6.3473-04	1.4286-04	6.5061-04	-6.3734+01	1.2684+01	-1.6732+02
9.5000+00	1.5120+00	5.0902-04	1.0839-04	5.2044-04	-6.5673+01	1.2021+01	-1.6798+02
1.0000+01	1.5915+00	4.1306-04	8.3464-05	4.2141-04	-6.7506+01	1.1424+01	-1.6858+02
1.1000+01	1.7507+00	2.8047-04	5.1426-05	2.8514-04	-7.0899+01	1.0390+01	-1.6961+02
1.2000+01	1.9099+00	1.9716-04	3.3093-05	1.9992-04	-7.3983+01	9.5282+00	-1.7047+02
1.2566+01	2.0000+00	1.6362-04	2.6209-05	1.6571-04	-7.5613+01	9.1005+00	-1.7090+02
1.3000+01	2.0690+00	1.4266-04	2.2081-05	1.4436-04	-7.6811+01	8.7980+00	-1.7120+02
1.4000+01	2.2282+00	1.0579-04	1.5191-05	1.0687-04	-7.9423+01	8.1717+00	-1.7183+02
1.5000+01	2.3873+00	8.0106-05	1.0729-05	8.0821-05	-8.1850+01	7.6285+00	-1.7237+02
1.6000+01	2.5465+00	6.1774-05	7.7523-06	6.2259-05	-8.4116+01	7.1529+00	-1.7285+02
1.7000+01	2.7056+00	4.8404-05	5.7145-06	4.8740-05	-8.6242+01	6.7331+00	-1.7327+02
1.8000+01	2.8648+00	3.8466-05	4.2873-06	3.8704-05	-8.8245+01	6.3598+00	-1.7364+02
1.8850+01	3.0000+00	3.1959-05	3.4006-06	3.2139-05	-8.9859+01	6.0737+00	-1.7393+02
1.9000+01	3.0239+00	3.0954-05	3.2675-06	3.1126-05	-9.0137+01	6.0257+00	-1.7397+02
2.0000+01	3.1831+00	2.5191-05	2.5255-06	2.5318-05	-9.1932+01	5.7249+00	-1.7428+02
2.1000+01	3.3423+00	2.0710-05	1.9769-06	2.0804-05	-9.3637+01	5.4527+00	-1.7455+02
2.2000+01	3.5014+00	1.7183-05	1.5653-06	1.7254-05	-9.5262+01	5.2052+00	-1.7479+02
2.3000+01	3.6606+00	1.4376-05	1.2525-06	1.4431-05	-9.6814+01	4.9791+00	-1.7502+02
2.4000+01	3.8197+00	1.2120-05	1.0118-06	1.2162-05	-9.8300+01	4.7719+00	-1.7523+02
2.5133+01	4.0000+00	1.0074-05	8.0291-07	1.0106-05	-9.9909+01	4.5571+00	-1.7544+02
2.7000+01	4.2972+00	7.5580-06	5.6063-07	7.5788-06	-1.0241+02	4.2422+00	-1.7576+02
3.0000+01	4.7746+00	4.9549-06	3.3069-07	4.9659-06	-1.0608+02	3.8183+00	-1.7618+02
3.1416+01	5.0000+00	4.1190-06	2.6249-07	4.1273-06	-1.0769+02	3.6463+00	-1.7635+02
3.2000+01	5.0930+00	3.8260-06	2.3936-07	3.8334-06	-1.0833+02	3.5798+00	-1.7642+02
3.4000+01	5.4113+00	3.0011-06	1.7669-07	3.0063-06	-1.1044+02	3.3694+00	-1.7663+02
3.6000+01	5.7296+00	2.3870-06	1.3272-07	2.3907-06	-1.1243+02	3.1823+00	-1.7682+02
3.7699+01	6.0000+00	1.9845-06	1.0536-07	1.9873-06	-1.1403+02	3.0389+00	-1.7696+02
3.8000+01	6.0479+00	1.9223-06	1.0125-07	1.9250-06	-1.1431+02	3.0149+00	-1.7699+02
4.0000+01	6.3662+00	1.5654-06	7.8321-08	1.5674-06	-1.1610+02	2.8642+00	-1.7714+02
4.2000+01	6.6845+00	1.2877-06	6.1352-08	1.2891-06	-1.1779+02	2.7279+00	-1.7727+02
4.3982+01	7.0000+00	1.0706-06	4.8708-08	1.0717-06	-1.1940+02	2.6050+00	-1.7740+02
4.6000+01	7.3211+00	8.9464-07	3.8916-08	8.9548-07	-1.2096+02	2.4907+00	-1.7751+02
4.8000+01	7.6394+00	7.5451-07	3.1451-08	7.5516-07	-1.2244+02	2.3870+00	-1.7761+02
5.0000+01	7.9577+00	6.4077-07	2.5641-08	6.4128-07	-1.2386+02	2.2915+00	-1.7771+02
5.0265+01	8.0000+00	6.2733-07	2.4971-08	6.2783-07	-1.2404+02	2.2794+00	-1.7772+02
5.4000+01	8.5944+00	4.7090-07	1.7447-08	4.7123-07	-1.2654+02	2.1218+00	-1.7788+02
5.6549+01	9.0000+00	3.9154-07	1.3852-08	3.9179-07	-1.2814+02	2.0262+00	-1.7797+02
5.8000+01	9.2310+00	3.5378-07	1.2203-08	3.5399-07	-1.2902+02	1.9755+00	-1.7802+02

6.2000+01	9.8676+00	2.7091-07	8.7415-09	2.7106-07	-1.3134+02	1.8401+00	-1.7815+02
6.2832+01	1.0000+01	2.5684-07	8.1777-09	2.5698-07	-1.3180+02	1.8236+00	-1.7818+02
6.6000+01	1.0504+01	2.1095-07	6.3940-09	2.1105-07	-1.3351+02	1.7361+00	-1.7826+02
7.0000+01	1.1141+01	1.6670-07	4.7638-09	1.6677-07	-1.3556+02	1.6369+00	-1.7836+02
7.4000+01	1.1777+01	1.3347-07	3.6079-09	1.3351-07	-1.3749+02	1.5484+00	-1.7845+02
7.8000+01	1.2414+01	1.0812-07	2.7727-09	1.0815-07	-1.3932+02	1.4690+00	-1.7853+02
8.2000+01	1.3051+01	8.8511-08	2.1591-09	8.8538-08	-1.4106+02	1.3974+00	-1.7860+02
8.6000+01	1.3687+01	7.3155-08	1.7015-09	7.3175-08	-1.4271+02	1.3324+00	-1.7867+02
9.0000+01	1.4324+01	6.0989-08	1.3555-09	6.1004-08	-1.4429+02	1.2732+00	-1.7873+02
9.5000+01	1.5120+01	4.9126-08	1.0343-09	4.9137-08	-1.4617+02	1.2062+00	-1.7879+02
1.0000+02	1.5915+01	4.0012-08	8.0032-10	4.0020-08	-1.4795+02	1.1459+00	-1.7885+02
1.0500+02	1.6711+01	3.2917-08	6.2705-10	3.2923-08	-1.4965+02	1.0913+00	-1.7891+02
1.1000+02	1.7507+01	2.7327-08	4.9690-10	2.7332-08	-1.5127+02	1.0417+00	-1.7896+02
1.2000+02	1.9099+01	1.9294-08	3.2159-10	1.9297-08	-1.5429+02	9.5491-01	-1.7905+02
1.2566+02	2.0000+01	1.6044-08	2.5536-10	1.6046-08	-1.5589+02	9.1187-01	-1.7909+02
1.3000+02	2.0690+01	1.4008-08	2.1551-10	1.4009-08	-1.5707+02	8.8146-01	-1.7912+02
1.4000+02	2.2282+01	1.0414-08	1.4878-10	1.0415-08	-1.5965+02	8.1850-01	-1.7918+02
1.5000+02	2.3873+01	7.9023-09	1.0537-10	7.9030-09	-1.6204+02	7.6393-01	-1.7924+02
1.8850+02	3.0000+01	3.1688-09	3.3623-11	3.1690-09	-1.6998+02	6.0792-01	-1.7939+02
2.0000+02	3.1831+01	2.5002-09	2.5002-11	2.5003-09	-1.7204+02	5.7295-01	-1.7943+02
2.5000+02	3.9789+01	1.0240-09	8.1925-12	1.0241-09	-1.7979+02	4.5836-01	-1.7954+02
2.5133+02	4.0000+01	1.0026-09	7.9784-12	1.0026-09	-1.7998+02	4.5594-01	-1.7954+02
3.0000+02	4.7746+01	4.9384-10	3.2923-12	4.9385-10	-1.8613+02	3.8197-01	-1.7962+02
3.1416+02	5.0000+01	4.1065-10	2.6143-12	4.1066-10	-1.8773+02	3.6476-01	-1.7964+02
3.7699+02	6.0000+01	1.9804-10	1.0506-12	1.9804-10	-1.9406+02	3.0396-01	-1.7970+02
4.0000+02	6.3662+01	1.5625-10	7.8127-13	1.5625-10	-1.9612+02	2.8648-01	-1.7971+02
4.3982+02	7.0000+01	1.0689-10	4.8608-13	1.0690-10	-1.9942+02	2.6054-01	-1.7974+02
5.0000+02	7.9577+01	6.4001-11	2.5600-13	6.4001-11	-2.0388+02	2.2918-01	-1.7977+02
5.0265+02	8.0000+01	6.2659-11	2.4931-13	6.2660-11	-2.0406+02	2.2797-01	-1.7977+02
5.6549+02	9.0000+01	3.9118-11	1.3835-13	3.9118-11	-2.0815+02	2.0264-01	-1.7980+02
6.0000+02	9.5493+01	3.0864-11	1.0288-13	3.0865-11	-2.1021+02	1.9099-01	-1.7981+02
6.2832+02	1.0000+02	2.5665-11	8.1695-14	2.5665-11	-2.1181+02	1.8238-01	-1.7982+02
7.0000+02	1.1141+02	1.6660-11	4.7600-14	1.6660-11	-2.1557+02	1.6370-01	-1.7984+02
8.0000+02	1.2732+02	9.7657-12	2.4414-14	9.7657-12	-2.2021+02	1.4324-01	-1.7986+02
1.0000+03	1.5915+02	4.0000-12	8.0000-15	4.0000-12	-2.2796+02	1.1459-01	-1.7989+02
1.2566+03	2.0000+02	1.6041-12	2.5529-15	1.6041-12	-2.3590+02	9.1189-02	-1.7991+02
1.5000+03	2.3873+02	7.9012-13	1.0535-15	7.9013-13	-2.4205+02	7.6394-02	-1.7992+02
1.8850+03	3.0000+02	3.1685-13	3.3619-16	3.1685-13	-2.4998+02	6.0793-02	-1.7994+02
2.0000+03	3.1831+02	2.5000-13	2.5000-16	2.5000-13	-2.5204+02	5.7296-02	-1.7994+02
2.5133+03	4.0000+02	1.0025-13	7.9779-17	1.0025-13	-2.5998+02	4.5595-02	-1.7995+02

**** TRANSIENT RESPONSE ****

SAMPLE CASE -- DELAY LINE NETWORK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0

RATIO 1

BODE GAIN	ROOT LOCUS GAIN	GAMMA
1.0000+00	4.0000+00	4.0000+00

START TIME	END TIME	INCREMENT
0.0000	2.0000+01	1.0000-01

SUM OF THE RESIDUES
(0.0000 ,-9.3132-10)

LAMBDA'S

ZEROS	NON-ZERO POLES	RESIDUES
	(-4.3140-01, 0.0000)	(5.9208-01, 9.8632-10)
	(-1.4930+00, 0.0000)	(-4.5252-01,-2.7870-09)
	(-3.7803-02,-2.4918+00)	(-6.9779-02,-8.5372-02)
	(-3.7803-02, 2.4918+00)	(-6.9779-02, 8.5372-02)

PIECEWISE QUADRATIC DRIVING FUNCTION

BREAK-POINT TIME	CONSTANT COEFFICIENT	LINEAR COEFFICIENT	QUADRATIC COEFFICIENT
0.0000	0.0000	0.0000	0.0000
1.0000+00	1.0000+00	0.0000	0.0000
1.2000+01	0.0000	0.0000	0.0000

TIME (SECONDS)	RESPONSE FUNCTION	INVERSE TRANSFORM	DRIVING FUNCTION
0.0000	0.0000	0.0000	0.0000
1.0000-01	0.0000	6.3237-04	0.0000
2.0000-01	0.0000	4.7711-03	0.0000
3.0000-01	0.0000	1.5093-02	0.0000
4.0000-01	0.0000	3.3320-02	0.0000
5.0000-01	0.0000	6.0198-02	0.0000
6.0000-01	0.0000	9.5537-02	0.0000
7.0000-01	0.0000	1.3829-01	0.0000
8.0000-01	0.0000	1.8666-01	0.0000
9.0000-01	0.0000	2.3830-01	0.0000
1.0000+00	0.0000	2.9045-01	0.0000
1.1000+00	1.5984-05	3.4019-01	1.0000+00
1.2000+00	2.4435-04	3.8461-01	1.0000+00
1.3000+00	1.1774-03	4.2104-01	1.0000+00
1.4000+00	3.5276-03	4.4723-01	1.0000+00
1.5000+00	8.1307-03	4.6149-01	1.0000+00
1.6000+00	1.5850-02	4.6280-01	1.0000+00
1.7000+00	2.7486-02	4.5091-01	1.0000+00
1.8000+00	4.3696-02	4.2634-01	1.0000+00
1.9000+00	6.4928-02	3.9035-01	1.0000+00
2.0000+00	9.1373-02	3.4486-01	1.0000+00
2.1000+00	1.2294-01	2.9236-01	1.0000+00
2.2000+00	1.5923-01	2.3573-01	1.0000+00
2.3000+00	1.9959-01	1.7808-01	1.0000+00
2.4000+00	2.4310-01	1.2253-01	1.0000+00
2.5000+00	2.8864-01	7.2089-02	1.0000+00
2.6000+00	3.3497-01	2.9395-02	1.0000+00
2.7000+00	3.8076-01	-3.3921-03	1.0000+00
2.8000+00	4.2472-01	-2.4735-02	1.0000+00
2.9000+00	4.6565-01	-3.3807-02	1.0000+00
3.0000+00	5.0248-01	-3.0534-02	1.0000+00
3.1000+00	5.3438-01	-1.5592-02	1.0000+00
3.2000+00	5.6081-01	9.6366-03	1.0000+00
3.3000+00	5.8150-01	4.3159-02	1.0000+00
3.4000+00	5.9650-01	8.2496-02	1.0000+00
3.5000+00	6.0617-01	1.2484-01	1.0000+00
3.6000+00	6.1117-01	1.6723-01	1.0000+00
3.7000+00	6.1238-01	2.0674-01	1.0000+00
3.8000+00	6.1088-01	2.4065-01	1.0000+00

3.9000+00	6.0785-01	2.6661-01	1.0000+00
4.0000+00	6.0453-01	2.8280-01	1.0000+00
4.1000+00	6.0213-01	2.8801-01	1.0000+00
4.2000+00	6.0175-01	2.8175-01	1.0000+00
4.3000+00	6.0433-01	2.6422-01	1.0000+00
4.4000+00	6.1058-01	2.3634-01	1.0000+00
4.5000+00	6.2093-01	1.9967-01	1.0000+00
4.6000+00	6.3555-01	1.5630-01	1.0000+00
4.7000+00	6.5428-01	1.0873-01	1.0000+00
4.8000+00	6.7671-01	5.9714-02	1.0000+00
4.9000+00	7.0215-01	1.2070-02	1.0000+00
5.0000+00	7.2970-01	-3.1473-02	1.0000+00
5.1000+00	7.5834-01	-6.8452-02	1.0000+00
5.2000+00	7.8692-01	-9.6820-02	1.0000+00
5.3000+00	8.1431-01	-1.1507-01	1.0000+00
5.4000+00	8.3942-01	-1.2231-01	1.0000+00
5.5000+00	8.6129-01	-1.1835-01	1.0000+00
5.6000+00	8.7913-01	-1.0367-01	1.0000+00
5.7000+00	8.9241-01	-7.9382-02	1.0000+00
5.8000+00	9.0083-01	-4.7209-02	1.0000+00
5.9000+00	9.0439-01	-9.3196-03	1.0000+00
6.0000+00	9.0338-01	3.1782-02	1.0000+00
6.1000+00	8.9832-01	7.3420-02	1.0000+00
6.2000+00	8.8998-01	1.1291-01	1.0000+00
6.3000+00	8.7929-01	1.4772-01	1.0000+00
6.4000+00	8.6733-01	1.7564-01	1.0000+00
6.5000+00	8.5521-01	1.9490-01	1.0000+00
6.6000+00	8.4402-01	2.0428-01	1.0000+00
6.7000+00	8.3479-01	2.0317-01	1.0000+00
6.8000+00	8.2841-01	1.9165-01	1.0000+00
6.9000+00	8.2554-01	1.7040-01	1.0000+00
7.0000+00	8.2665-01	1.4072-01	1.0000+00
7.1000+00	8.3192-01	1.0443-01	1.0000+00
7.2000+00	8.4126-01	6.3727-02	1.0000+00
7.3000+00	8.5434-01	2.1082-02	1.0000+00
7.4000+00	8.7058-01	-2.0939-02	1.0000+00
7.5000+00	8.8918-01	-5.9821-02	1.0000+00
7.6000+00	9.0922-01	-9.3260-02	1.0000+00
7.7000+00	9.2969-01	-1.1930-01	1.0000+00
7.8000+00	9.4951-01	-1.3645-01	1.0000+00
7.9000+00	9.6769-01	-1.4379-01	1.0000+00

8.0000+00	9.8331-01	-1.4098-01	1.0000+00
8.1000+00	9.9561-01	-1.2833-01	1.0000+00
8.2000+00	1.0040+00	-1.0675-01	1.0000+00
8.3000+00	1.0083+00	-7.7669-02	1.0000+00
8.4000+00	1.0083+00	-4.2988-02	1.0000+00
8.5000+00	1.0042+00	-4.9266-03	1.0000+00
8.6000+00	9.9650-01	3.4106-02	1.0000+00
8.7000+00	9.8581-01	7.1660-02	1.0000+00
8.8000+00	9.7294-01	1.0539-01	1.0000+00
8.9000+00	9.5884-01	1.3323-01	1.0000+00
9.0000+00	9.4452-01	1.5345-01	1.0000+00
9.1000+00	9.3098-01	1.6485-01	1.0000+00
9.2000+00	9.1915-01	1.6675-01	1.0000+00
9.3000+00	9.0988-01	1.5908-01	1.0000+00
9.4000+00	9.0381-01	1.4235-01	1.0000+00
9.5000+00	9.0139-01	1.1764-01	1.0000+00
9.6000+00	9.0285-01	8.6485-02	1.0000+00
9.7000+00	9.0816-01	5.0839-02	1.0000+00
9.8000+00	9.1706-01	1.2901-02	1.0000+00
9.9000+00	9.2905-01	-2.5001-02	1.0000+00
1.0000+01	9.4345-01	-6.0557-02	1.0000+00
1.0100+01	9.5944-01	-9.1618-02	1.0000+00
1.0200+01	9.7610-01	-1.1633-01	1.0000+00
1.0300+01	9.9247-01	-1.3323-01	1.0000+00
1.0400+01	1.0076+00	-1.4137-01	1.0000+00
1.0500+01	1.0207+00	-1.4032-01	1.0000+00
1.0600+01	1.0309+00	-1.3025-01	1.0000+00
1.0700+01	1.0378+00	-1.1184-01	1.0000+00
1.0800+01	1.0410+00	-8.6325-02	1.0000+00
1.0900+01	1.0404+00	-5.5332-02	1.0000+00
1.1000+01	1.0361+00	-2.0827-02	1.0000+00
1.1100+01	1.0284+00	1.5025-02	1.0000+00
1.1200+01	1.0180+00	4.9992-02	1.0000+00
1.1300+01	1.0054+00	8.1917-02	1.0000+00
1.1400+01	9.9163-01	1.0884-01	1.0000+00
1.1500+01	9.7747-01	1.2914-01	1.0000+00
1.1600+01	9.6387-01	1.4160-01	1.0000+00
1.1700+01	9.5170-01	1.4550-01	1.0000+00
1.1800+01	9.4174-01	1.4066-01	1.0000+00
1.1900+01	9.3462-01	1.2742-01	1.0000+00
1.2000+01	9.3079-01	1.0666-01	1.0000+00

1.210C+01	9.3048-01	7.9703-02	0.0000
1.220C+01	9.3352-01	4.8245-02	0.0000
1.230C+01	9.3922-01	1.4248-02	0.0000
1.240C+01	9.4645-01	-2.0185-02	0.0000
1.250C+01	9.5381-01	-5.2938-02	0.0000
1.260C+01	9.5970-01	-8.2017-02	0.0000
1.270C+01	9.6249-01	-1.0566-01	0.0000
1.280C+01	9.6066-01	-1.2248-01	0.0000
1.290C+01	9.5290-01	-1.3147-01	0.0000
1.300C+01	9.3822-01	-1.3217-01	0.0000
1.310C+01	9.1602-01	-1.2458-01	0.0000
1.320C+01	8.8615-01	-1.0926-01	0.0000
1.330C+01	8.4893-01	-8.7195-02	0.0000
1.340C+01	8.0512-01	-5.9813-02	0.0000
1.350C+01	7.5590-01	-2.8841-02	0.0000
1.360C+01	7.0279-01	3.7837-03	0.0000
1.370C+01	6.4756-01	3.6036-02	0.0000
1.380C+01	5.9212-01	6.5928-02	0.0000
1.390C+01	5.3844-01	9.1634-02	0.0000
1.400C+01	4.8835-01	1.1160-01	0.0000
1.410C+01	4.4354-01	1.2463-01	0.0000
1.420C+01	4.0536-01	1.2998-01	0.0000
1.430C+01	3.7480-01	1.2738-01	0.0000
1.440C+01	3.5241-01	1.1703-01	0.0000
1.450C+01	3.3828-01	9.9624-02	0.0000
1.460C+01	3.3202-01	7.6294-02	0.0000
1.470C+01	3.3281-01	4.8513-02	0.0000
1.480C+01	3.3945-01	1.8020-02	0.0000
1.490C+01	3.5040-01	-1.3289-02	0.0000
1.500C+01	3.6393-01	-4.3484-02	0.0000
1.510C+01	3.7820-01	-7.0717-02	0.0000
1.520C+01	3.9138-01	-9.3337-02	0.0000
1.530C+01	4.0173-01	-1.0999-01	0.0000
1.540C+01	4.0777-01	-1.1969-01	0.0000
1.550C+01	4.0830-01	-1.2191-01	0.0000
1.560C+01	4.0253-01	-1.1656-01	0.0000
1.570C+01	3.9006-01	-1.0403-01	0.0000
1.580C+01	3.7098-01	-8.5151-02	0.0000
1.590C+01	3.4578-01	-6.1131-02	0.0000
1.600C+01	3.1536-01	-3.3490-02	0.0000
1.610C+01	2.8099-01	-3.9578-03	0.0000

1.6200+01	2.4415-01	2.5631-02	0.0000
1.6300+01	2.0654-01	5.3454-02	0.0000
1.6400+01	1.6989-01	7.7811-02	0.0000
1.6500+01	1.3588-01	9.7226-02	0.0000
1.6600+01	1.0605-01	1.1054-01	0.0000
1.6700+01	8.1688-02	1.1698-01	0.0000
1.6800+01	6.3757-02	1.1620-01	0.0000
1.6900+01	5.2839-02	1.0830-01	0.0000
1.7000+01	4.9100-02	9.3817-02	0.0000
1.7100+01	5.2279-02	7.3694-02	0.0000
1.7200+01	6.1712-02	4.9211-02	0.0000
1.7300+01	7.6372-02	2.1905-02	0.0000
1.7400+01	9.4933-02	-6.5221-03	0.0000
1.7500+01	1.1586-01	-3.4313-02	0.0000
1.7600+01	1.3749-01	-5.9763-02	0.0000
1.7700+01	1.5815-01	-8.1324-02	0.0000
1.7800+01	1.7625-01	-9.7699-02	0.0000
1.7900+01	1.9040-01	-1.0792-01	0.0000
1.8000+01	1.9945-01	-1.1140-01	0.0000
1.8100+01	2.0260-01	-1.0799-01	0.0000
1.8200+01	1.9943-01	-9.7940-02	0.0000
1.8300+01	1.8993-01	-8.1923-02	0.0000
1.8400+01	1.7446-01	-6.0969-02	0.0000
1.8500+01	1.5381-01	-3.6408-02	0.0000
1.8600+01	1.2903-01	-9.7778-03	0.0000
1.8700+01	1.0148-01	1.7266-02	0.0000
1.8800+01	7.2653-02	4.3055-02	0.0000
1.8900+01	4.4139-02	6.6010-02	0.0000
1.9000+01	1.7495-02	8.4741-02	0.0000
1.9100+01	-5.8356-03	9.8125-02	0.0000
1.9200+01	-2.4620-02	1.0538-01	0.0000
1.9300+01	-3.7906-02	1.0610-01	0.0000
1.9400+01	-4.5078-02	1.0030-01	0.0000
1.9500+01	-4.5897-02	8.8370-02	0.0000
1.9600+01	-4.0509-02	7.1104-02	0.0000
1.9700+01	-2.9435-02	4.9598-02	0.0000
1.9800+01	-1.3535-02	2.5210-02	0.0000
1.9900+01	6.0438-03	-5.3920-04	0.0000
2.0000+01	2.7944-02	-2.6054-02	0.0000

RATIO 2 (DET 1/DET 4)

INPUT TRANSFER FUNCTION

BODE GAIN
1.0000+00

ROOT LOCUS GAIN
4.0000+00

ZEROS (1)
(-1.3970-08, 0.0000)

POLES (5)
(2.2751-09, 0.0000)
(-4.3140-01, 0.0000)
(-1.4930+00,-1.4663-11)
(-3.7803-02,-2.4918+00)
(-3.7803-02, 2.4918+00)

RESULTANT TRANSFER FUNCTION

BODE GAIN
1.0000+00

ROOT LOCUS GAIN
4.0000+00

GAMMA
4.0000+00

ZEROS (0)

POLES (4)
(-4.3140-01, 0.0000)
(-1.4930+00, 0.0000)
(-3.7803-02,-2.4918+00)
(-3.7803-02, 2.4918+00)

**** TRANSIENT RESPONSE ****

SAMPLE CASE -- DELAY LINE NETWORK
R=1.0, C1=0.25, C2=0.5, L1=0.5, L2=1.0

RATIO 2

BODE GAIN	ROOT LOCUS GAIN	GAMMA
1.0000+00	4.0000+00	4.0000+00

START TIME	END TIME	INCREMENT
0.0000	2.0000+01	1.0000-01

SUM OF THE RESIDUES
(0.0000 ,-9.3132-10)

LAMBDA'S

ZEROS	NON-ZERO POLES	RESIDUES
	(-4.3140-01, 0.0000)	(5.9208-01, 9.8632-10)
	(-1.4930+00, 0.0000)	(-4.5252-01,-2.7870-09)
	(-3.7803-02,-2.4918+00)	(-6.9779-02,-8.5372-02)
	(-3.7803-02, 2.4918+00)	(-6.9779-02, 8.5372-02)

PIECEWISE QUADRATIC DRIVING FUNCTION

BREAK-POINT TIME	CONSTANT COEFFICIENT	LINEAR COEFFICIENT	QUADRATIC COEFFICIENT
0.0000	0.0000	2.0000-01	0.0000
5.0000+00	1.0000+00	0.0000	0.0000
1.0000+01	3.0000+00	2.0000-01	0.0000
1.5000+01	0.0000	0.0000	0.0000

TIME (SECONDS)	RESPONSE FUNCTION	INVERSE TRANSFORM	DRIVING FUNCTION
0.0000	0.0000	0.0000	0.0000
1.0000-01	6.4388-08	6.3237-04	2.0000-02
2.0000-01	1.9854-06	4.7711-03	4.0000-02
3.0000-01	1.4487-05	1.5093-02	6.0000-02
4.0000-01	5.8501-05	3.3320-02	8.0000-02
5.0000-01	1.7060-04	6.0198-02	1.0000-01
6.0000-01	4.0452-04	9.5537-02	1.2000-01
7.0000-01	8.3075-04	1.3829-01	1.4000-01
8.0000-01	1.5345-03	1.8666-01	1.6000-01
9.0000-01	2.6121-03	2.3830-01	1.8000-01
1.0000+00	4.1664-03	2.9045-01	2.0000-01
1.1000+00	6.3012-03	3.4019-01	2.2000-01
1.2000+00	9.1155-03	3.8461-01	2.4000-01
1.3000+00	1.2698-02	4.2104-01	2.6000-01
1.4000+00	1.7120-02	4.4723-01	2.8000-01
1.5000+00	2.2435-02	4.6149-01	3.0000-01
1.6000+00	2.8671-02	4.6280-01	3.2000-01
1.7000+00	3.5830-02	4.5091-01	3.4000-01
1.8000+00	4.3889-02	4.2634-01	3.6000-01
1.9000+00	5.2799-02	3.9035-01	3.8000-01
2.0000+00	6.2488-02	3.4486-01	4.0000-01
2.1000+00	7.2865-02	2.9236-01	4.2000-01
2.2000+00	8.3827-02	2.3573-01	4.4000-01
2.3000+00	9.5259-02	1.7808-01	4.6000-01
2.4000+00	1.0705-01	1.2253-01	4.8000-01
2.5000+00	1.1908-01	7.2089-02	5.0000-01
2.6000+00	1.3126-01	2.9395-02	5.2000-01
2.7000+00	1.4351-01	-3.3921-03	5.4000-01
2.8000+00	1.5574-01	-2.4735-02	5.6000-01
2.9000+00	1.6793-01	-3.3807-02	5.8000-01
3.0000+00	1.8005-01	-3.0534-02	6.0000-01
3.1000+00	1.9212-01	-1.5592-02	6.2000-01
3.2000+00	2.0415-01	9.6366-03	6.4000-01
3.3000+00	2.1621-01	4.3159-02	6.6000-01
3.4000+00	2.2835-01	8.2496-02	6.8000-01
3.5000+00	2.4066-01	1.2484-01	7.0000-01
3.6000+00	2.5322-01	1.6723-01	7.2000-01
3.7000+00	2.6611-01	2.0674-01	7.4000-01
3.8000+00	2.7941-01	2.4065-01	7.6000-01

3.9000+00	2.9320-01	2.6661-01	7.8000-01
4.0000+00	3.0751-01	2.8280-01	8.0000-01
4.1000+00	3.2239-01	2.8801-01	8.2000-01
4.2000+00	3.3784-01	2.8175-01	8.4000-01
4.3000+00	3.5386-01	2.6422-01	8.6000-01
4.4000+00	3.7040-01	2.3634-01	8.8000-01
4.5000+00	3.8742-01	1.9967-01	9.0000-01
4.6000+00	4.0483-01	1.5630-01	9.2000-01
4.7000+00	4.2255-01	1.0873-01	9.4000-01
4.8000+00	4.4049-01	5.9714-02	9.6000-01
4.9000+00	4.5855-01	1.2070-02	9.8000-01
5.0000+00	4.7664-01	-3.1473-02	1.0000+00
5.1000+00	4.9466-01	-6.8452-02	1.0000+00
5.2000+00	5.1254-01	-9.6820-02	1.0000+00
5.3000+00	5.3023-01	-1.1507-01	1.0000+00
5.4000+00	5.4765-01	-1.2231-01	1.0000+00
5.5000+00	5.6476-01	-1.1835-01	1.0000+00
5.6000+00	5.8152-01	-1.0367-01	1.0000+00
5.7000+00	5.9788-01	-7.9382-02	1.0000+00
5.8000+00	6.1380-01	-4.7209-02	1.0000+00
5.9000+00	6.2926-01	-9.3196-03	1.0000+00
6.0000+00	6.4422-01	3.1782-02	1.0000+00
6.1000+00	6.5866-01	7.3420-02	1.0000+00
6.2000+00	6.7257-01	1.1291-01	1.0000+00
6.3000+00	6.8594-01	1.4772-01	1.0000+00
6.4000+00	6.9876-01	1.7564-01	1.0000+00
6.5000+00	7.1104-01	1.9490-01	1.0000+00
6.6000+00	7.2279-01	2.0428-01	1.0000+00
6.7000+00	7.3402-01	2.0317-01	1.0000+00
6.8000+00	7.4475-01	1.9165-01	1.0000+00
6.9000+00	7.5502-01	1.7040-01	1.0000+00
7.0000+00	7.6484-01	1.4072-01	1.0000+00
7.1000+00	7.7426-01	1.0443-01	1.0000+00
7.2000+00	7.8330-01	6.3727-02	1.0000+00
7.3000+00	7.9200-01	2.1082-02	1.0000+00
7.4000+00	8.0039-01	-2.0939-02	1.0000+00
7.5000+00	8.0848-01	-5.9821-02	1.0000+00
7.6000+00	8.1631-01	-9.3260-02	1.0000+00
7.7000+00	8.2390-01	-1.1930-01	1.0000+00
7.8000+00	8.3125-01	-1.3645-01	1.0000+00
7.9000+00	8.3838-01	-1.4379-01	1.0000+00

8.0000+00	8.4529-01	-1.4098-01	1.0000+00
8.1000+00	8.5198-01	-1.2833-01	1.0000+00
8.2000+00	8.5845-01	-1.0675-01	1.0000+00
8.3000+00	8.6468-01	-7.7669-02	1.0000+00
8.4000+00	8.7067-01	-4.2988-02	1.0000+00
8.5000+00	8.7640-01	-4.9266-03	1.0000+00
8.6000+00	8.8188-01	3.4106-02	1.0000+00
8.7000+00	8.8709-01	7.1660-02	1.0000+00
8.8000+00	8.9204-01	1.0539-01	1.0000+00
8.9000+00	8.9671-01	1.3323-01	1.0000+00
9.0000+00	9.0111-01	1.5345-01	1.0000+00
9.1000+00	9.0526-01	1.6485-01	1.0000+00
9.2000+00	9.0916-01	1.6675-01	1.0000+00
9.3000+00	9.1283-01	1.5908-01	1.0000+00
9.4000+00	9.1630-01	1.4235-01	1.0000+00
9.5000+00	9.1957-01	1.1764-01	1.0000+00
9.6000+00	9.2268-01	8.6485-02	1.0000+00
9.7000+00	9.2565-01	5.0839-02	1.0000+00
9.8000+00	9.2850-01	1.2901-02	1.0000+00
9.9000+00	9.3126-01	-2.5001-02	1.0000+00
1.0000+01	9.3395-01	-6.0557-02	1.0000+00
1.0100+01	9.3661-01	-9.1618-02	3.0200+00
1.0200+01	9.3965-01	-1.1633-01	3.0400+00
1.0300+01	9.4407-01	-1.3323-01	3.0600+00
1.0400+01	9.5132-01	-1.4137-01	3.0800+00
1.0500+01	9.6310-01	-1.4032-01	3.1000+00
1.0600+01	9.8120-01	-1.3025-01	3.1200+00
1.0700+01	1.0073+00	-1.1184-01	3.1400+00
1.0800+01	1.0427+00	-8.6325-02	3.1600+00
1.0900+01	1.0885+00	-5.5332-02	3.1800+00
1.1000+01	1.1450+00	-2.0827-02	3.2000+00
1.1100+01	1.2123+00	1.5025-02	3.2200+00
1.1200+01	1.2896+00	4.9992-02	3.2400+00
1.1300+01	1.3757+00	8.1917-02	3.2600+00
1.1400+01	1.4688+00	1.0884-01	3.2800+00
1.1500+01	1.5667+00	1.2914-01	3.3000+00
1.1600+01	1.6670+00	1.4160-01	3.3200+00
1.1700+01	1.7670+00	1.4550-01	3.3400+00
1.1800+01	1.8642+00	1.4066-01	3.3600+00
1.1900+01	1.9560+00	1.2742-01	3.3800+00
1.2000+01	2.0403+00	1.0666-01	3.4000+00

1.2100+01	2.1154+00	7.9703-02	3.4200+00
1.2200+01	2.1800+00	4.8245-02	3.4400+00
1.2300+01	2.2336+00	1.4248-02	3.4600+00
1.2400+01	2.2762+00	-2.0185-02	3.4800+00
1.2500+01	2.3084+00	-5.2938-02	3.5000+00
1.2600+01	2.3314+00	-8.2017-02	3.5200+00
1.2700+01	2.3469+00	-1.0566-01	3.5400+00
1.2800+01	2.3570+00	-1.2248-01	3.5600+00
1.2900+01	2.3640+00	-1.3147-01	3.5800+00
1.3000+01	2.3704+00	-1.3217-01	3.6000+00
1.3100+01	2.3786+00	-1.2458-01	3.6200+00
1.3200+01	2.3909+00	-1.0926-01	3.6400+00
1.3300+01	2.4090+00	-8.7195-02	3.6600+00
1.3400+01	2.4346+00	-5.9813-02	3.6800+00
1.3500+01	2.4685+00	-2.8841-02	3.7000+00
1.3600+01	2.5111+00	3.7837-03	3.7200+00
1.3700+01	2.5622+00	3.6036-02	3.7400+00
1.3800+01	2.6211+00	6.5928-02	3.7600+00
1.3900+01	2.6864+00	9.1634-02	3.7800+00
1.4000+01	2.7563+00	1.1160-01	3.8000+00
1.4100+01	2.8289+00	1.2463-01	3.8200+00
1.4200+01	2.9019+00	1.2998-01	3.8400+00
1.4300+01	2.9730+00	1.2738-01	3.8600+00
1.4400+01	3.0400+00	1.1703-01	3.8800+00
1.4500+01	3.1010+00	9.9624-02	3.9000+00
1.4600+01	3.1542+00	7.6294-02	3.9200+00
1.4700+01	3.1986+00	4.8513-02	3.9400+00
1.4800+01	3.2336+00	1.8020-02	3.9600+00
1.4900+01	3.2589+00	-1.3289-02	3.9800+00
1.5000+01	3.2751+00	-4.3484-02	4.0000+00
1.5100+01	3.2831+00	-7.0717-02	0.0000
1.5200+01	3.2837+00	-9.3337-02	0.0000
1.5300+01	3.2765+00	-1.0999-01	0.0000
1.5400+01	3.2610+00	-1.1969-01	0.0000
1.5500+01	3.2358+00	-1.2191-01	0.0000
1.5600+01	3.1997+00	-1.1656-01	0.0000
1.5700+01	3.1515+00	-1.0403-01	0.0000
1.5800+01	3.0903+00	-8.5151-02	0.0000
1.5900+01	3.0155+00	-6.1131-02	0.0000
1.6000+01	2.9274+00	-3.3490-02	0.0000
1.6100+01	2.8265+00	-3.9578-03	0.0000

1.6200+01	2.7143+00	2.5631-02	0.0000
1.6300+01	2.5927+00	5.3454-02	0.0000
1.6400+01	2.4643+00	7.7811-02	0.0000
1.6500+01	2.3318+00	9.7226-02	0.0000
1.6600+01	2.1985+00	1.1054-01	0.0000
1.6700+01	2.0676+00	1.1698-01	0.0000
1.6800+01	1.9421+00	1.1620-01	0.0000
1.6900+01	1.8250+00	1.0830-01	0.0000
1.7000+01	1.7187+00	9.3817-02	0.0000
1.7100+01	1.6250+00	7.3694-02	0.0000
1.7200+01	1.5452+00	4.9211-02	0.0000
1.7300+01	1.4795+00	2.1905-02	0.0000
1.7400+01	1.4278+00	-6.5221-03	0.0000
1.7500+01	1.3890+00	-3.4313-02	0.0000
1.7600+01	1.3614+00	-5.9763-02	0.0000
1.7700+01	1.3428+00	-8.1324-02	0.0000
1.7800+01	1.3305+00	-9.7699-02	0.0000
1.7900+01	1.3217+00	-1.0792-01	0.0000
1.8000+01	1.3134+00	-1.1140-01	0.0000
1.8100+01	1.3028+00	-1.0799-01	0.0000
1.8200+01	1.2874+00	-9.7940-02	0.0000
1.8300+01	1.2650+00	-8.1923-02	0.0000
1.8400+01	1.2342+00	-6.0969-02	0.0000
1.8500+01	1.1940+00	-3.6408-02	0.0000
1.8600+01	1.1442+00	-9.7778-03	0.0000
1.8700+01	1.0853+00	1.7266-02	0.0000
1.8800+01	1.0185+00	4.3055-02	0.0000
1.8900+01	9.4560-01	6.6010-02	0.0000
1.9000+01	8.6869-01	8.4741-02	0.0000
1.9100+01	7.9033-01	9.8125-02	0.0000
1.9200+01	7.1322-01	1.0538-01	0.0000
1.9300+01	6.4003-01	1.0610-01	0.0000
1.9400+01	5.7325-01	1.0030-01	0.0000
1.9500+01	5.1506-01	8.8370-02	0.0000
1.9600+01	4.6715-01	7.1104-02	0.0000
1.9700+01	4.3065-01	4.9598-02	0.0000
1.9800+01	4.0605-01	2.5210-02	0.0000
1.9900+01	3.9317-01	-5.3920-04	0.0000
2.0000+01	3.9119-01	-2.6054-02	0.0000

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 2

EIGENVALUE TEST CASE

OPTIONS

```
CLEAR  =  1
COMENT =  1
INPUT  =  4
NUNFLS =  0
NUVFLS =100
PLOT   =  0
SFREQR =  0, 0, 0, 0, 0, 0, 0
SROOTL =  0, 0, 0, 0, 0, 0, 0
STIMER =  0, 0, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 2

EIGENVALUE TEST CASE

INPUT MATRIX

DEGREE OF MATRIX = 2

	1	2	3	4	5	6	7	8	9
1	1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000
5	3.0877-02	-6.2602-03	9.0508-01	-8.7007-03	0.0000	0.0000	0.0000	0.0000	0.0000
6	-3.0893-02	1.5975-02	4.8340+00	-3.8029-02	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	9.2864-03	-2.8759-03	-2.9780-01	2.0080-03	0.0000	0.0000	0.0000	0.0000	0.0000
10	-6.5799-03	1.5982-03	6.5726-02	-3.5147-04	0.0000	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	3.0877-02	-6.2602-03	9.0508-01	-8.7007-03	0.0000	0.0000	0.0000	0.0000	0.0000
15	-1.8219-02	1.2138-02	4.4568+00	-3.5504-02	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	9.2864-03	-2.8759-03	-2.9780-01	2.0080-03	0.0000	0.0000	0.0000	0.0000	0.0000
19	1.6210-03	-8.8420-04	-1.7831-01	1.2821-03	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	10	11	12	13	14	15	16	17	18
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	6.2058-05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	19	20	21	22	23	24
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	6.2058-05	0.0000	0.0000	0.0000	0.0000	0.0000

22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DEGREE OF MATRIX = 1

	1	2	3	4	5	6	7	8	9
1	7.5600-01	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	8.0800-01	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	1.1060+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	1.1370+00	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	6.7000-03	0.0000	0.0000	0.0000	0.0000
6	-9.6842+00	5.0077+00	1.5153+03	-1.1921+01	2.2000-02	-2.2000-02	-1.0000+00	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	2.8100-03	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.8150-03
10	-3.1876+00	7.7424-01	3.1840+01	-1.7027-01	0.0000	0.0000	0.0000	0.0000	2.2000-02
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	-5.7113+00	3.8052+00	1.3971+03	-1.1130+01	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	7.8530-01	-4.2835-01	-8.6384+01	6.2110-01	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	10	11	12	13	14	15	16	17	18
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	-2.2000-02	-1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	2.7321-02	0.0000	-1.2461-02	1.4268-02	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	-2.0000-02	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	6.5000-03	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	2.2000-02	-2.2000-02	-1.0000+00	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	2.8100-03	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.8150-03
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.2000-02
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	19	20	21	22	23	24
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	-2.2000-02	-1.0000+00	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	2.7321-02	0.0000	-1.2461-02	1.4268-02	0.0000	0.0000
22	0.0000	0.0000	0.0000	-2.0000-02	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DEGREE OF MATRIX = 0

	1	2	3	4	5	6	7	8	9
1	9.4680+02	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	1.6320+03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	3.0600+03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	3.2350+03	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	2.9629-03	0.0000	1.0000+00	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	6.8965+00	-6.8965+00	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	-2.1600-01	1.0325+00	-1.0000+00	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	3.7000-01	0.0000	-1.0000+00	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.9007-03
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.3670+00
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	1.8060-01	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-2.9095+02	0.0000	0.0000

	10	11	12	13	14	15	16	17	18
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	1.1450+00	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	-3.3670+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	-4.0500-01	1.1240+00	-1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	1.5264+00	0.0000	-1.6138+00	1.8478+00	0.0000	0.0000	0.0000	0.0000	0.0000
13	1.8060-01	0.0000	0.0000	-1.0000+00	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	2.9629-03	0.0000	1.0000+00	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	6.8965+00	-6.8965+00	0.0000	0.0000	0.0000

16	0.0000	0.0000	0.0000	0.0000	0.0000	-2.1600-01	1.0325+00	-1.0000+00	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000	3.7000-01	0.0000	-1.0000+00	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.9007-03
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.3670+00
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	1.8060-01	0.0000	0.0000	0.0000
23	0.0000	-2.6680+02	0.0000	1.9870+03	0.0000	0.0000	-1.0200+03	0.0000	0.0000

	19	20	21	22	23	24
1	0.0000	0.0000	0.0000	0.0000	0.0000	-2.4360-04
2	0.0000	0.0000	0.0000	0.0000	0.0000	1.2561-04
3	0.0000	0.0000	0.0000	0.0000	0.0000	2.1149-05
4	0.0000	0.0000	0.0000	0.0000	0.0000	-1.2358-05
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	1.1450+00	0.0000	0.0000
18	0.0000	1.0000+00	0.0000	0.0000	0.0000	0.0000
19	-3.3670+00	0.0000	0.0000	0.0000	0.0000	0.0000
20	-4.0500-01	1.1240+00	-1.0000+00	0.0000	0.0000	0.0000
21	1.5264+00	0.0000	-1.6138+00	1.8478+00	0.0000	0.0000
22	1.8060-01	0.0000	0.0000	-1.0000+00	0.0000	0.0000
23	0.0000	-9.2800+02	0.0000	6.9115+03	-1.0000+00	0.0000

DETERMINANT NUMBER 1

LAST ROW ELEMENTS
COLUMN 23 HAS THE VALUE -1.0000+00

ITERANTS FOR EIGENVALUE 2

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-7.2600+00, 3.4188+01)	(-9.9889+09, 4.5243+10)	(-1.4743+12,-6.6997+11)
(-5.9400+00, 2.7972+01)	(9.6567+10,-1.3205+11)	(3.1201+12, 3.4855+12)
(-6.6000+00, 3.1080+01)	(1.1944+08, 5.4293+07)	(-2.4757+09, 3.3540+09)
(-6.6040+00, 3.1080+01)	(6.3827+06, 1.0224+07)	(-3.5990+08, 1.3085+08)
(-6.6043+00, 3.1079+01)	(2.0762+03, 5.7887+03)	(-1.9362+05, 2.6298+04)
(-6.6043+00, 3.1079+01)	(9.1672+02,-8.6242+02)	(2.0749+04, 3.4187+04)

EIGENVECTOR

(3.1630-08, 6.2783-07)
(-1.3725-07,-7.5099-08)
(-9.6274-09,-1.6998-09)
(5.2226-09, 8.5000-10)
(1.8422-02,-1.0277-03)
(7.5948-04,-5.5275-03)
(5.3267-04,-3.8644-03)
(3.8593-04,-2.7961-03)
(5.7871-04, 1.3907-03)
(4.7876-04, 5.7376-04)
(8.4303-05,-1.2500-05)
(-9.9142-05,-2.4642-04)
(-3.1765-04,-8.0330-04)
(-5.3576-03, 2.6266-04)
(-2.5223-04, 1.5800-03)
(-1.7496-04, 1.1069-03)
(-1.2616-04, 8.0156-04)
(-3.5625-04,-4.0726-04)
(-1.3267-04,-1.5179-04)
(-2.5612-05, 2.3904-05)
(2.4945-05, 8.8344-05)
(8.7742-05, 2.3434-04)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 4

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.1770+01, 4.4077+01)	(-1.5342+08,-1.3905+09)	(-9.8737+12, 1.2570+12)
(-9.6300+00, 3.6063+01)	(-1.1589+08,-8.7433+07)	(-2.1178+12, 1.5454+11)
(-1.0700+01, 4.0070+01)	(-8.9956+05,-6.3842+05)	(-3.1519+10, 6.6417+09)
(-1.0741+01, 3.9906+01)	(-2.9964+06, 3.1192+06)	(5.7155+09, 1.2377+11)
(-1.0743+01, 4.0073+01)	(-2.0669+04,-2.7492+04)	(-1.0012+09,-1.0713+08)
(-1.0744+01, 4.0073+01)	(1.9632+01,-1.8981+01)	(-1.3656+04,-7.9935+05)
(-1.0744+01, 4.0073+01)	(1.3884+01,-2.2610+00)	(2.2914+05,-3.4221+05)

EIGENVECTOR

(-1.3513-07, 2.0347-07)
(-2.3700-08,-1.4778-07)
(-1.0649-08,-5.5839-09)
(5.8394-09, 2.7490-09)
(1.0065-04, 8.5811-05)
(1.3275-05,-5.5095-05)
(7.7143-06,-2.9736-05)
(5.0976-06,-1.8802-05)
(-3.0765-04,-5.8215-04)
(-2.8500-05, 2.7345-05)
(-4.7902-05, 2.0368-05)
(-4.2300-05, 1.1819-05)
(-4.9060-06,-1.3752-06)
(9.4213-05, 9.5583-05)
(1.5135-05,-4.8544-05)
(8.9249-06,-2.6782-05)
(5.9457-06,-1.7167-05)
(-2.0541-04,-4.8717-04)
(-2.3636-05, 2.1450-05)
(-3.9297-05, 1.4509-05)
(-3.4597-05, 7.6205-06)
(-4.0732-06,-2.0746-06)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 6

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-8.910C+0C, 4.642C+01)	(1.8144+05,-4.4100+05)	(1.3909+13, 6.8289+12)
(-7.29C0+00, 3.798C+C1)	(-1.7523+05,-9.9031+04)	(-1.1470+12,-2.6128+11)
(-8.1000+0C, 4.220C+01)	(-3.8727+03, 1.8282+03)	(-3.6084+10,-2.2025+10)
(-8.1365+0C, 4.2264+C1)	(6.5861+02, 1.5681+03)	(-9.8345+09, 1.3875+10)
(-8.1097+0C, 4.2269+C1)	(-6.4437+0C, 5.0384+00)	(-7.7584+C7,-2.7710+07)
(-8.1097+0C, 4.2269+01)	(-3.0649-02, 2.0538-02)	(-3.3986+05,-1.5027+05)
(-8.1097+0C, 4.2269+C1)	(4.0423-02,-1.5579-02)	(3.5029+05, 2.6017+05)

EIGENVECTOR

(-9.7727-09,-1.5757-08)
(1.4174-08, 4.1935-09)
(6.1762-10,-9.2268-10)
(-3.0263-10, 5.0156-10)
(-1.3062-02,-1.1581-02)
(5.3002-03, 1.4480-02)
(-3.9494-03, 3.1020-03)
(-5.2226-03, 7.5126-05)
(1.0000+00, 0.0000)
(-4.1270-03,-5.8939-02)
(1.1818-02,-7.6718-02)
(1.4955-02,-6.2361-02)
(-4.6664-03,-4.8752-03)
(3.9865-03, 3.5837-03)
(-1.4420-03,-4.2167-03)
(1.1842-03,-9.1918-04)
(1.5341-03,-3.8248-05)
(-2.8749-01,-9.9521-04)
(1.1276-03, 1.6959-02)
(-3.4747-03, 2.2044-02)
(-4.3622-03, 1.7909-02)
(1.3397-03, 1.3949-03)
(0.0000 , 0.0000)
(-1.0978-02, 7.6690-02)

ITERANTS FOR EIGENVALUE 8

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-5.1700-01, 0.0000)	(2.6344+0C, 0.0000)	(-4.3092+09, 0.0000)

(-4.2300-01, 0.0000)	(-3.1224+00, 0.0000)	(4.1917+09, 0.0000)
(-4.7000-01, 0.0000)	(-2.4589-01, 0.0000)	(3.6622+08, 0.0000)
(-4.7401-01, 0.0000)	(7.0954-06,-9.4489-15)	(-1.0656+04, 0.0000)
(-4.7401-01,-1.5426-16)	(-7.0954-06, 2.8346-14)	(1.0656+04,-1.4190-05)
(-4.7401-01,-2.3617-19)	(1.8935-04, 2.5217-13)	(-2.8438+05,-2.1725-08)

EIGENVECTOR

(2.5732-07,-1.2327-29)
(-7.6977-08, 1.5600-30)
(-6.9122-09,-8.4282-32)
(3.8204-09, 5.2710-32)
(-9.2156-07,-4.6118-25)
(-7.6810-10,-2.5558-27)
(-6.7661-10,-2.0349-27)
(-5.3269-10,-1.5490-27)
(-1.5560-07,-7.7681-26)
(-4.2701-10,-3.4727-28)
(-7.3343-10,-9.5535-28)
(-6.5144-10,-9.3317-28)
(-2.1791-10,-5.3037-28)
(-7.8831-07,-3.9471-25)
(-5.1937-10,-2.3287-27)
(-5.7351-10,-1.7353-27)
(-4.7997-10,-1.2887-27)
(1.1706-07, 5.8419-26)
(-8.6252-10,-6.1355-28)
(-1.2897-09,-1.1162-27)
(-1.1003-09,-1.0061-27)
(-2.5196-10,-3.7603-28)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 9

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(1.5840+01, 0.0000)	(1.8325+01,-2.6528-19)	(3.7987+13, 0.0000)
(1.2960+01, 0.0000)	(-1.5724+01,-4.7627-08)	(-1.7852+13, 0.0000)
(1.4400+01, 0.0000)	(-8.2141-01, 1.3042-20)	(-1.2706+12, 0.0000)
(1.4469+01,-9.0888-11)	(-7.8627-03,-1.0770-09)	(-1.2339+10,-1.6900+03)
(1.4470+01, 1.2144-13)	(2.3044-05, 1.4393-12)	(3.6168+07, 2.2591+00)

(1.4470+01,-3.7845-16)
(1.4470+01, 1.6531-15)

(2.5943-06,-4.4854-15)
(-4.5135-06, 1.9593-14)

(4.0718+06,-7.0399-03)
(-7.0841+06, 3.0752-02)

EIGENVECTOR

(2.0872-07,-8.7791-24)
(-6.7788-08, 1.7990-24)
(-6.4374-09, 9.7323-26)
(3.5708-09,-5.1301-26)
(1.8681-05, 9.4104-22)
(-2.6606-06,-3.9102-22)
(-2.0782-06,-3.0874-22)
(-1.5710-06,-2.3432-22)
(6.7855-08,-7.3053-22)
(-3.2267-07,-6.8206-23)
(-8.5149-07,-1.4877-22)
(-8.2640-07,-1.3959-22)
(-4.1785-07,-5.3607-23)
(1.6146-05, 8.7090-22)
(-2.2839-06,-3.1352-22)
(-1.7782-06,-2.6580-22)
(-1.3426-06,-2.0671-22)
(-5.9335-06,-1.0591-21)
(-2.3975-07,-4.4080-23)
(-6.7647-07,-1.2118-22)
(-6.6326-07,-1.1835-22)
(-3.5348-07,-5.8825-23)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 10

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-3.4100-01, 4.2350+01)	(2.7331-02,-3.9082-02)	(-1.9872+12,-7.6646+11)
(-2.7900-01, 3.4650+01)	(-6.0048-02, 2.4328-01)	(-1.6855+12,-3.7184+12)
(-3.1000-01, 3.8500+01)	(-3.1102-04, 5.0005-04)	(1.1051+10,-9.2128+09)
(-3.1402-01, 3.8515+01)	(6.9355-05, 3.4140-05)	(-1.3422+09,-1.3310+09)
(-3.1204-01, 3.8515+01)	(-1.7623-08, 6.2106-08)	(8.9185+05,-1.3035+06)
(-3.1204-01, 3.8515+01)	(-3.1085-09, 7.7059-09)	(1.3204+05,-1.5456+05)

EIGENVECTOR

(-4.5381-07,-4.2956-09)
(-8.4428-07, 4.0286-08)
(-1.3415-08, 1.5795-10)
(7.0553-09,-7.9583-11)
(-1.5702-05, 1.1872-04)
(-2.2101-07, 5.8291-06)
(-3.8920-07, 3.0875-06)
(-3.5411-07, 1.9288-06)
(8.2621-05, 3.2572-05)
(2.6843-06,-5.4506-06)
(5.3861-06,-6.0992-06)
(4.9668-06,-4.6481-06)
(3.1296-07,-1.7379-07)
(-2.6990-05, 1.2991-04)
(2.5374-06, 9.3498-06)
(1.5076-06, 5.7746-06)
(1.0085-06, 3.9427-06)
(6.0458-05, 2.1106-05)
(1.8633-06,-4.2704-06)
(4.6363-06,-4.5232-06)
(4.4565-06,-3.3545-06)
(9.4656-07, 1.8938-07)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 12

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-3.7510-01, 4.6585+01)	(1.1277-04,-1.0860-04)	(5.2414+11, 1.2529+13)
(-3.0690-01, 3.8115+01)	(-2.1318-04, 5.0159-04)	(2.3056+11,-3.1356+11)
(-3.4100-01, 4.2350+01)	(-8.7126-05, 1.2671-04)	(-1.9872+12,-7.6646+11)
(-3.9315-01, 4.4347+01)	(6.7371-06,-3.3985-06)	(4.8433+10, 2.4141+11)
(-3.5524-01, 4.4258+01)	(2.9485-07,-4.3593-08)	(-8.1623+08, 9.4193+09)
(-3.5258-01, 4.4255+01)	(-1.6413-10,-1.4927-10)	(5.7994+06,-3.9790+06)
(-3.5258-01, 4.4255+01)	(1.2073-11,-1.4279-11)	(3.5278+05, 4.7636+05)

EIGENVECTOR
(-2.4074-07,-5.3526-10)
(3.8443-07, 5.3554-09)
(-1.9201-08, 3.0930-10)

(9.6813-09,-1.4498-10)
(-1.6297-05, 1.9091-04)
(6.3466-06, 7.3232-06)
(3.1394-06, 4.3183-06)
(1.8705-06, 2.8769-06)
(1.4442-04,-3.6941-05)
(-1.6061-06,-8.3945-06)
(1.4026-06,-1.1663-05)
(2.2270-06,-9.7092-06)
(3.8366-07,-5.3686-07)
(-2.4024-05, 2.0532-04)
(9.7579-06, 9.9957-06)
(5.6018-06, 6.3737-06)
(3.6761-06, 4.4218-06)
(1.1461-04,-3.2178-05)
(-1.3719-06,-6.6583-06)
(1.8525-06,-9.2793-06)
(2.6379-06,-7.7333-06)
(1.1514-06,-4.1937-07)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 14

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-3.0690-01, 3.8115+01)	(-4.1465-07, 9.9457-07)	(2.3056+11,-3.1356+11)
(-3.4100-01, 4.2350+01)	(-5.2342-07, 7.7100-07)	(-1.9872+12,-7.6646+11)
(-3.7510-01, 4.6585+01)	(-5.2771-07, 5.1840-07)	(5.2414+11, 1.2529+13)
(-2.6672+00, 5.6034+01)	(-1.2322-08, 1.9205-07)	(-3.6988+14, 1.4032+14)
(-7.6735-01, 5.7120+01)	(2.8689-08, 1.0345-08)	(7.0776+13, 7.4406+13)
(-5.6091-01, 5.6868+01)	(-4.0271-10,-6.3729-10)	(-4.4169+11,-2.2971+12)
(-5.6861-01, 5.6869+01)	(4.2517-13,-3.8212-13)	(1.6632+09,-6.1763+08)
(-5.6862-01, 5.6869+01)	(6.3329-14,-2.2944-14)	(2.0896+08, 6.0530+06)

EIGENVECTOR

(-1.0648-07, 1.0093-09)
(7.8388-08,-9.1600-10)
(1.2124-07,-1.2345-09)
(2.2337-05, 5.3033-07)
(-7.5476-05, 7.8252-04)

(2.3947-05,	5.3035-06)
(1.2606-05,	5.2837-06)
(7.8426-06,	4.2070-06)
(3.1521-04,	-3.4742-04)
(-1.4528-05,	-1.4495-05)
(-1.2178-05,	-2.6728-05)
(-7.8041-06,	-2.4171-05)
(-4.5652-08,	-1.5353-06)
(-9.1130-05,	8.2393-04)
(3.3569-05,	1.2474-05)
(1.9012-05,	1.0158-05)
(1.2379-05,	7.7940-06)
(2.7376-04,	-3.1156-04)
(-1.2065-05,	-1.1797-05)
(-8.3985-06,	-2.2516-05)
(-4.5535-06,	-2.0530-05)
(1.7518-06,	-1.8917-06)
(0.0000 ,	0.0000)
(1.0000+00,	0.0000)

ITERANTS FOR EIGENVALUE 16

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-3.0690-01, 3.8115+01)	(-2.2648-10, 5.6083-10)	(2.3056+11, -3.1356+11)
(-3.4100-01, 4.2350+01)	(-3.5610-10, 5.3994-10)	(-1.9872+12, -7.6646+11)
(-3.7510-01, 4.6585+01)	(-4.8757-10, 4.9548-10)	(5.2414+11, 1.2529+13)
(-2.9975+01, 5.3300+01)	(-1.9546-10, -4.7794-11)	(2.3233+16, -1.3288+16)
(-4.2416+01, 5.5637+01)	(-8.3510-11, -8.5202-11)	(2.2593+16, 2.8415+17)
(-5.5471+01, 5.6357+01)	(-1.0715-11, -6.5527-11)	(-1.4822+18, -5.8379+17)
(-6.9687+01, 5.5311+01)	(1.8589-11, -2.8424-11)	(5.2395+18, -3.3986+18)
(-8.1520+01, 5.2458+01)	(1.7867-11, -5.5871-12)	(3.0751+18, 1.3879+19)
(-9.2541+01, 4.7844+01)	(9.6599-12, 4.3556-12)	(-2.5298+19, -4.2097+18)
(-1.0279+02, 4.1314+01)	(2.4147-12, 5.8850-12)	(2.3511+19, -3.3158+19)
(-1.1219+02, 3.2702+01)	(-1.4302-12, 3.9514-12)	(2.6787+19, 5.5300+19)
(-1.2139+02, 2.1552+01)	(-2.6427-12, 1.6353-12)	(-1.0095+20, -1.3323+19)
(-1.3194+02, 7.1238+00)	(-2.6383-12, 1.7689-13)	(1.5979+20, -1.7392+20)
(-1.5022+02, -8.9544+00)	(-2.3883-12, 5.7654-13)	(1.1389+21, 8.0660+20)
(-1.7081+02, -2.8087+00)	(4.7926-14, 4.1508-13)	(1.8227+20, -1.4694+21)
(-1.7046+02, -1.7937-01)	(8.1185-15, 2.6293-14)	(-2.6496+19, -9.0697+19)
(-1.7041+02, 1.1066-03)	(1.5925-16, -1.6203-16)	(-5.4422+17, 5.5383+17)

(-1.7041+02,-9.2798-08)	(-1.5846-20, 1.3587-20)	(5.4151+13,-4.6434+13)
(-1.7041+02, 4.0998-12)	(1.1660-19,-6.3030-25)	(-3.9847+14, 2.0515+09)

EIGENVECTOR

(8.1589-09, 3.8099-22)
(-4.1141-09,-1.8783-22)
(-6.6273-10,-1.1203-22)
(3.8522-10, 1.6723-23)
(2.4480-03, 8.0822-12)
(1.5391-01, 5.0636-10)
(2.7971-03, 9.2037-12)
(-3.0356-02,-9.9870-11)
(-6.1172-06,-1.0952-13)
(4.5172-03, 1.4861-11)
(-1.0172-05,-3.3555-14)
(-1.8409-03,-6.0565-12)
(-1.1881-02,-3.9089-11)
(-7.3630-04,-2.3935-12)
(-4.4236-02,-1.4554-10)
(-8.0393-04,-2.6440-12)
(8.7249-03, 2.8705-11)
(3.6991-05, 3.1481-14)
(-1.2984-03,-4.2718-12)
(3.0358-06, 9.6452-15)
(5.2926-04, 1.7409-12)
(3.4149-03, 1.1235-11)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 17

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.0279+02, 4.1314+01)	(6.4726-14, 4.7487-14)	(2.3511+19,-3.3158+19)
(-1.1219+02, 3.2702+01)	(1.0304-14, 6.2081-14)	(2.6787+19, 5.5300+19)
(-1.2139+02, 2.1552+01)	(-3.2887-14, 4.7821-14)	(-1.0095+20,-1.3323+19)
(-9.4589+01, 2.2916+01)	(8.9050-15, 8.7808-15)	(6.1709+17, 1.0429+18)
(-8.9938+01, 1.9335+01)	(3.0895-15, 3.3677-15)	(3.3901+16, 2.1972+17)
(-8.6397+01, 1.8631+01)	(7.3244-16, 9.1982-16)	(2.7428+15, 3.4978+16)
(-8.5200+01, 1.8913+01)	(4.3191-17, 7.3809-17)	(8.6904+12, 2.1830+15)
(-8.5117+01, 1.8955+01)	(-2.3462-19, 8.9029-19)	(-1.6281+13, 1.6617+13)

(-8.5117+01, 1.8956+01)	(-3.2708-22, 2.1133-22)	(-9.8239+09, 5.5335+08)
(-8.5117+01, 1.8956+01)	(-3.8514-22,-2.5508-22)	(-5.2701+09,-1.0415+10)

EIGENVECTOR

(2.6779-08, 1.1075-08)
(-1.2991-08,-4.9383-09)
(-1.9412-09,-6.3175-10)
(1.1185-09, 3.5768-10)
(4.5425-03,-6.8039-05)
(4.3938-02,-2.3498-02)
(2.5749-03,-6.1691-04)
(-6.8319-03, 4.4385-03)
(7.2815-04,-2.0366-03)
(-6.4425-03,-1.9428-02)
(3.3354-05,-3.3308-04)
(2.6467-03, 7.4940-03)
(-1.2080-02, 4.5171-03)
(-1.3606-03, 1.9678-05)
(-1.2628-02, 6.7536-03)
(-7.3973-04, 1.7710-04)
(1.9638-03,-1.2759-03)
(-1.5567-04, 5.8872-04)
(1.8511-03, 5.5849-03)
(-1.0295-05, 9.5287-05)
(-7.6128-04,-2.1548-03)
(3.4720-03,-1.2985-03)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 19

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.2139+02, 2.1552+01)	(-2.9303-17, 1.6556-18)	(-1.0095+20,-1.3323+19)
(-9.4589+01, 2.2916+01)	(-2.3110-17, 1.6462-17)	(6.1709+17, 1.0429+18)
(-8.9938+01, 1.9335+01)	(-1.7251-17, 1.7380-17)	(3.3901+16, 2.1972+17)
(-8.2922+01,-1.0645+00)	(-2.7783-18,-1.3061-18)	(1.3583+16, 8.8573+15)
(-8.0770+01,-1.3678-01)	(-1.2475-20,-1.8072-19)	(3.8162+13, 7.3021+14)
(-8.0760+01, 5.7388-04)	(6.2538-22, 7.5850-22)	(-2.5216+12,-3.0579+12)
(-8.0761+01,-6.3083-09)	(1.2806-24,-8.3375-27)	(-5.1636+09, 3.3617+07)
(-8.0761+01, 8.2265-10)	(-6.6266-25, 1.0873-27)	(2.6719+09,-4.3840+06)

EIGENVECTOR

(3.2883-08, 5.8705-19)
(-1.5529-08,-2.5381-19)
(-2.2279-09,-3.0971-20)
(1.2786-09, 1.7453-20)
(-1.5058-05,-2.8109-17)
(-4.3897-06, 6.3972-16)
(-2.1354-06, 1.5185-18)
(-1.2566-06,-1.3661-16)
(4.0360-05, 4.7714-17)
(6.2599-06,-4.1208-17)
(-8.2812-07,-1.9099-17)
(-3.4661-06,-4.7777-18)
(-5.4901-07,-1.9038-16)
(-1.4938-05,-1.0939-16)
(-4.2819-06,-2.4382-16)
(-1.8291-06,-4.3580-17)
(-9.6365-07, 7.6693-18)
(4.2357-05, 1.0703-16)
(5.3264-06, 5.9846-17)
(-5.4109-07,-1.3559-17)
(-2.7654-06,-3.9478-17)
(-3.0661-07, 4.5807-17)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 20

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-9.9938+01, 1.9335+01)	(1.0792-18, 3.7998-19)	(3.3901+16, 2.1972+17)
(-9.4589+01, 2.2916+01)	(9.7271-19, 4.2148-19)	(6.1709+17, 1.0429+18)
(-1.2139+02, 2.1552+01)	(5.7972-19, 2.6676-19)	(-1.0095+20,-1.3323+19)
(-1.7704+02, 6.4358+01)	(-2.4561-20, 2.0869-19)	(-2.5746+23, 1.0488+23)
(-2.0339+02, 6.9830+01)	(-5.4193-20, 7.0370-20)	(-1.0755+24,-1.4627+24)
(-2.2301+02, 6.9013+01)	(-2.5284-20, 3.9972-21)	(2.3264+24,-1.5912+24)
(-2.2991+02, 6.2688+01)	(-2.0274-22,-2.9887-21)	(-1.2363+23, 4.6456+23)
(-2.2892+02, 6.1952+01)	(3.1098-23, 5.3343-23)	(-1.4889+21,-8.7644+21)
(-2.2893+02, 6.1974+01)	(5.0129-26,-8.3040-27)	(-7.1910+18,-1.4118+18)
(-2.2893+02, 6.1974+01)	(3.0425-27,-2.6989-27)	(-5.4738+17, 2.1080+17)

EIGENVECTOR

(3.7131-09, 2.1318-09)
(-1.9017-09,-1.0770-09)
(-3.1580-10,-1.7401-10)
(1.8421-10, 1.0116-10)
(-6.3202-06,-1.5355-06)
(-3.7465-07, 6.5219-07)
(-6.4962-08,-1.2405-07)
(1.3851-08,-2.6895-07)
(2.0042-05, 4.9387-06)
(9.3984-08,-6.1250-08)
(1.7339-07,-4.2468-08)
(1.5683-07,-2.2928-08)
(2.1871-08,-2.2248-08)
(-6.5117-06,-1.5684-06)
(-3.1902-07, 5.3333-07)
(-5.4119-08,-1.0371-07)
(1.3030-08,-2.2228-07)
(2.0084-05, 5.0072-06)
(1.2067-07,-5.8133-08)
(1.9863-07,-1.8966-08)
(1.7439-07, 2.2260-09)
(1.6355-08,-1.8317-08)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ITERANTS FOR EIGENVALUE 22

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.2139+02, 2.1552+01)	(4.0448-23, 5.3062-24)	(-1.0095+20,-1.3323+19)
(-1.7704+02, 6.4358+01)	(2.6531-23, 1.3176-23)	(-2.5746+23, 1.0488+23)
(-2.0339+02, 6.9830+01)	(2.1121-23, 1.2925-23)	(-1.0755+24,-1.4627+24)
(-4.4056+02,-1.0789-02)	(5.6663-30,-8.9947-29)	(-1.5144+25, 2.3816+26)
(-4.4056+02,-1.0594-07)	(4.8796-22,-8.8315-24)	(-1.2921+23, 2.3385+21)
(-4.4100+02,-1.0604-07)	(-3.6003-27,-8.6201-34)	(9.7661+27, 2.3602+21)
(-4.4012+02,-1.0583-07)	(3.7451-27,-8.9528-34)	(-9.6800+27, 2.3140+21)
(-4.4056+02,-1.0594-07)	(4.8796-22,-8.8315-24)	(-1.2921+23, 2.3385+21)
(-4.4056+02, 1.2417-12)	(1.2558-22, 1.0409-28)	(-3.3253+22,-2.7409+16)

EIGENVECTOR

(1.1524-09,-1.4001-17)
(-5.9226-10, 7.1956-18)
(-9.9061-11, 1.2035-18)
(5.7835-11,-7.0265-19)
(8.1644-05, 4.0490-14)
(-3.9401-02, 5.3117-16)
(2.5062-04,-5.6048-16)
(8.7694-03,-6.9343-16)
(-1.8341-02,-1.2667-13)
(1.0000+00, 0.0000)
(-1.4621-02,-1.7887-15)
(-4.2143-01, 7.0886-15)
(-2.2210-02,-8.2889-17)
(-2.8622-05, 4.1771-14)
(1.1327-02, 5.4687-17)
(-7.2005-05,-4.6311-16)
(-2.5210-03,-4.8998-16)
(5.2863-03,-1.2701-13)
(-2.8749-01, 1.9032-14)
(4.2035-03,-2.1139-15)
(1.2116-01,-1.0084-14)
(6.3850-03,-4.2099-16)
(0.0000 , 0.0000)
(9.2116-01,-1.1191-08)

ITERANTS FOR EIGENVALUE 23

LAMBDA	F SUB P (LAMBDA)	DET A(LAMBDA)
(-1.2139+02, 2.1552+01)	(1.2727-25, 8.0309-27)	(-1.0095+20,-1.3323+19)
(-1.7704+02, 6.4358+01)	(1.0653-25, 2.3982-26)	(-2.5746+23, 1.0488+23)
(-2.0339+02, 6.9830+01)	(9.6715-26, 2.6021-26)	(-1.0755+24,-1.4627+24)
(-4.6293+02,-6.2084-04)	(-4.1676-22,-2.3135-21)	(-8.1140+24,-4.5057+25)
(-4.6293+02,-1.4552-10)	(-5.7402-24,-5.4225-28)	(-1.1179+23,-1.0561+19)
(-4.6340+02,-1.4566-10)	(-1.7250-28,-5.5567-38)	(-3.5120+28,-1.1539+19)
(-4.6247+02,-1.4537-10)	(1.7251-28,-5.2884-38)	(3.2123+28,-9.6327+18)
(-4.6293+02,-1.4552-10)	(-5.7402-24,-5.4225-28)	(-1.1179+23,-1.0561+19)
(-4.6293+02, 7.4593-16)	(4.0923-24, 2.7794-33)	(7.9699+22, 5.4134+13)

EIGENVECTOR

(1.1335-09, 3.6398-27)
(-5.8272-10,-1.8653-27)
(-9.7527-11,-3.1023-28)
(5.6944-11, 1.8100-28)
(-3.4491-06,-5.3754-24)
(-2.7007-08, 1.7520-24)
(5.3103-08,-1.0840-25)
(6.0662-08,-4.9035-25)
(1.0800-05, 1.8070-23)
(-1.3917-06,-4.6998-23)
(1.7922-07, 8.0330-25)
(7.6509-07, 1.9937-23)
(3.1024-08, 1.0455-24)
(-3.5583-06,-5.5354-24)
(-1.4324-08,-4.1501-25)
(4.4237-08,-7.6817-26)
(4.8769-08, 1.0327-26)
(1.0801-05, 1.6964-23)
(-1.4009-06, 1.6788-23)
(1.8012-07,-1.2427-25)
(7.6982-07,-1.5083-23)
(3.0948-08,-3.0214-25)
(0.0000 , 0.0000)
(1.0000+00, 0.0000)

ACCURACY CHECK

(-2.0339+02, 6.9830+01) (3.7263-28,-3.1583-35) (-1.0755+24,-1.4627+24)
(4.6293+04, 0.0000) (3.7263-28, 3.7710-39) (7.8574+29, 0.0000)

********* OVERFLOW OCCURRED AT LOCATION 026216

CHARACTERISTIC POLYNOMIAL OF DETERMINANT NO. 1

LEADING COEFFICIENT	LAST NON-ZERO COEFFICIENT	LAST COEFFICIENT
3.7263-28	-9.2827+10	0.0000

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 3

ROOT LOCUS TEST CASE NO. 1 (D'AZZO & HOUPIS, P. 234)

OPTIONS

```
CLEAR  =  1
COMENT =  1
INPUT  =  2
NUNFLS =  0
NOVFLS =100
PLOT   =  1
SFREQR =  0, 0, 0, 0, 0, 0, 0
SROOTL =  1, 0, 0, 0, 0, 0, 0
STIMER =  0, 0, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 3

ROOT LOCUS TEST CASE NO. 1 (D'AZZO & HOUPIS, P. 234)

INPUT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN
0.0000	1.0000+00

ZEROS (1)	POLES (2)
(-1.0000+00, 0.0000)	(-1.5000+00, 1.0000+00)
	(-1.5000+00,-1.0000+00)

RESULTANT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN	GAMMA
3.0769-01	1.0000+00	3.2500+00

ZEROS (1)	POLES (2)
(-1.0000+00, 0.0000)	(-1.5000+00, 1.0000+00)
	(-1.5000+00,-1.0000+00)

**** ROOT LOCUS ****

ROOT LOCUS TEST CASE NO. 1 (D'AZZO & HOUPIS, P. 234)

RATIO 1

PHASE	BODE GAIN	ROOT LOCUS GAIN	GAMMA	CENTROID
.C	3.C769-01	1.CCCC+CC	3.25CC+CC	-2.CCCC+CC

	GAIN LOCUS (CONSTANT PHASE)		PHASE LOCUS (CONSTANT GAIN)	
	UP	DOWN	INCREASE	DECREASE
EXTENT OF TRACE	1.0000+01	4.CCCC+C1	6.0000+01	6.0000+01
MAXIMUM STEP SIZE	5.0000-01	5.CCCC-01	2.0000+CC	2.0000+CC

OPEN-LOOP ZEROS

(-1.0000+00, 0.0000)

OPEN-LOOP POLES

(-1.5000+00, 1.0000+00)

(-1.5000+00,-1.0000+00)

ESTIMATES FOR CLOSED-LOOP POLES

(-1.5000+00, 1.0000+00)

(-1.5000+00,-1.0000+00)

NOMINAL CLOSED-LOOP POLES

(-1.0000+00, 1.118C+CC)

(-1.0000+00,-1.1180+CC)

INCREASING GAIN TO 1.0000+01 DECIBELS FROM NOMINAL
CLOSED-LOOP POLE (-1.0000+00, 1.1180+00)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DECIBELS FROM NOMINAL
3.0769-01	0.0000	(-1.0000+00, 1.1180+00)	0.0000
3.2592-01	0.0000	(-9.7037-01, 1.1176+00)	5.0000-01
3.4524-01	0.0000	(-9.3899-01, 1.1164+00)	1.0000+00
3.6569-01	0.0000	(-9.0575-01, 1.1141+00)	1.5000+00
3.8736-01	0.0000	(-8.7054-01, 1.1105+00)	2.0000+00
4.1031-01	0.0000	(-8.3324-01, 1.1055+00)	2.5000+00
4.3463-01	0.0000	(-7.9373-01, 1.0988+00)	3.0000+00
4.6038-01	0.0000	(-7.5188-01, 1.0902+00)	3.5000+00
4.8766-01	0.0000	(-7.0755-01, 1.0791+00)	4.0000+00
5.1655-01	0.0000	(-6.6060-01, 1.0653+00)	4.5000+00
5.4716-01	0.0000	(-6.1086-01, 1.0481+00)	5.0000+00
5.7958-01	0.0000	(-5.5818-01, 1.0270+00)	5.5000+00
6.1393-01	0.0000	(-5.0237-01, 1.0012+00)	6.0000+00
6.5030-01	0.0000	(-4.4326-01, 9.6956-01)	6.5000+00
6.8884-01	0.0000	(-3.8064-01, 9.3080-01)	7.0000+00
7.2965-01	0.0000	(-3.1432-01, 8.8308-01)	7.5000+00
7.7289-01	0.0000	(-2.4406-01, 8.2375-01)	8.0000+00
8.1868-01	0.0000	(-1.6964-01, 7.4867-01)	8.5000+00
8.6719-01	0.0000	(-9.0814-02, 6.5068-01)	9.0000+00
9.1858-01	0.0000	(-7.3149-03, 5.1437-01)	9.5000+00
9.7300-01	0.0000	(8.1132-02, 2.8488-01)	1.0000+01

DECREASING GAIN TO -4.0000+01 DECIBELS FROM NOMINAL
CLOSED-LOOP POLE (-1.0000+00, 1.1180+00)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DECIBELS FROM NOMINAL
3.0769-01	0.0000	(-1.0000+00, 1.1180+00)	0.0000
2.9048-01	0.0000	(-1.0280+00, 1.1177+00)	-5.0000-01
2.7423-01	0.0000	(-1.0544+00, 1.1167+00)	-1.0000+00
2.5889-01	0.0000	(-1.0793+00, 1.1152+00)	-1.5000+00
2.4441-01	0.0000	(-1.1028+00, 1.1133+00)	-2.0000+00
2.3074-01	0.0000	(-1.1251+00, 1.1110+00)	-2.5000+00
2.1783-01	0.0000	(-1.1460+00, 1.1085+00)	-3.0000+00
2.0564-01	0.0000	(-1.1658+00, 1.1057+00)	-3.5000+00
1.9414-01	0.0000	(-1.1845+00, 1.1027+00)	-4.0000+00
1.8328-01	0.0000	(-1.2022+00, 1.0996+00)	-4.5000+00
1.7303-01	0.0000	(-1.2188+00, 1.0964+00)	-5.0000+00
1.6335-01	0.0000	(-1.2346+00, 1.0932+00)	-5.5000+00
1.5421-01	0.0000	(-1.2494+00, 1.0899+00)	-6.0000+00
1.4559-01	0.0000	(-1.2634+00, 1.0866+00)	-6.5000+00
1.3744-01	0.0000	(-1.2767+00, 1.0833+00)	-7.0000+00
1.2975-01	0.0000	(-1.2892+00, 1.0800+00)	-7.5000+00
1.2249-01	0.0000	(-1.3009+00, 1.0768+00)	-8.0000+00
1.1564-01	0.0000	(-1.3121+00, 1.0736+00)	-8.5000+00
1.0917-01	0.0000	(-1.3226+00, 1.0705+00)	-9.0000+00
1.0307-01	0.0000	(-1.3325+00, 1.0674+00)	-9.5000+00
9.7301-02	0.0000	(-1.3419+00, 1.0645+00)	-1.0000+01
9.1858-02	0.0000	(-1.3507+00, 1.0616+00)	-1.0500+01
8.6720-02	0.0000	(-1.3591+00, 1.0588+00)	-1.1000+01
8.1869-02	0.0000	(-1.3670+00, 1.0561+00)	-1.1500+01
7.7289-02	0.0000	(-1.3744+00, 1.0535+00)	-1.2000+01
7.2966-02	0.0000	(-1.3814+00, 1.0510+00)	-1.2500+01
6.8884-02	0.0000	(-1.3881+00, 1.0485+00)	-1.3000+01
6.5031-02	0.0000	(-1.3943+00, 1.0462+00)	-1.3500+01
6.1393-02	0.0000	(-1.4002+00, 1.0439+00)	-1.4000+01
5.7959-02	0.0000	(-1.4058+00, 1.0418+00)	-1.4500+01
5.4717-02	0.0000	(-1.4111+00, 1.0397+00)	-1.5000+01
5.1656-02	0.0000	(-1.4161+00, 1.0377+00)	-1.5500+01
4.8766-02	0.0000	(-1.4208+00, 1.0358+00)	-1.6000+01
4.6038-02	0.0000	(-1.4252+00, 1.0340+00)	-1.6500+01
4.3463-02	0.0000	(-1.4294+00, 1.0323+00)	-1.7000+01
4.1032-02	0.0000	(-1.4333+00, 1.0306+00)	-1.7500+01

3.8736-02	0.0000	(-1.4371+00, 1.0291+00)	-1.8000+01
3.6569-02	0.0000	(-1.4406+00, 1.0276+00)	-1.8500+01
3.4524-02	0.0000	(-1.4439+00, 1.0261+00)	-1.9000+01
3.2593-02	0.0000	(-1.4470+00, 1.0248+00)	-1.9500+01
3.0769-02	0.0000	(-1.4500+00, 1.0235+00)	-2.0000+01
2.9048-02	0.0000	(-1.4528+00, 1.0222+00)	-2.0500+01
2.7423-02	0.0000	(-1.4554+00, 1.0211+00)	-2.1000+01
2.5889-02	0.0000	(-1.4579+00, 1.0200+00)	-2.1500+01
2.4441-02	0.0000	(-1.4603+00, 1.0189+00)	-2.2000+01
2.3074-02	0.0000	(-1.4625+00, 1.0179+00)	-2.2500+01
2.1783-02	0.0000	(-1.4646+00, 1.0169+00)	-2.3000+01
2.0565-02	0.0000	(-1.4666+00, 1.0160+00)	-2.3500+01
1.9414-02	0.0000	(-1.4685+00, 1.0152+00)	-2.4000+01
1.8328-02	0.0000	(-1.4702+00, 1.0143+00)	-2.4500+01
1.7303-02	0.0000	(-1.4719+00, 1.0136+00)	-2.5000+01
1.6335-02	0.0000	(-1.4735+00, 1.0128+00)	-2.5500+01
1.5421-02	0.0000	(-1.4749+00, 1.0121+00)	-2.6000+01
1.4559-02	0.0000	(-1.4763+00, 1.0115+00)	-2.6500+01
1.3744-02	0.0000	(-1.4777+00, 1.0109+00)	-2.7000+01
1.2975-02	0.0000	(-1.4789+00, 1.0103+00)	-2.7500+01
1.2250-02	0.0000	(-1.4801+00, 1.0097+00)	-2.8000+01
1.1564-02	0.0000	(-1.4812+00, 1.0092+00)	-2.8500+01
1.0917-02	0.0000	(-1.4823+00, 1.0087+00)	-2.9000+01
1.0307-02	0.0000	(-1.4833+00, 1.0082+00)	-2.9500+01
9.7302-03	0.0000	(-1.4842+00, 1.0078+00)	-3.0000+01
9.1859-03	0.0000	(-1.4851+00, 1.0073+00)	-3.0500+01
8.6720-03	0.0000	(-1.4859+00, 1.0069+00)	-3.1000+01
8.1869-03	0.0000	(-1.4867+00, 1.0065+00)	-3.1500+01
7.7289-03	0.0000	(-1.4874+00, 1.0062+00)	-3.2000+01
7.2966-03	0.0000	(-1.4881+00, 1.0058+00)	-3.2500+01
6.8884-03	0.0000	(-1.4888+00, 1.0055+00)	-3.3000+01
6.5031-03	0.0000	(-1.4894+00, 1.0052+00)	-3.3500+01
6.1393-03	0.0000	(-1.4900+00, 1.0049+00)	-3.4000+01
5.7959-03	0.0000	(-1.4906+00, 1.0047+00)	-3.4500+01
5.4717-03	0.0000	(-1.4911+00, 1.0044+00)	-3.5000+01
5.1656-03	0.0000	(-1.4916+00, 1.0042+00)	-3.5500+01
4.8766-03	0.0000	(-1.4921+00, 1.0039+00)	-3.6000+01
4.6038-03	0.0000	(-1.4925+00, 1.0037+00)	-3.6500+01
4.3463-03	0.0000	(-1.4929+00, 1.0035+00)	-3.7000+01
4.1032-03	0.0000	(-1.4933+00, 1.0033+00)	-3.7500+01
3.8737-03	0.0000	(-1.4937+00, 1.0031+00)	-3.8000+01

3.657C-03	0.0000	(-1.4941+00, 1.0029+00)	-3.8500+01
3.4524-03	0.0000	(-1.4944+00, 1.0028+00)	-3.9000+01
3.2593-03	0.0000	(-1.4947+00, 1.0026+00)	-3.9500+01
3.077C-03	0.0000	(-1.4950+00, 1.0025+00)	-4.0000+01

INCREASING PHASE TO 6.0000+01 DEGREES FROM NOMINAL
CLOSED-LOOP POLE (-1.0000+00, 1.1180+00)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DEGREES FROM NOMINAL
3.0769-01	0.0000	(-1.0000+00, 1.1180+00)	0.0000
3.0769-01	2.0000+00	(-1.0003+00, 1.1007+00)	2.0000+00
3.0769-01	4.0000+00	(-1.0012+00, 1.0837+00)	4.0000+00
3.0769-01	6.0000+00	(-1.0026+00, 1.0670+00)	6.0000+00
3.0769-01	8.0000+00	(-1.0046+00, 1.0506+00)	8.0000+00
3.0769-01	1.0000+01	(-1.0070+00, 1.0346+00)	1.0000+01
3.0769-01	1.2000+01	(-1.0099+00, 1.0188+00)	1.2000+01
3.0769-01	1.4000+01	(-1.0133+00, 1.0035+00)	1.4000+01
3.0769-01	1.6000+01	(-1.0170+00, 9.8851-01)	1.6000+01
3.0769-01	1.8000+01	(-1.0211+00, 9.7389-01)	1.8000+01
3.0769-01	2.0000+01	(-1.0256+00, 9.5963-01)	2.0000+01
3.0769-01	2.2000+01	(-1.0304+00, 9.4574-01)	2.2000+01
3.0769-01	2.4000+01	(-1.0355+00, 9.3222-01)	2.4000+01
3.0769-01	2.6000+01	(-1.0409+00, 9.1905-01)	2.6000+01
3.0769-01	2.8000+01	(-1.0465+00, 9.0624-01)	2.8000+01
3.0769-01	3.0000+01	(-1.0523+00, 8.9378-01)	3.0000+01
3.0769-01	3.2000+01	(-1.0584+00, 8.8166-01)	3.2000+01
3.0769-01	3.4000+01	(-1.0647+00, 8.6988-01)	3.4000+01
3.0769-01	3.6000+01	(-1.0711+00, 8.5843-01)	3.6000+01
3.0769-01	3.8000+01	(-1.0777+00, 8.4730-01)	3.8000+01
3.0769-01	4.0000+01	(-1.0845+00, 8.3648-01)	4.0000+01
3.0769-01	4.2000+01	(-1.0914+00, 8.2596-01)	4.2000+01
3.0769-01	4.4000+01	(-1.0984+00, 8.1573-01)	4.4000+01
3.0769-01	4.6000+01	(-1.1056+00, 8.0578-01)	4.6000+01
3.0769-01	4.8000+01	(-1.1128+00, 7.9610-01)	4.8000+01
3.0769-01	5.0000+01	(-1.1201+00, 7.8669-01)	5.0000+01
3.0769-01	5.2000+01	(-1.1275+00, 7.7753-01)	5.2000+01
3.0769-01	5.4000+01	(-1.1350+00, 7.6861-01)	5.4000+01
3.0769-01	5.6000+01	(-1.1426+00, 7.5992-01)	5.6000+01
3.0769-01	5.8000+01	(-1.1503+00, 7.5145-01)	5.8000+01
3.0769-01	6.0000+01	(-1.1580+00, 7.4320-01)	6.0000+01

DECREASING PHASE TO -6.0000+01 DEGREES FROM NOMINAL
CLOSED-LOOP POLE (-1.0000+00, 1.1180+00)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DEGREES FROM NOMINAL
3.0769-01	0.0000	(-1.0000+00, 1.1180+00)	0.0000
3.0769-01	-2.0000+00	(-1.0003+00, 1.1356+00)	-2.0000+00
3.0769-01	-4.0000+00	(-1.0013+00, 1.1535+00)	-4.0000+00
3.0769-01	-6.0000+00	(-1.0029+00, 1.1715+00)	-6.0000+00
3.0769-01	-8.0000+00	(-1.0052+00, 1.1898+00)	-8.0000+00
3.0769-01	-1.0000+01	(-1.0082+00, 1.2082+00)	-1.0000+01
3.0769-01	-1.2000+01	(-1.0119+00, 1.2268+00)	-1.2000+01
3.0769-01	-1.4000+01	(-1.0164+00, 1.2454+00)	-1.4000+01
3.0769-01	-1.6000+01	(-1.0217+00, 1.2642+00)	-1.6000+01
3.0769-01	-1.8000+01	(-1.0278+00, 1.2829+00)	-1.8000+01
3.0769-01	-2.0000+01	(-1.0347+00, 1.3017+00)	-2.0000+01
3.0769-01	-2.2000+01	(-1.0424+00, 1.3203+00)	-2.2000+01
3.0769-01	-2.4000+01	(-1.0510+00, 1.3390+00)	-2.4000+01
3.0769-01	-2.6000+01	(-1.0603+00, 1.3574+00)	-2.6000+01
3.0769-01	-2.8000+01	(-1.0706+00, 1.3757+00)	-2.8000+01
3.0769-01	-3.0000+01	(-1.0816+00, 1.3938+00)	-3.0000+01
3.0769-01	-3.2000+01	(-1.0935+00, 1.4116+00)	-3.2000+01
3.0769-01	-3.4000+01	(-1.1063+00, 1.4291+00)	-3.4000+01
3.0769-01	-3.6000+01	(-1.1198+00, 1.4462+00)	-3.6000+01
3.0769-01	-3.8000+01	(-1.1342+00, 1.4630+00)	-3.8000+01
3.0769-01	-4.0000+01	(-1.1494+00, 1.4793+00)	-4.0000+01
3.0769-01	-4.2000+01	(-1.1655+00, 1.4951+00)	-4.2000+01
3.0769-01	-4.4000+01	(-1.1822+00, 1.5104+00)	-4.4000+01
3.0769-01	-4.6000+01	(-1.1998+00, 1.5251+00)	-4.6000+01
3.0769-01	-4.8000+01	(-1.2181+00, 1.5392+00)	-4.8000+01
3.0769-01	-5.0000+01	(-1.2371+00, 1.5527+00)	-5.0000+01
3.0769-01	-5.2000+01	(-1.2568+00, 1.5655+00)	-5.2000+01
3.0769-01	-5.4000+01	(-1.2772+00, 1.5776+00)	-5.4000+01
3.0769-01	-5.6000+01	(-1.2982+00, 1.5890+00)	-5.6000+01
3.0769-01	-5.8000+01	(-1.3198+00, 1.5995+00)	-5.8000+01
3.0769-01	-6.0000+01	(-1.3420+00, 1.6092+00)	-6.0000+01

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 4

ROOT LOCUS TEST CASE NO. 2

OPTIONS

```
CLEAR  =  1
COMENT =  1
INPUT  =  2
NUNFLS =  0
NOVFLS =100
PLOT   =  1
SFREQR =  0, 0, 0, 0, 0, 0, 0
SROOTL =  1, 0, 0, 0, 0, 0, 0
STIMER =  0, 0, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 4

ROOT LOCUS TEST CASE NO. 2

INPUT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN
0.0000	1.0000+00

ZEROS (1)	POLES (2)
(-1.0000+00, 0.0000)	(-1.5000+00, 1.0000+00)
	(-1.5000+00,-1.0000+00)

RESULTANT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN	GAMMA
3.0769-01	1.0000+00	3.2500+00

ZEROS (1)	POLES (2)
(-1.0000+00, 0.0000)	(-1.5000+00, 1.0000+00)
	(-1.5000+00,-1.0000+00)

**** ROOT LOCUS ****

ROOT LOCUS TEST CASE NO. 2

RATIO 1

PHASE	BODE GAIN	ROOT LOCUS GAIN	GAMMA	CENTROID
180.0	3.0769-01	1.0000+00	3.2500+00	-2.0000+00

	GAIN LOCUS (CONSTANT PHASE)		PHASE LOCUS (CONSTANT GAIN)	
	UP	DOWN	INCREASE	DECREASE
EXTENT OF TRACE	2.0000+00	4.0000+01	6.0000+01	6.0000+01
MAXIMUM STEP SIZE	1.0000-01	5.0000-01	2.0000+00	2.0000+00

OPEN-LOOP ZEROS

(-1.0000+00, 0.0000)

OPEN-LOOP POLES

(-1.5000+00, 1.0000+00)

(-1.5000+00,-1.0000+00)

ESTIMATES FOR CLOSED-LOOP POLES

(-1.5000+00, 1.0000+00)

(-1.5000+00,-1.0000+00)

NOMINAL CLOSED-LOOP POLES

(-2.0000+00, 5.0000-01)

(-2.0000+00,-5.0000-01)

INCREASING GAIN TO 2.0000+00 DECIBELS FROM NOMINAL
CLOSED-LOOP POLE (-2.0000+00, 5.0000-01)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DECIBELS FROM NOMINAL
3.0769-01	1.8000+02	(-2.0000+00, 5.0000-01)	0.000C
3.0991-01	1.8000+02	(-2.0036+00, 4.9271-01)	6.2500-02
3.1215-01	1.8000+02	(-2.0072+00, 4.8523-01)	1.2500-01
3.1441-01	1.8000+02	(-2.0109+00, 4.7756-01)	1.8750-01
3.1668-01	1.8000+02	(-2.0146+00, 4.6967-01)	2.5000-01
3.1896-01	1.8000+02	(-2.0183+00, 4.6155-01)	3.1250-01
3.2127-01	1.8000+02	(-2.0221+00, 4.5320-01)	3.7500-01
3.2359-01	1.8000+02	(-2.0258+00, 4.4461-01)	4.3750-01
3.2592-01	1.8000+02	(-2.0296+00, 4.3574-01)	5.0000-01
3.2828-01	1.8000+02	(-2.0335+00, 4.2659-01)	5.6250-01
3.3065-01	1.8000+02	(-2.0373+00, 4.1713-01)	6.2500-01
3.3304-01	1.8000+02	(-2.0412+00, 4.0735-01)	6.8750-01
3.3544-01	1.8000+02	(-2.0451+00, 3.9722-01)	7.5000-01
3.3786-01	1.8000+02	(-2.0490+00, 3.8670-01)	8.1250-01
3.4030-01	1.8000+02	(-2.0530+00, 3.7577-01)	8.7500-01
3.4276-01	1.8000+02	(-2.0570+00, 3.6439-01)	9.3750-01
3.4524-01	1.8000+02	(-2.0610+00, 3.5251-01)	1.0000+00
3.4773-01	1.8000+02	(-2.0651+00, 3.4007-01)	1.0625+00
3.5024-01	1.8000+02	(-2.0691+00, 3.2701-01)	1.1250+00
3.5277-01	1.8000+02	(-2.0733+00, 3.1326-01)	1.1875+00
3.5532-01	1.8000+02	(-2.0774+00, 2.9871-01)	1.2500+00
3.5788-01	1.8000+02	(-2.0816+00, 2.8325-01)	1.3125+00
3.6047-01	1.8000+02	(-2.0858+00, 2.6669-01)	1.3750+00
3.6307-01	1.8000+02	(-2.0900+00, 2.4884-01)	1.4375+00
3.6569-01	1.8000+02	(-2.0943+00, 2.2938-01)	1.5000+00
3.6833-01	1.8000+02	(-2.0985+00, 2.0786-01)	1.5625+00
3.7099-01	1.8000+02	(-2.1029+00, 1.8355-01)	1.6250+00
3.7367-01	1.8000+02	(-2.1072+00, 1.5514-01)	1.6875+00
3.7637-01	1.8000+02	(-2.1116+00, 1.1975-01)	1.7500+00
3.7909-01	1.8000+02	(-2.1160+00, 6.7086-02)	1.8125+00
3.8183-01	1.8000+02	(-2.0467+00, 0.000C)	1.8750+00
3.8458-01	1.8000+02	(-2.0004+00, 0.000C)	1.9375+00
3.8736-01	1.8000+02	(-1.9692+00, 0.0000)	2.000C+00

DECREASING GAIN TO -4.0000+01 DECIBELS FROM NOMINAL
CLOSED-LOOP POLE (-2.0000+00, 5.0000-01)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DECIBELS FROM NOMINAL
3.0769-01	1.8000+02	(-2.0000+00, 5.0000-01)	0.0000
2.9048-01	1.8000+02	(-1.9720+00, 5.5241-01)	-5.0000-01
2.7423-01	1.8000+02	(-1.9456+00, 5.9648-01)	-1.0000+00
2.5889-01	1.8000+02	(-1.9207+00, 6.3428-01)	-1.5000+00
2.4441-01	1.8000+02	(-1.8972+00, 6.6716-01)	-2.0000+00
2.3074-01	1.8000+02	(-1.8749+00, 6.9604-01)	-2.5000+00
2.1783-01	1.8000+02	(-1.8540+00, 7.2162-01)	-3.0000+00
2.0564-01	1.8000+02	(-1.8342+00, 7.4442-01)	-3.5000+00
1.9414-01	1.8000+02	(-1.8155+00, 7.6485-01)	-4.0000+00
1.8328-01	1.8000+02	(-1.7978+00, 7.8324-01)	-4.5000+00
1.7303-01	1.8000+02	(-1.7812+00, 7.9986-01)	-5.0000+00
1.6335-01	1.8000+02	(-1.7654+00, 8.1492-01)	-5.5000+00
1.5421-01	1.8000+02	(-1.7506+00, 8.2862-01)	-6.0000+00
1.4559-01	1.8000+02	(-1.7366+00, 8.4110-01)	-6.5000+00
1.3744-01	1.8000+02	(-1.7233+00, 8.5251-01)	-7.0000+00
1.2975-01	1.8000+02	(-1.7108+00, 8.6296-01)	-7.5000+00
1.2249-01	1.8000+02	(-1.6991+00, 8.7254-01)	-8.0000+00
1.1564-01	1.8000+02	(-1.6879+00, 8.8134-01)	-8.5000+00
1.0917-01	1.8000+02	(-1.6774+00, 8.8945-01)	-9.0000+00
1.0307-01	1.8000+02	(-1.6675+00, 8.9692-01)	-9.5000+00
9.7301-02	1.8000+02	(-1.6581+00, 9.0382-01)	-1.0000+01
9.1858-02	1.8000+02	(-1.6493+00, 9.1019-01)	-1.0500+01
8.6720-02	1.8000+02	(-1.6409+00, 9.1609-01)	-1.1000+01
8.1869-02	1.8000+02	(-1.6330+00, 9.2156-01)	-1.1500+01
7.7289-02	1.8000+02	(-1.6256+00, 9.2662-01)	-1.2000+01
7.2966-02	1.8000+02	(-1.6186+00, 9.3133-01)	-1.2500+01
6.8884-02	1.8000+02	(-1.6119+00, 9.3570-01)	-1.3000+01
6.5031-02	1.8000+02	(-1.6057+00, 9.3976-01)	-1.3500+01
6.1393-02	1.8000+02	(-1.5998+00, 9.4355-01)	-1.4000+01
5.7959-02	1.8000+02	(-1.5942+00, 9.4707-01)	-1.4500+01
5.4717-02	1.8000+02	(-1.5889+00, 9.5036-01)	-1.5000+01
5.1656-02	1.8000+02	(-1.5839+00, 9.5342-01)	-1.5500+01
4.8766-02	1.8000+02	(-1.5792+00, 9.5628-01)	-1.6000+01
4.6038-02	1.8000+02	(-1.5748+00, 9.5895-01)	-1.6500+01
4.3463-02	1.8000+02	(-1.5706+00, 9.6145-01)	-1.7000+01
4.1032-02	1.8000+02	(-1.5667+00, 9.6378-01)	-1.7500+01

3.8736-02	1.8000+02	(-1.5629+00, 9.6597-01)	-1.8000+01
3.6569-02	1.8000+02	(-1.5594+00, 9.6801-01)	-1.8500+01
3.4524-02	1.8000+02	(-1.5561+00, 9.6992-01)	-1.9000+01
3.2593-02	1.8000+02	(-1.5530+00, 9.7172-01)	-1.9500+01
3.0769-02	1.8000+02	(-1.5500+00, 9.7340-01)	-2.0000+01
2.9048-02	1.8000+02	(-1.5472+00, 9.7497-01)	-2.0500+01
2.7423-02	1.8000+02	(-1.5446+00, 9.7645-01)	-2.1000+01
2.5889-02	1.8000+02	(-1.5421+00, 9.7783-01)	-2.1500+01
2.4441-02	1.8000+02	(-1.5397+00, 9.7914-01)	-2.2000+01
2.3074-02	1.8000+02	(-1.5375+00, 9.8036-01)	-2.2500+01
2.1783-02	1.8000+02	(-1.5354+00, 9.8150-01)	-2.3000+01
2.0565-02	1.8000+02	(-1.5334+00, 9.8258-01)	-2.3500+01
1.9414-02	1.8000+02	(-1.5315+00, 9.8359-01)	-2.4000+01
1.8328-02	1.8000+02	(-1.5298+00, 9.8455-01)	-2.4500+01
1.7303-02	1.8000+02	(-1.5281+00, 9.8544-01)	-2.5000+01
1.6335-02	1.8000+02	(-1.5265+00, 9.8628-01)	-2.5500+01
1.5421-02	1.8000+02	(-1.5251+00, 9.8707-01)	-2.6000+01
1.4559-02	1.8000+02	(-1.5237+00, 9.8782-01)	-2.6500+01
1.3744-02	1.8000+02	(-1.5223+00, 9.8852-01)	-2.7000+01
1.2975-02	1.8000+02	(-1.5211+00, 9.8918-01)	-2.7500+01
1.2250-02	1.8000+02	(-1.5199+00, 9.8980-01)	-2.8000+01
1.1564-02	1.8000+02	(-1.5188+00, 9.9038-01)	-2.8500+01
1.0917-02	1.8000+02	(-1.5177+00, 9.9093-01)	-2.9000+01
1.0307-02	1.8000+02	(-1.5167+00, 9.9145-01)	-2.9500+01
9.7302-03	1.8000+02	(-1.5158+00, 9.9194-01)	-3.0000+01
9.1859-03	1.8000+02	(-1.5149+00, 9.9240-01)	-3.0500+01
8.6720-03	1.8000+02	(-1.5141+00, 9.9283-01)	-3.1000+01
8.1869-03	1.8000+02	(-1.5133+00, 9.9324-01)	-3.1500+01
7.7289-03	1.8000+02	(-1.5126+00, 9.9362-01)	-3.2000+01
7.2966-03	1.8000+02	(-1.5119+00, 9.9398-01)	-3.2500+01
6.8884-03	1.8000+02	(-1.5112+00, 9.9432-01)	-3.3000+01
6.5031-03	1.8000+02	(-1.5106+00, 9.9465-01)	-3.3500+01
6.1393-03	1.8000+02	(-1.5100+00, 9.9495-01)	-3.4000+01
5.7959-03	1.8000+02	(-1.5094+00, 9.9524-01)	-3.4500+01
5.4717-03	1.8000+02	(-1.5089+00, 9.9550-01)	-3.5000+01
5.1656-03	1.8000+02	(-1.5084+00, 9.9576-01)	-3.5500+01
4.8766-03	1.8000+02	(-1.5079+00, 9.9600-01)	-3.6000+01
4.6038-03	1.8000+02	(-1.5075+00, 9.9622-01)	-3.6500+01
4.3463-03	1.8000+02	(-1.5071+00, 9.9644-01)	-3.7000+01
4.1032-03	1.8000+02	(-1.5067+00, 9.9664-01)	-3.7500+01
3.8737-03	1.8000+02	(-1.5063+00, 9.9683-01)	-3.8000+01

3.5570-03	1.8000+02	(-1.5059+00, 9.9701-01)	-3.8500+01
3.4524-03	1.8000+02	(-1.5056+00, 9.9718-01)	-3.9000+01
3.2593-03	1.8000+02	(-1.5053+00, 9.9733-01)	-3.9500+01
3.0770-03	1.8000+02	(-1.5050+00, 9.9748-01)	-4.0000+01

INCREASING PHASE TO 6.000C+01 DEGREES FROM NOMINAL
CLOSED-LOOP POLE (-2.0000+CC, 5.CCC0-01)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DEGREES FROM NOMINAL
3.0769-C1	1.8000+02	(-2.0000+00, 5.0000-01)	0.0000
3.0769-01	1.8200+02	(-2.0344+C0, 5.1957-01)	2.0000+00
3.0769-01	1.840C+02	(-2.0673+00, 5.4316-01)	4.0000+00
3.0769-C1	1.8600+02	(-2.0979+C0, 5.7027-01)	6.0000+0C
3.0769-01	1.8800+02	(-2.1256+00, 6.0023-01)	8.0000+00
3.0769-01	1.9000+02	(-2.1503+00, 6.3237-01)	1.0000+01
3.0769-C1	1.9200+02	(-2.172C+00, 6.6609-01)	1.2000+01
3.0769-01	1.9400+02	(-2.1906+00, 7.0091-01)	1.4000+01
3.0769-01	1.9600+02	(-2.2064+C0, 7.3643-01)	1.6000+01
3.0769-01	1.9800+02	(-2.2195+00, 7.7235-01)	1.8000+01
3.0769-01	2.0000+02	(-2.2300+00, 8.0846-01)	2.0000+01
3.0769-01	2.0200+02	(-2.2382+0C, 8.4456-01)	2.2000+01
3.0769-01	2.0400+02	(-2.2441+00, 8.8051-01)	2.4000+01
3.0769-01	2.0600+02	(-2.2479+0C, 9.1619-01)	2.6000+01
3.0769-01	2.0800+02	(-2.2498+0C, 9.5152-01)	2.8000+01
3.0769-01	2.1000+02	(-2.2498+0C, 9.8642-01)	3.0000+01
3.0769-01	2.1200+02	(-2.2479+0C, 1.0208+00)	3.2000+01
3.0769-01	2.1400+02	(-2.2444+00, 1.0546+00)	3.4000+01
3.0769-01	2.1600+02	(-2.2393+00, 1.0878+00)	3.6000+01
3.0769-01	2.1800+02	(-2.2327+0C, 1.1204+00)	3.8000+01
3.0769-C1	2.2000+02	(-2.2246+0C, 1.1522+00)	4.0000+01
3.0769-C1	2.2200+02	(-2.2151+00, 1.1833+00)	4.2000+01
3.0769-01	2.2400+02	(-2.2044+00, 1.2136+00)	4.4000+01
3.0769-01	2.2600+02	(-2.1923+0C, 1.2431+00)	4.6000+01
3.0769-01	2.2800+02	(-2.1791+00, 1.2717+00)	4.8000+01
3.0769-01	2.3000+02	(-2.1647+00, 1.2995+00)	5.0000+01
3.0769-01	2.3200+02	(-2.1492+C0, 1.3263+00)	5.2000+C1
3.0769-01	2.3400+C2	(-2.1327+00, 1.3522+C0)	5.4000+01
3.0769-01	2.3600+02	(-2.1153+C0, 1.3772+00)	5.6000+C1
3.0769-01	2.3800+02	(-2.0969+C0, 1.4012+C0)	5.8000+C1
3.0769-01	2.4000+02	(-2.0777+C0, 1.4242+00)	6.0000+01

DECREASING PHASE TO -6.0000+01 DEGREES FROM NOMINAL
CLOSED-LOOP POLE (-2.0000+00, 5.0000-01)

BODE GAIN	PHASE	CLOSED-LOOP POLES	DEGREES FROM NOMINAL
3.0769-01	1.8000+02	(-2.0000+00, 5.0000-01)	0.0000
3.0769-01	1.7800+02	(-1.9650+00, 4.8467-01)	-2.0000+00
3.0769-01	1.7600+02	(-1.9302+00, 4.7340-01)	-4.0000+00
3.0769-01	1.7400+02	(-1.8966+00, 4.6574-01)	-6.0000+00
3.0769-01	1.7200+02	(-1.8646+00, 4.6105-01)	-8.0000+00
3.0769-01	1.7000+02	(-1.8345+00, 4.5872-01)	-1.0000+01
3.0769-01	1.6800+02	(-1.8062+00, 4.5818-01)	-1.2000+01
3.0769-01	1.6600+02	(-1.7797+00, 4.5898-01)	-1.4000+01
3.0769-01	1.6400+02	(-1.7549+00, 4.6079-01)	-1.6000+01
3.0769-01	1.6200+02	(-1.7316+00, 4.6334-01)	-1.8000+01
3.0769-01	1.6000+02	(-1.7097+00, 4.6644-01)	-2.0000+01
3.0769-01	1.5800+02	(-1.6890+00, 4.6995-01)	-2.2000+01
3.0769-01	1.5600+02	(-1.6694+00, 4.7377-01)	-2.4000+01
3.0769-01	1.5400+02	(-1.6508+00, 4.7782-01)	-2.6000+01
3.0769-01	1.5200+02	(-1.6332+00, 4.8205-01)	-2.8000+01
3.0769-01	1.5000+02	(-1.6163+00, 4.8642-01)	-3.0000+01
3.0769-01	1.4800+02	(-1.6001+00, 4.9089-01)	-3.2000+01
3.0769-01	1.4600+02	(-1.5846+00, 4.9544-01)	-3.4000+01
3.0769-01	1.4400+02	(-1.5697+00, 5.0005-01)	-3.6000+01
3.0769-01	1.4200+02	(-1.5553+00, 5.0471-01)	-3.8000+01
3.0769-01	1.4000+02	(-1.5414+00, 5.0942-01)	-4.0000+01
3.0769-01	1.3800+02	(-1.5280+00, 5.1416-01)	-4.2000+01
3.0769-01	1.3600+02	(-1.5150+00, 5.1893-01)	-4.4000+01
3.0769-01	1.3400+02	(-1.5023+00, 5.2374-01)	-4.6000+01
3.0769-01	1.3200+02	(-1.4901+00, 5.2857-01)	-4.8000+01
3.0769-01	1.3000+02	(-1.4781+00, 5.3342-01)	-5.0000+01
3.0769-01	1.2800+02	(-1.4664+00, 5.3831-01)	-5.2000+01
3.0769-01	1.2600+02	(-1.4550+00, 5.4322-01)	-5.4000+01
3.0769-01	1.2400+02	(-1.4439+00, 5.4816-01)	-5.6000+01
3.0769-01	1.2200+02	(-1.4330+00, 5.5313-01)	-5.8000+01
3.0769-01	1.2000+02	(-1.4223+00, 5.5813-01)	-6.0000+01

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 5

FREQUENCY RESPONSE TEST CASE (D'AZZO & HOUPIS, P. 298)

OPTIONS

```
CLEAR  =  1
COMENT =  1
INPUT  =  2
NUNFLS =  0
NOVFLS =100
PLOT   =  1
SFREQR =  1, 0, 0, 0, 0, 0, 0
SROCTL =  0, 0, 0, 0, 0, 0, 0
STIMER =  0, 0, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 5

FREQUENCY RESPONSE TEST CASE (D'AZZO & HOUPIS, P. 298)

INPUT TRANSFER FUNCTION

BODE GAIN
4.0000+00

ROOT LOCUS GAIN
0.0000

ZEROS (1)
(-2.0000+00, 0.0000)

POLES (4)
(0.0000 , 0.0000)
(-5.0000-01, 0.0000)
(-1.6000+00, 7.8400+00)
(-1.6000+00,-7.8400+00)

RESULTANT TRANSFER FUNCTION

BODE GAIN
4.0000+00

ROOT LOCUS GAIN
6.4026+01

GAMMA
1.6006+01

ZEROS (1)
(-2.0000+00, 0.0000)

POLES (4)
(0.0000 , 0.0000)
(-5.0000-01, 0.0000)
(-1.6000+00, 7.8400+00)
(-1.6000+00,-7.8400+00)

**** FREQUENCY RESPONSE ****

FREQUENCY RESPONSE TEST CASE (D'AZZO & HOUPIS, P. 298)

RATIO 1

FREQUENCY (RAD/SEC)	FREQUENCY (HZ)	TRANSFER FUNCTION (REAL)	TRANSFER FUNCTION (IMAGINARY)	GAIN (RATIO)	GAIN (DB)	PHASE (DEG)	PHASE MARGIN
6.2832-03	1.0000-03	-6.1990+00	-6.3654+02	6.3657+02	5.6077+01	-9.0558+01	8.9442+01
1.0000-02	1.5915-03	-6.1975+00	-3.9988+02	3.9993+02	5.2040+01	-9.0888+01	8.9112+01
1.2566-02	2.0000-03	-6.1961+00	-3.1816+02	3.1822+02	5.0054+01	-9.1116+01	8.8884+01
1.5000-02	2.3873-03	-6.1944+00	-2.6648+02	2.6656+02	4.8516+01	-9.1332+01	8.8668+01
1.8850-02	3.0000-03	-6.1912+00	-2.1198+02	2.1207+02	4.6529+01	-9.1673+01	8.8327+01
2.0000-02	3.1831-03	-6.1901+00	-1.9976+02	1.9985+02	4.6014+01	-9.1775+01	8.8225+01
2.5000-02	3.9789-03	-6.1846+00	-1.5969+02	1.5981+02	4.4072+01	-9.2218+01	8.7782+01
2.5133-02	4.0000-03	-6.1845+00	-1.5885+02	1.5897+02	4.4026+01	-9.2230+01	8.7770+01
3.0000-02	4.7746-03	-6.1779+00	-1.3297+02	1.3311+02	4.2484+01	-9.2660+01	8.7340+01
3.1416-02	5.0000-03	-6.1758+00	-1.2694+02	1.2709+02	4.2082+01	-9.2785+01	8.7215+01
3.7699-02	6.0000-03	-6.1653+00	-1.0564+02	1.0582+02	4.0492+01	-9.3340+01	8.6660+01
4.0000-02	6.3662-03	-6.1609+00	-9.9513+01	9.9704+01	3.9974+01	-9.3543+01	8.6457+01
4.3982-02	7.0000-03	-6.1529+00	-9.0411+01	9.0620+01	3.9145+01	-9.3893+01	8.6107+01
5.0000-02	7.9577-03	-6.1392+00	-7.9394+01	7.9631+01	3.8022+01	-9.4422+01	8.5578+01
5.0265-02	8.0000-03	-6.1386+00	-7.8968+01	7.9206+01	3.7975+01	-9.4445+01	8.5555+01
6.0000-02	9.5493-03	-6.1129+00	-6.5942+01	6.6225+01	3.6420+01	-9.5296+01	8.4704+01
6.2832-02	1.0000-02	-6.1046+00	-6.2904+01	6.3200+01	3.6014+01	-9.5543+01	8.4457+01
7.0000-02	1.1141-02	-6.0821+00	-5.6302+01	5.6630+01	3.5061+01	-9.6166+01	8.3834+01
8.0000-02	1.2732-02	-6.0469+00	-4.9045+01	4.9416+01	3.3877+01	-9.7029+01	8.2971+01
9.0000-02	1.4324-02	-6.0076+00	-4.3377+01	4.3791+01	3.2828+01	-9.7885+01	8.2115+01
1.0000-01	1.5915-02	-5.9642+00	-3.8822+01	3.9278+01	3.1883+01	-9.8734+01	8.1266+01
1.2566-01	2.0000-02	-5.8358+00	-3.0383+01	3.0939+01	2.9810+01	-1.0087+02	7.9128+01
1.5000-01	2.3873-02	-5.6939+00	-2.4981+01	2.5622+01	2.8172+01	-1.0284+02	7.7160+01
1.8850-01	3.0000-02	-5.4373+00	-1.9200+01	1.9955+01	2.6001+01	-1.0581+02	7.4188+01
2.0000-01	3.1831-02	-5.3546+00	-1.7889+01	1.8673+01	2.5424+01	-1.0666+02	7.3336+01
2.5000-01	3.9789-02	-4.9742+00	-1.3551+01	1.4435+01	2.3188+01	-1.1016+02	6.9843+01
2.5133-01	4.0000-02	-4.9638+00	-1.3459+01	1.4345+01	2.3134+01	-1.1024+02	6.9755+01
3.0000-01	4.7746-02	-4.5776+00	-1.0633+01	1.1576+01	2.1271+01	-1.1329+02	6.6707+01
3.1416-01	5.0000-02	-4.4652+00	-9.9748+00	1.0929+01	2.0771+01	-1.1412+02	6.5884+01
3.7699-01	6.0000-02	-3.9787+00	-7.6681+00	8.6389+00	1.8729+01	-1.1742+02	6.2577+01
4.0000-01	6.3662-02	-3.8083+00	-7.0146+00	7.9817+00	1.8042+01	-1.1850+02	6.1502+01
4.3982-01	7.0000-02	-3.5265+00	-6.0599+00	7.0113+00	1.6916+01	-1.2020+02	5.9803+01
5.0000-01	7.9577-02	-3.1357+00	-4.9409+00	5.8520+00	1.5346+01	-1.2240+02	5.7599+01
5.0265-01	8.0000-02	-3.1195+00	-4.8988+00	5.8077+00	1.5280+01	-1.2249+02	5.7511+01

5.6549-01	9.0000-02	-2.7605+00	-4.0383+00	4.8917+00	1.3789+01	-1.2436+02	5.5644+01
6.0000-01	9.5493-02	-2.5833+00	-3.6590+00	4.4790+00	1.3024+01	-1.2522+02	5.4777+01
6.2832-01	1.0000-01	-2.4478+00	-3.3868+00	4.1788+00	1.2421+01	-1.2586+02	5.4143+01
7.0000-01	1.1141-01	-2.1422+00	-2.8231+00	3.5439+00	1.0990+01	-1.2719+02	5.2809+01
8.0000-01	1.2732-01	-1.7935+00	-2.2542+00	2.8806+00	9.1897+00	-1.2851+02	5.1494+01
9.0000-01	1.4324-01	-1.5176+00	-1.8524+00	2.3947+00	7.5851+00	-1.2933+02	5.0674+01
1.0000+00	1.5915-01	-1.2982+00	-1.5595+00	2.0291+00	6.1462+00	-1.2978+02	5.0224+01
1.2566+00	2.0000-01	-9.1110-01	-1.0918+00	1.4220+00	3.0580+00	-1.2985+02	5.0154+01
1.5000+00	2.3873-01	-6.8750-01	-8.4481-01	1.0892+00	7.4217-01	-1.2914+02	5.0862+01
1.8850+00	3.0000-01	-4.7989-01	-6.2459-01	7.8766-01	-2.0732+00	-1.2754+02	5.2464+01
2.0000+00	3.1831-01	-4.3837-01	-5.8069-01	7.2758-01	-2.7623+00	-1.2705+02	5.2950+01
2.5000+00	3.9789-01	-3.1809-01	-4.5037-01	5.5138-01	-5.1710+00	-1.2523+02	5.4767+01
2.5133+00	4.0000-01	-3.1585-01	-4.4784-01	5.4801-01	-5.2242+00	-1.2519+02	5.4806+01
3.0000+00	4.7746-01	-2.5410-01	-3.7497-01	4.5296-01	-6.8788+00	-1.2412+02	5.5876+01
3.1416+00	5.0000-01	-2.4194-01	-3.5930-01	4.3316-01	-7.2670+00	-1.2395+02	5.6045+01
3.5000+00	5.5704-01	-2.1915-01	-3.2711-01	3.9373-01	-8.0960+00	-1.2382+02	5.6179+01
3.7699+00	6.0000-01	-2.0796-01	-3.0826-01	3.7185-01	-8.5927+00	-1.2401+02	5.5995+01
4.0000+00	6.3662-01	-2.0166-01	-2.9492-01	3.5728-01	-8.9399+00	-1.2436+02	5.5636+01
4.3982+00	7.0000-01	-1.9673-01	-2.7630-01	3.3918-01	-9.3913+00	-1.2545+02	5.4549+01
4.5000+00	7.1620-01	-1.9657-01	-2.7225-01	3.3580-01	-9.4785+00	-1.2583+02	5.4169+01
5.0000+00	7.9577-01	-2.0202-01	-2.5504-01	3.2536-01	-9.7527+00	-1.2838+02	5.1616+01
5.0265+00	8.0000-01	-2.0260-01	-2.5421-01	3.2507-01	-9.7605+00	-1.2855+02	5.1445+01
5.5000+00	8.7535-01	-2.1804-01	-2.3952-01	3.2390-01	-9.7919+00	-1.3231+02	4.7688+01
5.6549+00	9.0000-01	-2.2528-01	-2.3431-01	3.2504-01	-9.7612+00	-1.3388+02	4.6125+01
6.0000+00	9.5493-01	-2.4554-01	-2.2042-01	3.2996-01	-9.6308+00	-1.3809+02	4.1914+01
6.2832+00	1.0000+00	-2.6627-01	-2.0486-01	3.3596-01	-9.4743+00	-1.4243+02	3.7573+01
6.5000+00	1.0345+00	-2.8419-01	-1.8887-01	3.4123-01	-9.3392+00	-1.4639+02	3.3609+01
7.0000+00	1.1141+00	-3.2618-01	-1.3174-01	3.5178-01	-9.0747+00	-1.5801+02	2.1993+01
7.5000+00	1.1937+00	-3.4695-01	-4.1581-02	3.4943-01	-9.1328+00	-1.7317+02	6.8341+00
8.0000+00	1.2732+00	-3.1633-01	5.8073-02	3.2162-01	-9.8532+00	1.6960+02	-1.0403+01
8.5000+00	1.3528+00	-2.4286-01	1.2213-01	2.7184-01	-1.1314+01	1.5330+02	-2.6698+01
9.0000+00	1.4324+00	-1.6707-01	1.3951-01	2.1766-01	-1.3245+01	1.4014+02	-3.9864+01
9.5000+00	1.5120+00	-1.1090-01	1.3057-01	1.7131-01	-1.5324+01	1.3034+02	-4.9658+01
1.0000+01	1.5915+00	-7.4176-02	1.1333-01	1.3544-01	-1.7365+01	1.2321+02	-5.6794+01
1.1000+01	1.7507+00	-3.5901-02	8.0611-02	8.8245-02	-2.1086+01	1.1401+02	-6.5994+01
1.2000+01	1.9099+00	-1.9402-02	5.7746-02	6.0918-02	-2.4305+01	1.0857+02	-7.1428+01
1.2566+01	2.0000+00	-1.4268-02	4.8413-02	5.0472-02	-2.5939+01	1.0642+02	-7.3579+01
1.3000+01	2.0690+00	-1.1468-02	4.2580-02	4.4097-02	-2.7112+01	1.0507+02	-7.4926+01
1.4000+01	2.2282+00	-7.2631-03	3.2319-02	3.3126-02	-2.9597+01	1.0267+02	-7.7334+01
1.5000+01	2.3873+00	-4.8528-03	2.5157-02	2.5621-02	-3.1828+01	1.0092+02	-7.9082+01
1.6000+01	2.5465+00	-3.3827-03	2.0003-02	2.0287-02	-3.3856+01	9.9598+01	-8.0402+01

1.7000+01	2.7056+00	-2.4400-03	1.6194-02	1.6377-02	-3.5715+01	9.8568+01	-8.1432+01
1.8000+01	2.8648+00	-1.8103-03	1.3313-02	1.3435-02	-3.7435+01	9.7744+01	-8.2256+01
1.8850+01	3.0000+00	-1.4312-03	1.1389-02	1.1479-02	-3.8802+01	9.7162+01	-8.2838+01
1.9000+01	3.0239+00	-1.3751-03	1.1089-02	1.1174-02	-3.9036+01	9.7069+01	-8.2931+01
2.0000+01	3.1831+00	-1.0656-03	9.3432-03	9.4038-03	-4.0534+01	9.6507+01	-8.3493+01
2.1000+01	3.3423+00	-8.4011-04	7.9516-03	7.9959-03	-4.1943+01	9.6031+01	-8.3969+01
2.2000+01	3.5014+00	-6.7228-04	6.8276-03	6.8607-03	-4.3273+01	9.5623+01	-8.4377+01
2.3000+01	3.6606+00	-5.4507-04	5.9090-03	5.9341-03	-4.4533+01	9.5270+01	-8.4730+01
2.4000+01	3.8197+00	-4.4707-04	5.1504-03	5.1698-03	-4.5731+01	9.4961+01	-8.5039+01
2.5133+01	4.0000+00	-3.6162-04	4.4421-03	4.4567-03	-4.7020+01	9.4654+01	-8.5346+01
2.7000+01	4.2972+00	-2.6135-04	3.5357-03	3.5454-03	-4.9007+01	9.4227+01	-8.5773+01
3.0000+01	4.7746+00	-1.6364-04	2.5363-03	2.5415-03	-5.1898+01	9.3692+01	-8.6308+01
3.1416+01	5.0000+00	-1.3372-04	2.1953-03	2.1994-03	-5.3154+01	9.3486+01	-8.6514+01
3.2000+01	5.0930+00	-1.2341-04	2.0726-03	2.0763-03	-5.3654+01	9.3408+01	-8.6592+01
3.4000+01	5.4113+00	-9.4927-05	1.7162-03	1.7188-03	-5.5296+01	9.3166+01	-8.6834+01
3.6000+01	5.7296+00	-7.4279-05	1.4375-03	1.4394-03	-5.6836+01	9.2958+01	-8.7042+01
3.7699+01	6.0000+00	-6.1024-05	1.2466-03	1.2481-03	-5.8075+01	9.2803+01	-8.7197+01
3.8000+01	6.0479+00	-5.8998-05	1.2164-03	1.2178-03	-5.8288+01	9.2777+01	-8.7223+01
4.0000+01	6.3662+00	-4.7481-05	1.0386-03	1.0397-03	-5.9662+01	9.2617+01	-8.7383+01
4.2000+01	6.6845+00	-3.8662-05	8.9406-04	8.9489-04	-6.0965+01	9.2476+01	-8.7524+01
4.3982+01	7.0000+00	-3.1866-05	7.7619-04	7.7684-04	-6.2193+01	9.2351+01	-8.7649+01
4.6000+01	7.3211+00	-2.6424-05	6.7665-04	6.7716-04	-6.3386+01	9.2236+01	-8.7764+01
4.8000+01	7.6394+00	-2.2136-05	5.9416-04	5.9457-04	-6.4516+01	9.2134+01	-8.7866+01
5.0000+01	7.9577+00	-1.8688-05	5.2460-04	5.2493-04	-6.5598+01	9.2040+01	-8.7960+01
5.0265+01	8.0000+00	-1.8283-05	5.1620-04	5.1652-04	-6.5738+01	9.2028+01	-8.7972+01
5.4000+01	8.5944+00	-1.3598-05	4.1502-04	4.1524-04	-6.7634+01	9.1877+01	-8.8123+01
5.6549+01	9.0000+00	-1.1248-05	3.6074-04	3.6091-04	-6.8852+01	9.1786+01	-8.8214+01
5.8000+01	9.2310+00	-1.0136-05	3.3402-04	3.3417-04	-6.9521+01	9.1738+01	-8.8262+01
6.2000+01	9.8676+00	-7.7117-06	2.7284-04	2.7295-04	-7.1278+01	9.1619+01	-8.8381+01
6.2832+01	1.0000+01	-7.3025-06	2.6204-04	2.6214-04	-7.1629+01	9.1596+01	-8.8404+01
6.6000+01	1.0504+01	-5.9730-06	2.2577-04	2.2585-04	-7.2924+01	9.1515+01	-8.8485+01
7.0000+01	1.1141+01	-4.6992-06	1.8895-04	1.8900-04	-7.4471+01	9.1425+01	-8.8575+01
7.4000+01	1.1777+01	-3.7484-06	1.5973-04	1.5977-04	-7.5930+01	9.1344+01	-8.8656+01
7.8000+01	1.2414+01	-3.0269-06	1.3624-04	1.3628-04	-7.7311+01	9.1273+01	-8.8727+01
8.2000+01	1.3051+01	-2.4713-06	1.1715-04	1.1718-04	-7.8623+01	9.1208+01	-8.8792+01
8.6000+01	1.3687+01	-2.0377-06	1.0147-04	1.0149-04	-7.9871+01	9.1150+01	-8.8850+01
9.0000+01	1.4324+01	-1.6954-06	8.8474-05	8.8490-05	-8.1062+01	9.1098+01	-8.8902+01
9.5000+01	1.5120+01	-1.3626-06	7.5170-05	7.5182-05	-8.2478+01	9.1039+01	-8.8961+01
1.0000+02	1.5915+01	-1.1078-06	6.4407-05	6.4417-05	-8.3820+01	9.0985+01	-8.9015+01
1.0500+02	1.6711+01	-9.0987-07	5.5607-05	5.5614-05	-8.5096+01	9.0937+01	-8.9063+01
1.1000+02	1.7507+01	-7.5431-07	4.8340-05	4.8346-05	-8.6313+01	9.0894+01	-8.9106+01

1.2000+02	1.9099+01	-5.3136-07	3.7205-05	3.7209-05	-8.8587+01	9.0818+01	-8.9182+01
1.2566+02	2.0000+01	-4.4137-07	3.2386-05	3.2389-05	-8.9792+01	9.0781+01	-8.9219+01
1.3000+02	2.0690+01	-3.8508-07	2.9245-05	2.9247-05	-9.0678+01	9.0754+01	-8.9246+01
1.4000+02	2.2282+01	-2.8588-07	2.3404-05	2.3405-05	-9.2614+01	9.0700+01	-8.9300+01
1.5000+02	2.3873+01	-2.1669-07	1.9021-05	1.9022-05	-9.4415+01	9.0653+01	-8.9347+01
1.8850+02	3.0000+01	-8.6646-08	9.5758-06	9.5762-06	-1.0038+02	9.0518+01	-8.9482+01
2.0000+02	3.1831+01	-6.8327-08	8.0151-06	8.0154-06	-1.0192+02	9.0488+01	-8.9512+01
2.5000+02	3.9789+01	-2.7942-08	4.1015-06	4.1016-06	-1.0774+02	9.0390+01	-8.9610+01
2.5133+02	4.0000+01	-2.7356-08	4.0368-06	4.0369-06	-1.0788+02	9.0388+01	-8.9612+01
3.0000+02	4.7746+01	-1.3464-08	2.3729-06	2.3729-06	-1.1249+02	9.0325+01	-8.9675+01
3.1416+02	5.0000+01	-1.1194-08	2.0662-06	2.0662-06	-1.1370+02	9.0310+01	-8.9690+01
3.7699+02	6.0000+01	-5.3953-09	1.1955-06	1.1955-06	-1.1845+02	9.0259+01	-8.9741+01
4.0000+02	6.3662+01	-4.2564-09	1.0008-06	1.0008-06	-1.1999+02	9.0244+01	-8.9756+01
4.3982+02	7.0000+01	-2.9113-09	7.5275-07	7.5276-07	-1.2247+02	9.0222+01	-8.9778+01
5.0000+02	7.9577+01	-1.7427-09	5.1233-07	5.1233-07	-1.2581+02	9.0195+01	-8.9805+01
5.0265+02	8.0000+01	-1.7062-09	5.0425-07	5.0425-07	-1.2595+02	9.0194+01	-8.9806+01
5.6549+02	9.0000+01	-1.0650-09	3.5413-07	3.5414-07	-1.2902+02	9.0172+01	-8.9828+01
6.0000+02	9.5493+01	-8.4025-10	2.9646-07	2.9646-07	-1.3056+02	9.0162+01	-8.9838+01
6.2832+02	1.0000+02	-6.9868-10	2.5815-07	2.5816-07	-1.3176+02	9.0155+01	-8.9845+01
7.0000+02	1.1141+02	-4.5349-10	1.8669-07	1.8669-07	-1.3458+02	9.0139+01	-8.9861+01
8.0000+02	1.2732+02	-2.6580-10	1.2506-07	1.2506-07	-1.3806+02	9.0122+01	-8.9878+01
1.0000+03	1.5915+02	-1.0886-10	6.4029-08	6.4029-08	-1.4387+02	9.0097+01	-8.9903+01
1.2566+03	2.0000+02	-4.3653-11	3.2266-08	3.2266-08	-1.4983+02	9.0078+01	-8.9922+01
1.5000+03	2.3873+02	-2.1502-11	1.8971-08	1.8971-08	-1.5444+02	9.0065+01	-8.9935+01
1.8850+03	3.0000+02	-8.6222-12	9.5600-09	9.5600-09	-1.6039+02	9.0052+01	-8.9948+01
2.0000+03	3.1831+02	-6.8030-12	8.0033-09	8.0033-09	-1.6193+02	9.0049+01	-8.9951+01
2.5133+03	4.0000+02	-2.7281-12	4.0331-09	4.0331-09	-1.6789+02	9.0039+01	-8.9961+01

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 6

TIME RESPONSE TEST CASE (VAN VALKENBURG P. 144)

OPTIONS

```
CLEAR  =  1
COMENT =  1
INPUT  =  2
NUNFLS =  0
NOVFLS =100
PLOT   =  1
SFREQR =  0, 0, 0, 0, 0, 0, 0
SROOTL =  0, 0, 0, 0, 0, 0, 0
STIMER =  1, 0, 0, 0, 0, 0, 0
```

LINEAR SYSTEMS DYNAMICS PROGRAM

DATA CASE NO. 6

TIME RESPONSE TEST CASE (VAN VALKENBURG P. 144)

INPUT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN
0.0000	1.0000+00

ZEROS (2)	POLES (3)
(-5.0000+00, 0.0000)	(-2.0000+00, 1.0000+00)
(-1.0000+00, 0.0000)	(-2.0000+00,-1.0000+00)
	(0.0000 , 0.0000)

RESULTANT TRANSFER FUNCTION

BODE GAIN	ROOT LOCUS GAIN	GAMMA
1.0000+00	1.0000+00	1.0000+00

ZEROS (2)	POLES (3)
(-5.0000+00, 0.0000)	(0.0000 , 0.0000)
(-1.0000+00, 0.0000)	(-2.0000+00,-1.0000+00)
	(-2.0000+00, 1.0000+00)

**** TRANSIENT RESPONSE ****

TIME RESPONSE TEST CASE (VAN VALKENBURG P. 144)

RATIO 1

BODE GAIN	ROOT LOCUS GAIN	GAMMA
1.0000+00	1.0000+00	1.0000+00

START TIME	END TIME	INCREMENT
0.0000	5.0000+00	5.0000-02

SUM OF THE RESIDUES	LAMBDA'S
(1.0000+00, 0.0000)	(1.0000+00, 0.0000)

ZEROS	NON-ZERO POLES	RESIDUES
(-5.0000+00, 0.0000)	(-2.0000+00,-1.0000+00)	(0.0000 , 1.0000+00)
(-1.0000+00, 0.0000)	(-2.0000+00, 1.0000+00)	(0.0000 ,-1.0000+00)

PIECEWISE QUADRATIC DRIVING FUNCTION

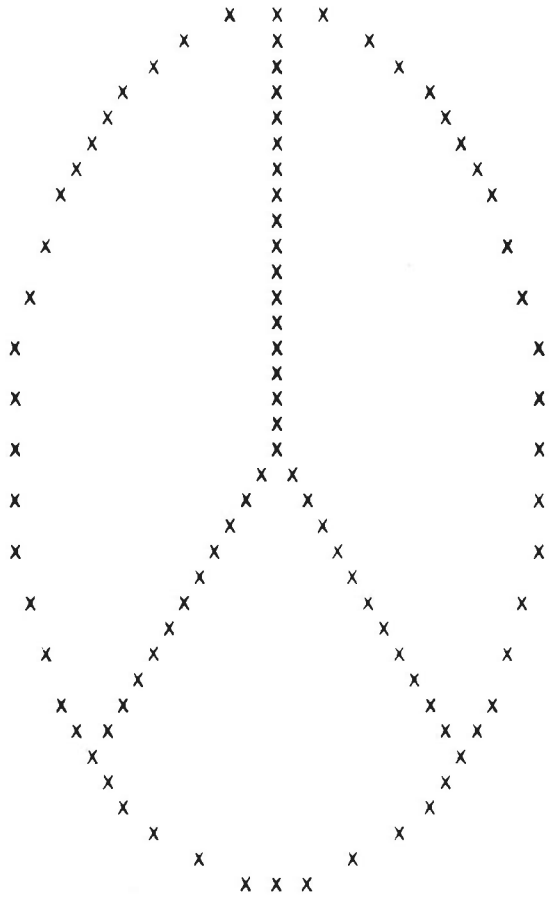
BREAK-POINT TIME	CONSTANT COEFFICIENT	LINEAR COEFFICIENT	QUADRATIC COEFFICIENT
0.0000	1.0000+00	0.0000	0.0000

TIME (SECONDS)	RESPONSE FUNCTION	INVERSE TRANSFORM	DRIVING FUNCTION
0.0000	0.0000	1.0000+00	1.0000+00
5.0000-02	5.2339-02	1.0904+00	1.0000+00
1.0000-01	1.0875-01	1.1635+00	1.0000+00
1.5000-01	1.6843-01	1.2214+00	1.0000+00
2.0000-01	2.3068-01	1.2663+00	1.0000+00
2.5000-01	2.9488-01	1.3001+00	1.0000+00
3.0000-01	3.6053-01	1.3244+00	1.0000+00
3.5000-01	4.2719-01	1.3406+00	1.0000+00
4.0000-01	4.9447-01	1.3500+00	1.0000+00
4.5000-01	5.6209-01	1.3537+00	1.0000+00
5.0000-01	6.2977-01	1.3527+00	1.0000+00
5.5000-01	6.9730-01	1.3480+00	1.0000+00
6.0000-01	7.6451-01	1.3401+00	1.0000+00
6.5000-01	8.3127-01	1.3299+00	1.0000+00
7.0000-01	8.9747-01	1.3177+00	1.0000+00
7.5000-01	9.6302-01	1.3042+00	1.0000+00
8.0000-01	1.0279+00	1.2897+00	1.0000+00
8.5000-01	1.0920+00	1.2745+00	1.0000+00
9.0000-01	1.1553+00	1.2590+00	1.0000+00
9.5000-01	1.2179+00	1.2433+00	1.0000+00
1.0000+00	1.2796+00	1.2278+00	1.0000+00
1.0500+00	1.3407+00	1.2124+00	1.0000+00
1.1000+00	1.4009+00	1.1975+00	1.0000+00
1.1500+00	1.4604+00	1.1830+00	1.0000+00
1.2000+00	1.5192+00	1.1691+00	1.0000+00
1.2500+00	1.5773+00	1.1558+00	1.0000+00
1.3000+00	1.6348+00	1.1431+00	1.0000+00
1.3500+00	1.6917+00	1.1311+00	1.0000+00
1.4000+00	1.7479+00	1.1199+00	1.0000+00
1.4500+00	1.8036+00	1.1092+00	1.0000+00
1.5000+00	1.8589+00	1.0993+00	1.0000+00
1.5500+00	1.9136+00	1.0901+00	1.0000+00
1.6000+00	1.9679+00	1.0815+00	1.0000+00
1.6500+00	2.0218+00	1.0735+00	1.0000+00
1.7000+00	2.0752+00	1.0662+00	1.0000+00
1.7500+00	2.1284+00	1.0594+00	1.0000+00
1.8000+00	2.1812+00	1.0532+00	1.0000+00
1.8500+00	2.2337+00	1.0475+00	1.0000+00
1.9000+00	2.2860+00	1.0423+00	1.0000+00

1.9500+00	2.3380+00	1.0376+00	1.0000+00
2.0000+00	2.3897+00	1.0333+00	1.0000+00
2.0500+00	2.4413+00	1.0294+00	1.0000+00
2.1000+00	2.4927+00	1.0259+00	1.0000+00
2.1500+00	2.5439+00	1.0227+00	1.0000+00
2.2000+00	2.5949+00	1.0199+00	1.0000+00
2.2500+00	2.6459+00	1.0173+00	1.0000+00
2.3000+00	2.6967+00	1.0150+00	1.0000+00
2.3500+00	2.7474+00	1.0129+00	1.0000+00
2.4000+00	2.7980+00	1.0111+00	1.0000+00
2.4500+00	2.8485+00	1.0095+00	1.0000+00
2.5000+00	2.8989+00	1.0081+00	1.0000+00
2.5500+00	2.9493+00	1.0068+00	1.0000+00
2.6000+00	2.9996+00	1.0057+00	1.0000+00
2.6500+00	3.0499+00	1.0047+00	1.0000+00
2.7000+00	3.1001+00	1.0039+00	1.0000+00
2.7500+00	3.1503+00	1.0031+00	1.0000+00
2.8000+00	3.2004+00	1.0025+00	1.0000+00
2.8500+00	3.2505+00	1.0019+00	1.0000+00
2.9000+00	3.3006+00	1.0014+00	1.0000+00
2.9500+00	3.3507+00	1.0010+00	1.0000+00
3.0000+00	3.4007+00	1.0007+00	1.0000+00
3.0500+00	3.4507+00	1.0004+00	1.0000+00
3.1000+00	3.5007+00	1.0002+00	1.0000+00
3.1500+00	3.5507+00	9.9997-01	1.0000+00
3.2000+00	3.6007+00	9.9981-01	1.0000+00
3.2500+00	3.6507+00	9.9967-01	1.0000+00
3.3000+00	3.7007+00	9.9957-01	1.0000+00
3.3500+00	3.7507+00	9.9949-01	1.0000+00
3.4000+00	3.8007+00	9.9943-01	1.0000+00
3.4500+00	3.8506+00	9.9939-01	1.0000+00
3.5000+00	3.9006+00	9.9936-01	1.0000+00
3.5500+00	3.9506+00	9.9934-01	1.0000+00
3.6000+00	4.0005+00	9.9934-01	1.0000+00
3.6500+00	4.0505+00	9.9934-01	1.0000+00
3.7000+00	4.1005+00	9.9935-01	1.0000+00
3.7500+00	4.1504+00	9.9937-01	1.0000+00
3.8000+00	4.2004+00	9.9939-01	1.0000+00
3.8500+00	4.2504+00	9.9941-01	1.0000+00
3.9000+00	4.3003+00	9.9944-01	1.0000+00
3.9500+00	4.3503+00	9.9946-01	1.0000+00

4.0000+00	4.4003+00	9.9949-01	1.0000+00
4.0500+00	4.4503+00	9.9952-01	1.0000+00
4.1000+00	4.5002+00	9.9955-01	1.0000+00
4.1500+00	4.5502+00	9.9958-01	1.0000+00
4.2000+00	4.6002+00	9.9961-01	1.0000+00
4.2500+00	4.6502+00	9.9964-01	1.0000+00
4.3000+00	4.7002+00	9.9966-01	1.0000+00
4.3500+00	4.7501+00	9.9969-01	1.0000+00
4.4000+00	4.8001+00	9.9971-01	1.0000+00
4.4500+00	4.8501+00	9.9974-01	1.0000+00
4.5000+00	4.9001+00	9.9976-01	1.0000+00
4.5500+00	4.9501+00	9.9978-01	1.0000+00
4.6000+00	5.0001+00	9.9980-01	1.0000+00
4.6500+00	5.0501+00	9.9982-01	1.0000+00
4.7000+00	5.1001+00	9.9983-01	1.0000+00
4.7500+00	5.1501+00	9.9985-01	1.0000+00
4.8000+00	5.2000+00	9.9987-01	1.0000+00
4.8500+00	5.2500+00	9.9988-01	1.0000+00
4.9000+00	5.3000+00	9.9989-01	1.0000+00
4.9500+00	5.3500+00	9.9990-01	1.0000+00
5.0000+00	5.4000+00	9.9991-01	1.0000+00

END OF LSD EXECUTION. NORMAL TERMINATION. 6 DATA CASES PROCESSED THIS TRIP.



THIS TRIP WAS TAKEN ON 12/10/68 AT 03&27&29.

```
                NOIREC = 1
                NTYPE=2
                TITLE=ID=SAMPLE CASE -- DELAY LINE NETWORK
                XLABEL=ID=FREQUENCY(RAD/SEC)
                YLABEL=ID=GAIN -- PHASE
                CADD=C.0,0.C,-180.0
                PLOT=1,6,8,ENDLST
                ENDPLT
                ENDFIL

MICROFILM PLCT COMPLETED
                NTYPE=C
                CADD=C.0,0.C,C.C
                XLABEL=ID=TIME(SEC)
                YLABEL=ID=RESPONSE -- DRIVING FUNCTION
                PLOT=1,2,4,ENDLST
                ENDPLT
                ENDFIL

MICROFILM PLOT COMPLETED
                REPEAT

MICROFILM PLCT CCMPLETED
                NOIREC=C
                XLABEL=ID=
                YLABEL=ID=
                TITLE=ID=SAMPLE RCOT LOCUS PLOT (GAIN)
                XHI = +0.1
                XLO = -2.3
                YHI = 1.12
                YLO = -0.05
                PLOT = 1,1, 1,5, 1,6, ENDLST
                ENDPLT
                NOADV=1
                NCHAR=-20
                PLOT = 1,1, 1,2, ENDLST
                ENDPLT
                NOADV=1
```

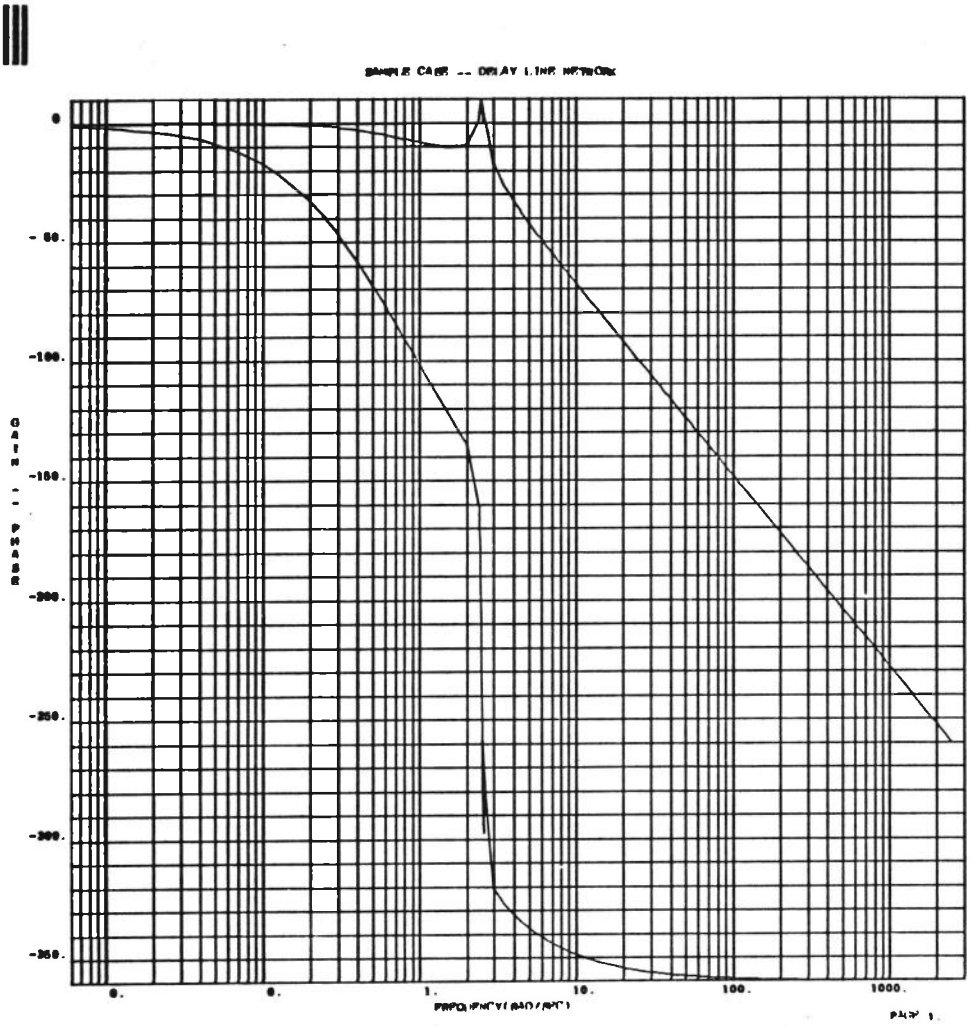
```
NCHAR=-29
PLOT = 1,1, 1,3, ENDLST
ENDPLT
NOADV=1
NCHAR=-4
PLOT = 1,1, 1,4, ENDLST
ENDPLT
NCHAR=5
TITLE=ID=SAMPLE ROOT LOCUS PLOT (PHASE)
XHI = -0.95
XLO = -2.25
YHI = 1.65
YLO = -0.05
PLOT = 1,1, 1,7, 1,8, ENDLST
ENDPLT
NOADV=1
NCHAR=-20
PLOT = 1,1, 1,2, ENDLST
ENDPLT
NOADV=1
NCHAR=-29
PLOT = 1,1, 1,3, ENDLST
ENDPLT
NOADV=1
NCHAR=-4
PLOT = 1,1, 1,4, ENDLST
ENDPLT
ENDFIL

MICROFILM PLOT COMPLETED

MICROFILM PLOT COMPLETED
          REPEAT

MICROFILM PLOT COMPLETED

MICROFILM PLOT COMPLETED
```

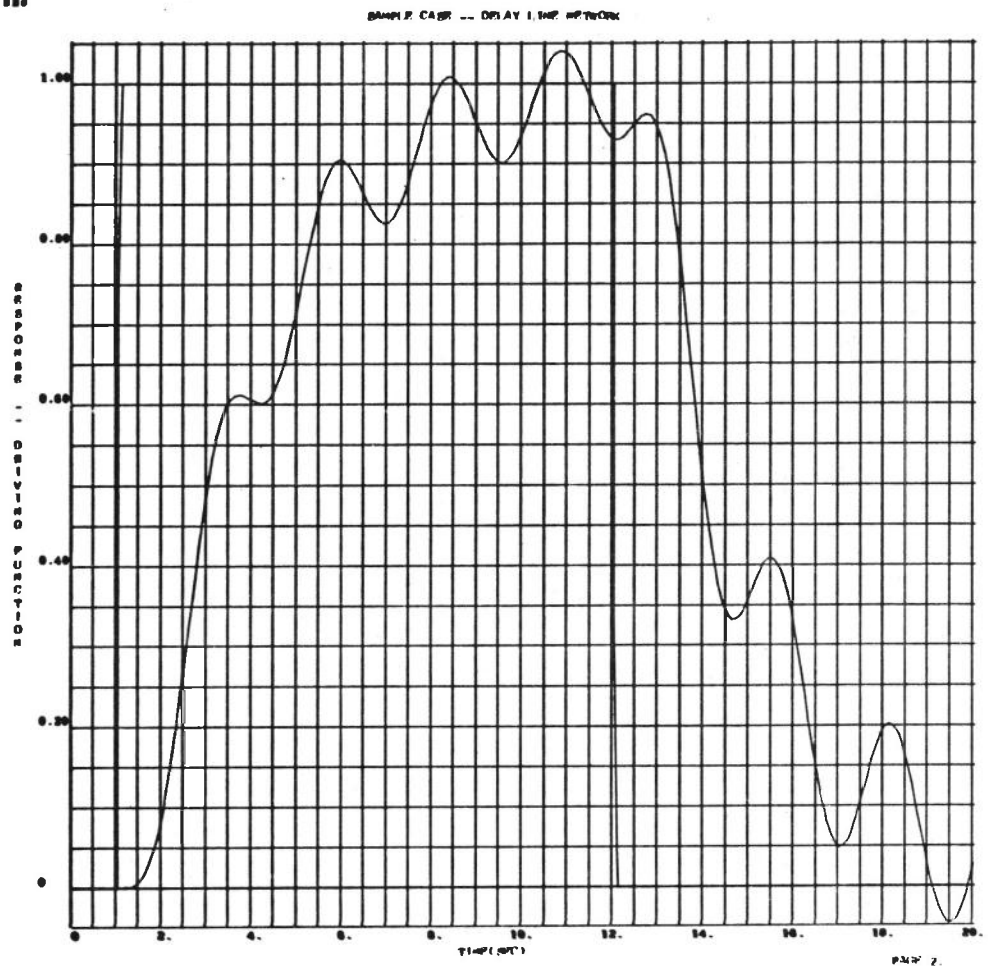
```
              NCHAR=5
              NOIREC=1
              NTYPE=2
              XHI = 0.0
              XLO = 0.0
              YHI = 0.0
              YLO = 0.0
              TITLE=ID=SAMPLE BODE PLOT
              XLABEL=ID=FREQUENCY (RAD/SEC)
              YLABEL=ID=GAIN  --  PHASE
              CADD = 0.0, 0.0, -180.0
              PLOT=1,6,8,ENDLST
              ENDPLT
              NTYPE=0
              TITLE=ID=SAMPLE NICHOLS CHART
              XLABEL=ID=PHASE
              YLABEL=ID=GAIN
              CADD=-180.0,0.0
              PLOT=8,6,ENDLST
              ENDPLT
              ENDFIL

MICROFILM PLOT COMPLETED

MICROFILM PLOT COMPLETED
              CADD = 0.0, 0.0, 0.0
              TITLE=ID=SAMPLE TRANSIENT RESPONSE
              XLABEL=ID=TIME (SEC)
              YLABEL=ID=RESPONSE  --  DRIVING FUNCTION
              PLOT=1,2,4,ENDLST
              ENDPLT
              ENDFIL

MICROFILM PLOT COMPLETED
              ENDRUN
```

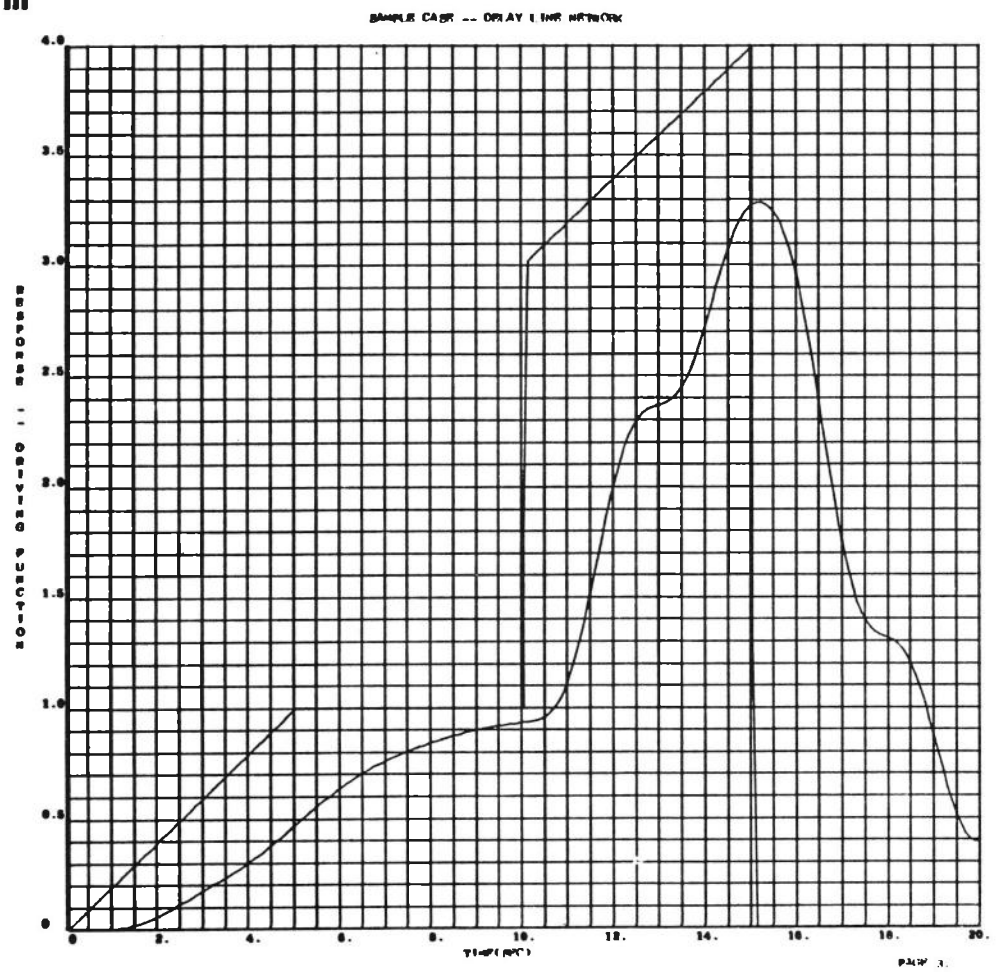
```
& EOF
```

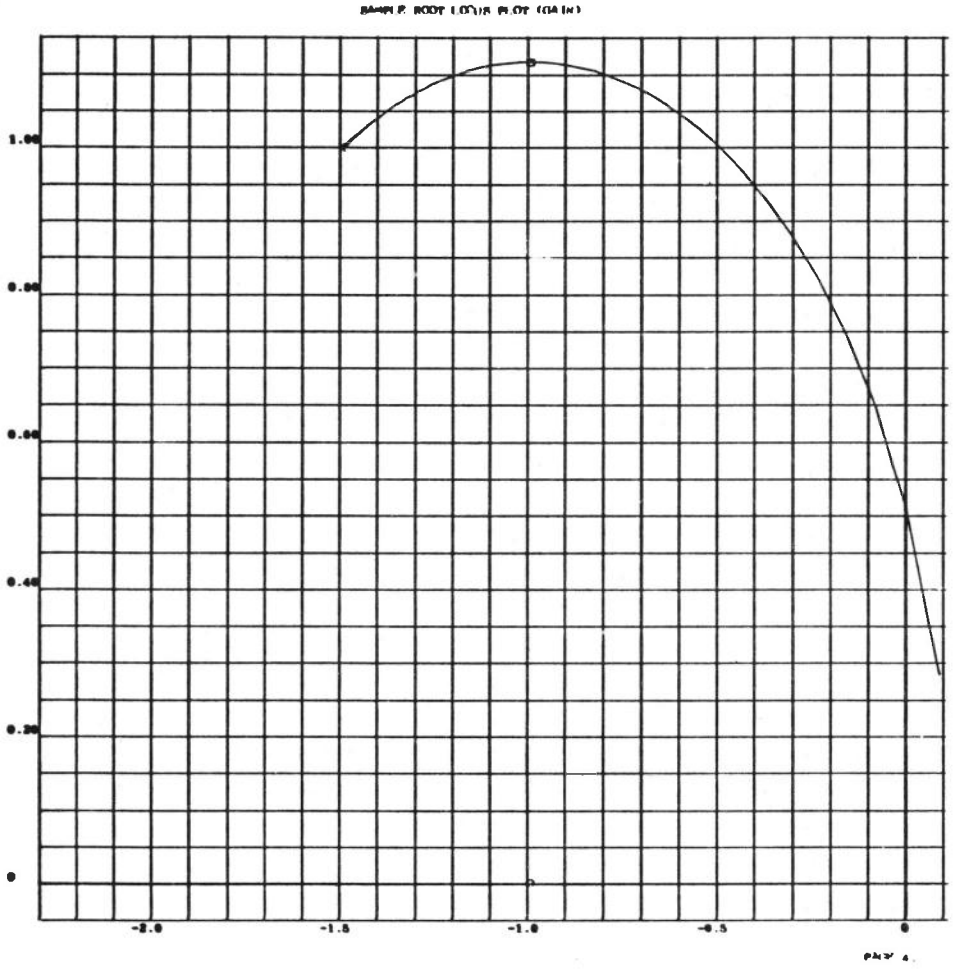
```
FCE &  03&29&22
```

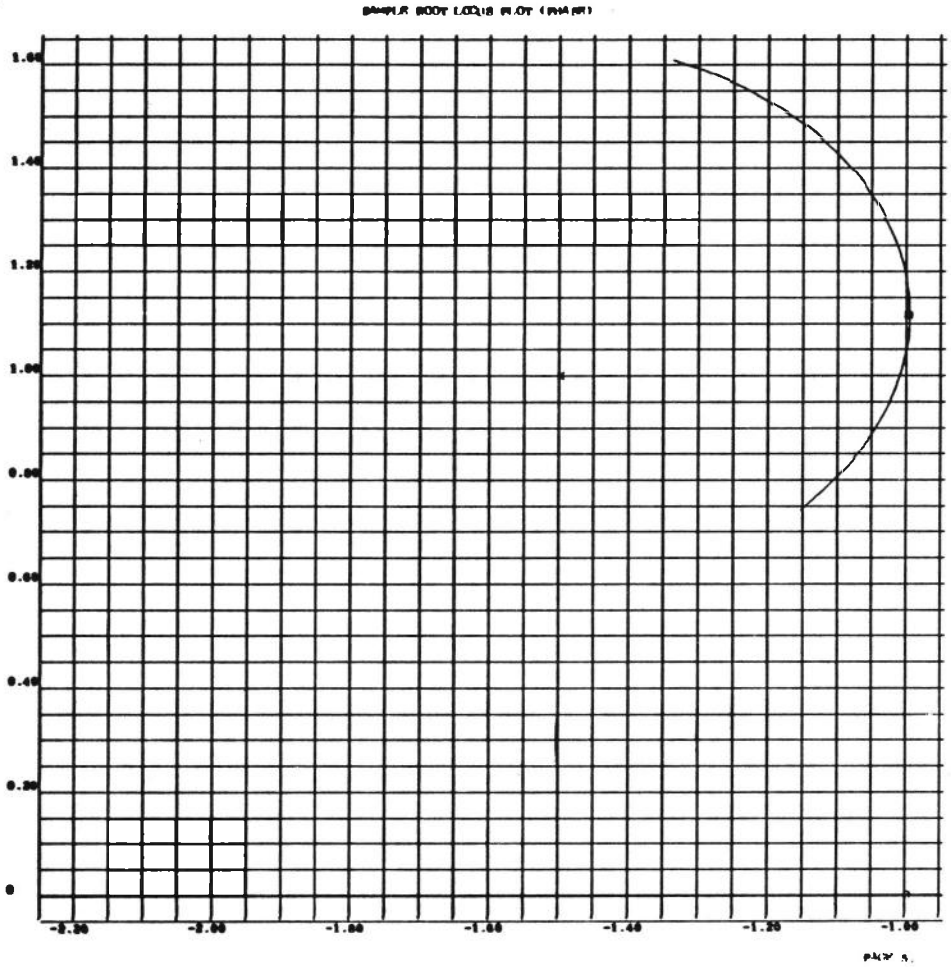
4.3 SAMPLE PLOTS

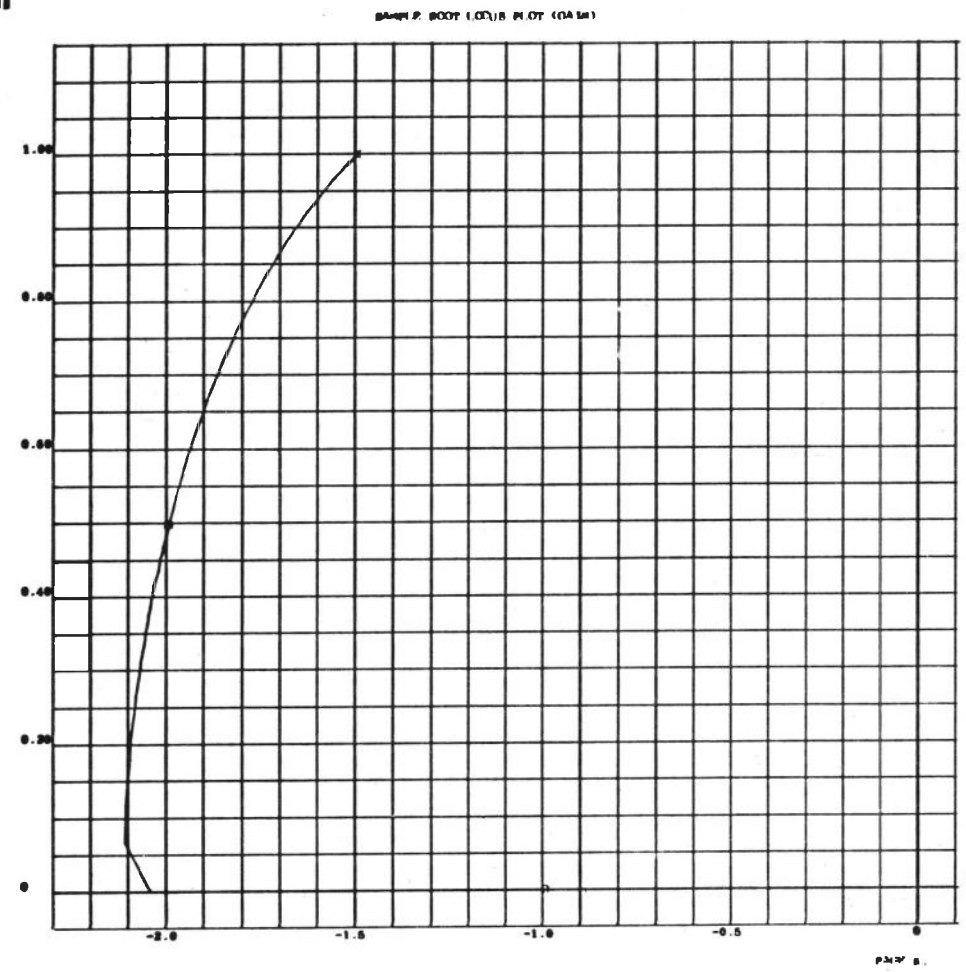


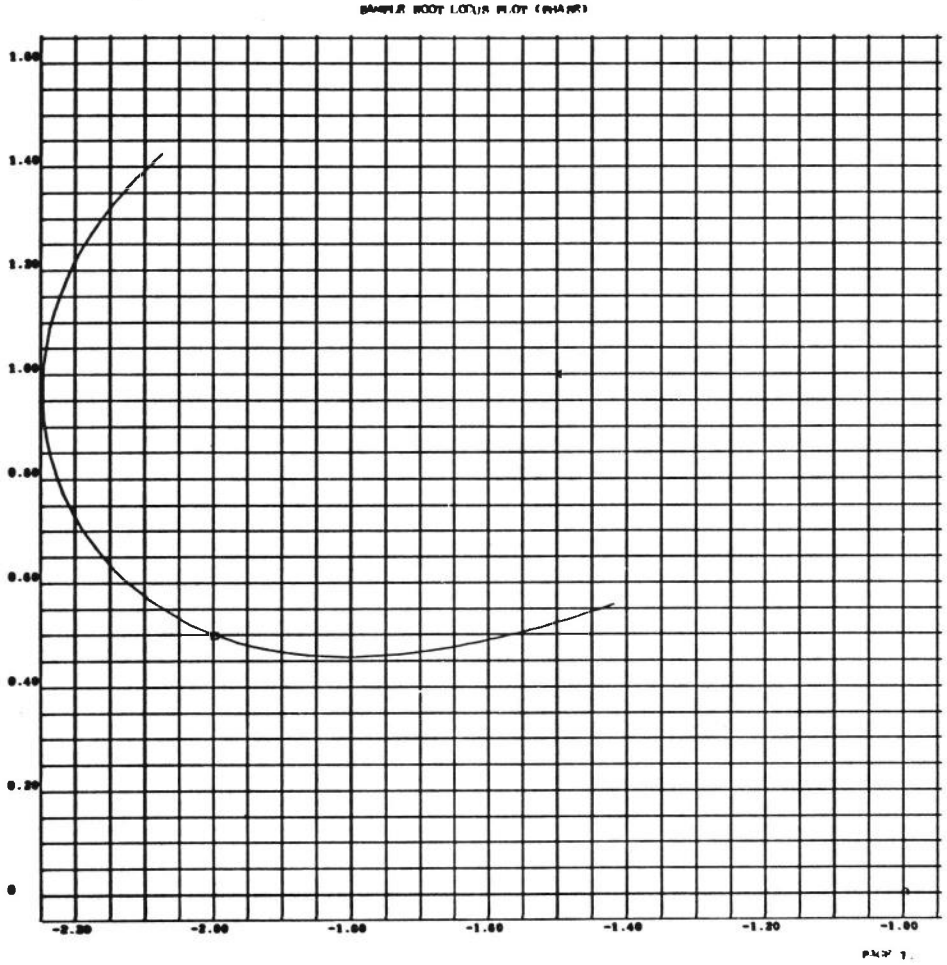

1.00
0.80
0.60
0.40
0.20
0
0
2.
4.
6.
8.
10.
12.
14.
16.
18.
20.

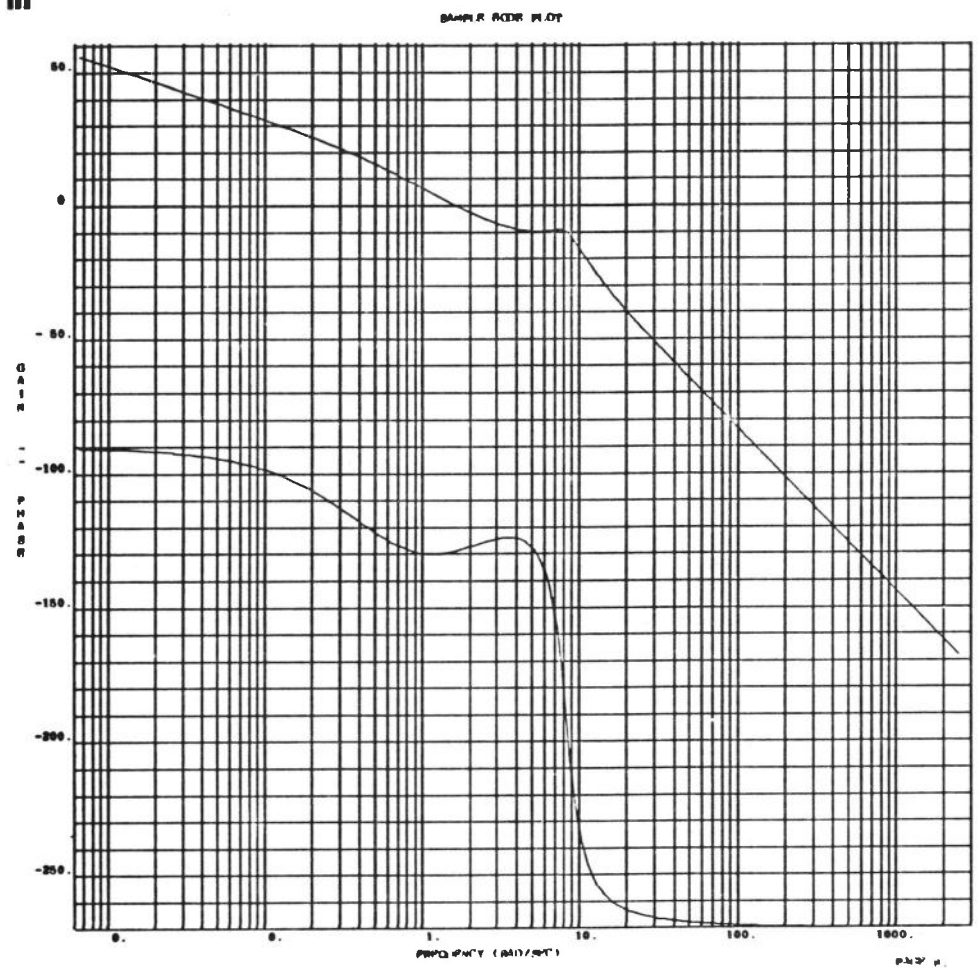

SAMPLE CASE -- DELAY LINE NETWORK
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
2.
4.
6.
8.
10.
12.
14.
16.
18.
20.

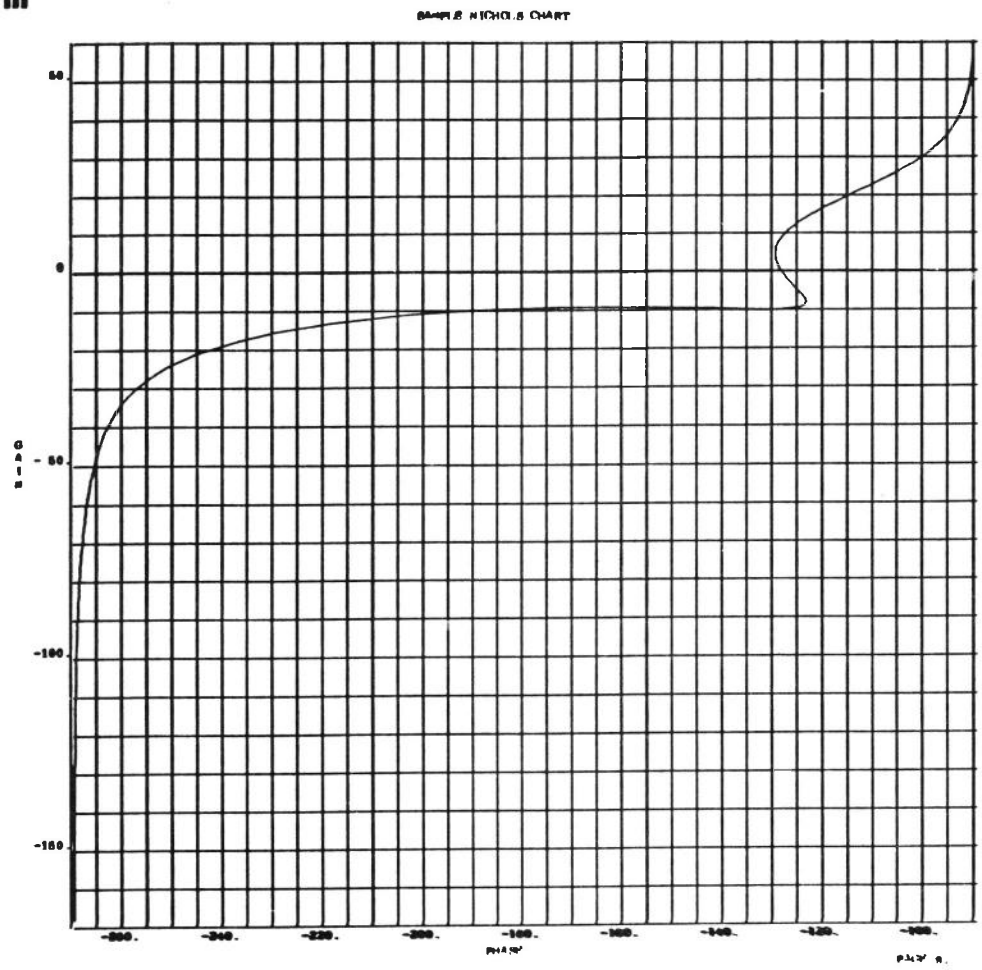

1.00
0.80
0.60
0.40
0.20
0
-2.0
-1.5
-1.0
-0.5
0

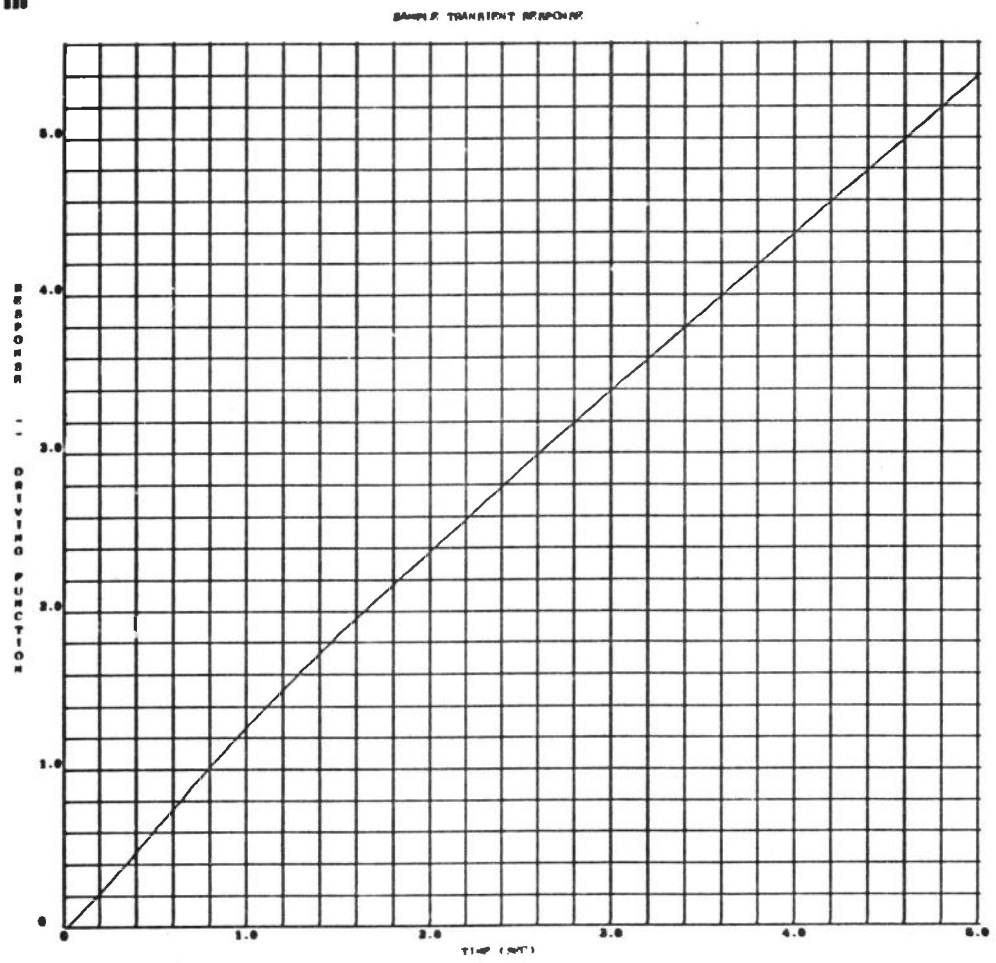



1.00
0.80
0.60
0.40
0.20
0
-2.0
-1.5
-1.0
-0.5
0


1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0
-2.20
-2.00
-1.80
-1.60
-1.40
-1.20
-1.00


50.
0
-50.
-100.
-150.
-200.
-250.
0.
0.
1.
10.
100.
1000.


NICHOLS CHART
50
0
-50
-100
-150
GAIN
-260.
-240.
-220.
-200.
-180.
-160.
-140.
-120.
-100.
PHASE


0
1.0
2.0
3.0
4.0
5.0
6.0

5. OPERATING PROCEDURES

The LSD Program is written in FORTRAN V for use with the SRU 1108 EXEC II system. Presently, this program is in production only for the 1108 system. No input tapes are required by this program in addition to the standard input tapes required by the 1108 system.

The LSD Program requires the use of one output tape. If no tape assignments are made, a drum file will be used, and the user must indicate this on his run request form. Drum files may be used when the user does not require any plot output and when he does not wish to save an LSD data tape.

If tape assignments are made without the use of "=", a FASTRAND file will be used for the output tape, and the user must indicate this on his run request form. FASTRAND files may be used when the user requires plot output but does not wish to save an LSD data tape.

If tape assignments are made with the use of "=", an actual output tape will be generated and may be saved by the user. Tape may be used in lieu of drum files and FASTRAND files and must be used when the user desires to save an LSD data tape.

5.1 LSD DECK SETUP

5.1.1 No Plot Output Desired, No Data Tape Saved

```
c
c
l
|
$JOB, etc.
▽△ASG△X = (PCF tape number)
▽△XQT△CUR
△TRW△X
△IN△X
△TRI△X
▽△XQT△HC003C
[ LSD data deck
▽△EOF
```

5.1.2 Plot Output Desired, No Data Tape Saved

```
c
c
1
↓
$JOB, etc.
▽△ASG△X = (PCF tape number)
▽△ASG△F
▽△XQT△CUR
△TRW△X
△IN△X
△TRI△X
▽△XQT△HC003C
[ LSD data deck
▽△XQT△ TRWPLT
[ TRWPLT data deck
▽△EOF
```

5.1.3 No Plot Output Desired, Data Tape Saved

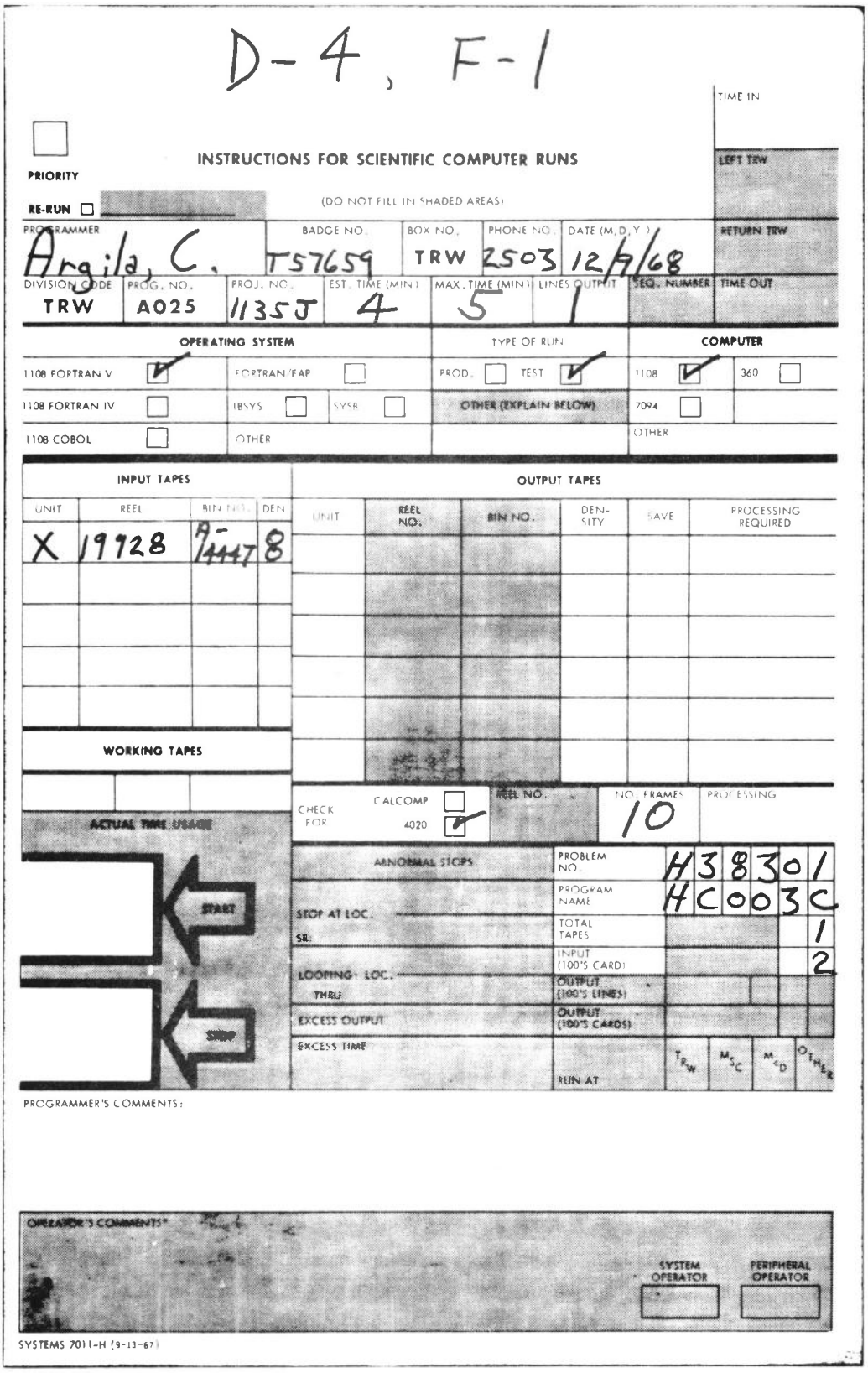
```
c
c
1
↓
$JOB, etc.
▽△ASG△X = (PCF tape number)
▽△ASG△F = SAVEF
▽△XQT△CUR
△TRW△X
△IN△X
△TRI△X
▽△XQT△HC003C
[ LSD data deck
▽△EOF
```

5.2 COMPUTER RUN REQUEST

In submitting the card deck for a computer run, the run time may be estimated at approximately 20 seconds per data case, one minute minimum. The print output may be estimated at approximately 15 pages per data case, 100 pages minimum. The estimates for run time and print output will vary greatly depending on the type of data case being run; hence, no firm rules can be given. The user should allow a sufficient margin for error.

Microfilm and CalComp output will depend on the number of plots generated by the plot program.

5. 2. 1 Sample Run Request Form



D-4, F-1

INSTRUCTIONS FOR SCIENTIFIC COMPUTER RUNS

PRIORITY ☐ RE-RUN ☐ (DO NOT FILL IN SHADED AREAS)

TIME IN / LEFT TRW / RETURN TRW / TIME OUT

PROGRAMMER	BADGE NO.	BOX NO.	PHONE NO.	DATE (M, D, Y)
Argila, C.	T5765 9	TRW	2503	12/6/68

DIVISION CODE	PROG. NO.	PROJ. NO.	EST. TIME (MIN.)	MAX. TIME (MIN.)	LINES OUTPUT	SEQ. NUMBER
TRW	A025	1135J	4	5	1	

OPERATING SYSTEM				TYPE OF RUN		COMPUTER	
1108 FORTRAN V	☑	FORTRAN/FAP	☐	PROD. ☐	TEST ☑	1108 ☑	360 ☐
1108 FORTRAN IV	☐	IBSYS ☐	SYSR ☐	OTHER (EXPLAIN BELOW)		7094 ☐	
1108 COBOL	☐	OTHER				OTHER	

INPUT TAPES

UNIT	REEL	BIN NO.	DEN.
X	19728	P-4447	8

OUTPUT TAPES

UNIT	REEL NO.	BIN NO.	DEN-SITY	SAVE	PROCESSING REQUIRED

WORKING TAPES

CHECK FOR: CALCOMP ☐ 4020 ☑ | REEL NO. | NO. FRAMES: 10 | PROCESSING

ACTUAL TIME USAGE

ABNORMAL STOPS

STOP AT LOC.

SR.

LOOPING LOC.

THRU

EXCESS OUTPUT

EXCESS TIME

PROBLEM NO.	H3830 1
PROGRAM NAME	HC003C
TOTAL TAPES	1
INPUT (100'S CARD)	2
OUTPUT (100'S LINES)	
OUTPUT (100'S CARDS)	
RUN AT	T_{RW} M_{SC} M_{CD} O_{THER}

PROGRAMMER'S COMMENTS:

OPERATOR'S COMMENTS*

SYSTEM OPERATOR | PERIPHERAL OPERATOR

SYSTEMS 7011-H (9-13-67)

APPENDIX

UTILITY PROGRAM

The LSD package contains the Utility Program UTILT1 which interrogates the namelist input for the LSD Program and provides diagnostic information on namelist errors. Data cases are set up as input to UTILT1 exactly as they would be set up as input to the LSD Program. Once the program PCF tape has been entered into the user PCF area, only the following control card is necessary in order to execute UTILT1:

```
c
c
1
▽Δ XQT Δ UTILT1
```

A message is printed out for each data case that is successfully interrogated; if a namelist error is encountered, the proper diagnostic information is printed out and UTILT1 is terminated.

D. A. S.

TRW SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE 5512.30-013

TO: A. Rasumoff CC: (See Distribution) DATE: 24 January 1969

SUBJECT: Completion of HC003D

FROM: C. A. Argila

BLDG.	MAIL STA.	EXT.
H1	2061	2503

The Linear Systems Dynamics (LSD) Program has been modified to improve its frequency response capabilities and to enable the user to supress superfluous print output. This version of the LSD Program is currently in production at HCC as HC003D and supersedes HC003C. In addition, the HC003D package contains a modified version of TRWPLT (as documented in HCC IOC 3145.30-063) and the utility program UTILT1.

HCC IOC's 5512.30-014 and 5512.30-015 document changes to the HC003C User's Manual and the HC003C Programmer's Manual, respectively, for these modifications.

C. A. Argila
Electrical & Electronics Group

Approved: W. P. Bennett
W. P. Bennett, Head
Subsystems Analysis Section

CAA/idf

Distribution:

D. L. Ball
R. Chan
V. A. Dulock
A. P. Goldberg
J. W. Pool
L. H. Robinson
J. E. Suber

D. A. S.

TRW SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE

5512.30-014

TO: File

CC: (See Distribution)

DATE: 24 January 1969

SUBJECT: Changes in the HC003C User's Manual for HC003D.

FROM: C. A. Argila

BLDG. MAIL STA. EXT.

The Linear Systems Dynamics (LSD) Program has been modified to improve its frequency response capabilities and to enable the user to supress superfluous print output. These modifications necessitate changes in the HC003C User's Manual so that user documentation is consistent with HC003D. These changes are listed below:

Page	Change
1-9	The last two lines of §1.3 should read: ···parameter (or the sum of any parameters) as output and any parameter as input.
2-1	In the first line of §2., the words "data deck" should be underscored.
2-1	In §2.1, the input option, PRINT, has been added. PRINT is described as follows: PRINT = 0, no effect = 1, the eigenvalue iterants and eigenvectors (generated when INPUT =1 or 4) will be printed. PRINT is initialized to 1.
2-5	In §2.4 the description of FREQ(I) should read: FREQ is a table of 1000 entries containing 143 standard frequencies ranging from 0.00628 to 2513 radians per second, followed by 857 zero entries. The user may add frequencies to this table (in any order whatsoever) and may alter the standard frequencies. The first zero entry occurring in this table will terminate the user portion of the table; the LSD program will, in addition, add frequencies to this table near resonance points.

Page	Change
3-4	The third paragraph in the "Remarks" column should read: If this message follows a frequency response analysis, then: • All elements of the Table FREQ are zero, or • The size of the frequency table was exceeded, or • All frequencies were found to be singular.

C. A. Argila

C. A. Argila
Electrical and Electronics Group

Approved: W. P. Bennett

W. P. Bennett, Head
Subsystems Analysis Section

CAA/idf

Distribution:

D. L. Ball
R. Chan
V. A. Dulock
W. O. Fraser
A. P. Goldberg
M. Z. Matesich
A. J. Paroczai
J. W. Pool
L. H. Robinson
J. E. Suber