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OVER-ALL TRANSFER FUNCTIONS OF A POSITION-CONTROLLED JT-60 PLASMA COLUMN

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Over-all Transfer Functions of a Position-Controlled JT-60 Plasma Column

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After briefly describing a kinetics model for a position-controlled toroidal plasma column in a Tokamak device, Over-all transfer functions of an externally controlled JT-60 plasma column are given. The influence of parameters on characteristics of the system is examined.

Keywords: JT-60 Tokamak, Plasma Column, Position Control, Over-all Transfer Function, Parameter Study

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位置制御されたJT－60プラズマ柱の周波数応答特性

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トカマク型プラズマ閉じ込め装置における位置制御されたプラズマ柱の応答解析モデルについて言及した後，このモデルに基づき外部制御系により位置制御されたJT－60プラズマ柱の周波数応答特性を求め，諸定数の伝達特性への影響について検討を加えた。

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INTRODUCTION

A plasma column stays at a position where the expansive force balances with the inward force. The former results from the kinetic energy of plasma particles and the magnetic energy of the plasma current, while the latter results from the interaction of the plasma current with the vertical field. And so, the plasma column position may be controlled by regulating the vertical field.

The author reported a kinetics model for the horizontal motion of a toroidal plasma column in reference (4) and the model was combined with a model for a position-controller, and the inherent characteristics of a JT-60 plasma column motion were given in reference (5). And now, after briefing the model, he applies the model to analyze JT-60 and gives overall transfer functions of the position-controlled plasma column, and also investigates the influence of the time constant of the vertical field coil, the influence of the time constant of the controller and the influence of the proportional coefficient of the controller, on the characteristics of the system.

1. A KINETICS MODEL OF A POSITION-CONTROLLED TOROIDAL PLASMA COLUMN

A kinetics model for the horizontal motion of a toroidal plasma column was given in reference (4) and the model was combined with a model of a position-controller in reference (6). Now, the model of a position-controlled troidal plasma column is briefed here.

It is assumed in the model that the plasma column has a circular cross-section, that the current is distributed homogeneously over the column cross-section and that the asymmetry of distribution of the plasma pressure resulting from the toroidality is small.

1.1 Description of a plasma confining device

A plasma confining device, of which the cross-sectional configuration is conceptually shown in Fig. 1.1.0, is now considered. A plasma column of minor radius a and major radius R is confined in a conducting case (conductor ℓ) of radius r_ℓ; on a circle of radius r_v is located the conductor v, of which the current has a cosinusoidal density profile over the cross-section; and the toroidal coil (conductor t) is assumed to have the form of an axisymmetric toroidal shell with minor radius r_t. The conductors are assumed to have a circular cross-section of which the center is located on the torus axis. Subscripts ℓ, v and t are used to signify the variables and the constants, in conductor ℓ, v and t respectively; p, in the plasma column, and 0 in the initial equilibrium state.

1.2 Equation of motion of a toroidal plasma column

In the vicinity of the equilibrium, the motion of a toroidal plasma column is written as[4),(5]

$$M \frac{d^2R}{dt^2} = \frac{\mu_o}{2} I_p^2 \Gamma - 2\pi R I_p B_z \qquad (1)$$

where M is total mass of the plasma column, I_p is the plasma current and B_z is the vertical field which is given in initial equilibrium state as[1),(2]

$$B_{zo} = \frac{\mu_o}{4\pi} \frac{I_p}{R} \Gamma \qquad (2)$$

where $\Gamma = \ell n \frac{8R}{a} + \beta_\theta + \frac{\ell_i - 3}{2}$

and $\mu_o \ell_i / 4\pi$ is the internal inductance of the plasma column per unit length. The vertical field B_z is composed of B_i ($i = \ell, v, t$) which is produced by the conductor currents I_i ($i = \ell, v, t$) and the disturbance B_d.

$$B_z = \sum_{i=\ell,v,t,d} B_i \tag{3}$$

where B_i ($i = \ell, t, d$) are assumed to be homogeneous but B_v to have a positional gradient given below:

$$B_v = B_{vc} \left(1 + m \frac{\delta R}{R_o}\right) \tag{4}$$

where m is a constant characterizing the positional gradient of the field B_v and given as below by the stability conditions of the plasma column motion.[4]

$$-\frac{3}{2} < m < 0 \tag{5}$$

The minor radius of the plasma column is assumed to vary with column displacement as follows.

$$a = a_o \left(1 + \alpha \frac{\delta R}{R_o}\right) \tag{6}$$

where $0 < \alpha < \frac{1}{2}$ [4]

The plasma current I_p varies with the column displacement as follows.

$$I_p = I_{po} \left(1 + n \frac{\delta R}{R_o}\right) \tag{7}$$

where $-1 < n < 0$ [4]

Using equations (2), (3), (4), (6), (7), Eq. (1) is reduced to a linear one in the vicinity of a steady equilibrium state.[4],[5]

$$G \frac{\delta R}{R_o} = \sum_{i=\ell,vc,t,d} \frac{\delta B_i}{B_{vco}} \tag{8}$$

where $\delta B_i = B_i - B_{io}$ ($i = z, \ell, v, t, d$)

$B_{io} = 0$ ($i = \ell, t, d$)

$$\delta B_v = B_{vco}\, m \frac{\delta R}{R_o} + \delta B_{vc}$$

$$\Gamma_o = \ell n \frac{8R_o}{a_o} + \beta_\theta + \frac{\ell_i - 3}{2}$$

$$G = \frac{1-\alpha}{\Gamma_o} - 1 + n - m$$

$$B_{vco} = \frac{\mu_o \Gamma_o I_{po}}{4\pi R_o}$$

1.3 Circuit equations

Some assumptions are made. (1) Each of the conductors has a circular cross-section coaxial with the plasma column; (2) each of the conductor current has a cosinusoidal density profile on the cross-section, and (3) the plasma current has a homogeneous density profile on the column cross-section. With the assumptions, self (L) and mutual (M) inductances are written as[4]

$$\begin{aligned} L_i &= \frac{\pi^2}{4} \mu_o R_o N_i^2 \quad (i = \ell,\ v,\ t) \\ M_{pi} &= -\frac{\pi \mu_o}{2 r_i} R_o N_i \delta R \quad (i = \ell,\ v,\ t) \\ M_{ij} &= \frac{\pi^2 r_i}{4 r_j} \mu_o R_o N_i N_j \quad (i = \ell,\ v,\ \ j = v,\ t,\ \ i \neq j) \end{aligned} \tag{10}$$

where N is number of turns of a conductor.
With the inductances, a set of circuit equations is written in the vicinity of a steady equilibrium state as below[4],[5]

$$0 = \frac{1}{T_\ell} \frac{\delta I_\ell}{I_{po}} + \frac{d}{dt}\left(\frac{\delta I_\ell}{I_{po}}\right) = \frac{2R_o}{\pi r_\ell} \frac{d}{dt}\left(\frac{\delta R}{R_o}\right) + \frac{r_\ell N_v}{r_v} \frac{d}{dt}\left(\frac{\delta I_v}{I_{po}}\right) + \frac{r_\ell}{r_t} \frac{d}{dt}\left(\frac{\delta I_t}{I_{po}}\right)$$

$$\frac{r_v \Gamma_o}{\pi r_v R_o N_v} \frac{\delta V}{V_o} = \frac{1}{T_v} \frac{\delta I_v}{I_{po}} + \frac{d}{dt}\left(\frac{\delta I_v}{I_{po}}\right) - \frac{2R_o}{\pi r_v N_v} \frac{d}{dt}\left(\frac{\delta R}{R_o}\right) + \frac{r_\ell}{r_v N_v} \frac{d}{dt}\left(\frac{\delta I_\ell}{I_{po}}\right) + \frac{r_v}{r_v N_v} \frac{d}{dt}\left(\frac{\delta I_t}{I_{po}}\right) \tag{11}$$

$$0 = \frac{1}{T_t} \frac{\delta I_t}{I_{po}} + \frac{d}{dt}\left(\frac{\delta I_t}{I_{po}}\right) - \frac{2R_o}{\pi r_t} \frac{d}{dt}\left(\frac{\delta R}{R_o}\right) + \frac{r_\ell}{r_t} \frac{d}{dt}\left(\frac{\delta I_\ell}{I_{po}}\right) + \frac{r_v N_v}{r_t} \frac{d}{dt} \frac{\delta I_v}{I_{po}}$$

where $T_i = \frac{L_i}{R_i}$ $(i = \ell, v, t)$

and R_i $(i = \ell, v, t)$ are resistances of the conductors, I_i $(i = \ell, v, t)$ are the conductor currents, and V is the voltage applied to the terminal of the conductor v.

Each of the conductor currents produces at the plasma column a homogeneous vertical field of which the normalized density is given as follow.

$$\frac{\delta B_i}{B_{vio}} = \frac{\pi R_o N_i}{r_i \Gamma_o} \frac{\delta I_i}{I_{po}} \quad (i = \ell, v, t) \tag{12}$$

1.4 Equation of a position-controller

The control action of a plasma column is written as below.

$$\frac{d}{dt}\left(\frac{\delta V}{V_o}\right) + \frac{1}{T_f} \frac{\delta V}{V_o} = \frac{P}{T_f}\left(\frac{\delta R}{R_o} - C\right) \tag{13}$$

where C is the setting point of the plasma column position, P is the coefficient of the controller and T_f is its time constant. The position error is used as the actuating signal, and the vertical field is regulated by changing the terminal voltage of the conductor v so as the plasma column is maintained at a position.

2. OVER-ALL TRANSFER FUNCTION OF A POSITION-CONTROLLED TOROIDAL PLASMA COLUMN

The kinetics model of a position-controlled toroidal plasma column is applied to analyze the characteristics of JT-60 and its over-all transfer functions are given which show the influence of the proportional coefficient P, the time constants T_f and T_v, on the characteristics of the system.

2.1 Values of parameters

Parameters required for analyzing the kinetics of a position-controlled plasma column are listed in Table 1, where the values concern JT-60.

Γ_o, defined by Eq. (8), depends on β_θ and ℓ_i, and G, defined by Eq. (8), depends on m, α, n. The influence of these parameters on the characteristics of plasma column motion was investigated[4] and, it was found that, Γ_o can be set at 2.2 and G at -0.8. And also the influence of the intrinsic time constants of conductors, T_ℓ, T_v and T_t, on the characteristics were investigated and it is said in the report that T_ℓ can be set at 0.05 sec., T_t at 5.0 sec., but the value of T_v can not be fixed. And now, T_v is successively set at one of three T_vs (0.25, 0.5, 1.0 (sec)) for investigating its influence on the characteristics. The proportional coefficient of the controller P and its time constant T_f are also used as parameters, and their influence on the characteristics is investigated.

2.2 Over-all transfer function of a position-controlled toroidal plasma column

Over-all transfer functions of position controlled JT-60 plasma column were obtained and are given in Figs. 1.1.1 ∿ 3.3.24 where the intrinsic time constant of the conductor ℓ, T_ℓ, is set at 0.05 sec. and that of the conductor t, T_t, at 5.0 sec. The intrinsic time constant of the conductor v, T_v, is set at 0.25 sec. in Figs. 1.1.1 ∿ 1.3.20, at 0.5 sec. in Figs. 2.1.1 ∿ 2.3.22 and at 1.0 sec. in Figs. 3.1.1 ∿ 3.3.24. The time constant of the controller, T_f, is set at 0.025 sec. in Figs. 1.1.1 ∿ 1.1.19, 2.1.1 ∿ 2.1.21 and 3.1.1 ∿ 3.1.24, at 0.05 sec. in Figs. 1.2.1 ∿ 1.2.19, 2.2.1 ∿ 2.2.21 and 3.2.1 ∿ 3.2.24, and at 0.1 sec. in Figs. 1.3.1 ∿ 1.3.20, 2.3.1 ∿ 2.3.22 and 3.3.1 ∿ 3.3.24. The proportional coefficient of the controller, P, is successively set at the values for each pair of T_v and T_f. The

minimum value of P is 1.0 and the maximum is the critical value with which the system exhibits a critical stable oscillation. Values of these parameters for the figures are listed in Table 2.

With the over-all transfer functions, the influence of the intrinsic time constant of the conductor v, T_v, on the characteristics, the influence of the time constant of the controller, T_f, and also the influence of the proportional coefficient of the controller, P, can be investigated. It is seen in the figures that, regardless of the value of P, the gain curves approach to zero decibel line in low frequency range and show flat profiles, and, in high frequency range, they fall down. This implies that the system has a low pass filter characteristics. Their profile is monotone with small values of P, but, increasing the value of P, they augment in the control frequency range and become to have a maximum value. The augmentation of gain curves gives to the system the higher cut-off frequency and improves the time response of the system. On the other-hand, if the gain characteristics go up too much, the system becomes to exhibit the oscillatory response and may lose the stability. Increasing the value of P, the cut-off frequency increases but the gain magin and the phase one decrease[6], and with the largest value of P which given for a pair of the intrinsic time constant, T_v, and the time constant of controller, T_f, the system exhibites a critical oscillation. With increase of the value of T_v or T_f, or of both, the critical value of P becomes larger and the critical frequency higher. Increasing the value of T_f without change of T_v, the cut-off frequency decreases and the frequency at which the gain has a maximum value, becomes lower, but the maximum value larger. On the other hand, increasing the value of T_v without change of T_f, the cut-off frequency decreases, but the frequency at which the gain has a maximum value, becomes higher and the maximum value smaller. And it is said that the characteristics are affected more by T_v than by T_f.

It is also seen in the figures that, regardless of the value of P, the phase curves approach to zero degree line in low frequency range and show flat profiles, and, in high frequency range, they fall down and reach 240 degrees at 10^2 Hz. Increasing the value of P, the phase becomes to keep zero degree even in higher frequency range and then fall down sharply. Increasing the value of T_f without change of T_v, the phase curves start to fall down in lower frequency range, but increasing the value of T_v without change of T_f, the phase curves stay on zero degree line even in

higher frequency range. And the characteristics are affected more by T_v than by T_f.

The over-all transfer functions shown here, give amount of knowledge of the characteristics of the controlled toroidal plasma column and useful information for control performance of the plasma column.

3. SUMMARY AND CONCLUSION

Over-all transfer functions of a position-controlled JT-60 plasma column have been given, which show parametrically the influence of the intrinsic time constant of the conductor v on the characteristics, the influence of the time constant of the controller, and the influence of the proportional coefficient of the controller.

The obtained characteristics say that the system can be treated as a kind of low-pass filter. The cut-off frequency of the filter becomes higher with increase of value of the proportional coefficient of the controller and the system responds to higher frequency component. On the other hand, the stability condition of the system gives the maximum value of the proportional coefficient. Concerning the intrinsic time constant of the conductor and the proportional coefficient of the controller, increase of their values brings lower cut-off frequency in the system and spoils the response.

For clarifying the response of the system, it is needed to investigate the statics and dynamics of the system. The control performance characteristics of a position-controlled toroidal plasma column are discussed in reference (6).

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Table 1 List of notations

Notation	Value	Complement
R_o	3.0	Major radius of plasma column
a_o	1.0	Minor radius of plasma column
r_ℓ	1.2	Minor radius of conductor ℓ
r_v	1.4	Minor radius of conductor v
r_t	1.8	Minor radius of conductor t
N_ℓ	1	Equivalent number of turns of conductor ℓ
N_v	64	Equivalent number of turns of conductor v
N_t	1	Equivalent number of turns of conductor t
T_ℓ	0.05	Intrinsic time constant of conductor ℓ
T_v	0.25,0.5,1.0	Intrinsic time constant of conductor v
T_t	5.0	Intrinsic time constant of conductor t
β_θ	0.1	Value of poloidal beta
ℓ_i	0.9	Internal inductance of plasma column
m	$-1.5<$ <0	Positional gradient of vertical field
α	$0<$ <0.5	Positional gradient of minor radius
n	$-1<$ <0	Positional gradient of plasma current
Γ_o	2.2	$\Gamma_o = \ell n \frac{8R_o}{a_o} + \beta_\theta + \frac{\ell_i - 3}{2}$
G	-0.8	$G = \frac{1-\alpha}{\Gamma_o} - 1 + n - m$
P		Proportional coefficient of controller
T_f	0.025,0.05,0.10	Time constant of controller
C		Setting point of controller

Table 2 List of figures

Fig.	T_v (sec)	T_f (sec)
1.1.1 ∿ 1.1.19	0.25	0.025
1.2.1 ∿ 1.2.19	0.25	0.050
1.3.1 ∿ 1.3.20	0.25	0.10
2.1.1 ∿ 2.1.21	0.50	0.025
2.2.1 ∿ 2.2.21	0.50	0.050
2.3.1 ∿ 2.3.22	0.50	0.10
3.1.1 ∿ 3.1.24	1.0	0.025
3.2.1 ∿ 3.2.24	1.0	0.050
3.3.1 ∿ 3.3.24	1.0	0.10

Fig.	P
. .1	1.0
2	10.0
3	12.59
4	15.85
5	19.95
6	25.12
7	31.62
8	39.81

Fig.	P
. . 9	50.11
10	63.09
11	79.42
12	100.0
13	125.9
14	158.5
15	199.5
16	251.2

Fig.	P
. .17	316.2
18	398.1
19	501.1
20	630.9
21	794.2
22	1000
23	1259
24	1585

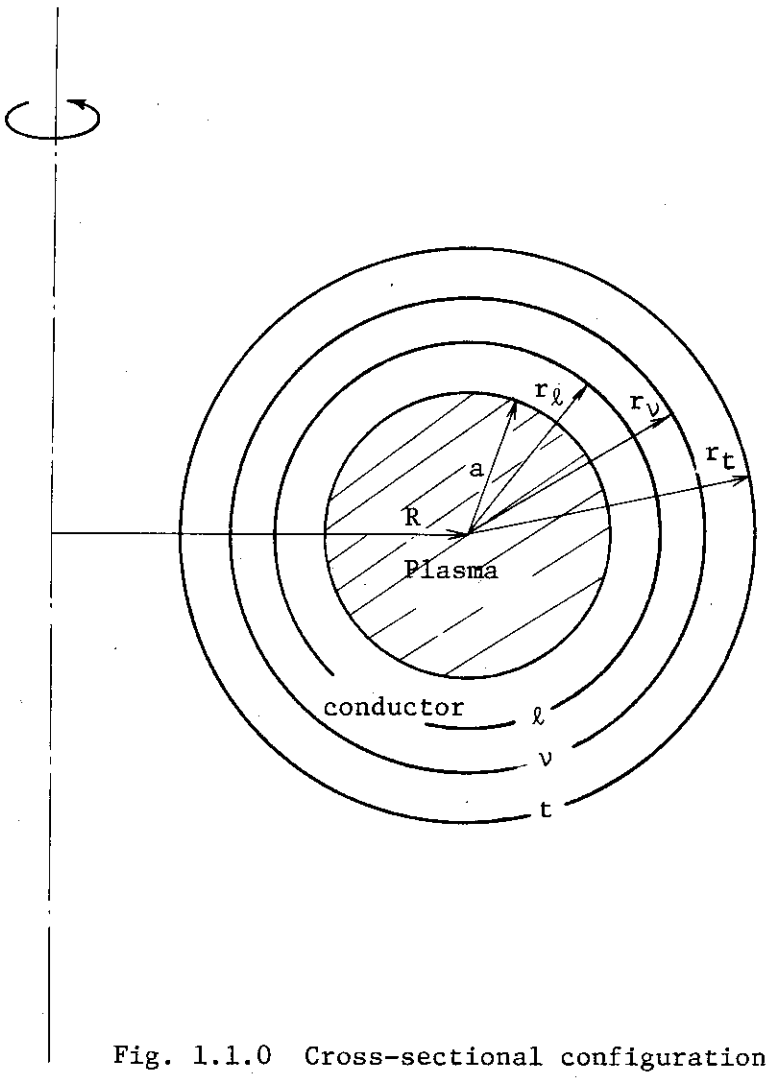

Fig. 1.1.0 Cross-sectional configuration of the plasma device model

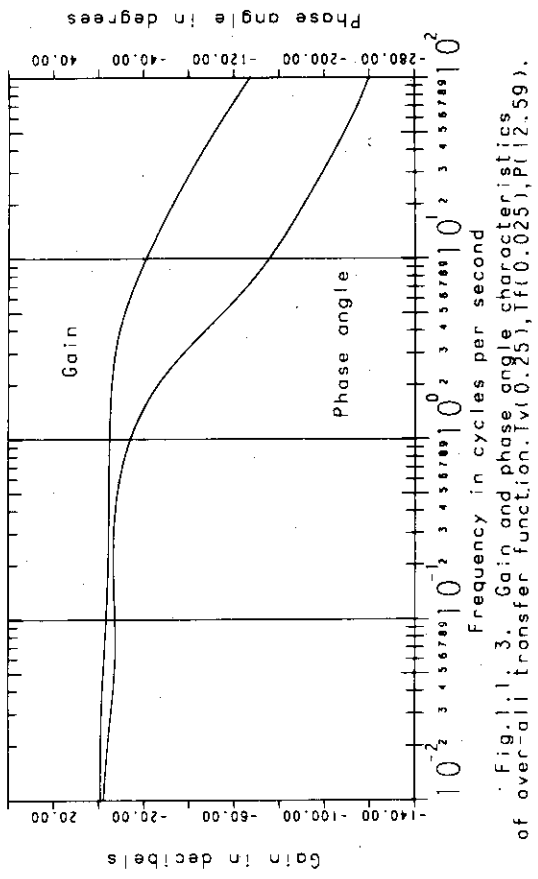

Fig.1.1. 3. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(12.59).

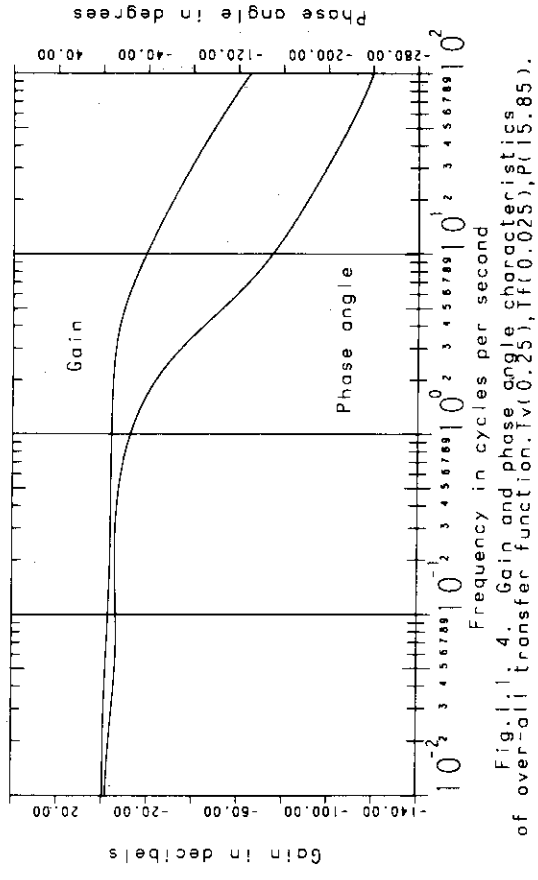

Fig.1.1. 4. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(15.85).

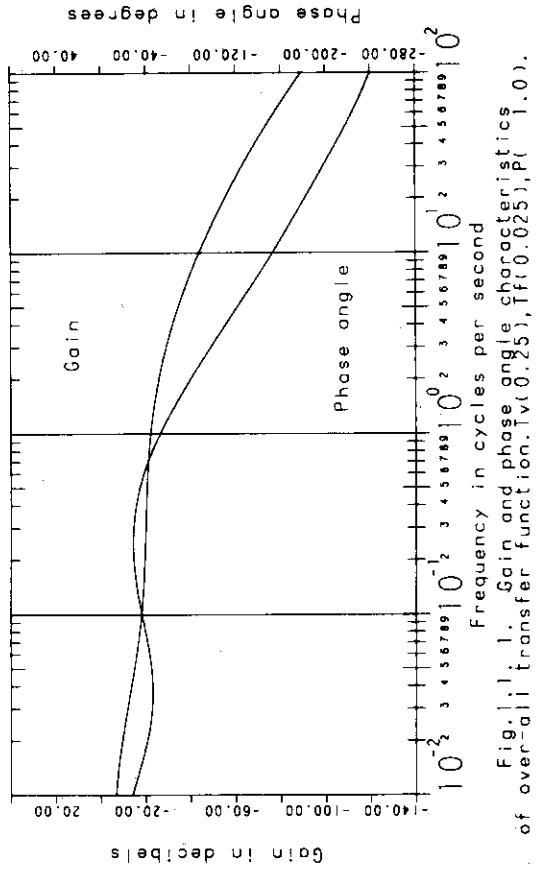

Fig.1.1. 1. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(1.0).

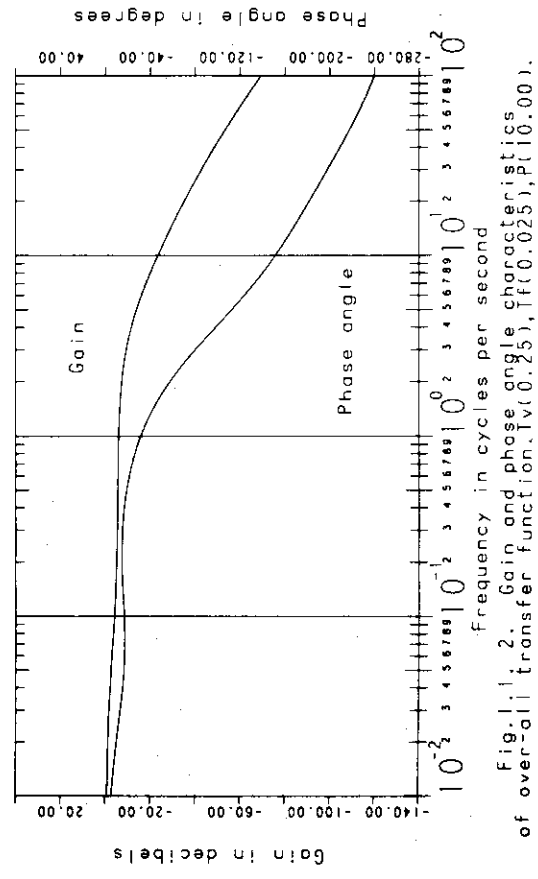

Fig.1.1. 2. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(10.00).

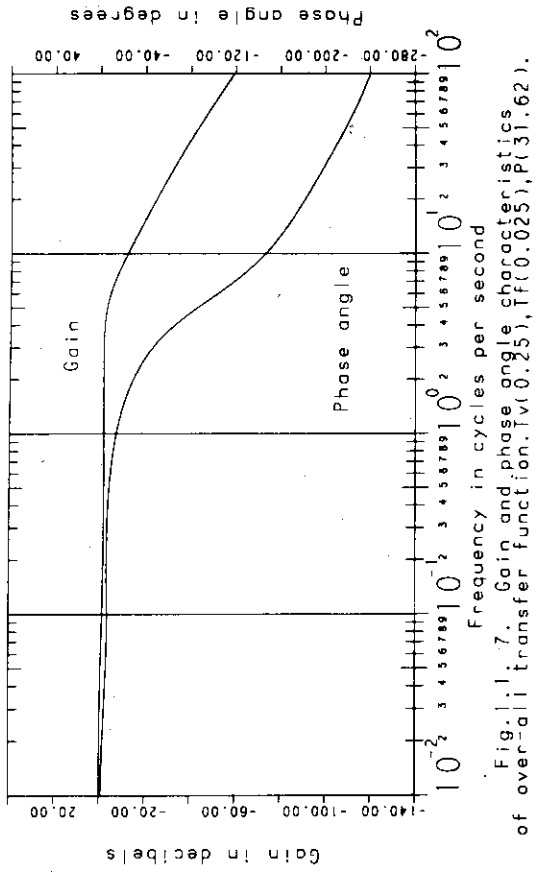

Fig.1.1. 7. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(31.62).

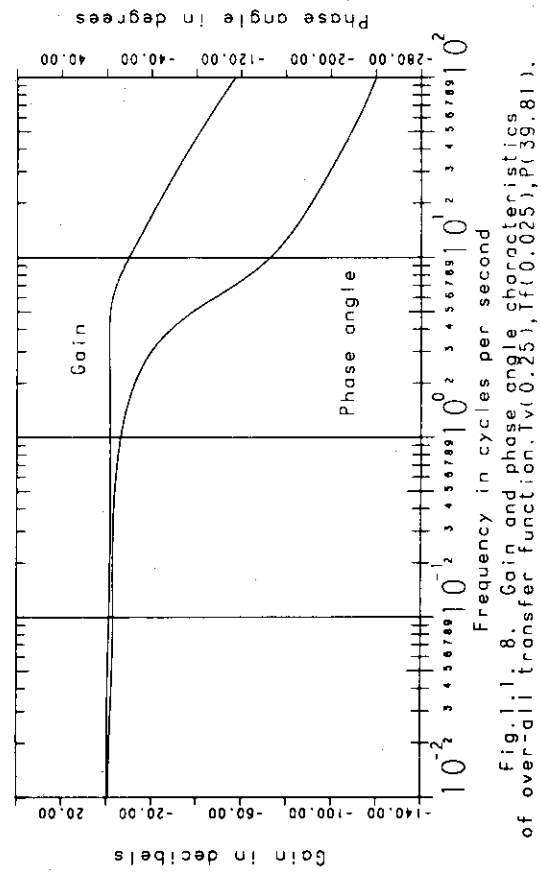

Fig.1.1. 8. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(39.81).

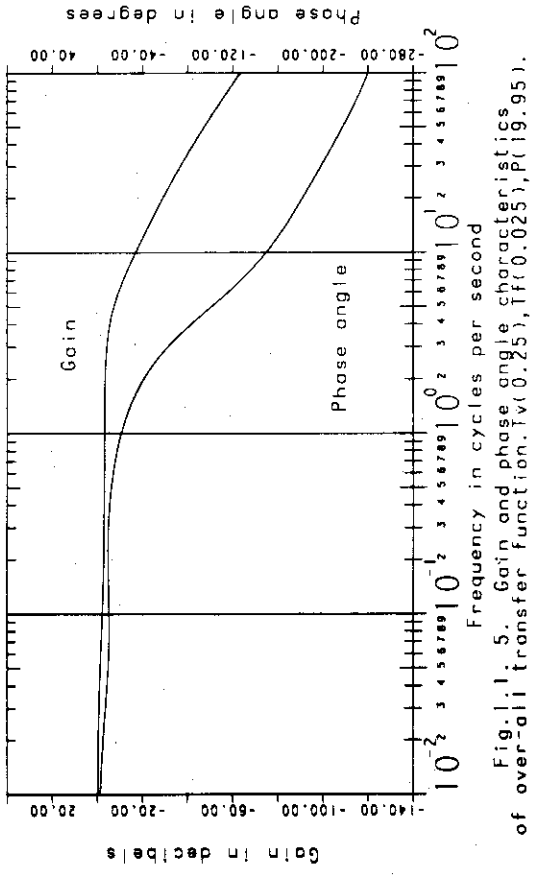

Fig.1.1. 5. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(19.95).

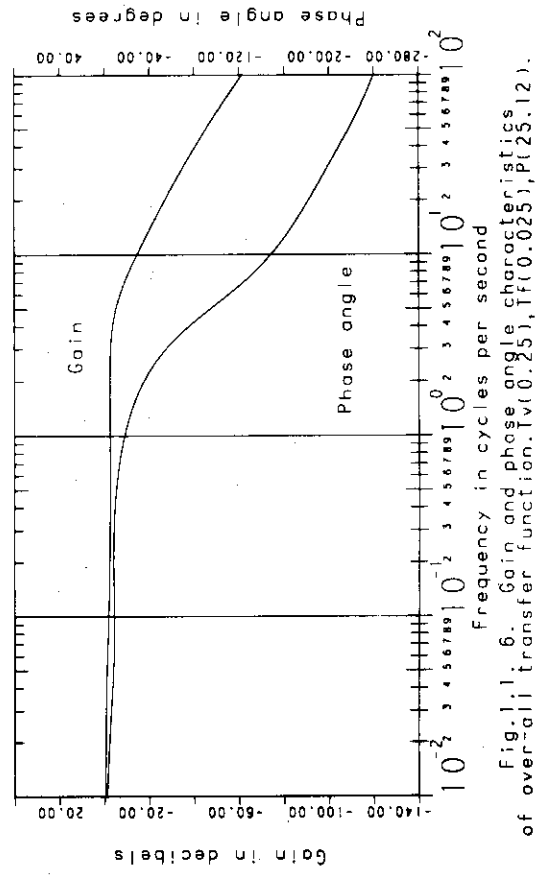

Fig.1.1. 6. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(25.12).

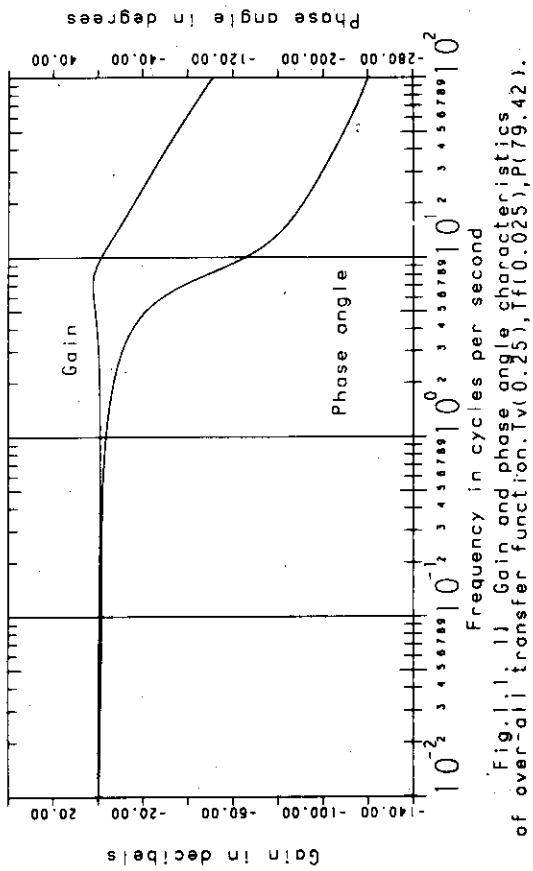

Fig.1.1.11 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(79.42).

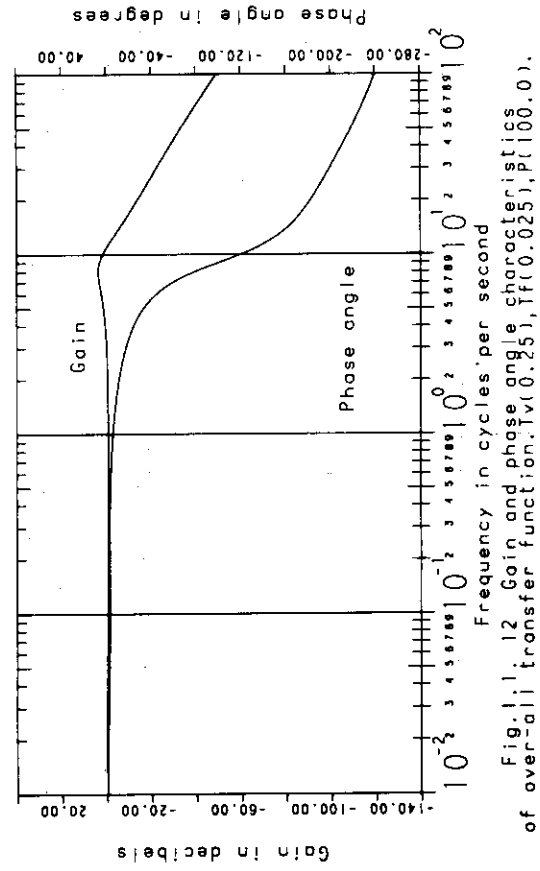

Fig.1.1.12 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(100.0).

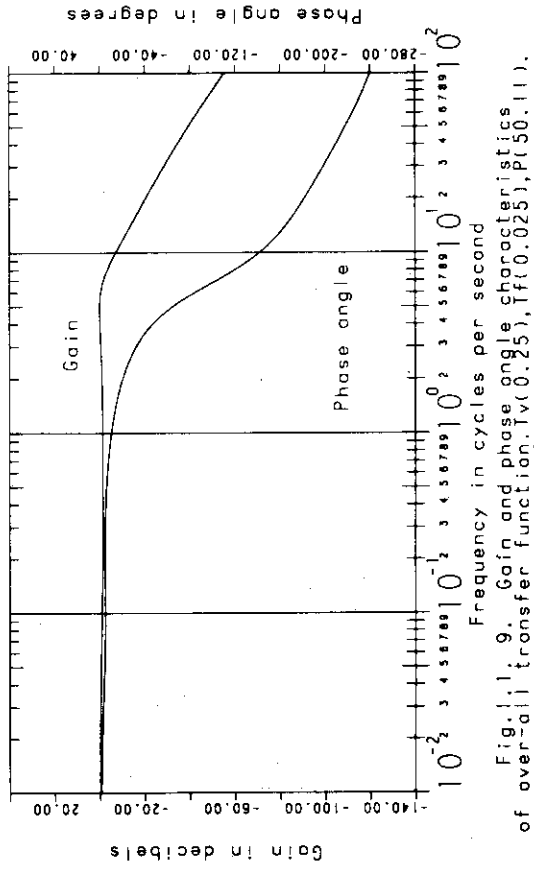

Fig.1.1.9 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(50.11).

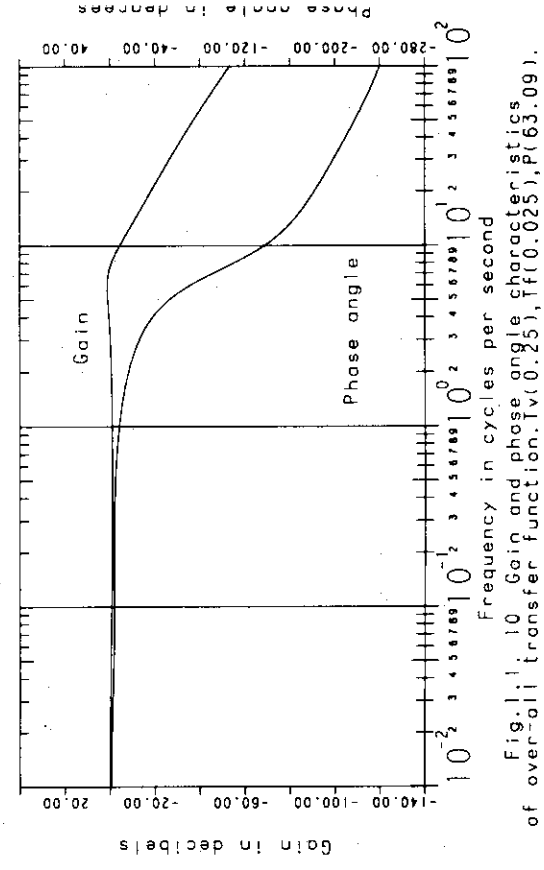

Fig.1.1.10 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.025),P(63.09).

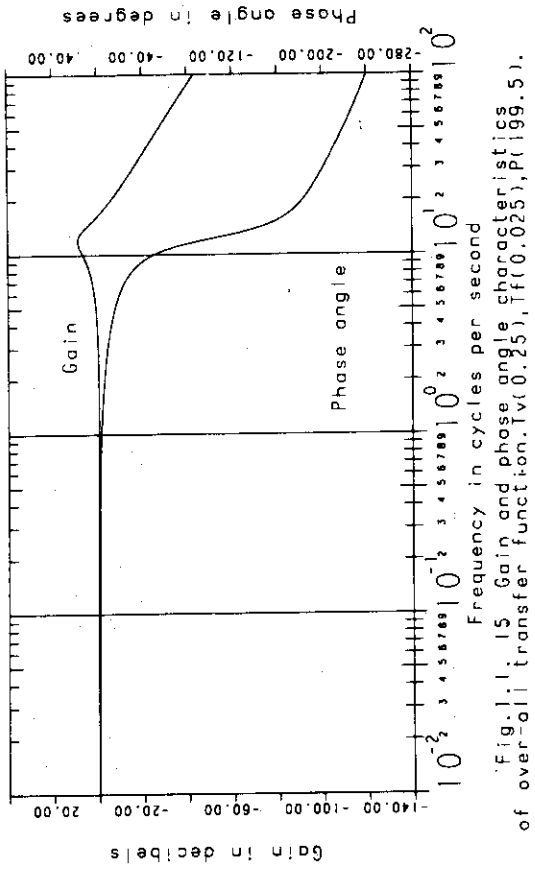

Fig. 1. 15 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(199.5).

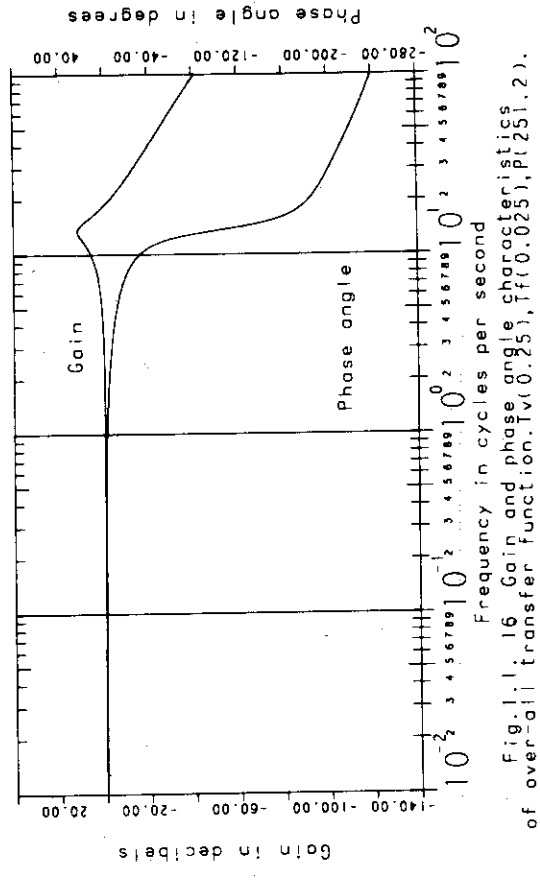

Fig. 1. 16 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(251.2).

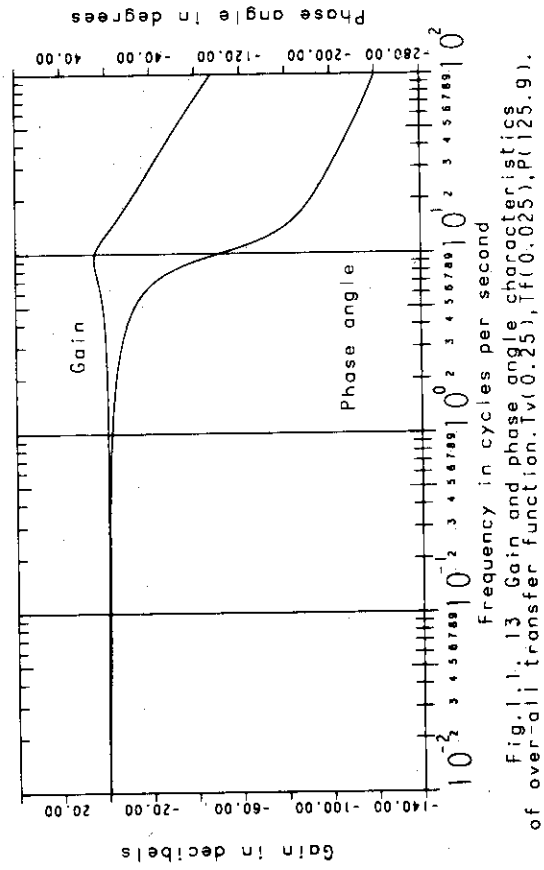

Fig. 1. 13 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(125.9).

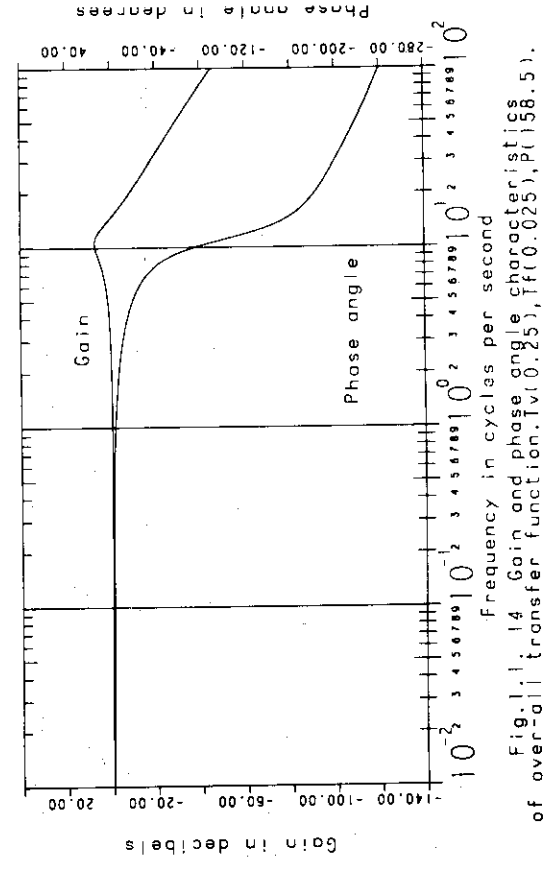

Fig. 1. 14 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(158.5).

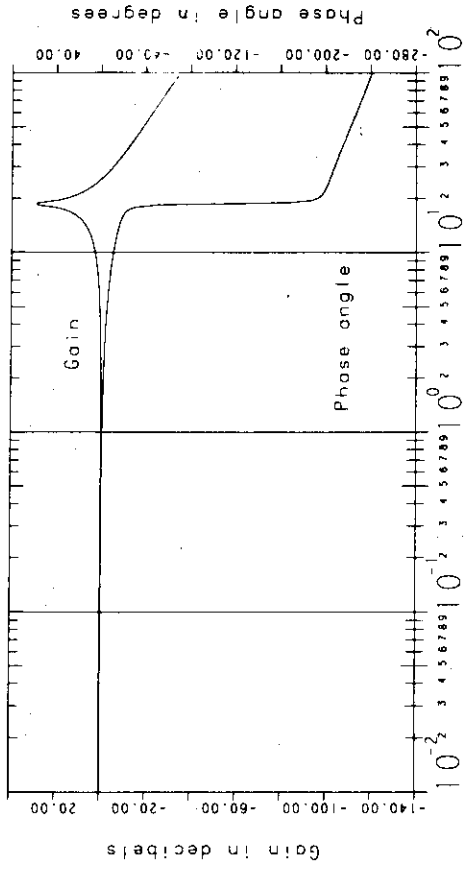

Fig. 1.1.19 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(501.1).

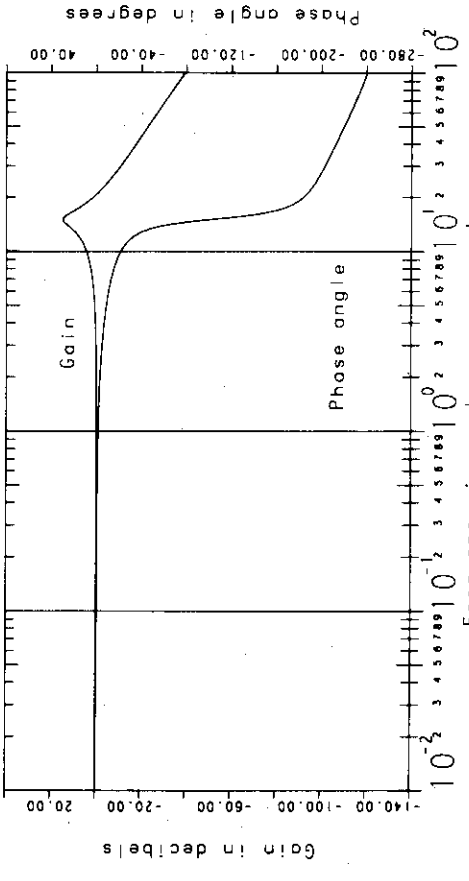

Fig. 1.1.17 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(316.2).

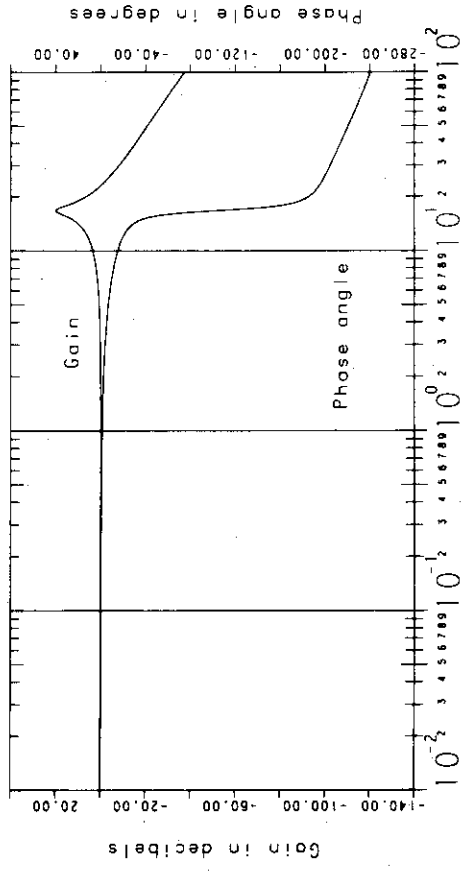

Fig. 1.1.18 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.025), P(398.1).

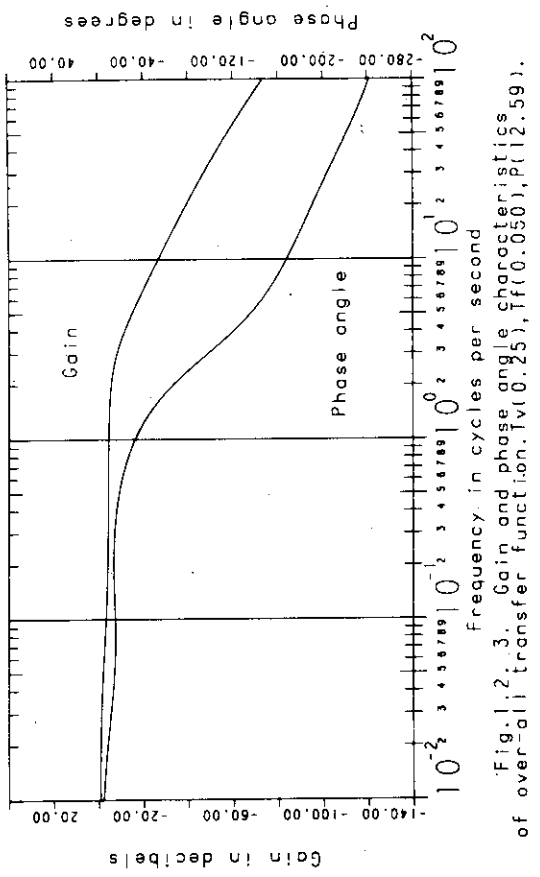

Fig.1.2.3. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(12.59).

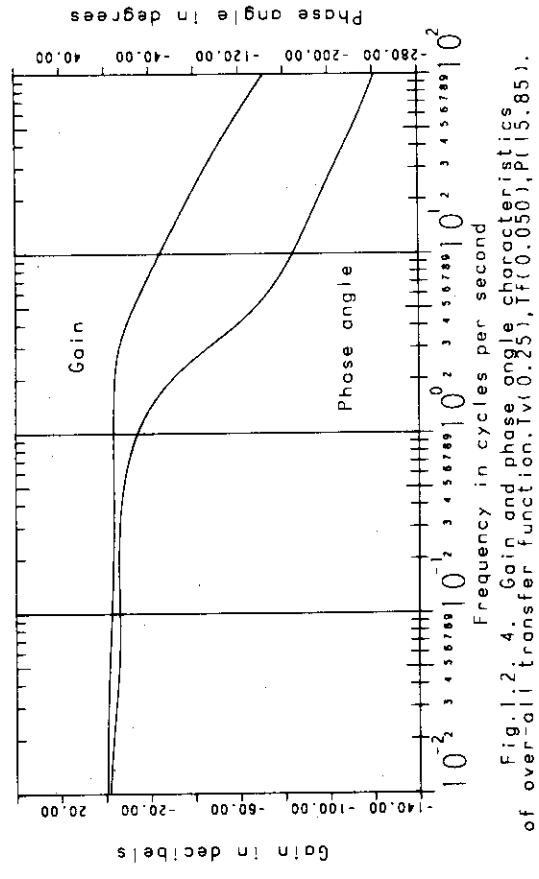

Fig.1.2.4. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(15.85).

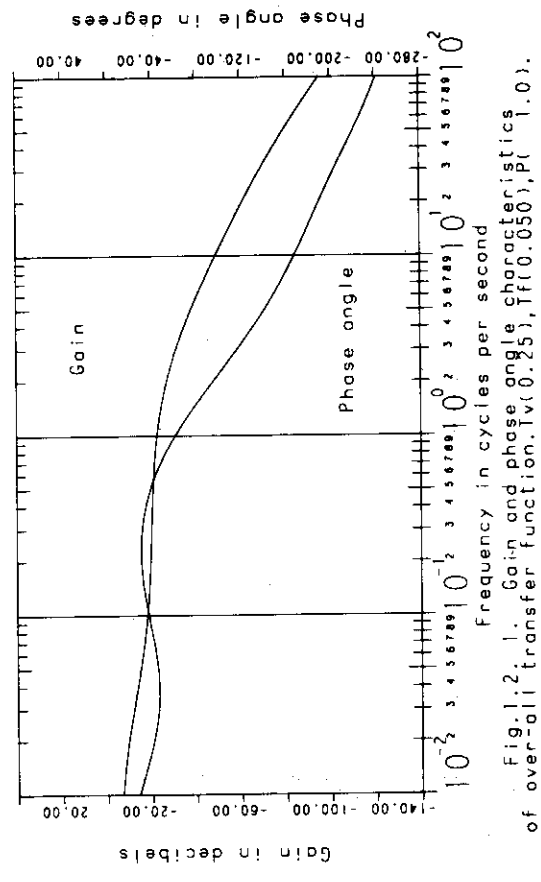

Fig.1.2.1. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(1.0).

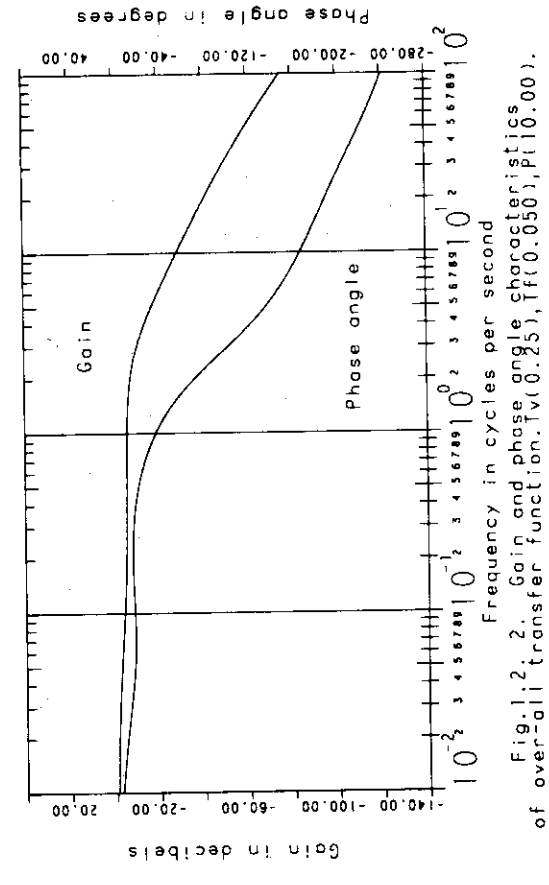

Fig.1.2.2. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(10.00).

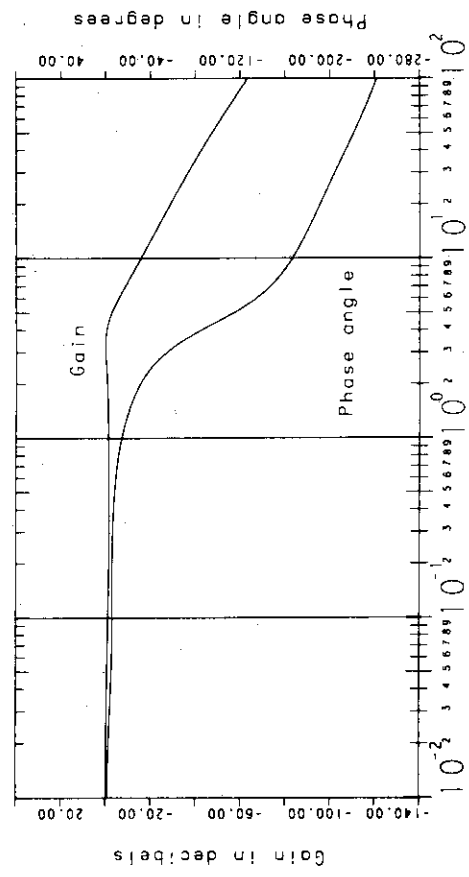

Fig. 1.2. 8. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(39.81).

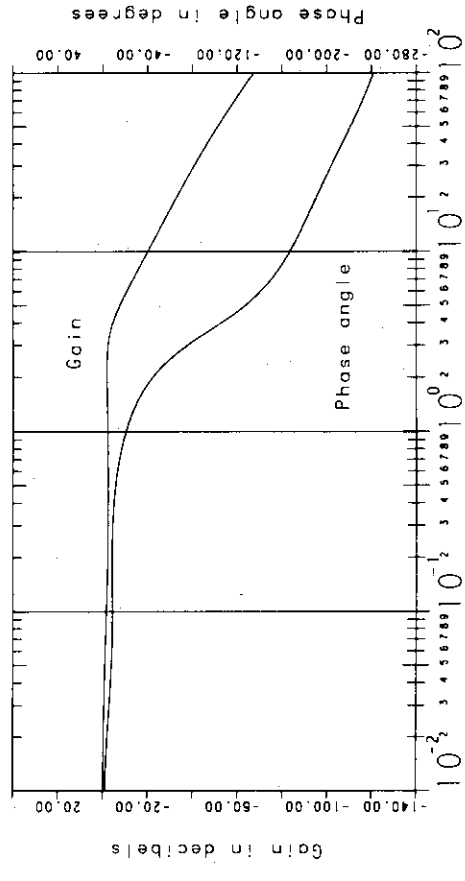

Fig. 1.2. 6. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(25.12).

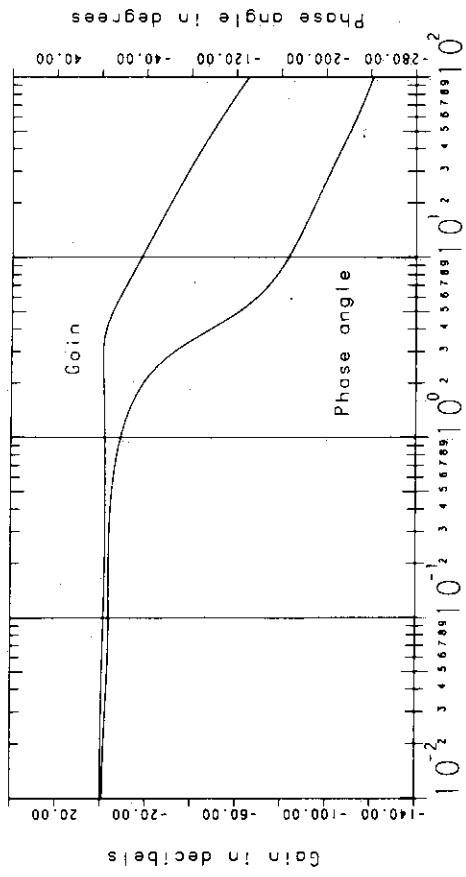

Fig. 1.2. 7. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(31.62).

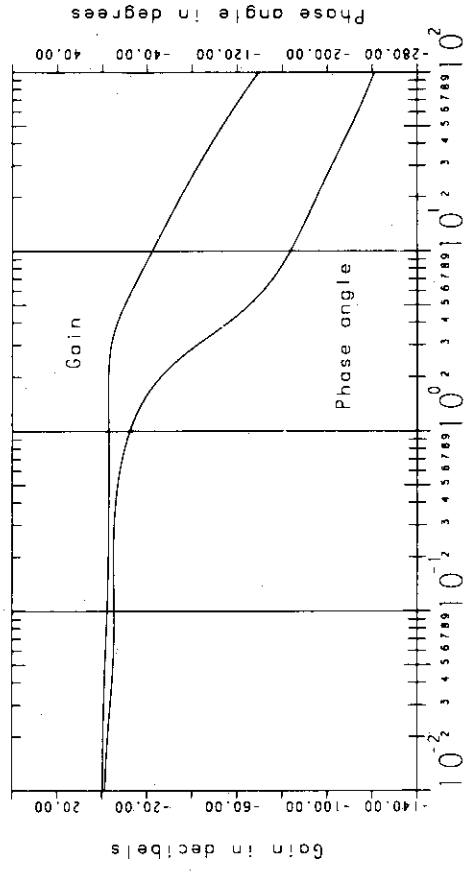

Fig. 1.2. 5. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(19.95).

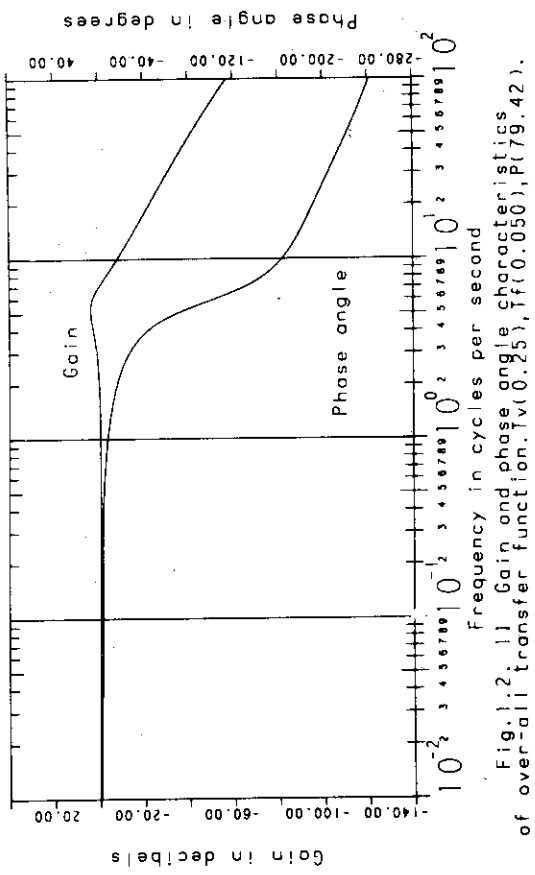

Fig. 1.2. 11 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.050), P(79.42).

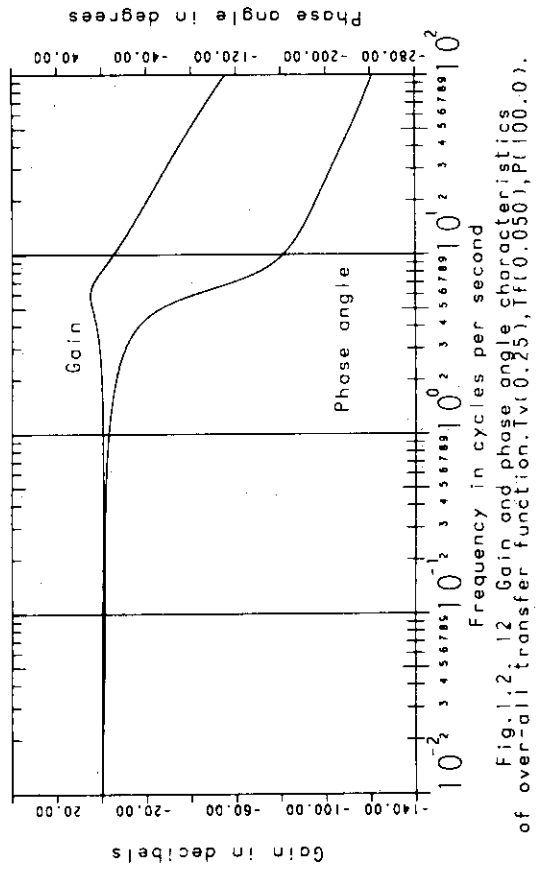

Fig. 1.2. 12 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.050), P(100.0).

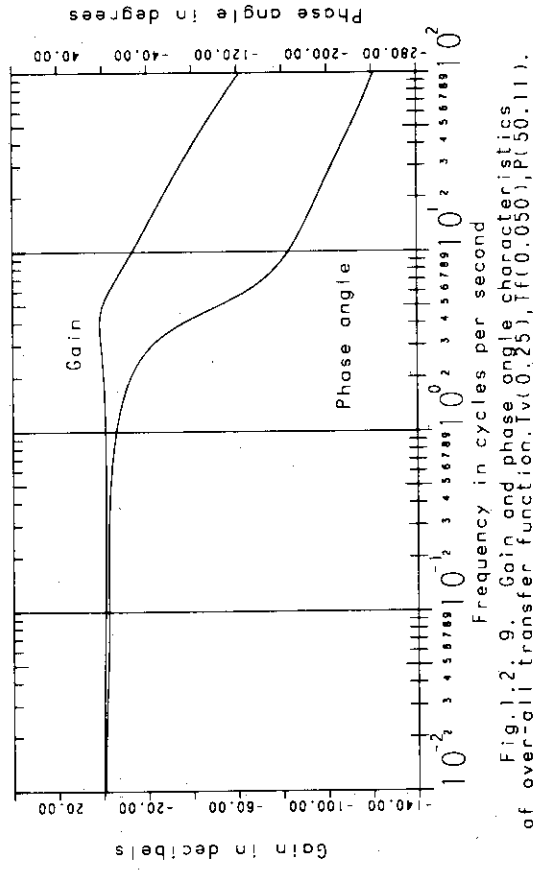

Fig. 1.2. 9. Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.050), P(50.11).

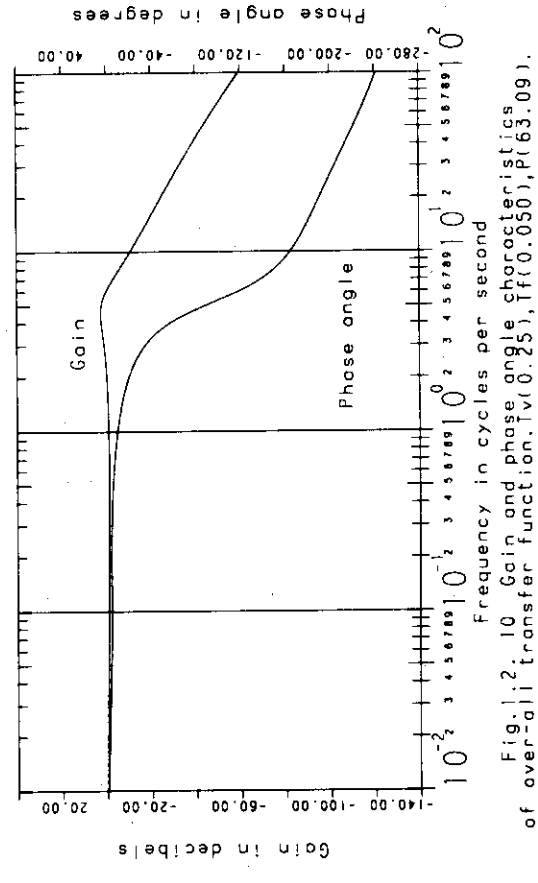

Fig. 1.2. 10 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.050), P(63.09).

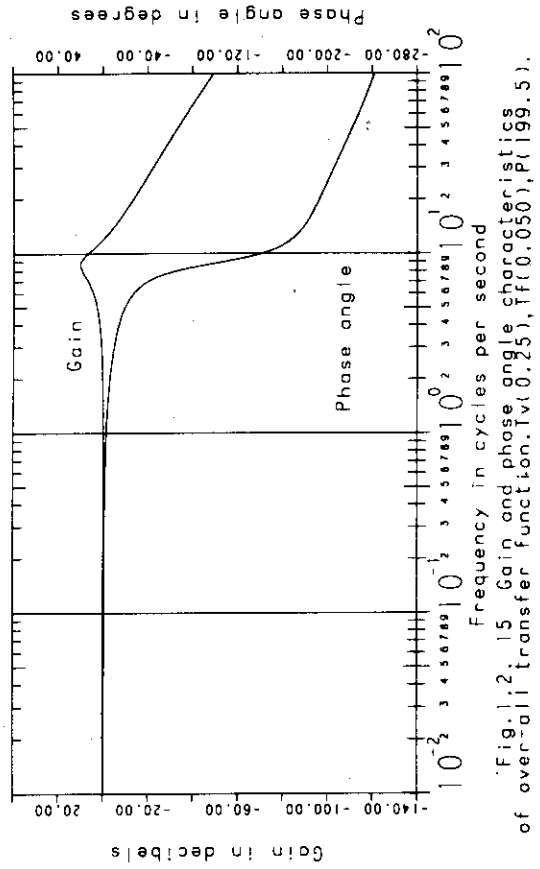

Fig.1.2.15 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(199.5).

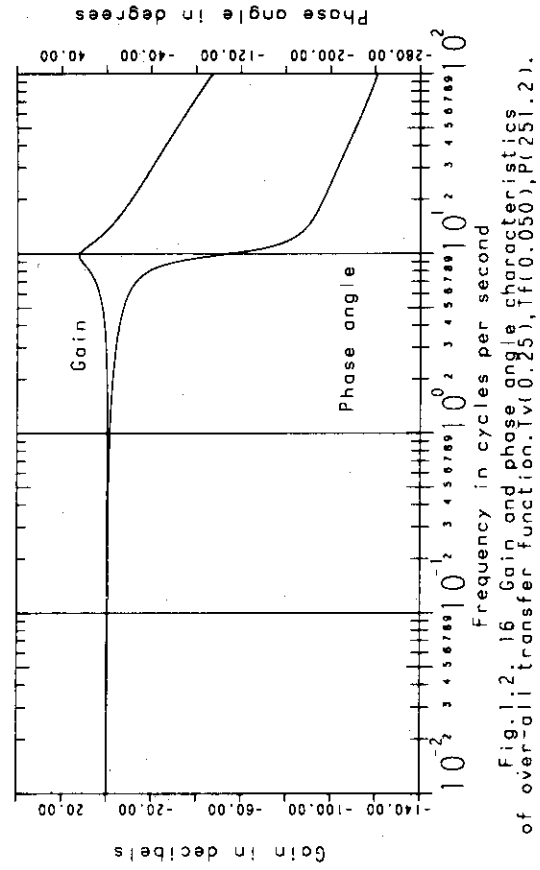

Fig.1.2.16 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(251.2).

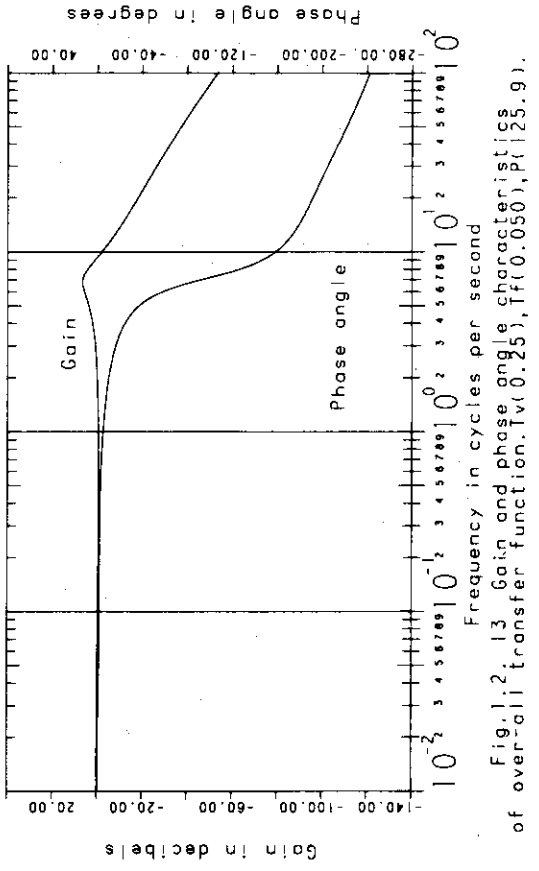

Fig.1.2.13 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(125.9).

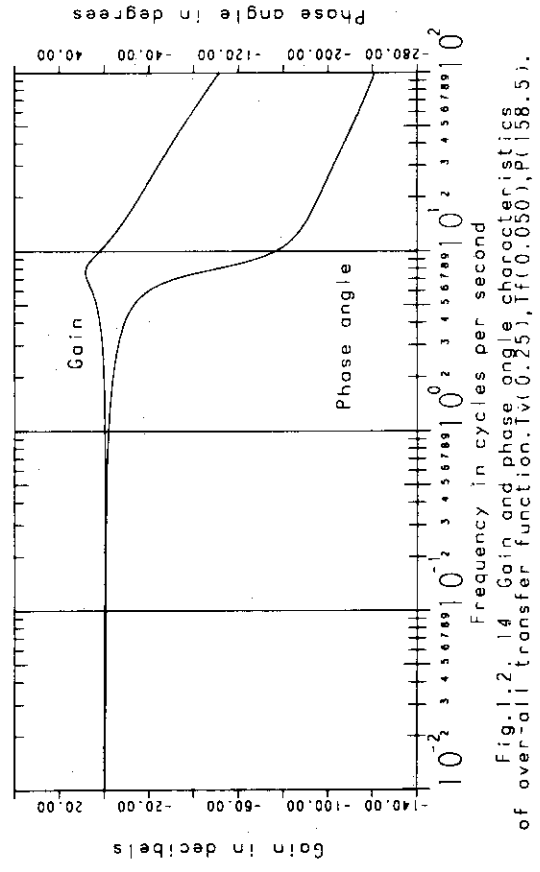

Fig.1.2.14 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(158.5).

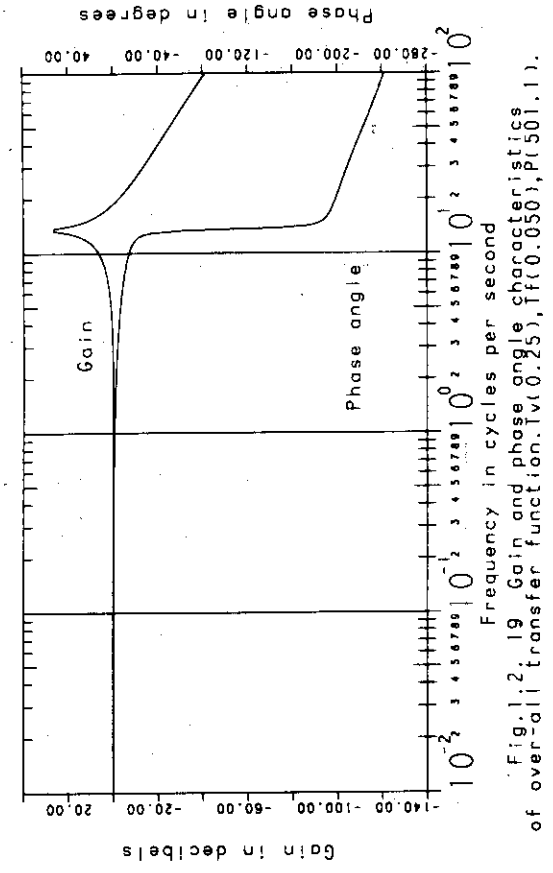

Fig.1.2.19 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(501.1).

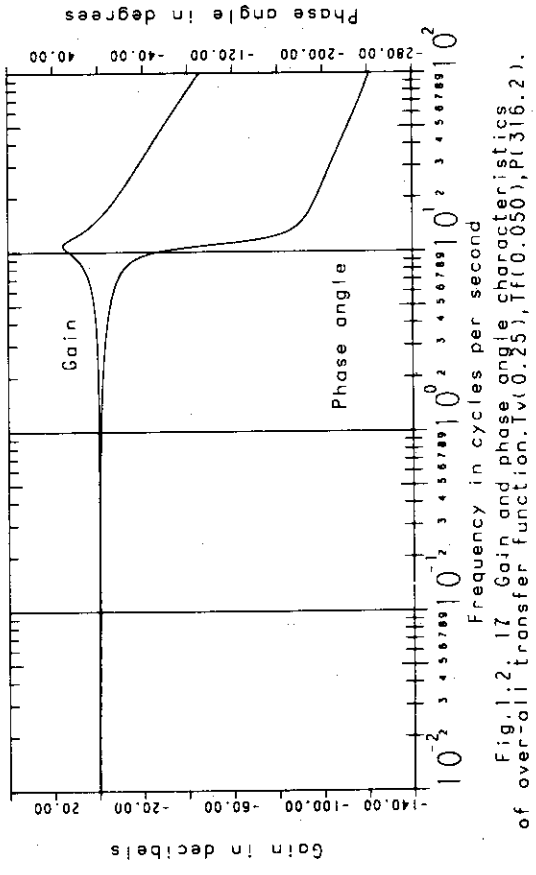

Fig.1.2.17 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(316.2).

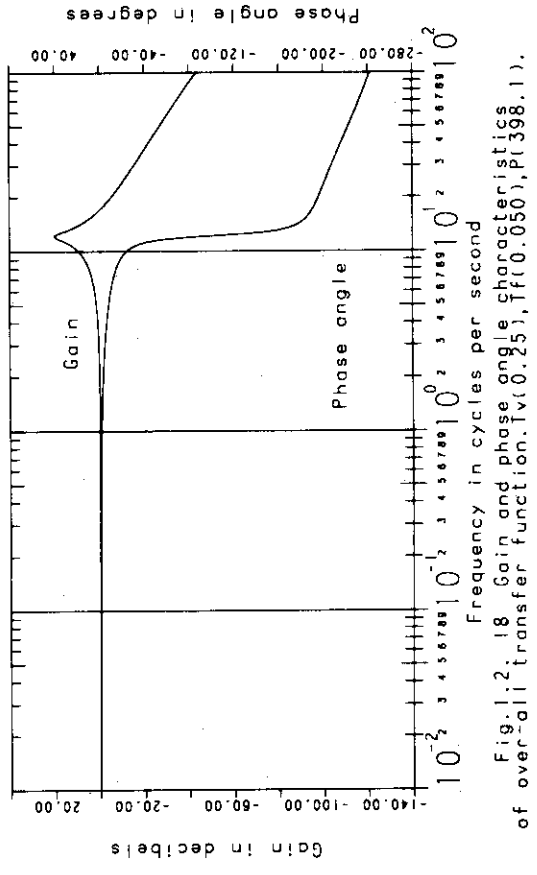

Fig.1.2.18 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.050),P(398.1).

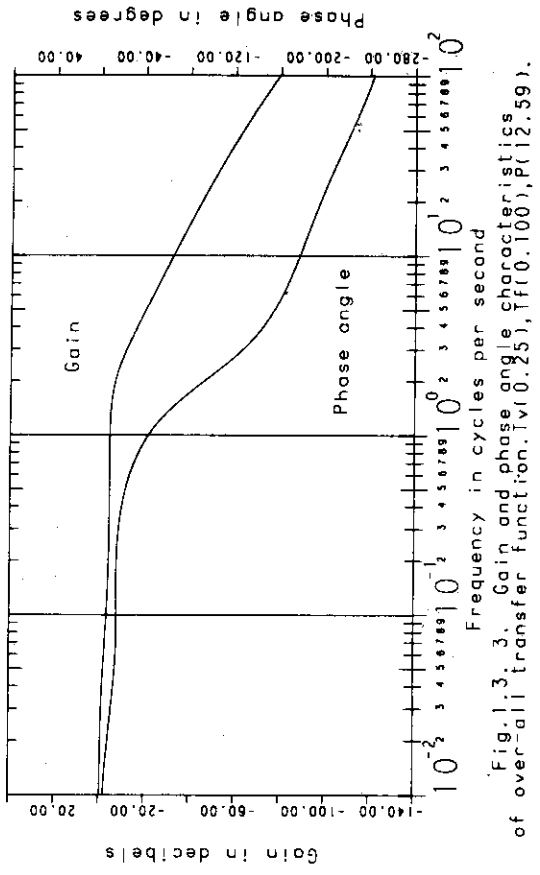

Fig.1.3. 1. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(1.0).

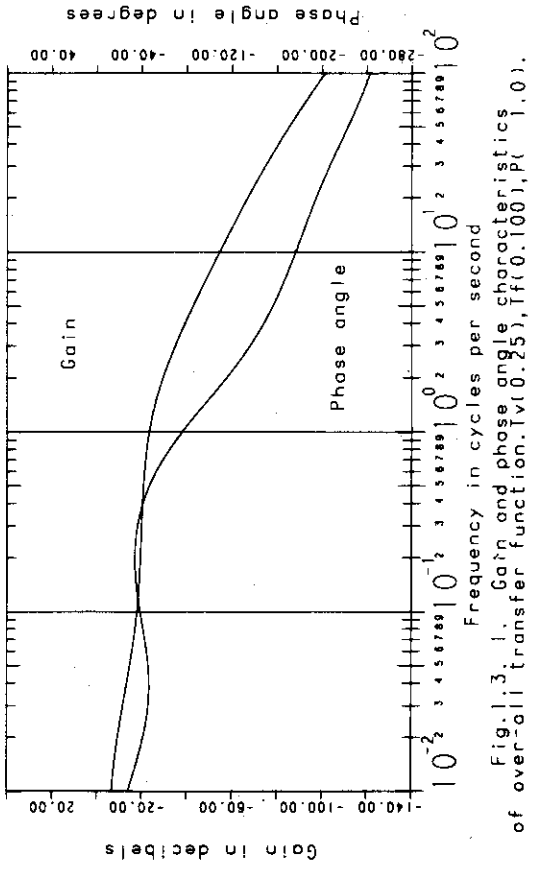

Fig.1.3. 2. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(10.00).

Fig.1.3. 3. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(12.59).

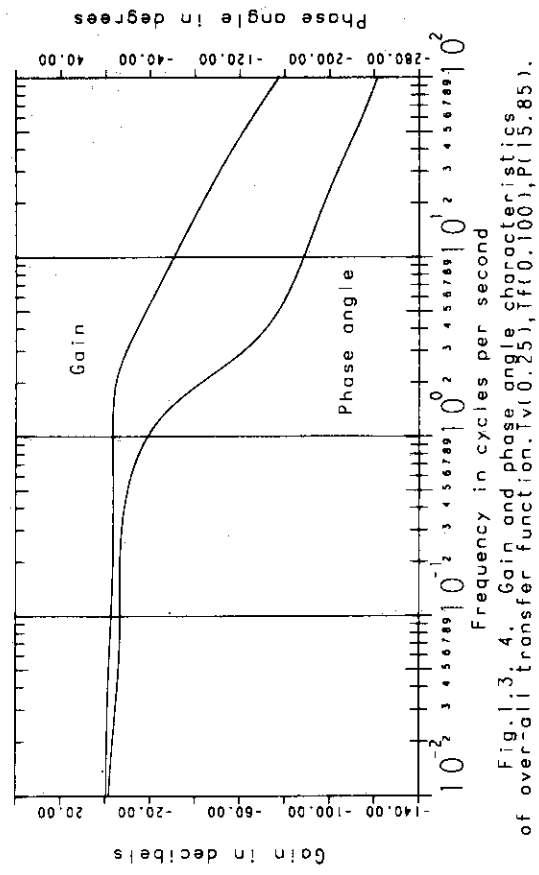

Fig.1.3. 4. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(15.85).

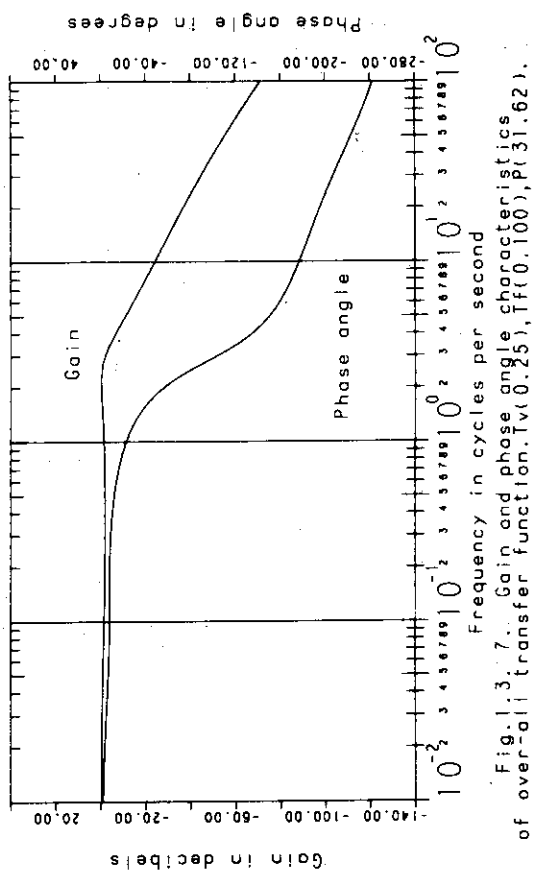

Fig.I.3.7. Gain and phase angle characteristics of over-all transfer function.Tv(0.251),Tf(0.100),P(31.62).

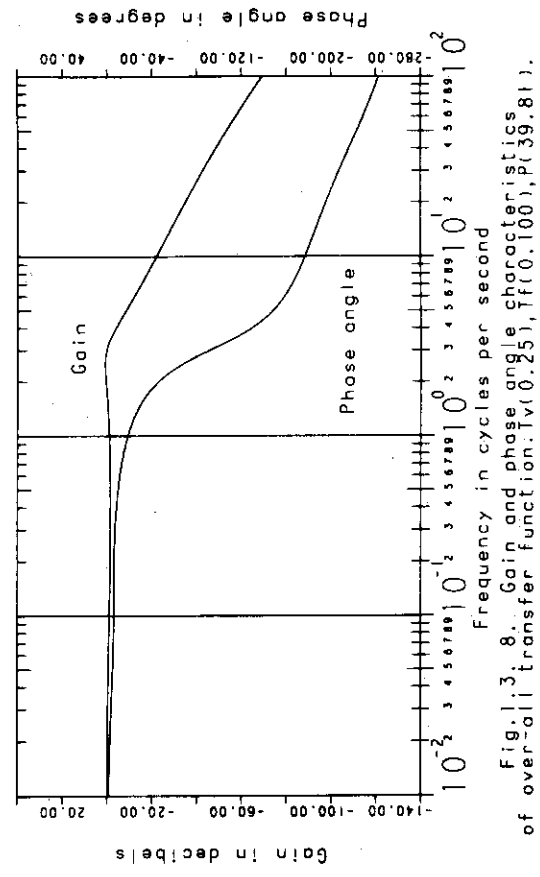

Fig.I.3.8. Gain and phase angle characteristics of over-all transfer function.Tv(0.251),Tf(0.100),P(39.81).

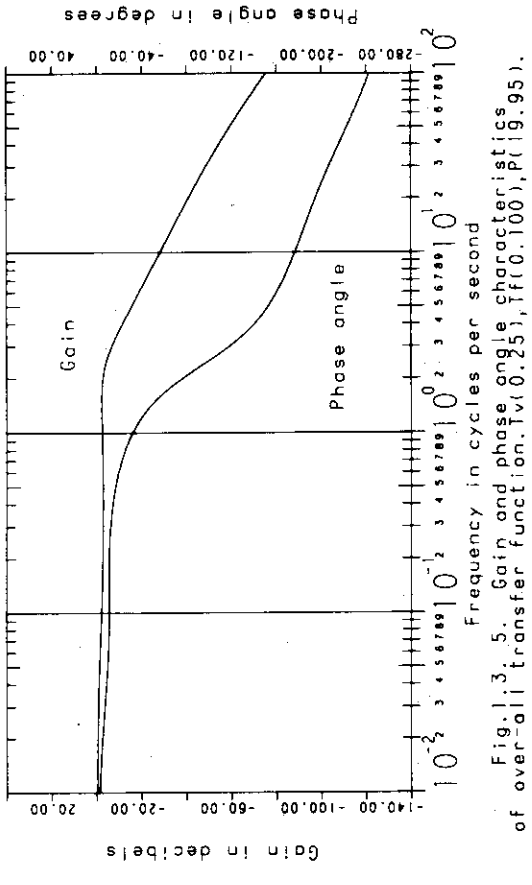

Fig.I.3.5. Gain and phase angle characteristics of over-all transfer function.Tv(0.251),Tf(0.100),P(19.95).

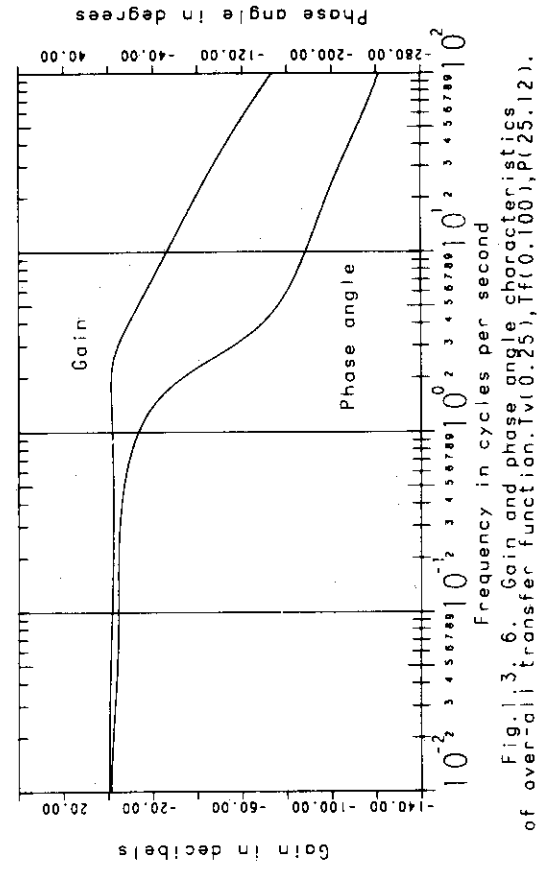

Fig.I.3.6. Gain and phase angle characteristics of over-all transfer function.Tv(0.251),Tf(0.100),P(25.12).

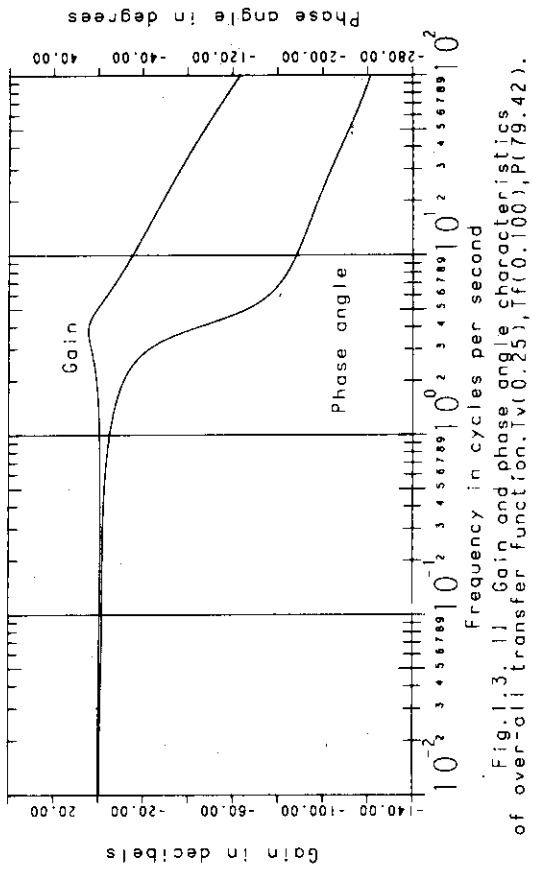

Fig.1.3. 11 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(79.42).

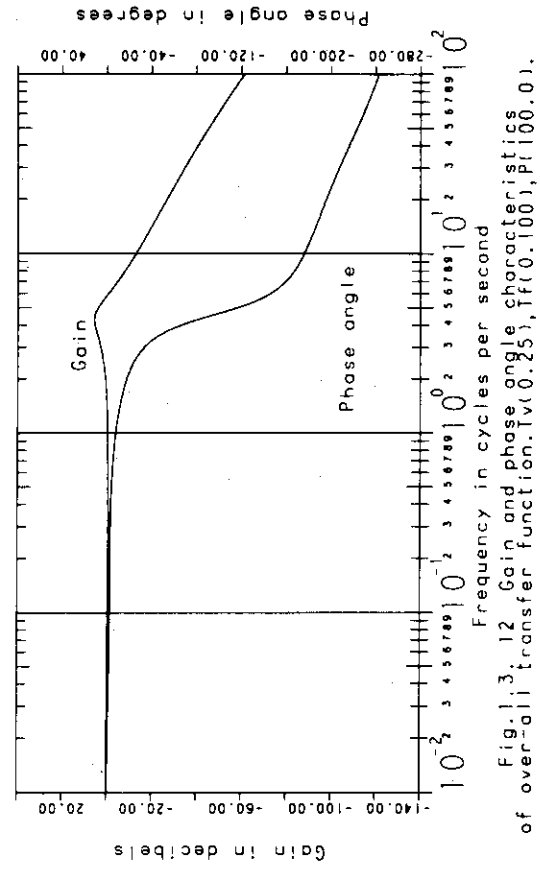

Fig.1.3. 12 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(100.0).

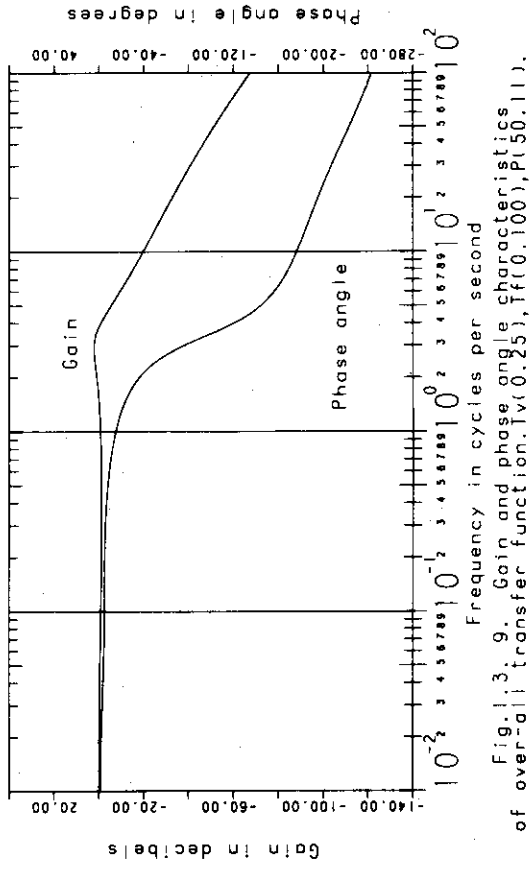

Fig.1.3. 9. Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(50.11).

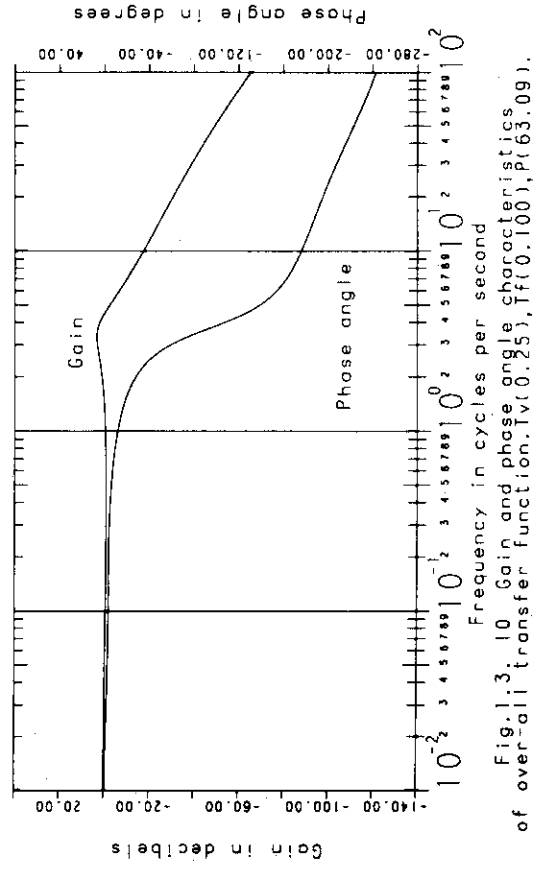

Fig.1.3. 10 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(63.09).

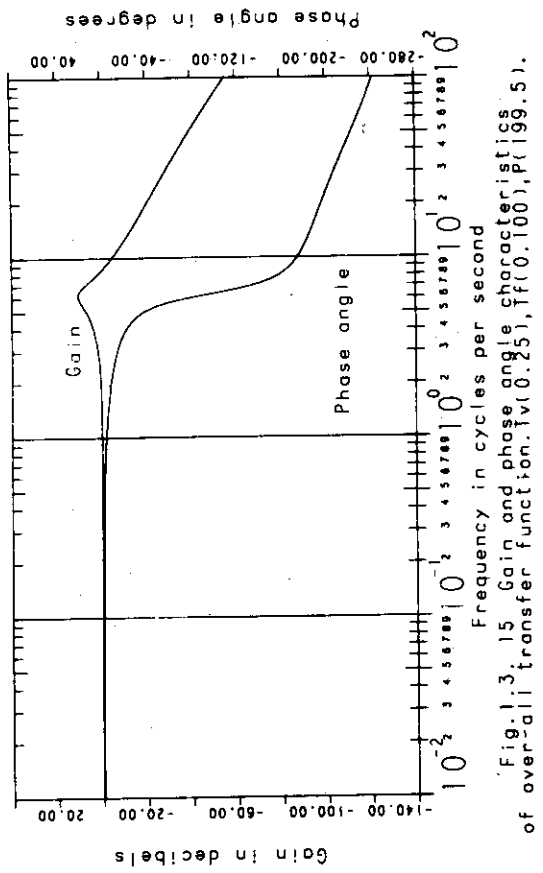

Fig. 1.3.15 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.100), P(199.5).

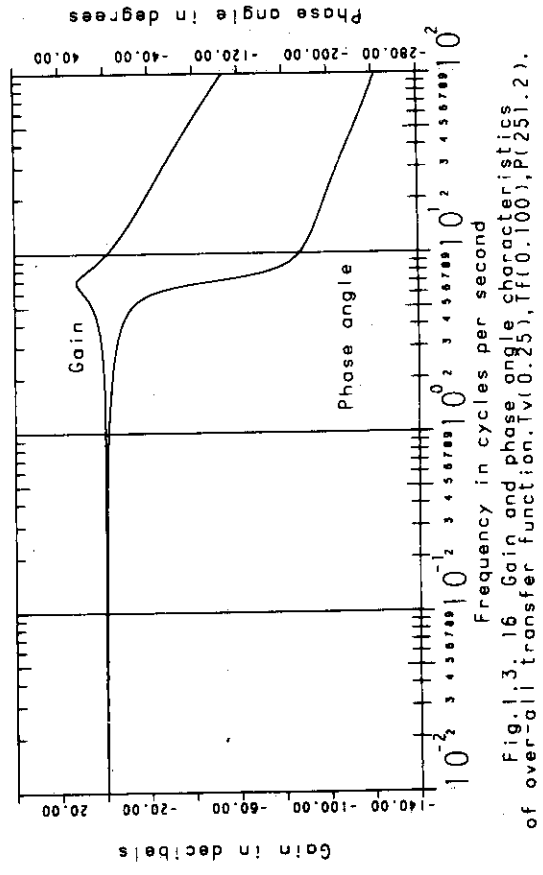

Fig. 1.3.16 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.100), P(251.2).

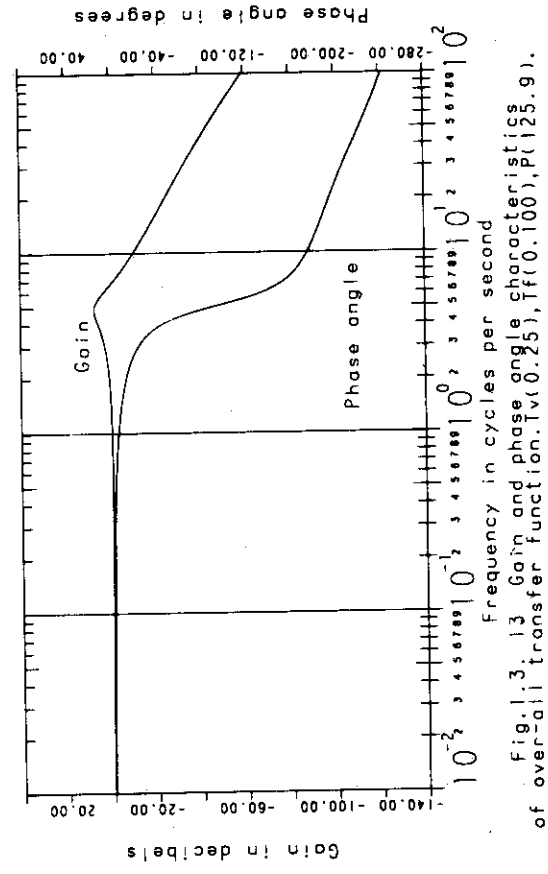

Fig. 1.3.13 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.100), P(125.9).

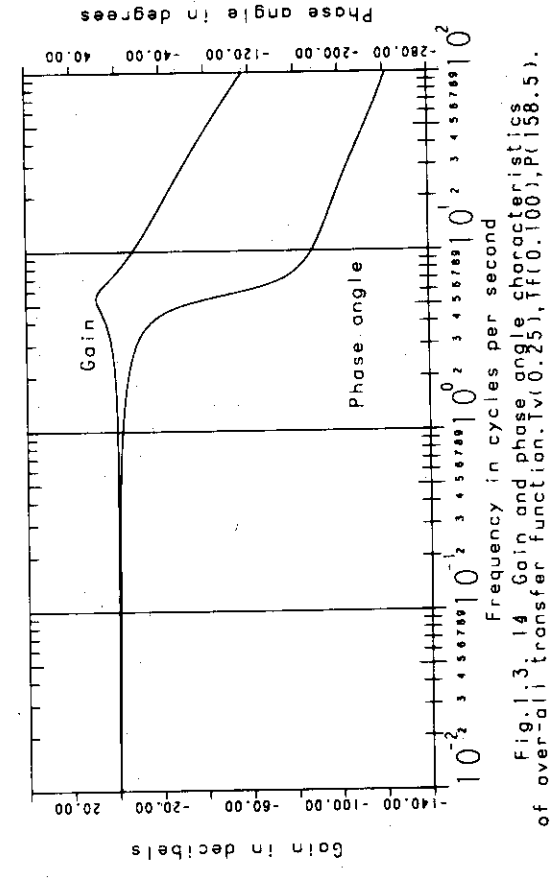

Fig. 1.3.14 Gain and phase angle characteristics of over-all transfer function. Tv(0.25), Tf(0.100), P(158.5).

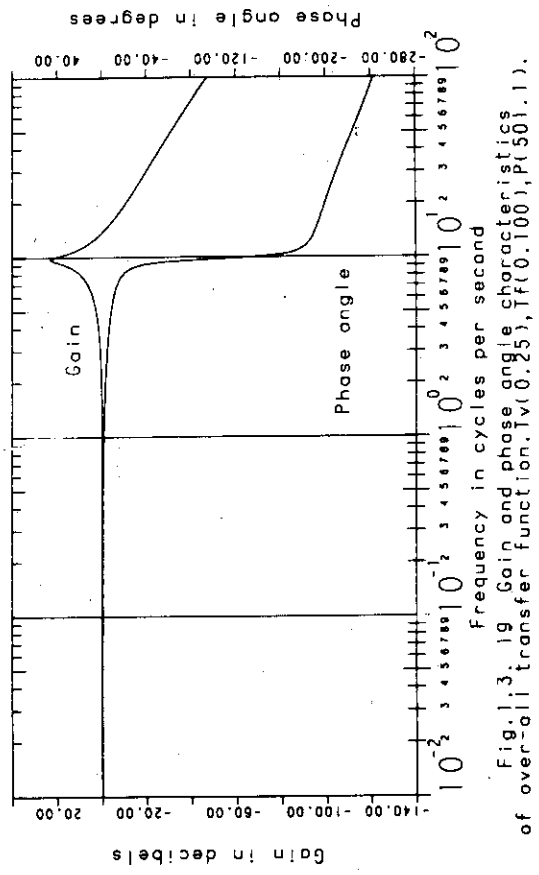

Fig.1.3.19 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(501.1).

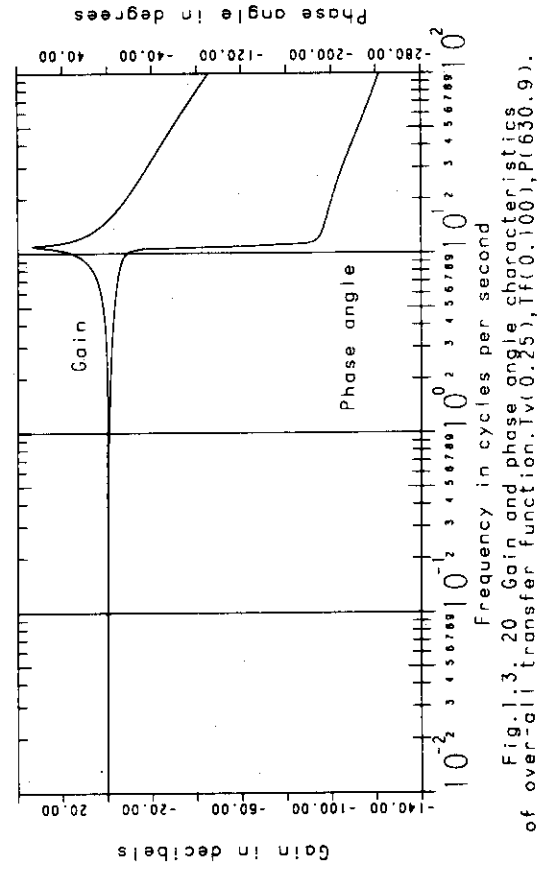

Fig.1.3.20 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(630.9).

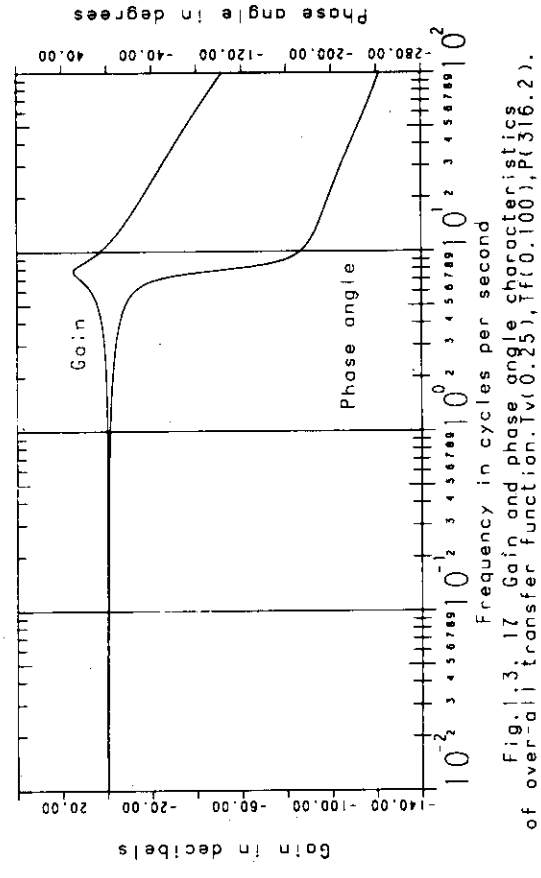

Fig.1.3.17 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(316.2).

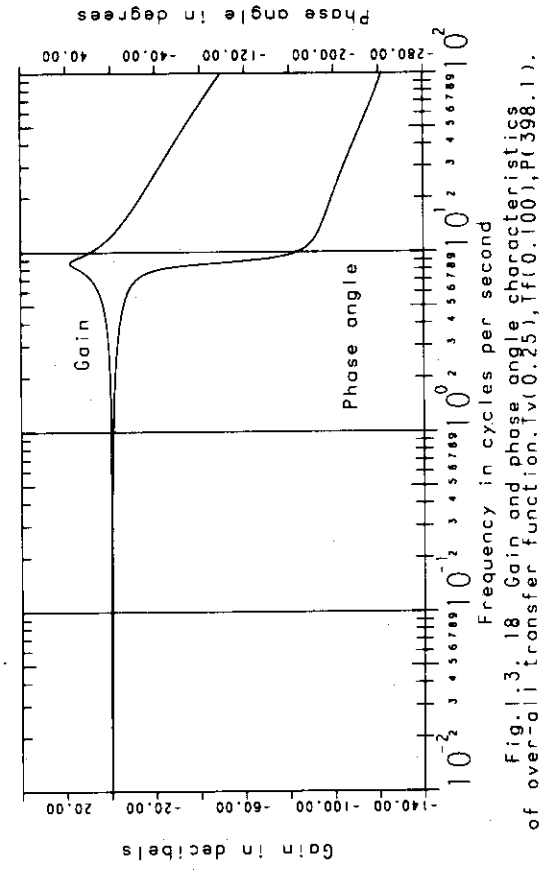

Fig.1.3.18 Gain and phase angle characteristics of over-all transfer function.Tv(0.25),Tf(0.100),P(398.1).

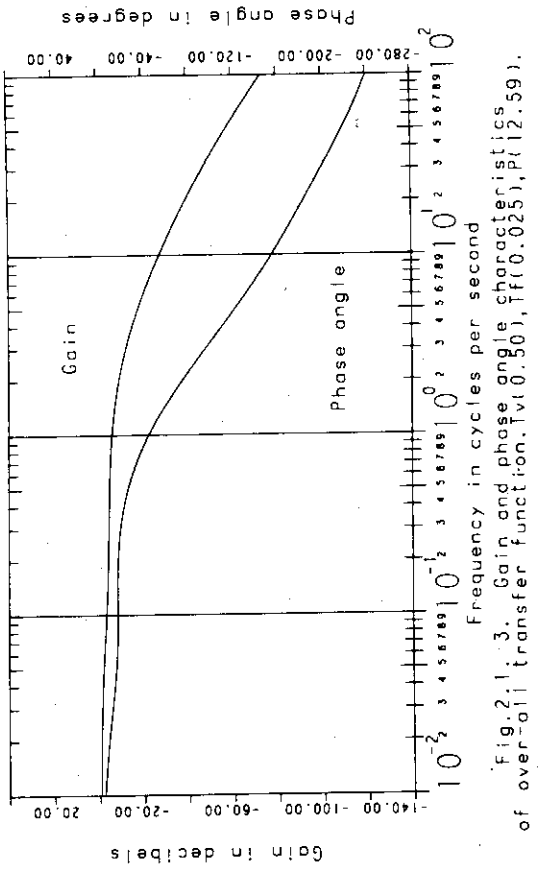

Fig.2.1. 1. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(12.59).

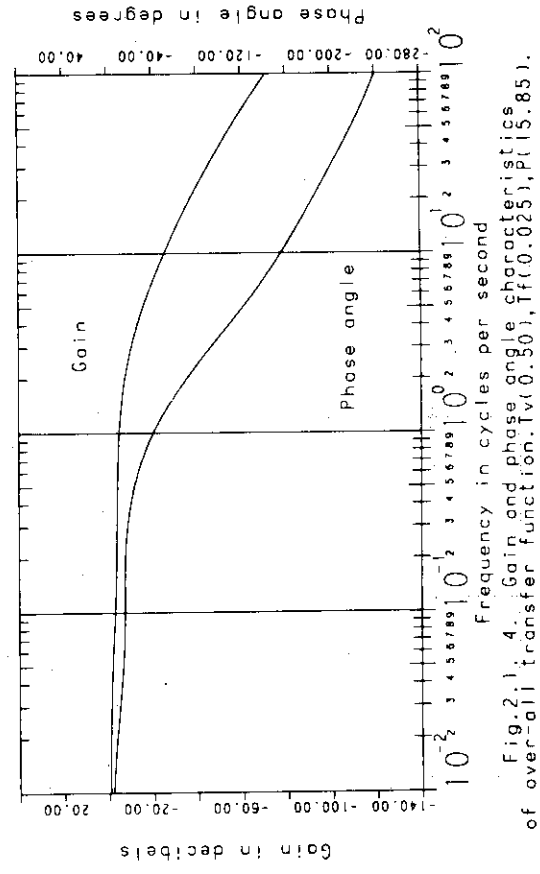

Fig.2.1. 4. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(15.85).

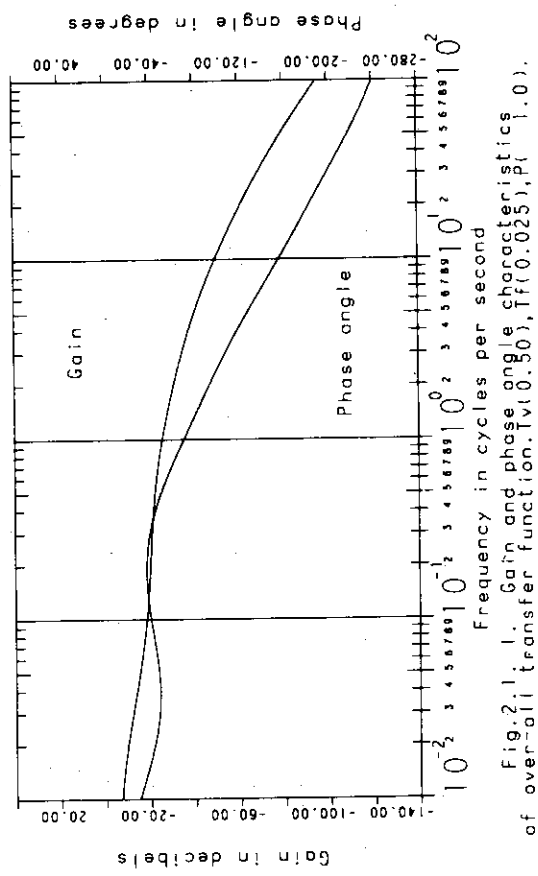

Fig.2.1. 1. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(1.0).

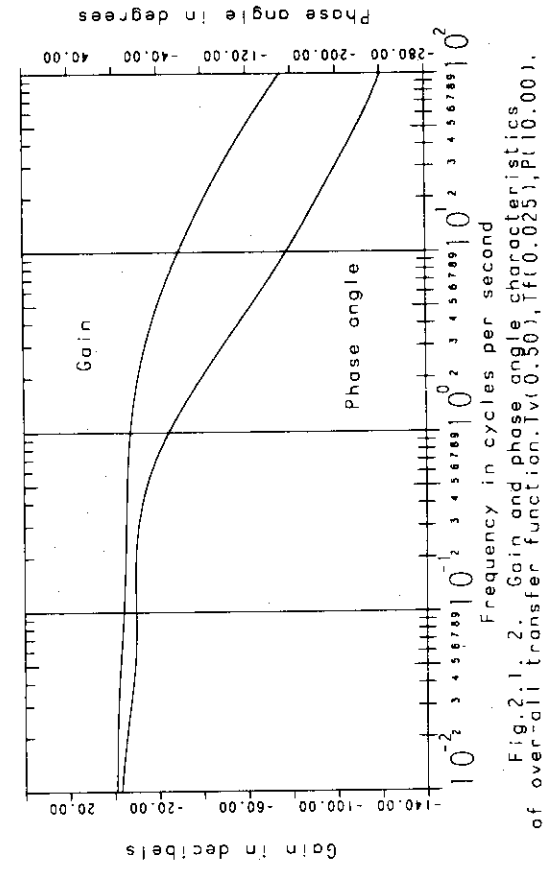

Fig.2.1. 2. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(10.00).

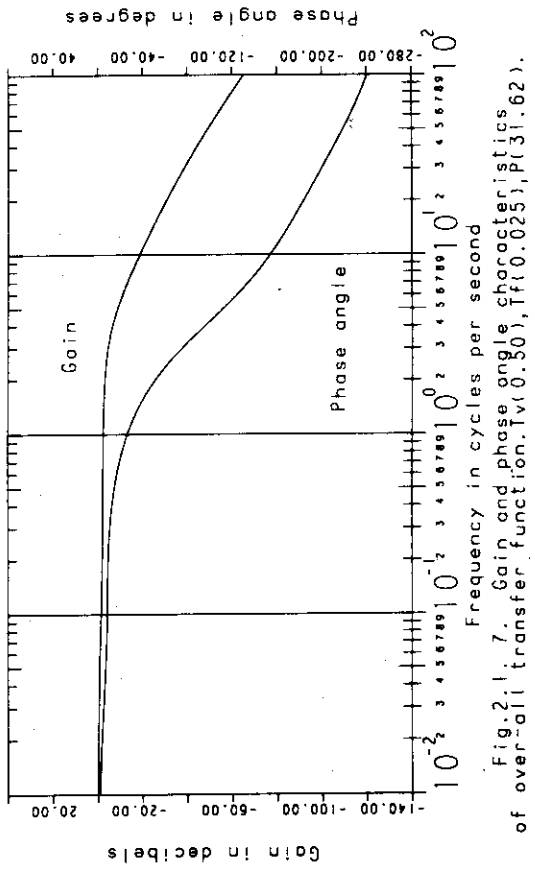

Fig.2.1．7. Gain and phase angle characteristics of over-all transfer function.Tv(0.30),Tf(0.025),P(31.62).

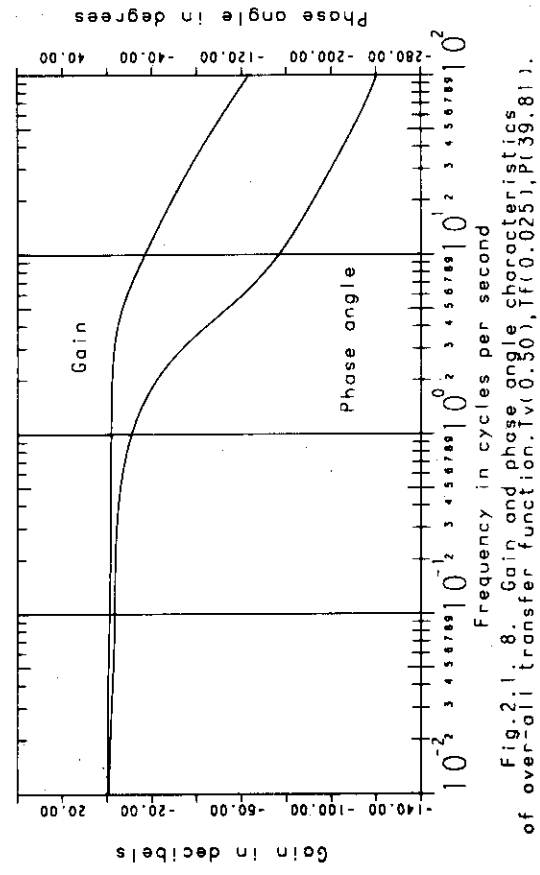

Fig.2.1．8. Gain and phase angle characteristics of over-all transfer function.Tv(0.30),Tf(0.025),P(39.81).

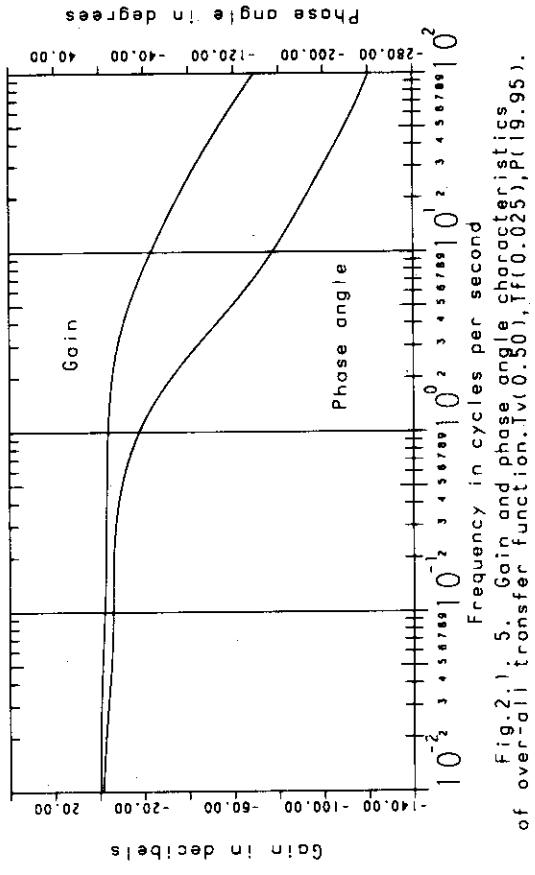

Fig.2.1．5. Gain and phase angle characteristics of over-all transfer function.Tv(0.30),Tf(0.025),P(19.95).

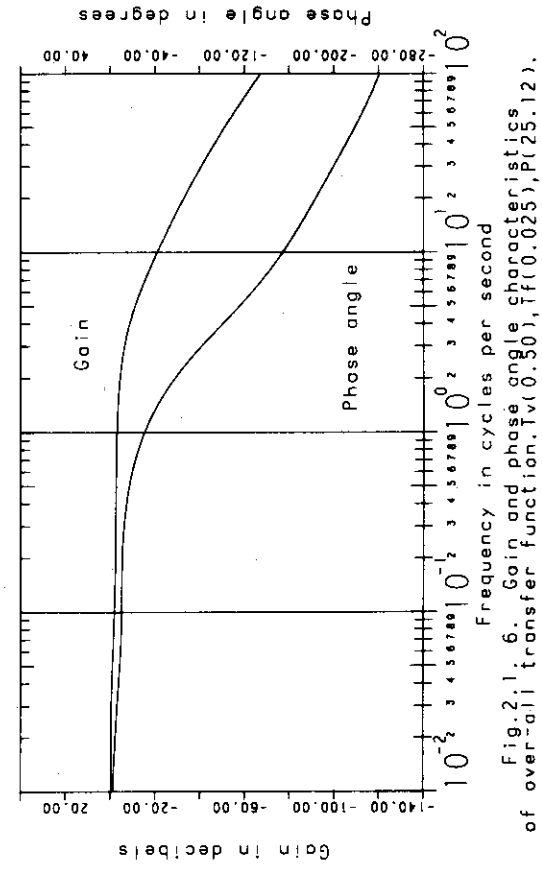

Fig.2.1．6. Gain and phase angle characteristics of over-all transfer function.Tv(0.30),Tf(0.025),P(25.12).

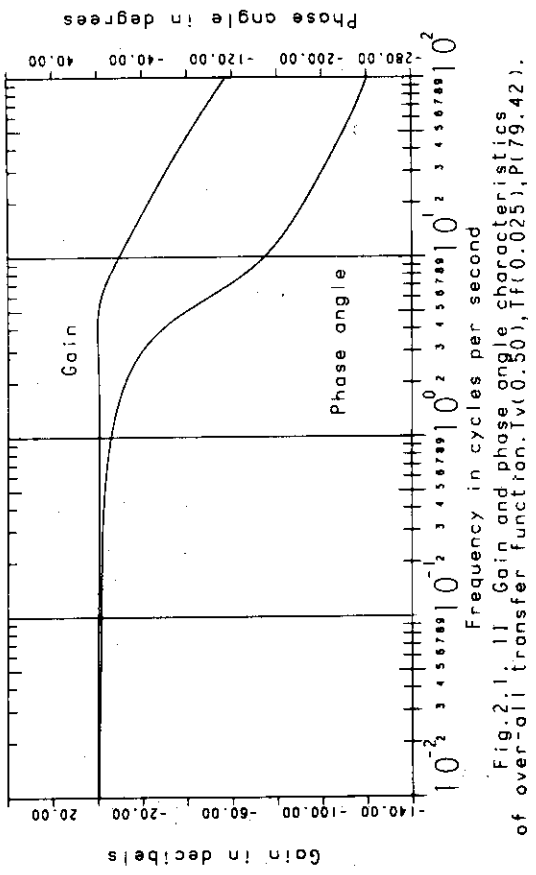

Fig.2.1－11 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(79.42).

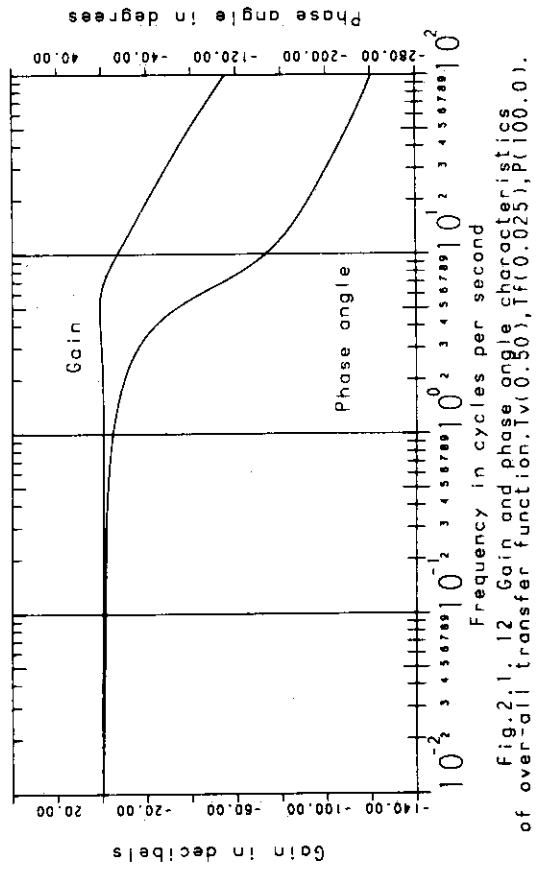

Fig.2.1－12 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(100.0).

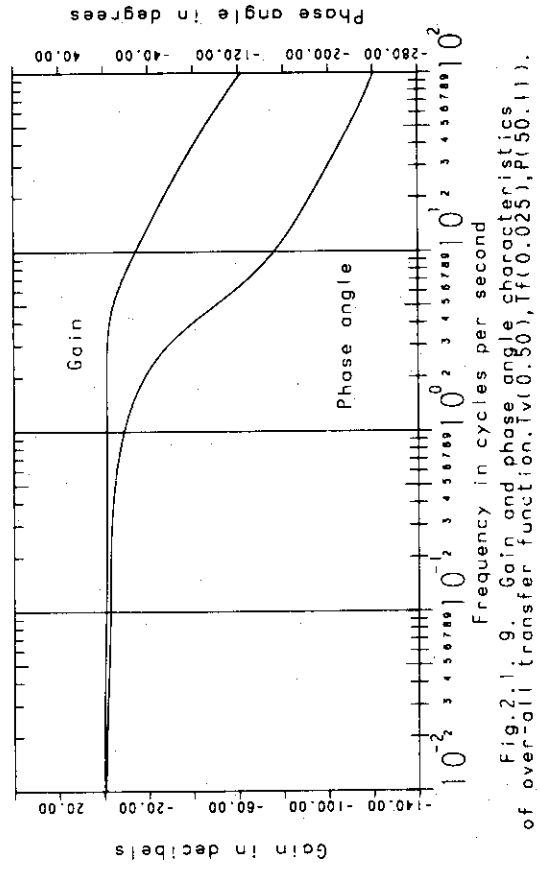

Fig.2.1－9 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(50.11).

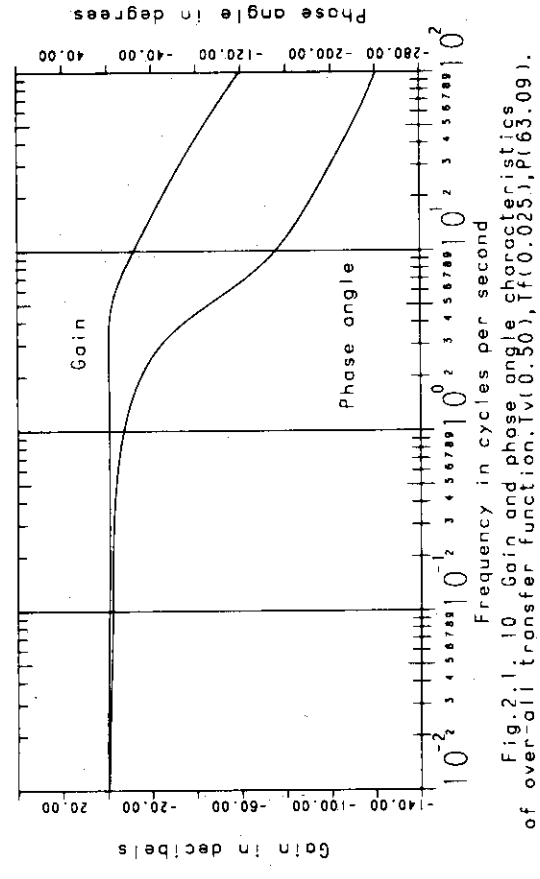

Fig.2.1－10 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(63.09).

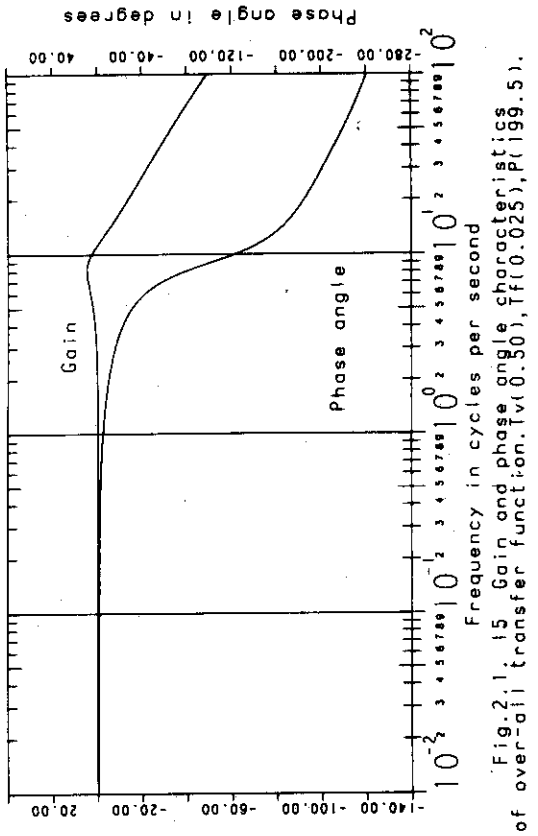

Fig.2.1.15 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.025),P(199.5).

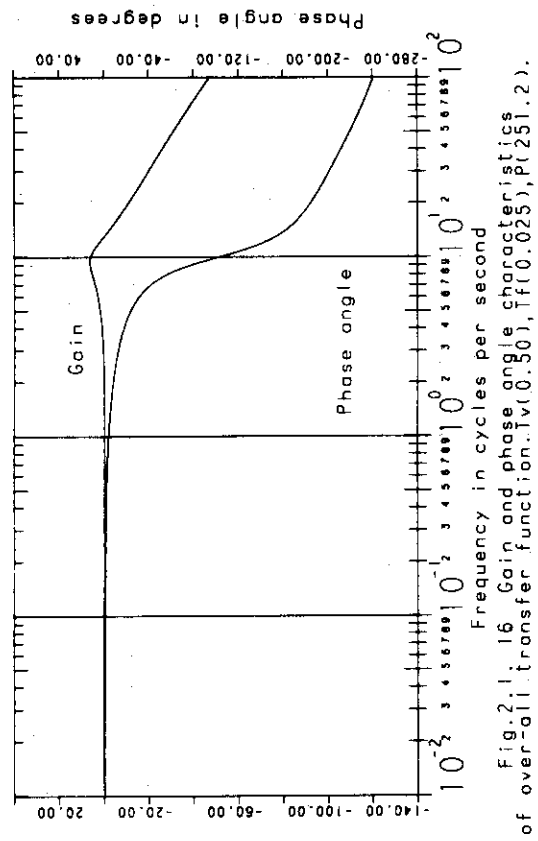

Fig.2.1.16 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.025),P(251.2).

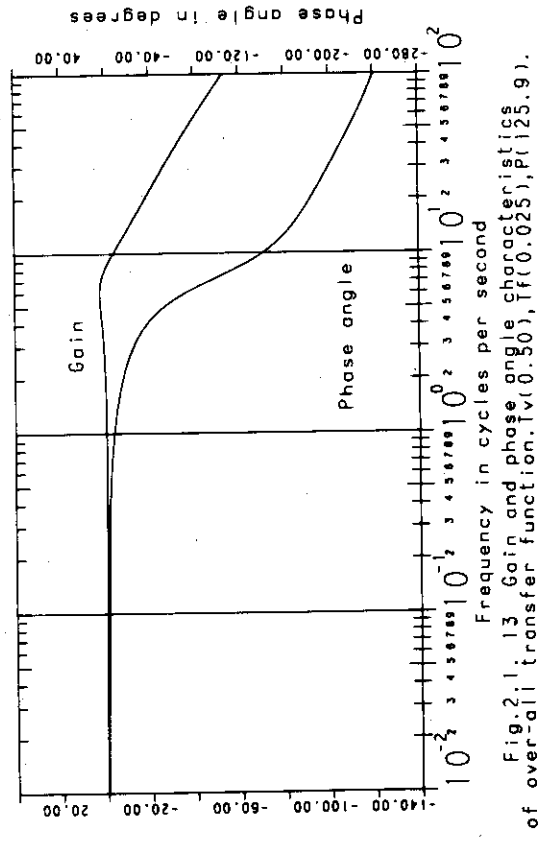

Fig.2.1.13 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.025),P(125.9).

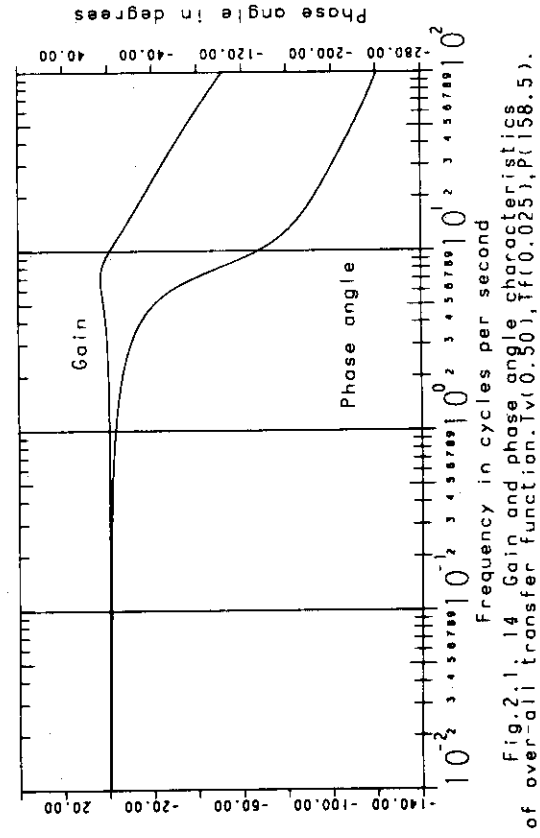

Fig.2.1.14 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.025),P(158.5).

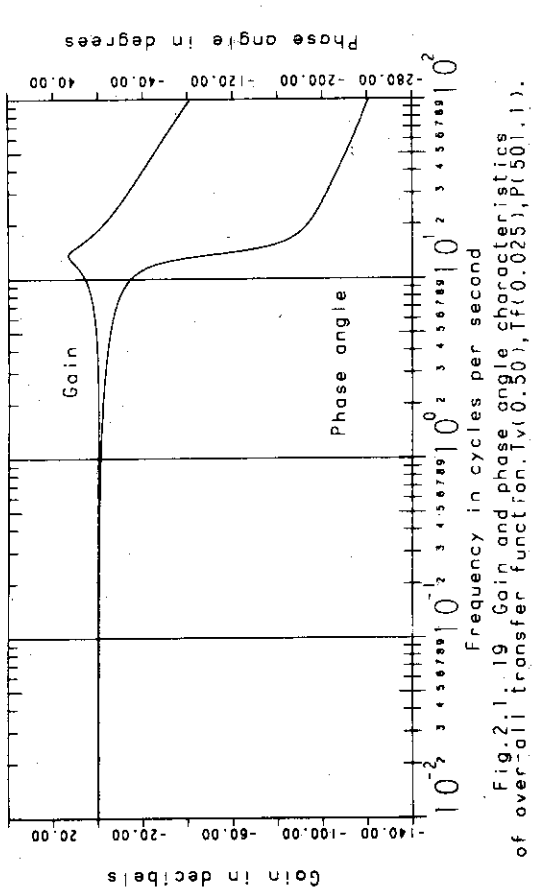

Fig.2.1.19 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(501.1).

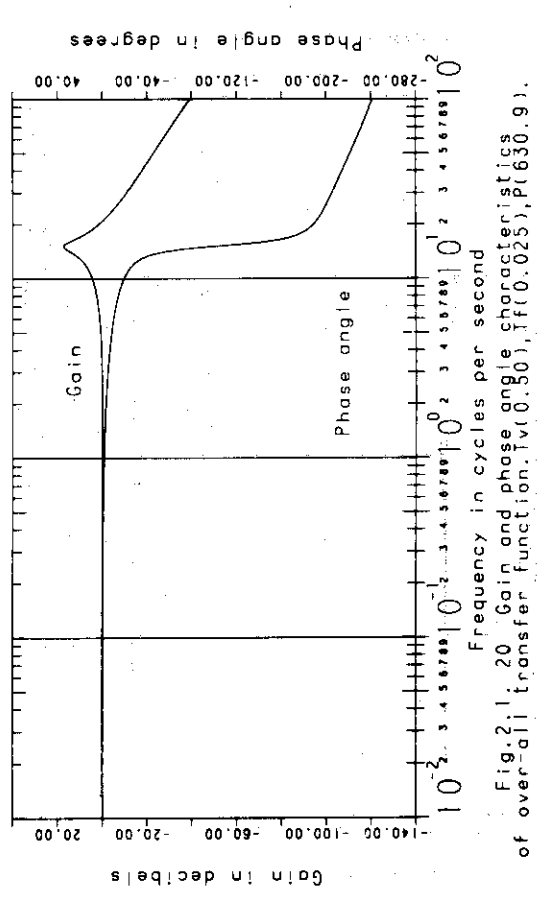

Fig.2.1.20 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(630.9).

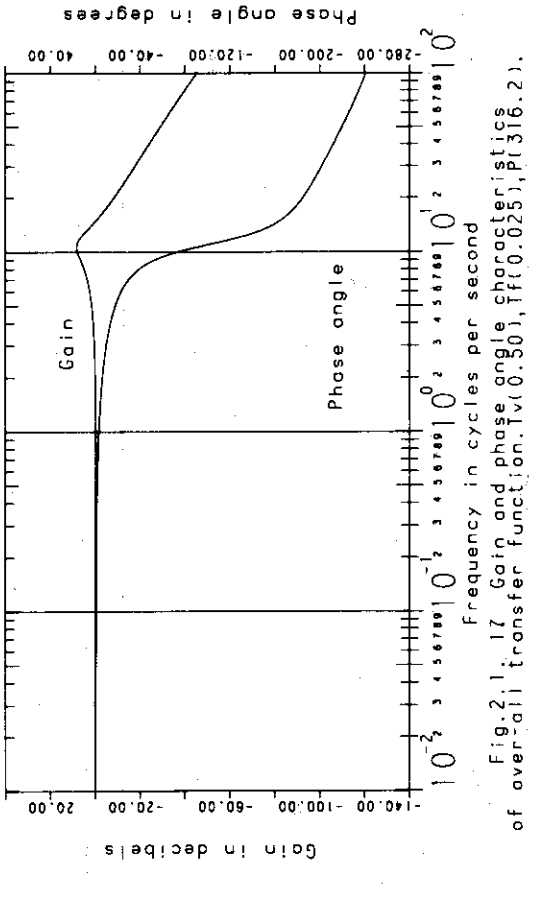

Fig.2.1.17 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(316.2).

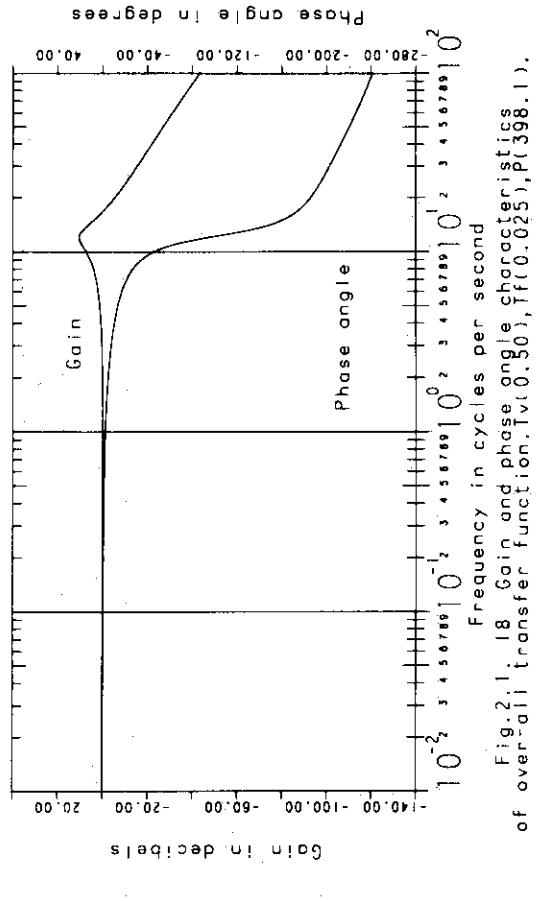

Fig.2.1.18 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(398.1).

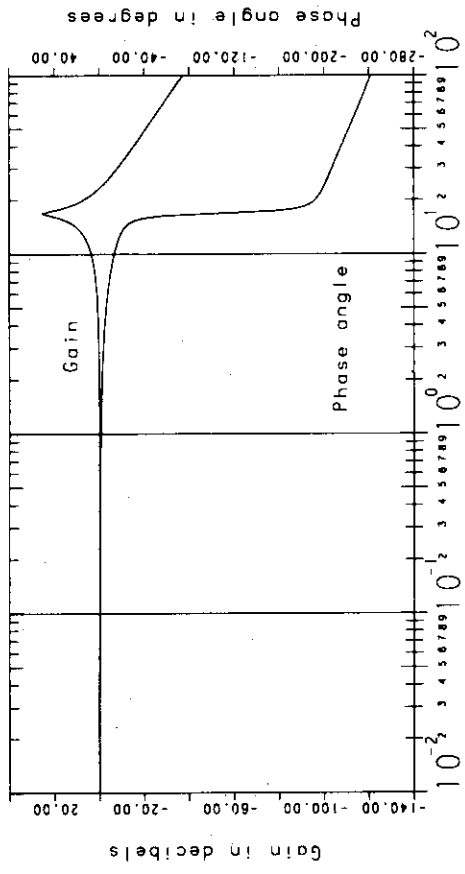

Fig.2.1.21 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.025),P(794.2).

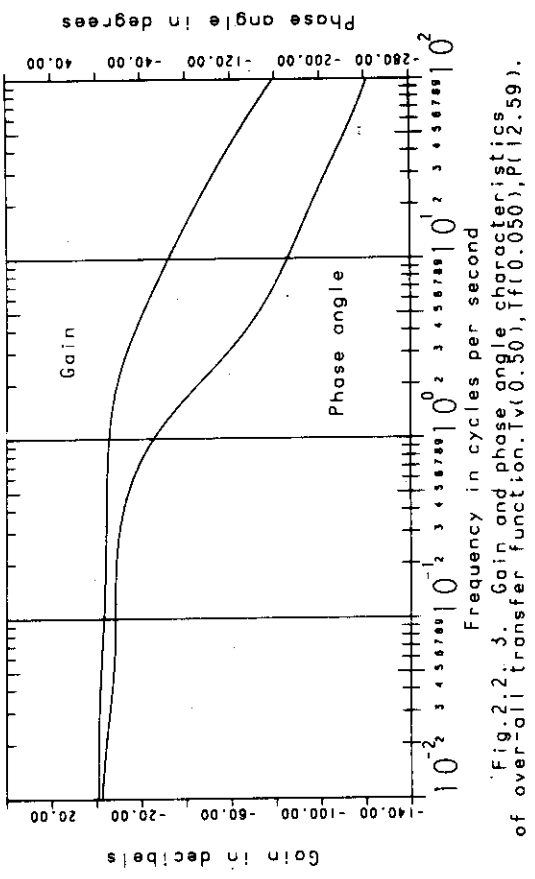

Fig.2.2.1. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),Pf(1.0).

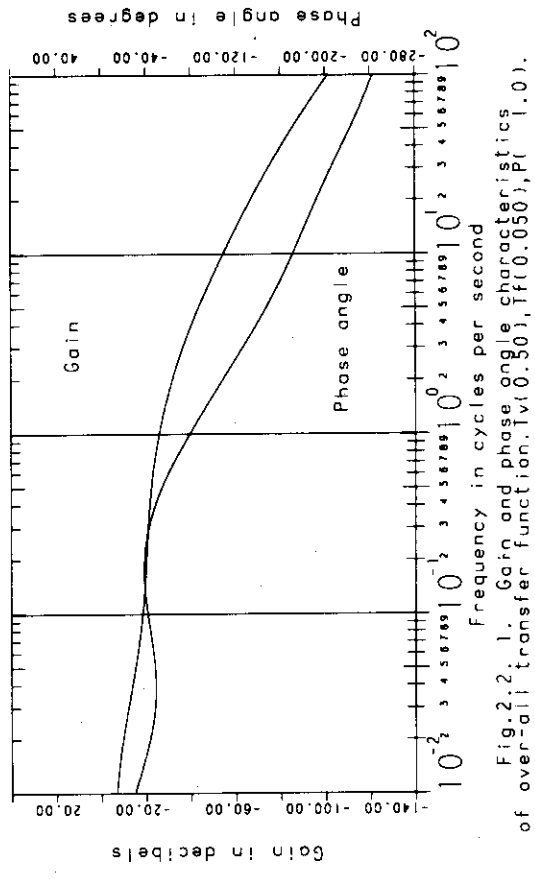

Fig.2.2.2. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),Pf(10.00).

Fig.2.2.3. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),Pf(12.59).

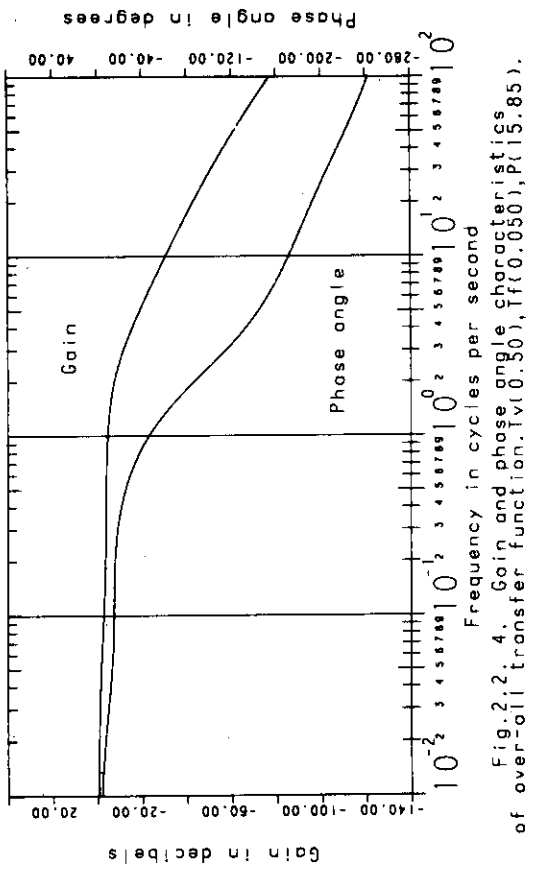

Fig.2.2.4. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),Pf(15.85).

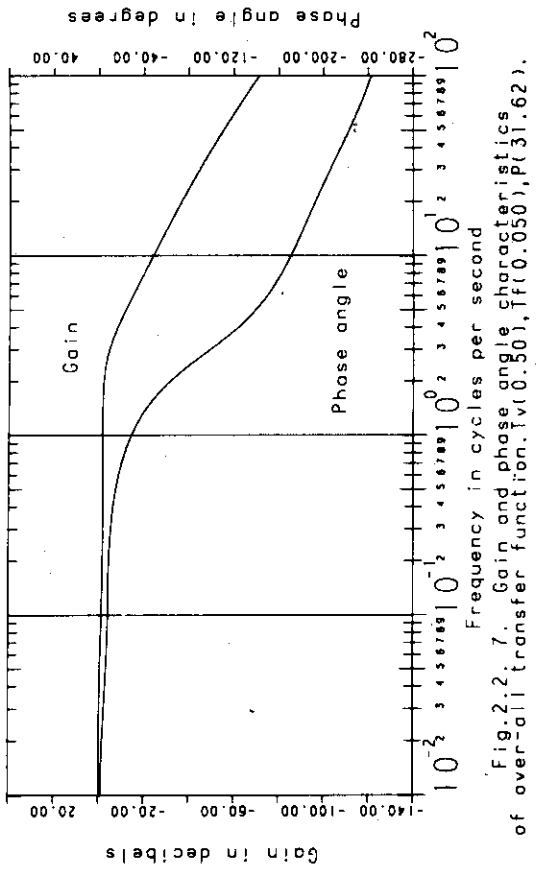

Fig.2.2; 7. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(31.62).

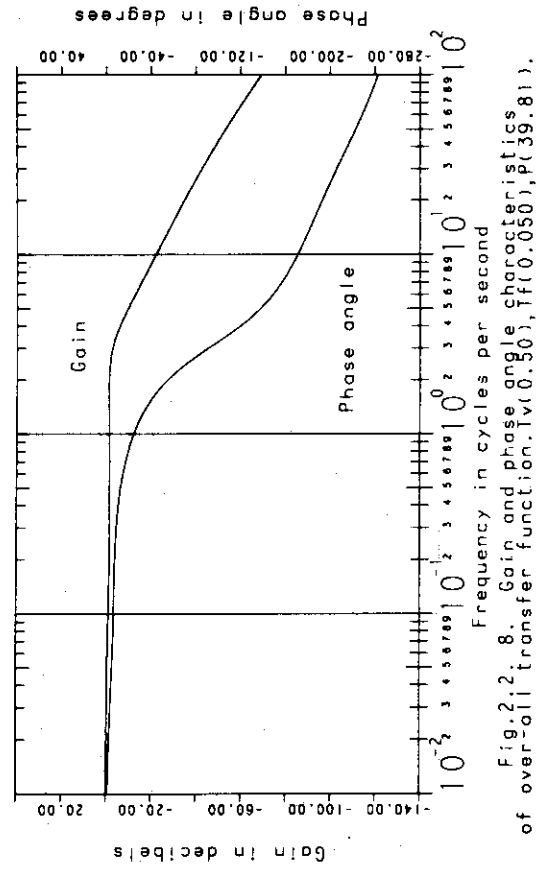

Fig.2.2; 8. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(39.81).

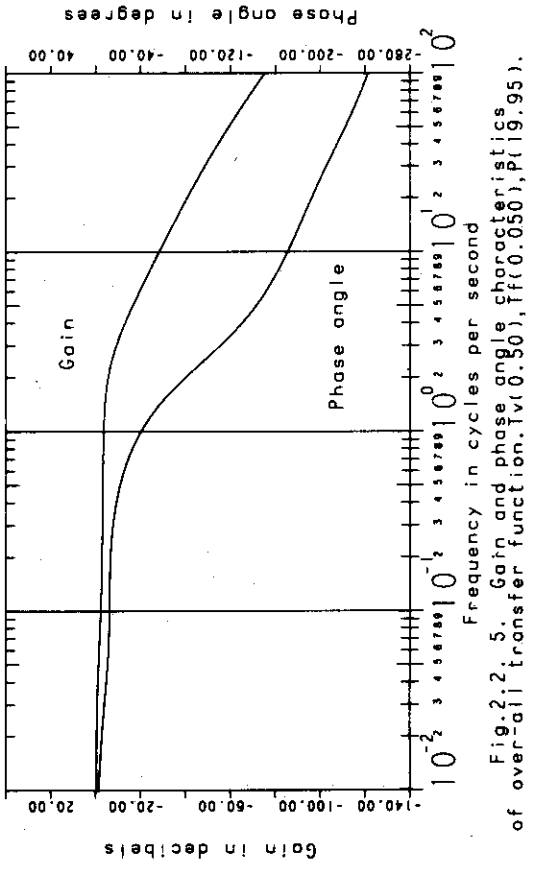

Fig.2.2; 5. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(19.95).

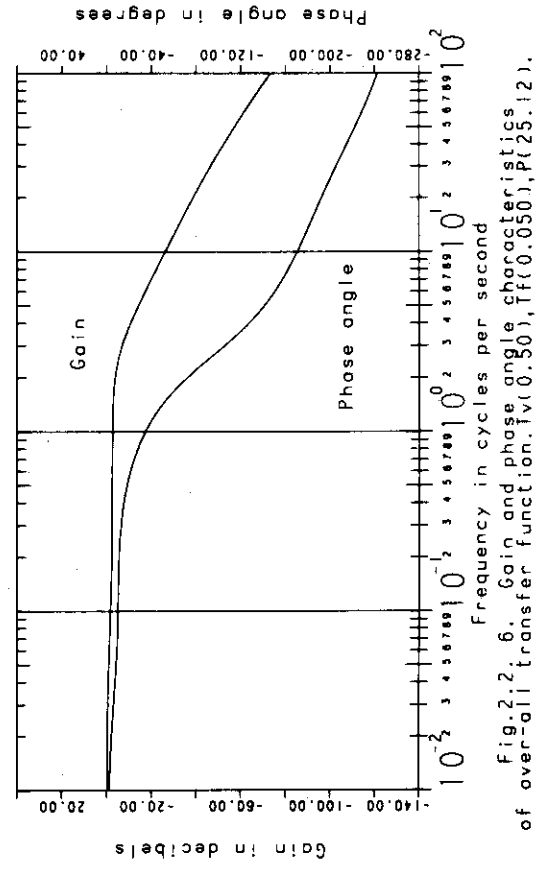

Fig.2.2; 6. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(25.12).

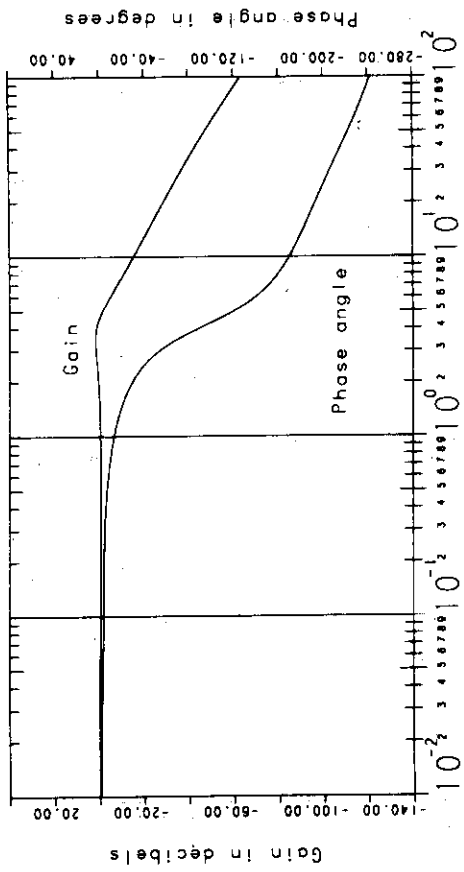

Fig.2.2. 11 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(79.42).

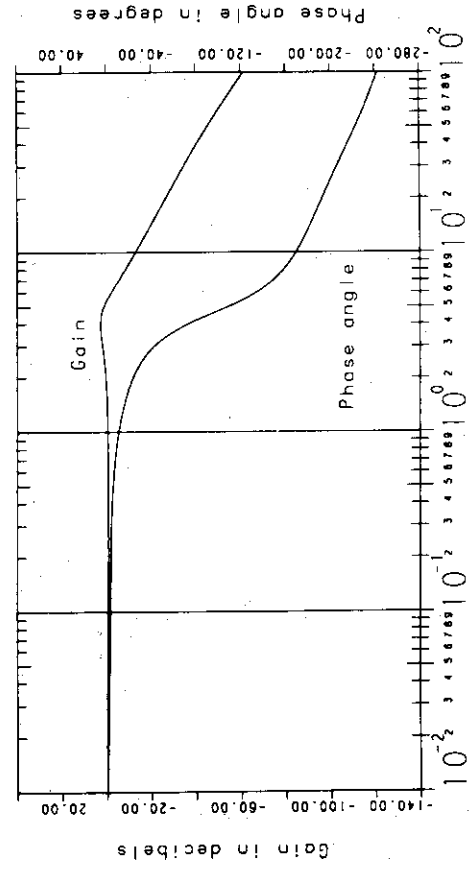

Fig.2.2. 12 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(100.0).

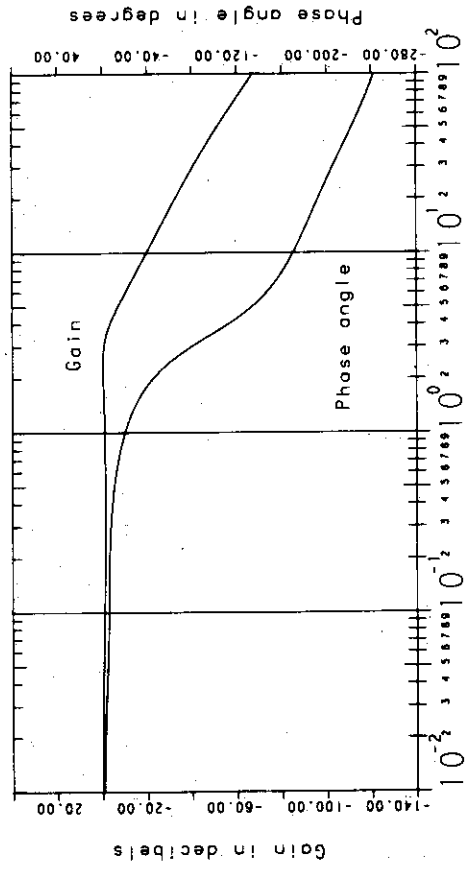

Fig.2.2. 9 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(50.11).

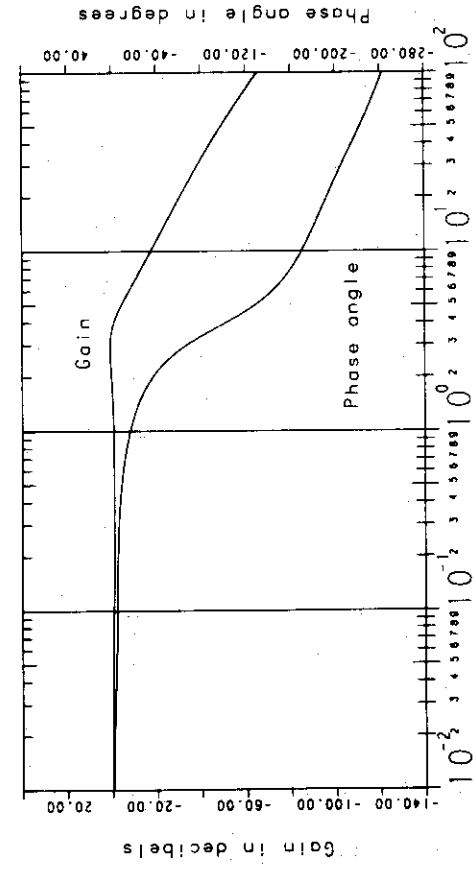

Fig.2.2. 10 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(63.09).

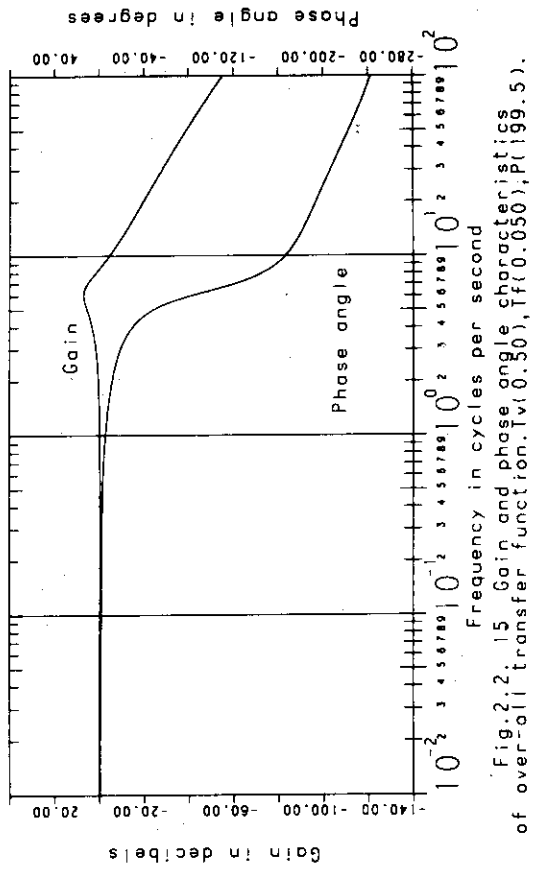

Fig.2.2.15 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(199.5).

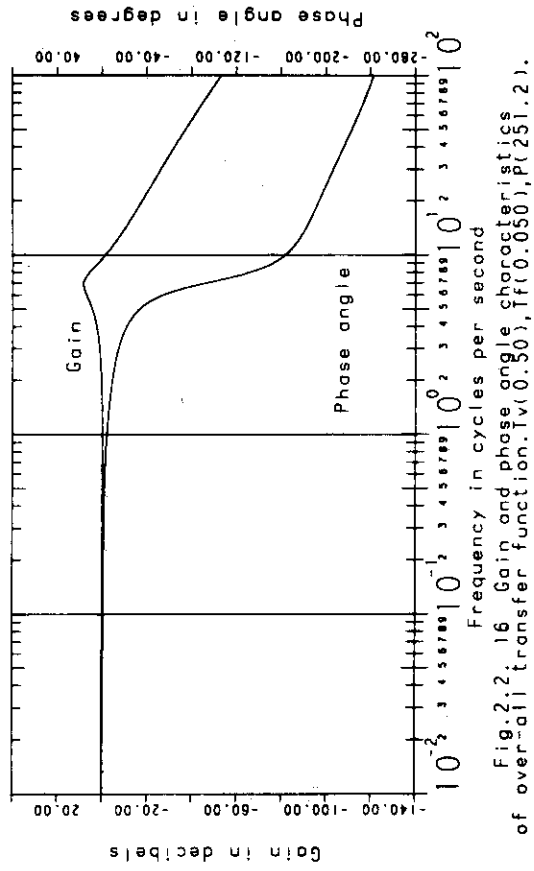

Fig.2.2.16 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(251.2).

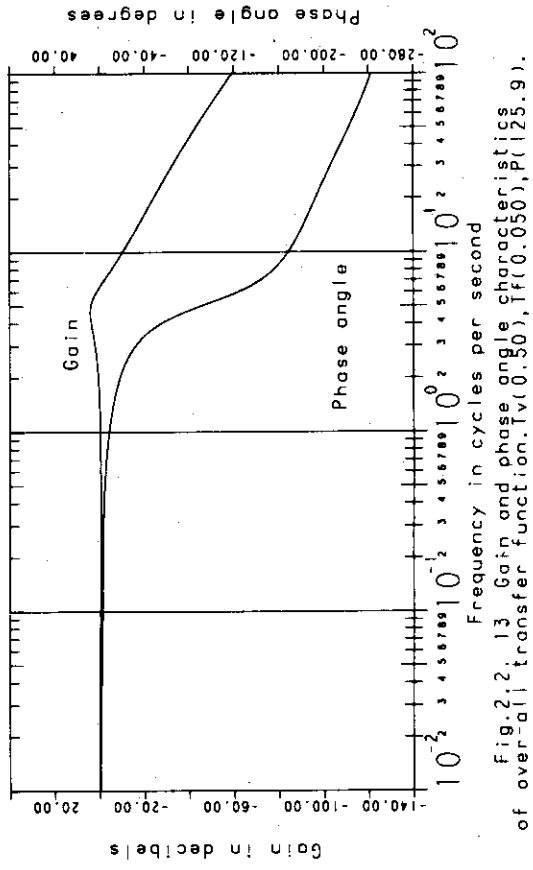

Fig.2.2.13 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(125.9).

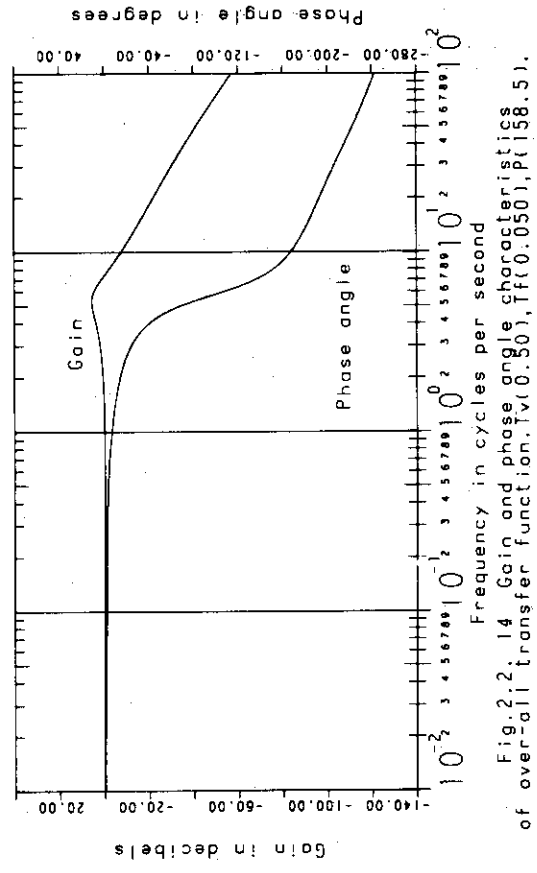

Fig.2.2.14 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.050),P(158.5).

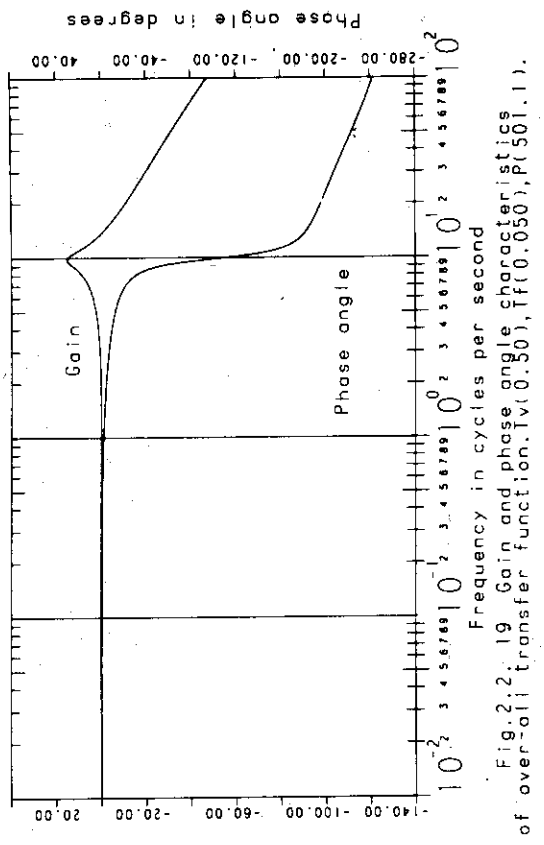

Fig.2.2. 19 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.050),P(501.1).

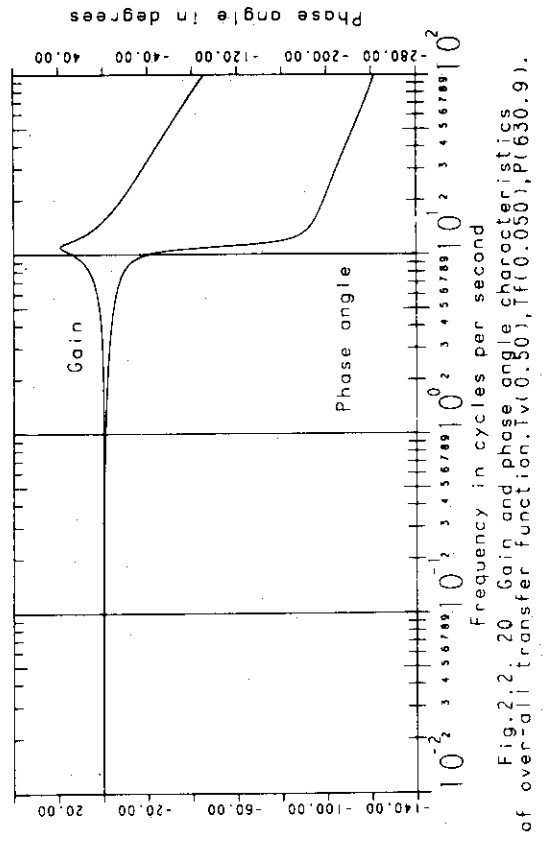

Fig.2.2. 20 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.050),P(630.9).

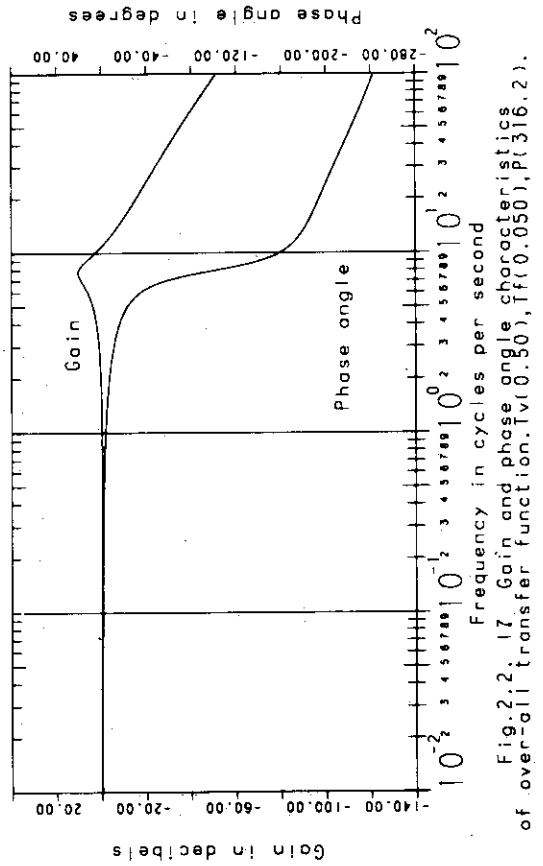

Fig.2.2. 17 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.050),P(316.2).

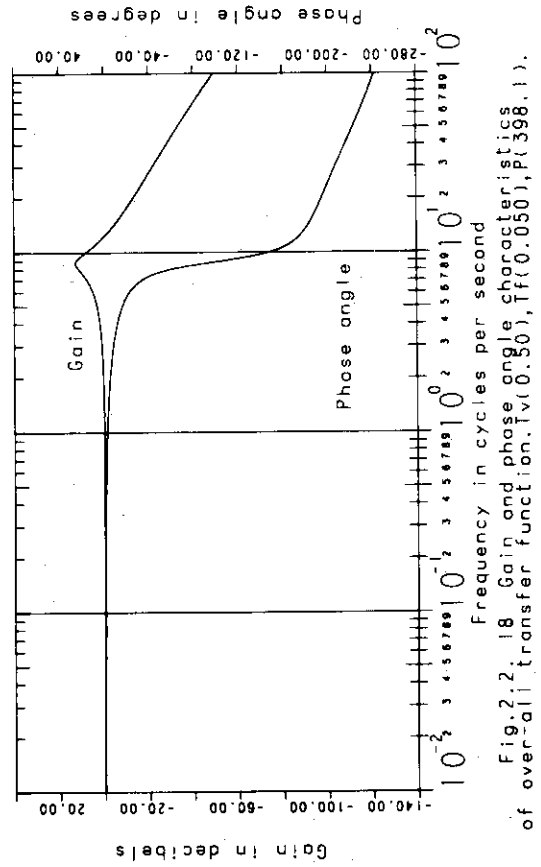

Fig.2.2. 18 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.050),P(398.1).

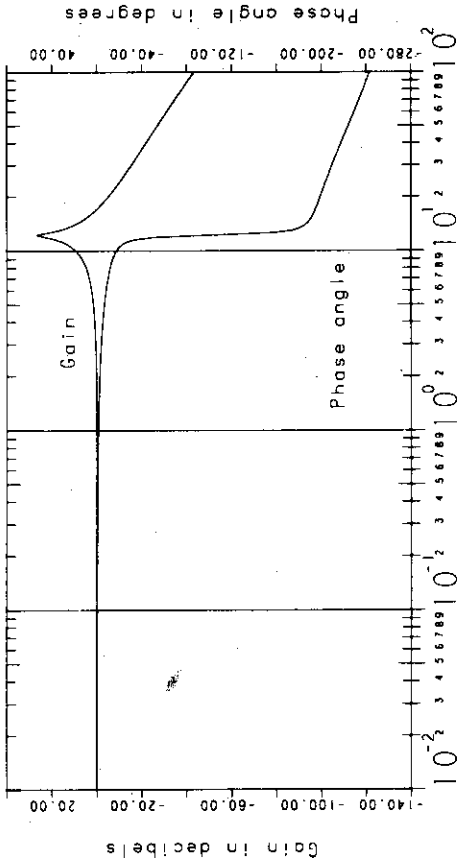

Fig.2.2.21 Gain and phase angle characteristics of over-all transfer function.Tv(0.501),Tf(0.050),P(794.21).

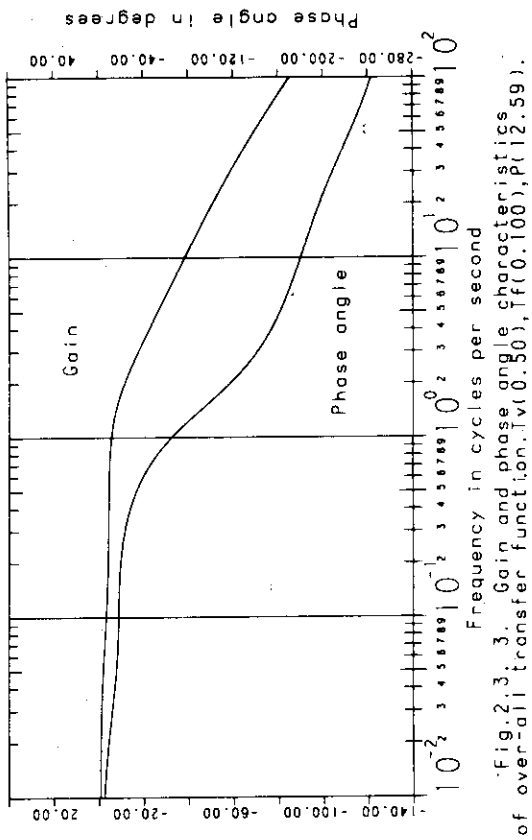

Fig.2.3.1. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(1.0).

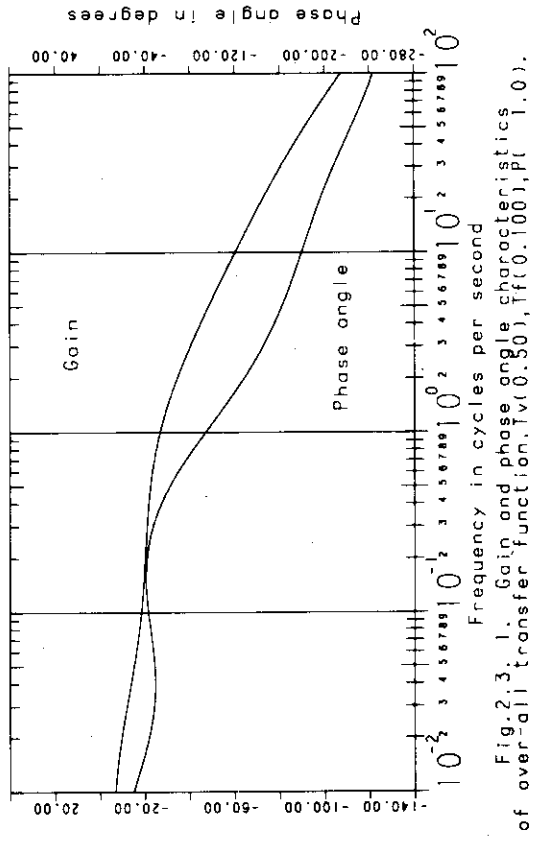

Fig.2.3.2. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(10.00).

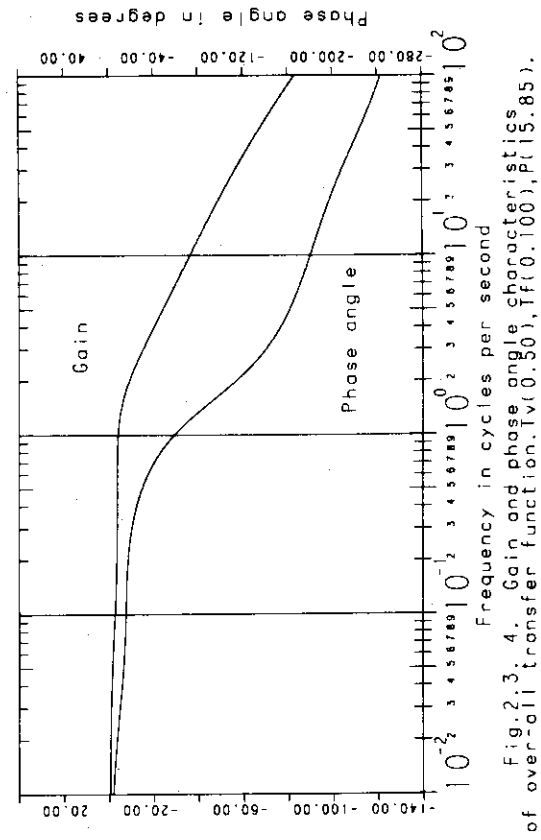

Fig.2.3.3. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(12.59).

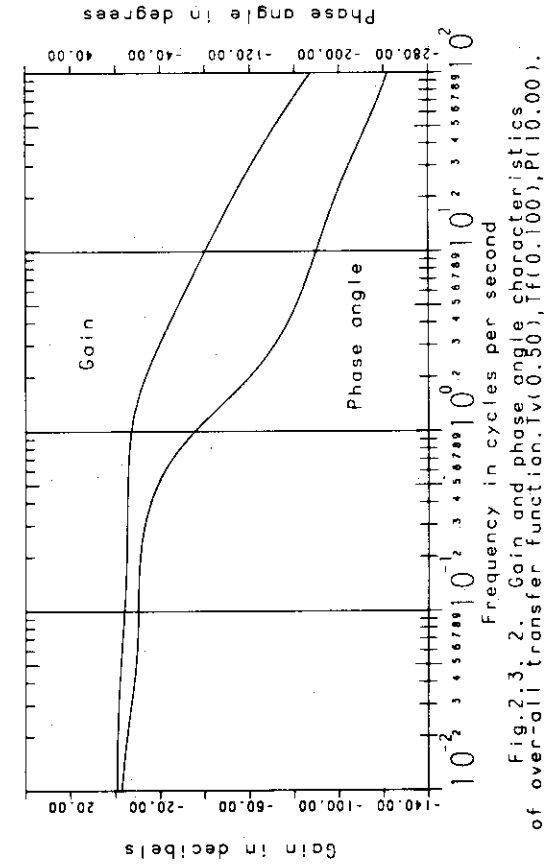

Fig.2.3.4. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(15.85).

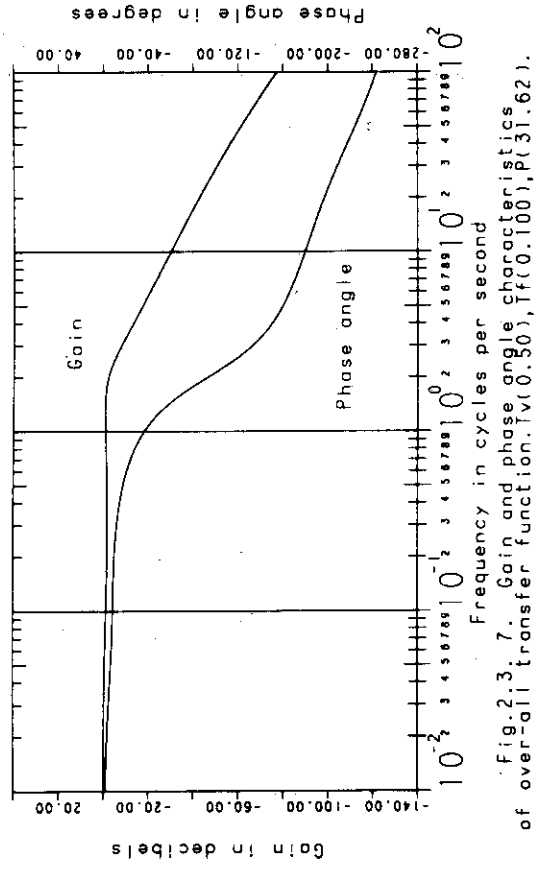

Fig.2.3. 7. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(31.62).

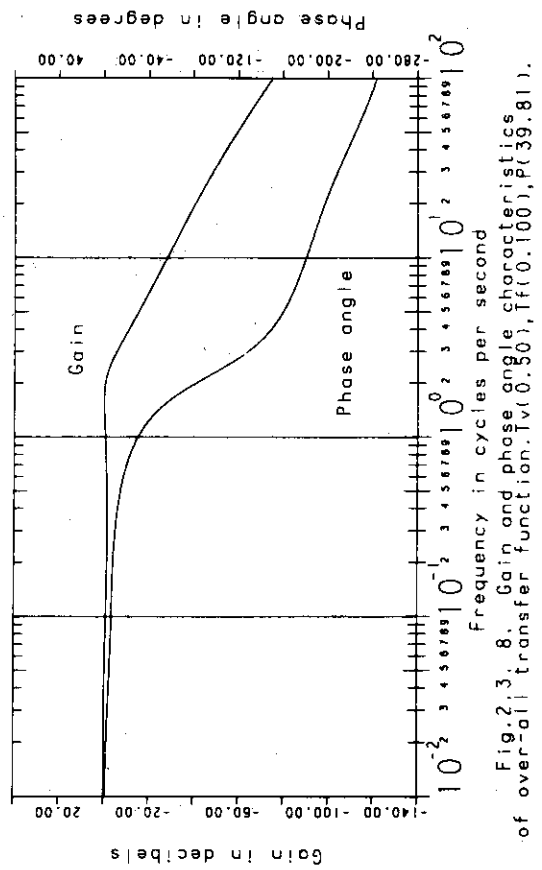

Fig.2.3. 8. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(39.81).

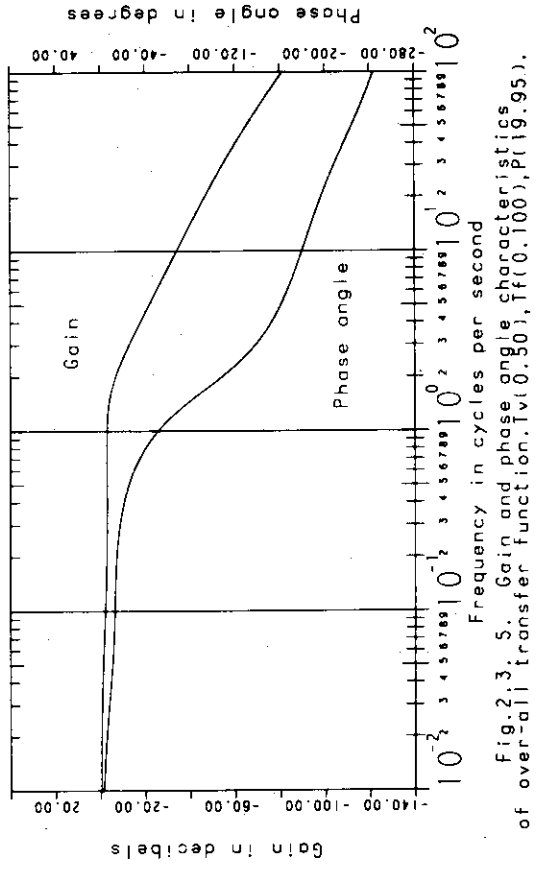

Fig.2.3. 5. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(19.95).

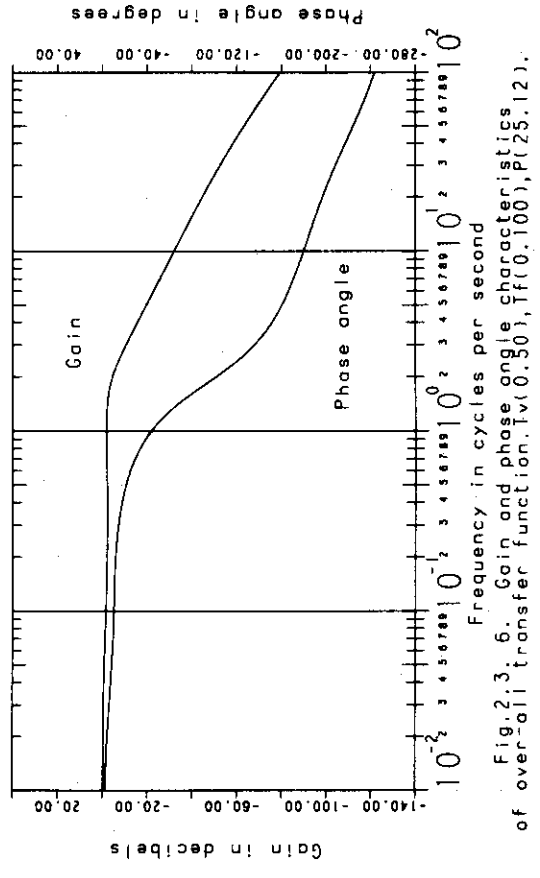

Fig.2.3. 6. Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(25.12).

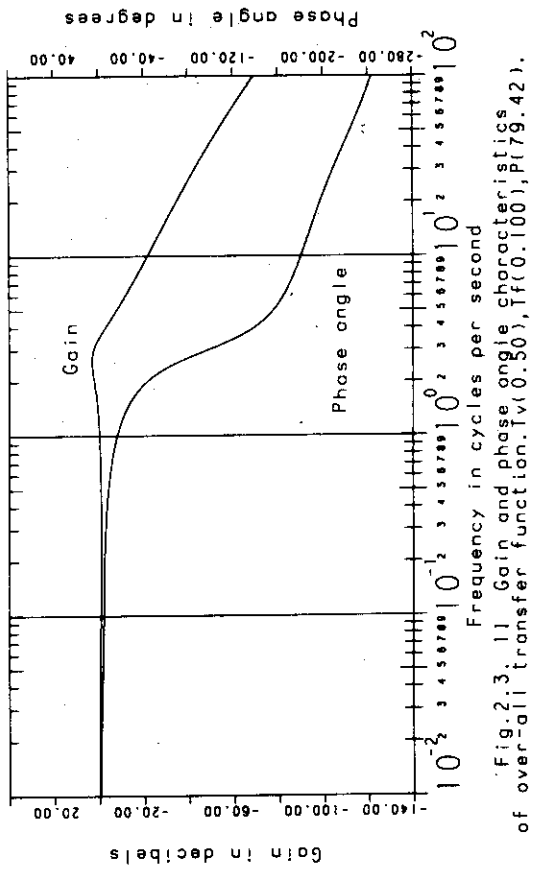

Fig.2.3.11 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(79.42).

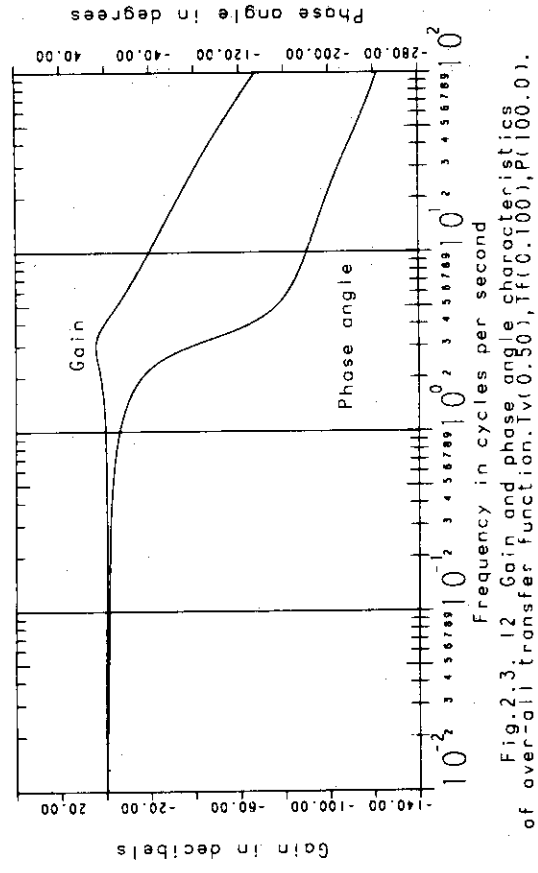

Fig.2.3.12 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(100.0).

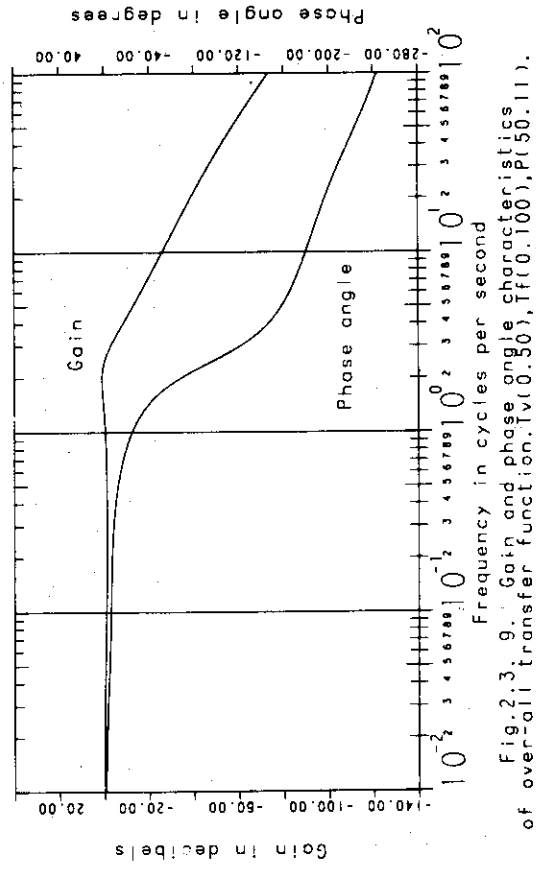

Fig.2.3.9 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(50.11).

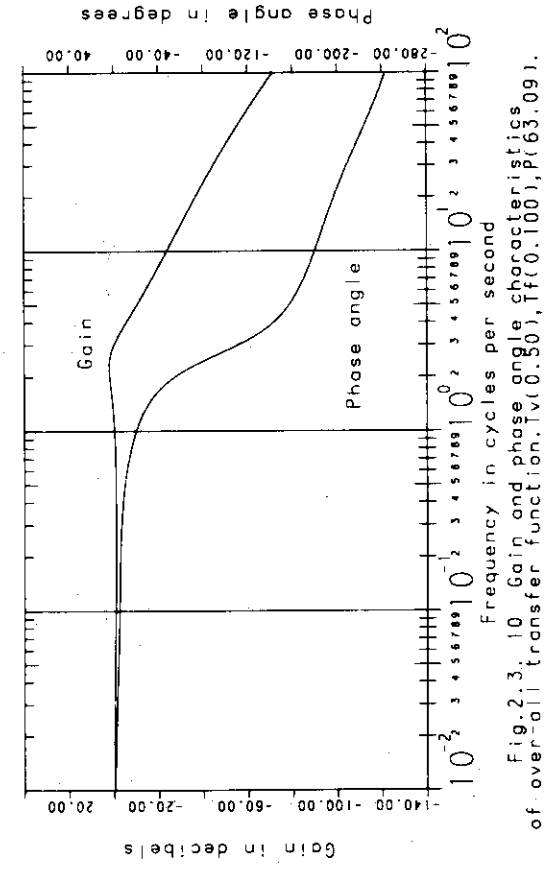

Fig.2.3.10 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(63.09).

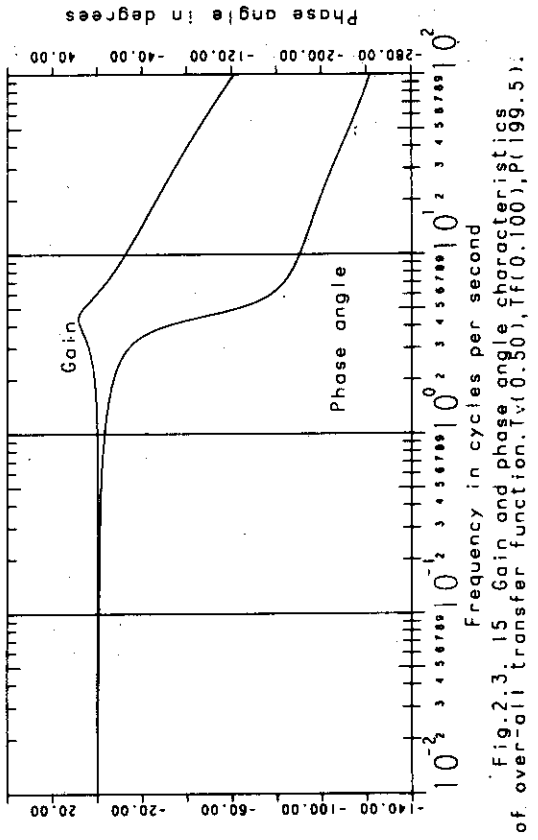

Fig.2.3. 15 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(199.5).

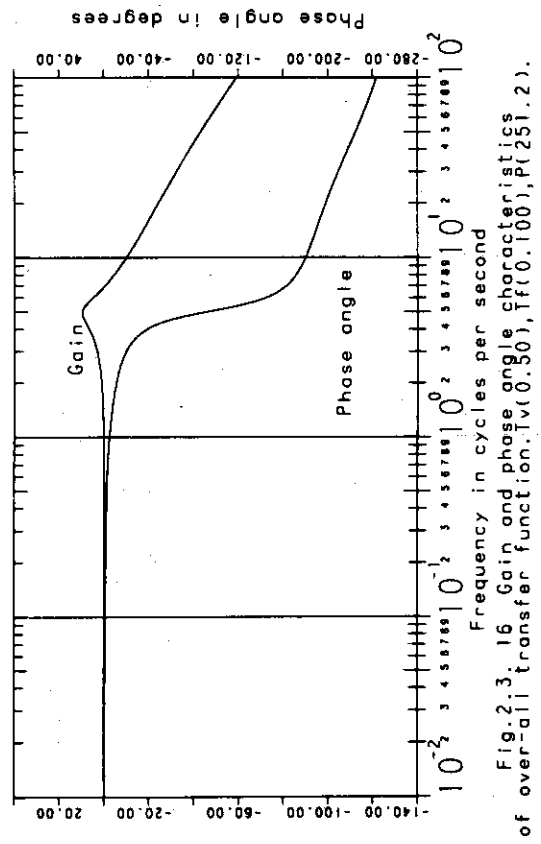

Fig.2.3. 16 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(251.2).

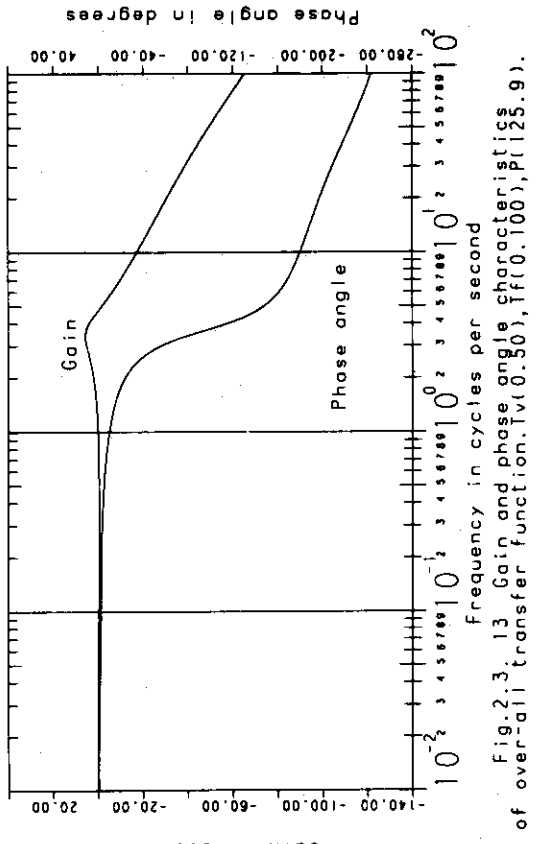

Fig.2.3. 13 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(125.9).

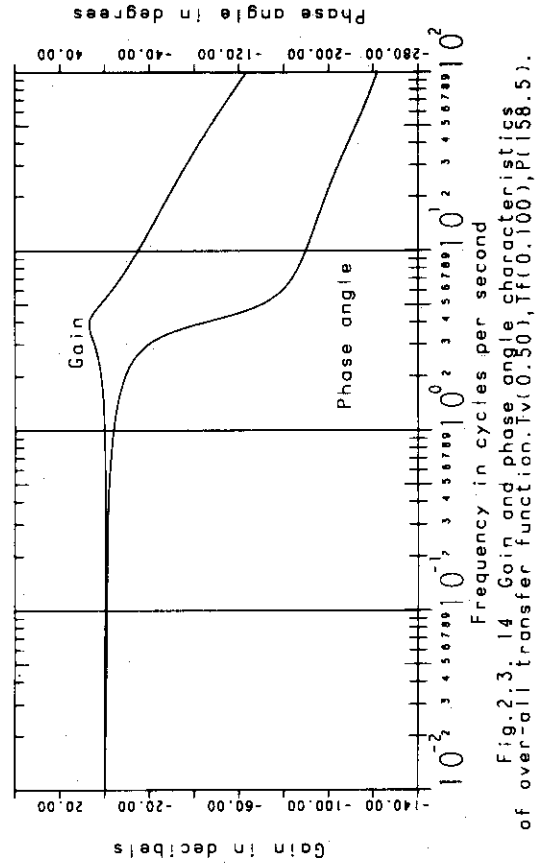

Fig.2.3. 14 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(158.5).

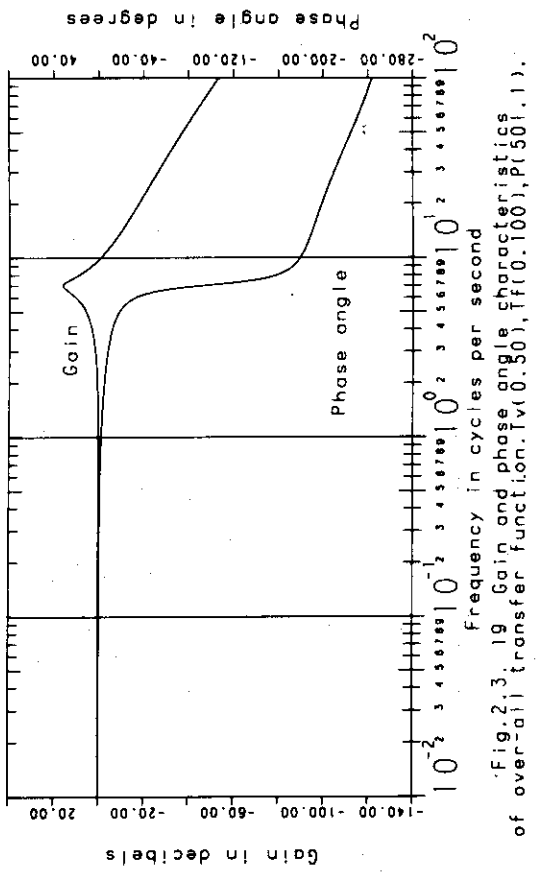

Fig.2.3.19 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(501.1).

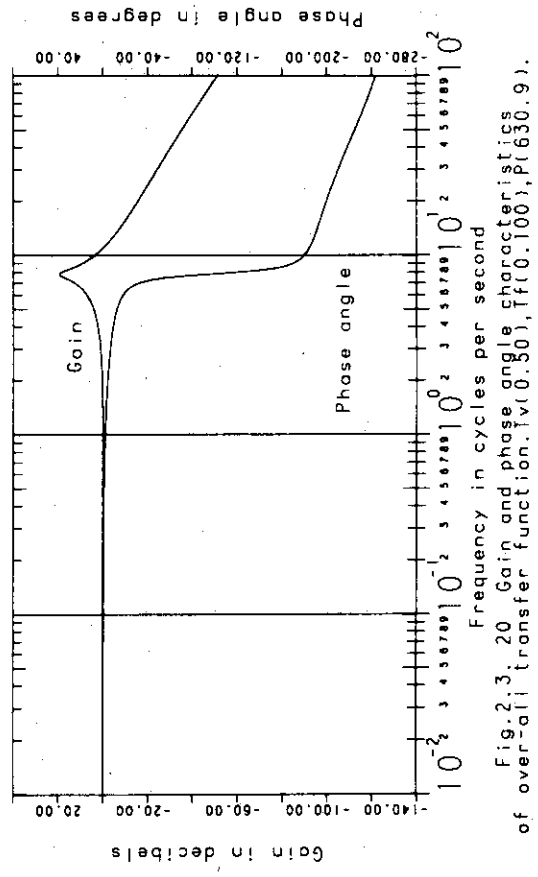

Fig.2.3.20 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(630.9).

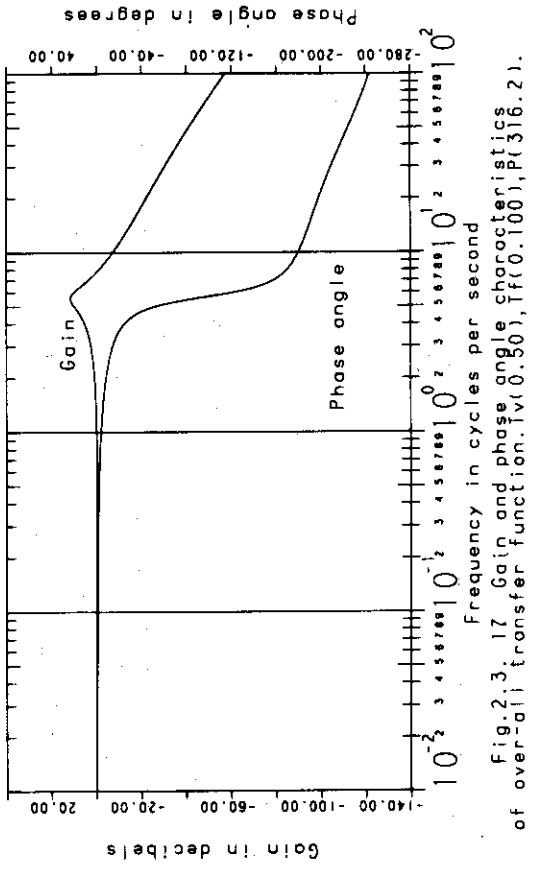

Fig.2.3.17 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(316.2).

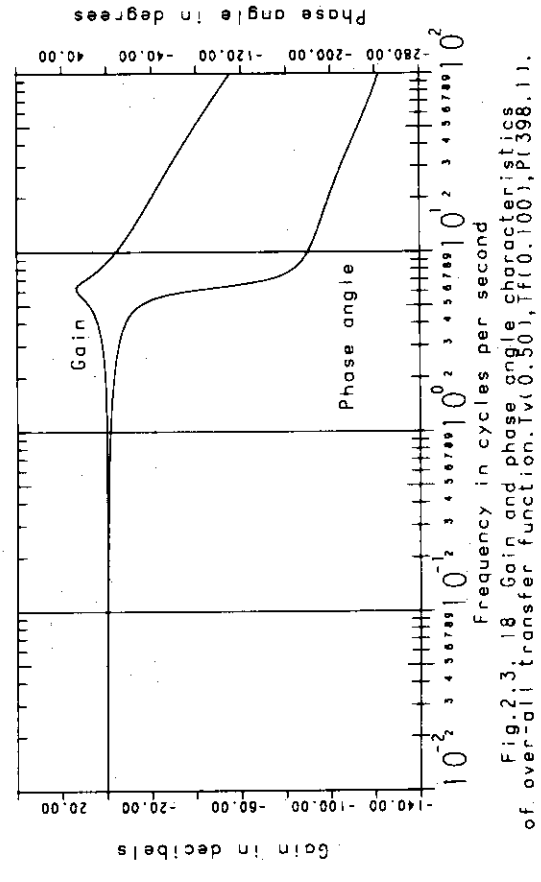

Fig.2.3.18 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),Pf(398.1).

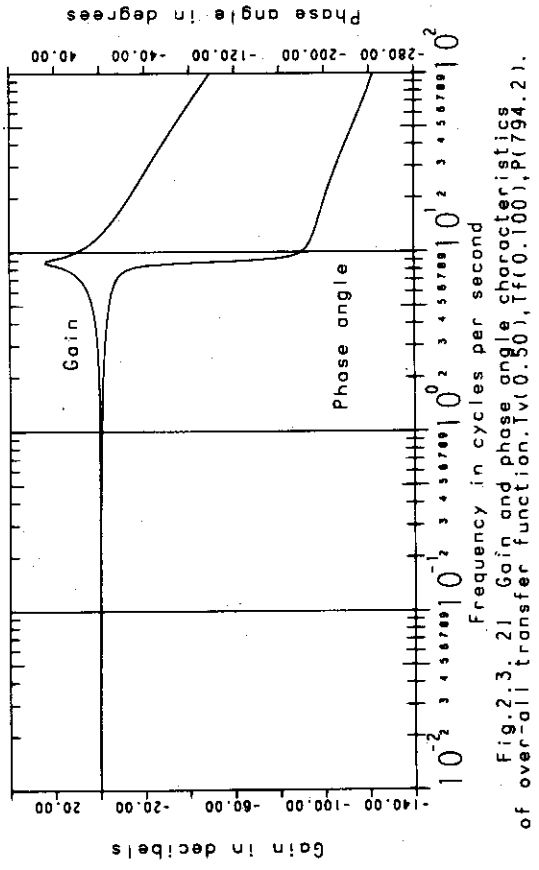

Fig.2.3.21 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(794.2).

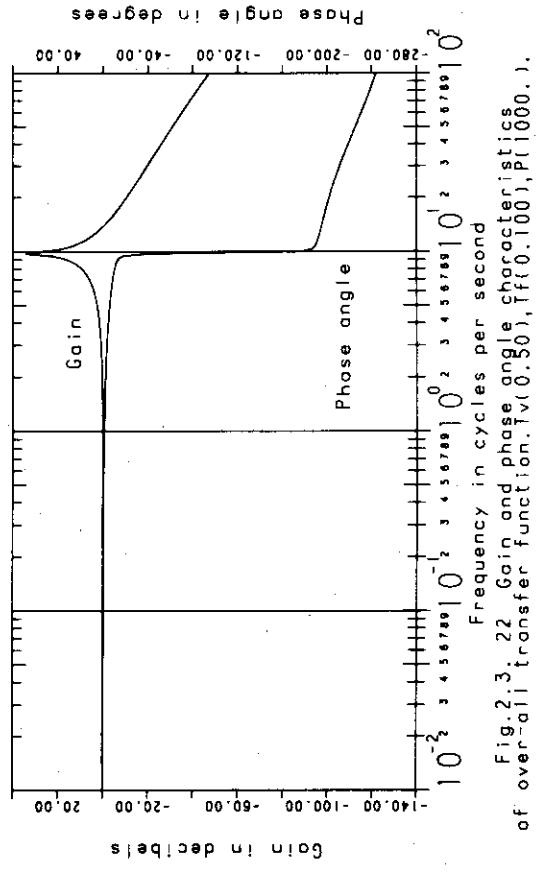

Fig.2.3.22 Gain and phase angle characteristics of over-all transfer function.Tv(0.50),Tf(0.100),P(1000.).

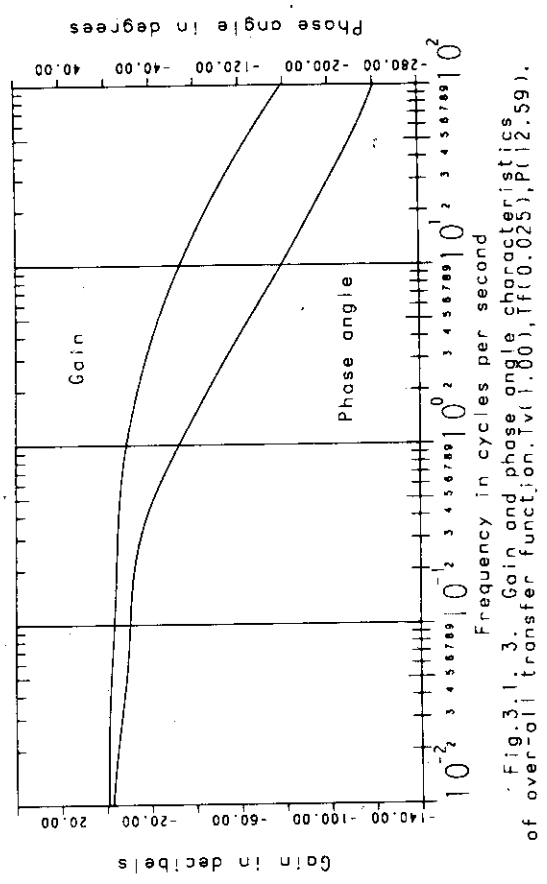

Fig.3.1.3. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(12.59).

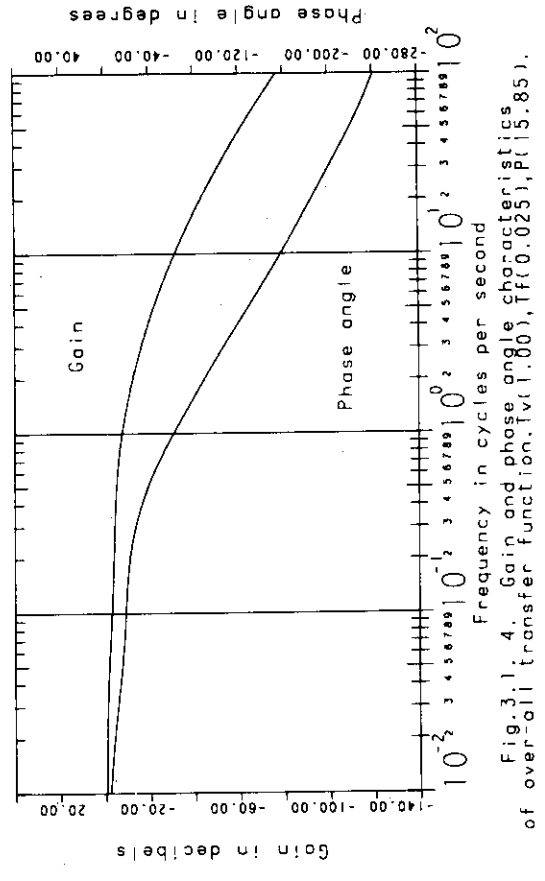

Fig.3.1.4. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(15.85).

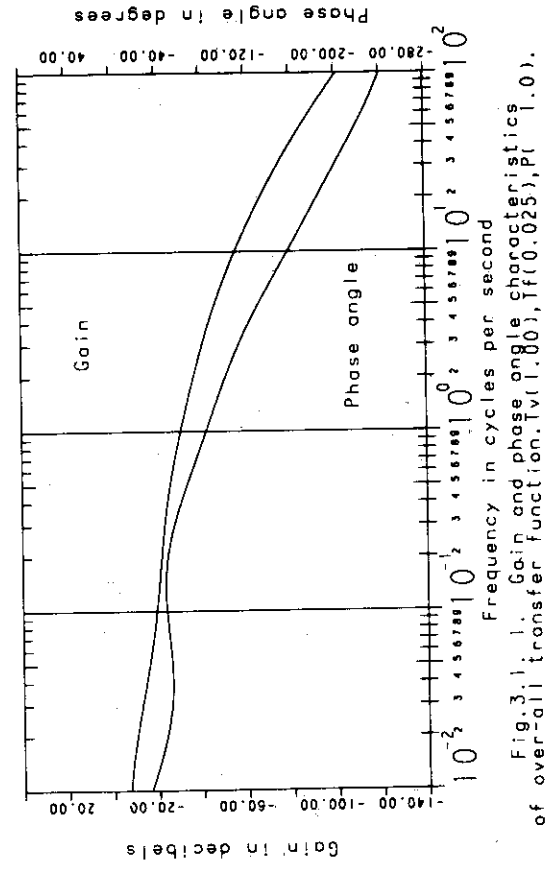

Fig.3.1.1. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(1.0).

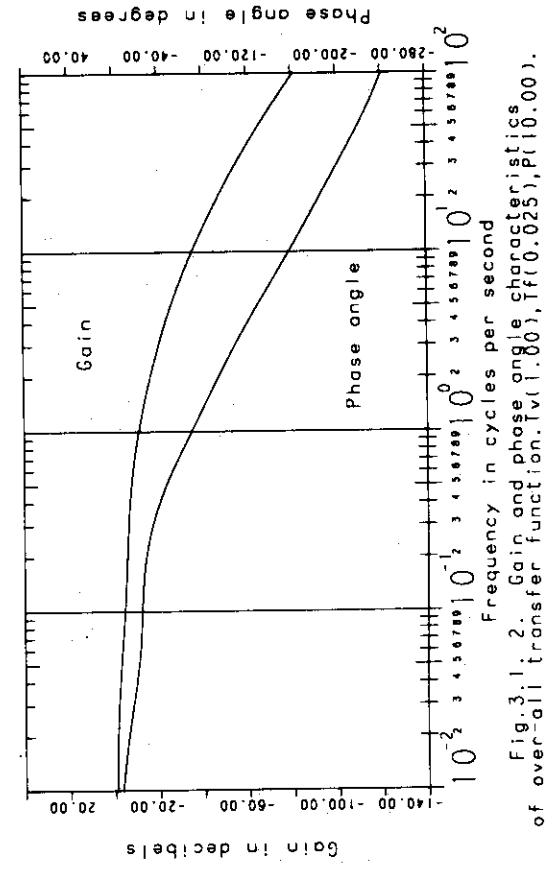

Fig.3.1.2. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(10.00).

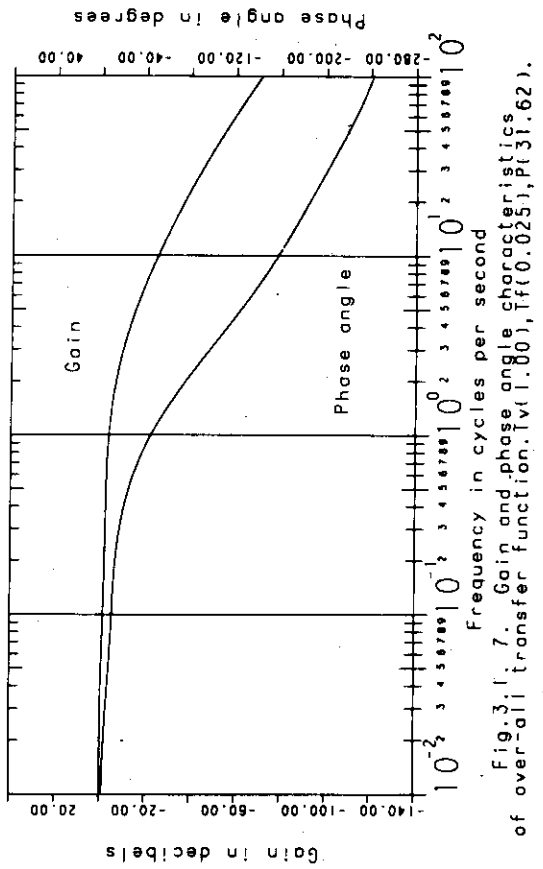

Fig.3.1.7. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(31.62).

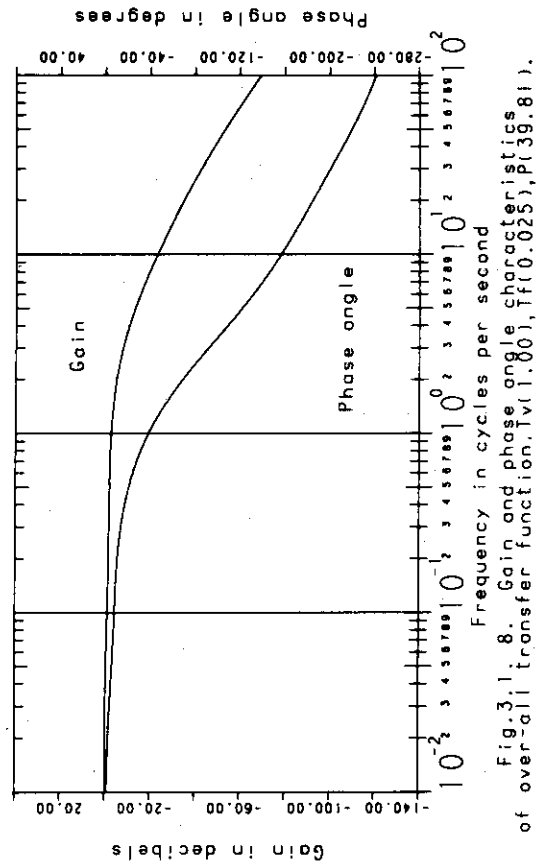

Fig.3.1.8. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(39.81).

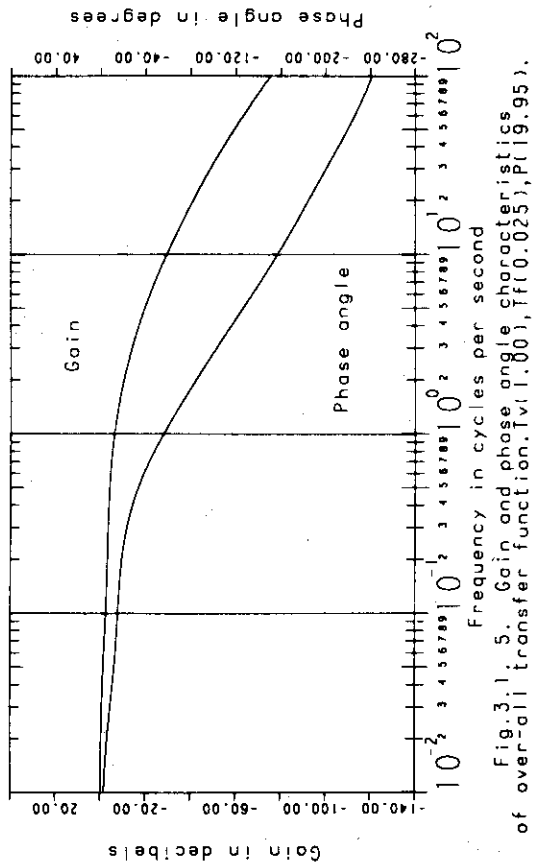

Fig.3.1.5. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(19.95).

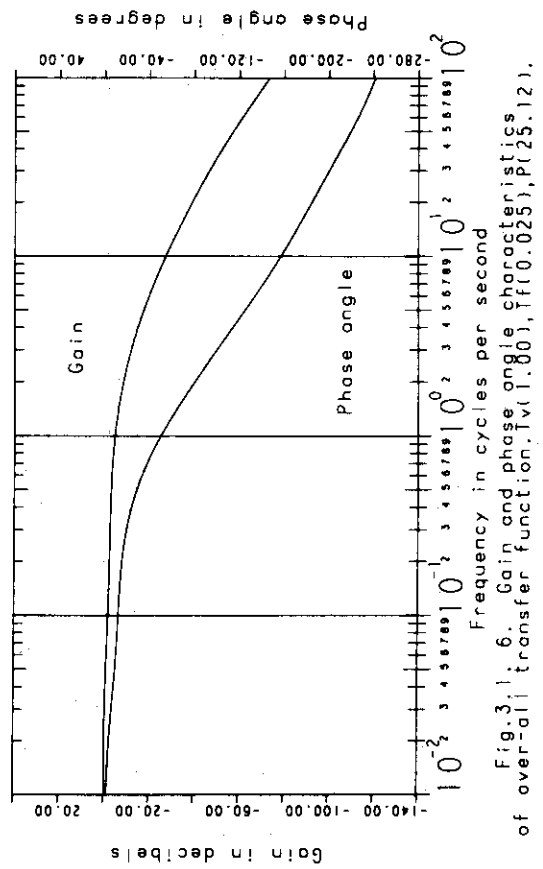

Fig.3.1.6. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(25.12).

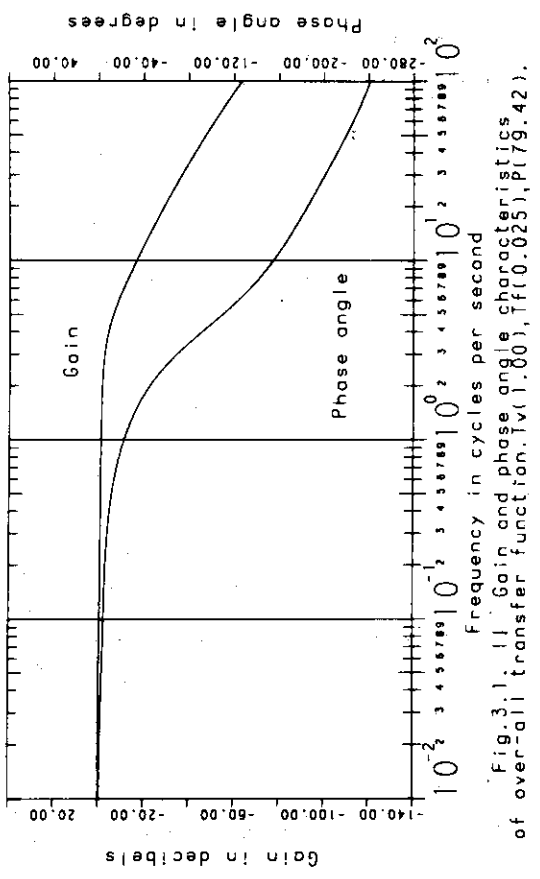

Fig.3.1.11 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(79.42).

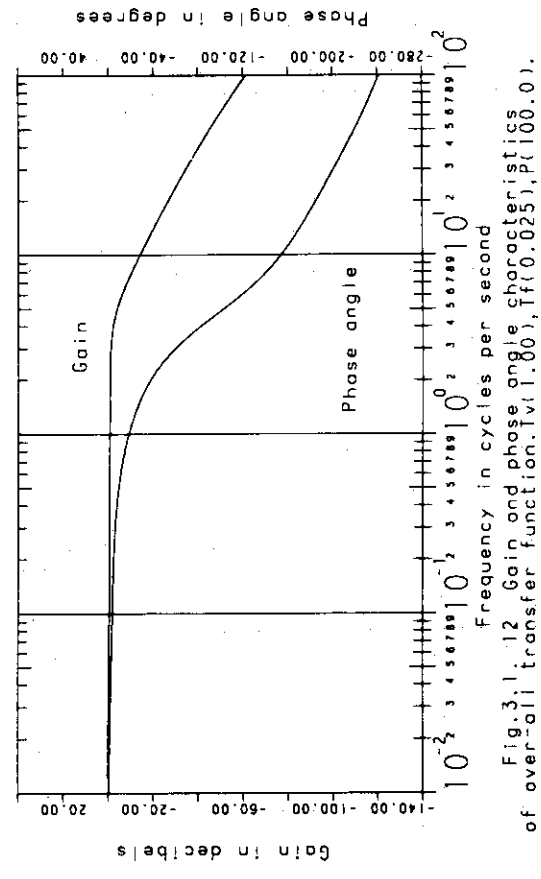

Fig.3.1.12 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(100.0).

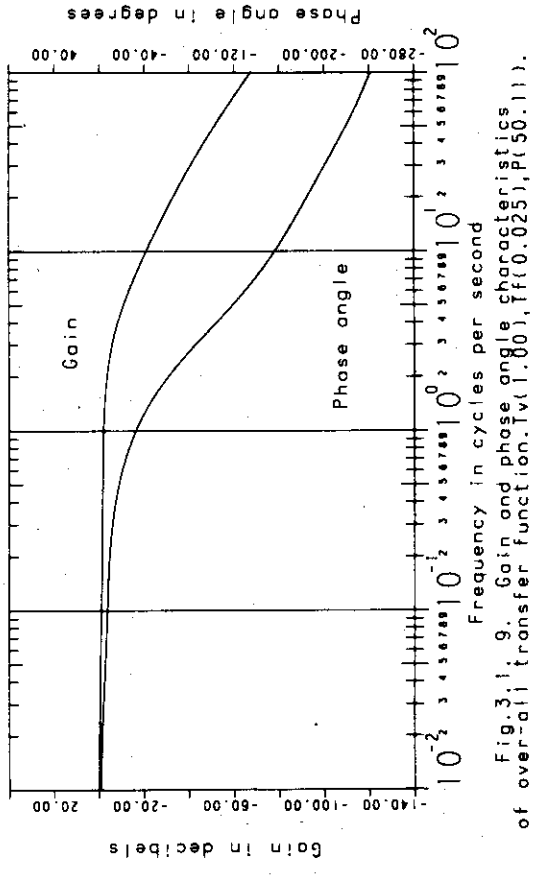

Fig.3.1.9 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(50.11).

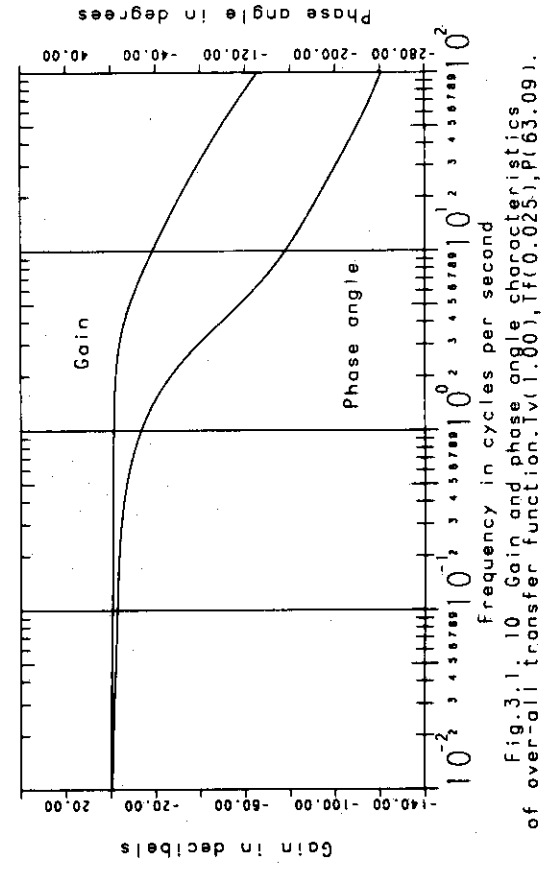

Fig.3.1.10 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(63.09).

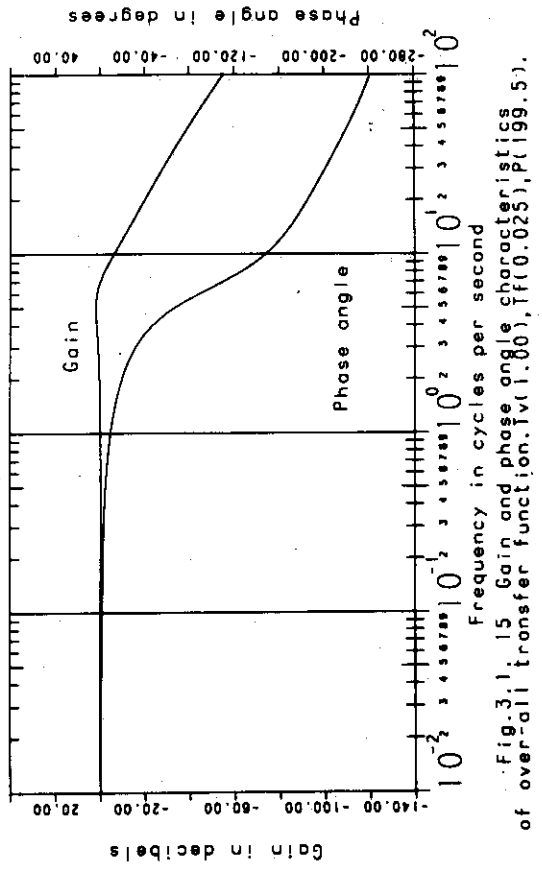

Fig.3.1.15 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.025),P(199.5).

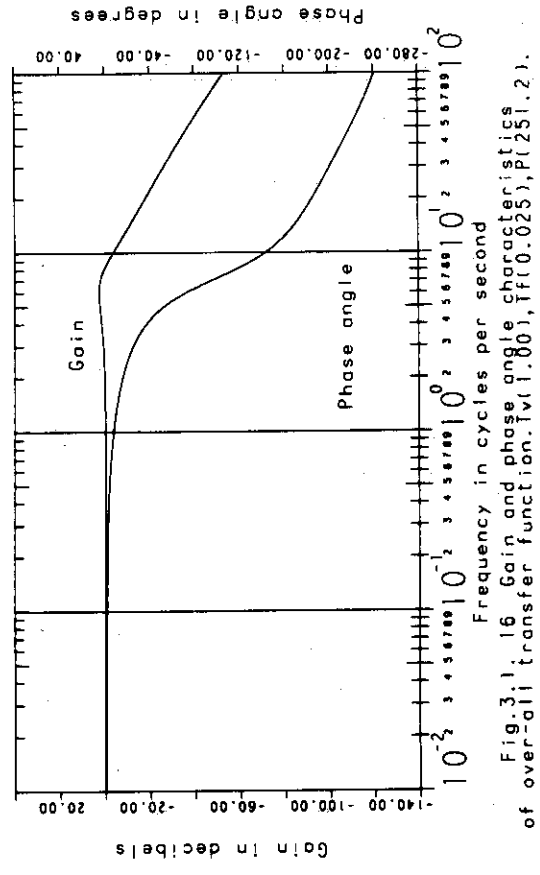

Fig.3.1.16 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.025),P(251.2).

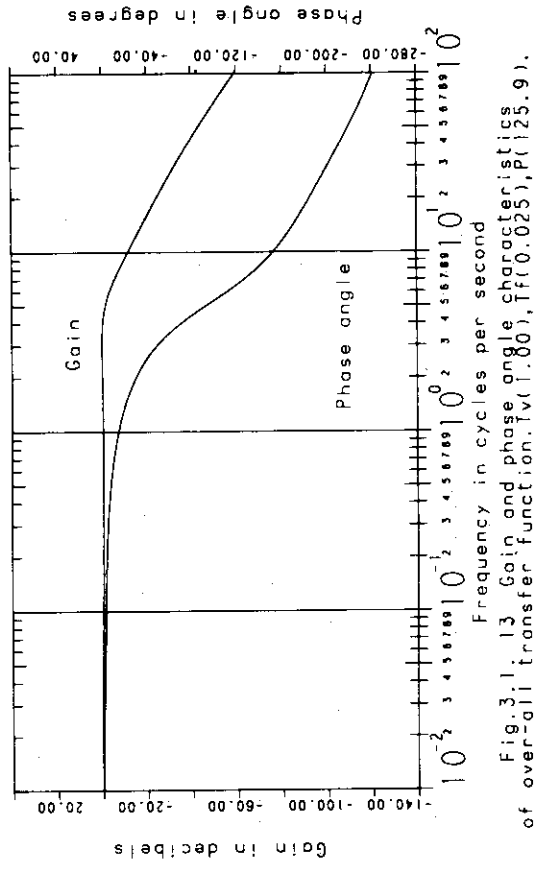

Fig.3.1.13 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.025),P(125.9).

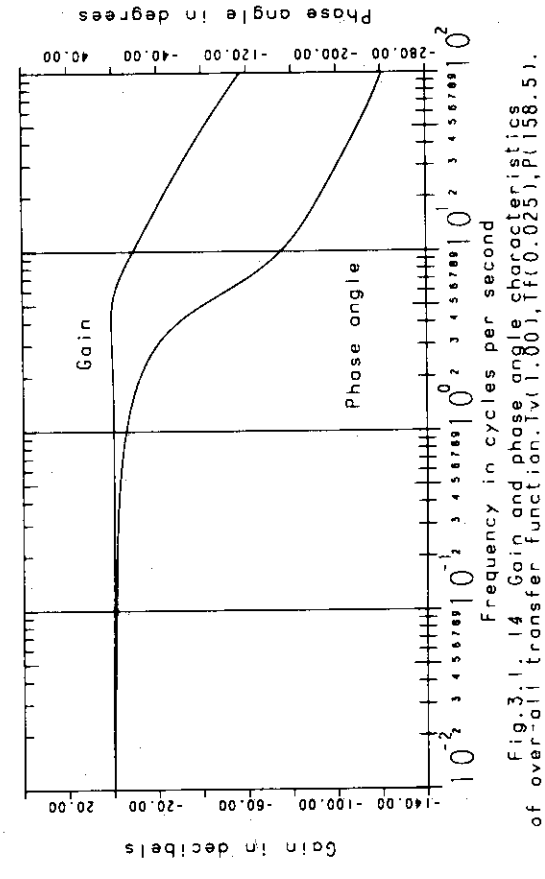

Fig.3.1.14 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.025),P(158.5).

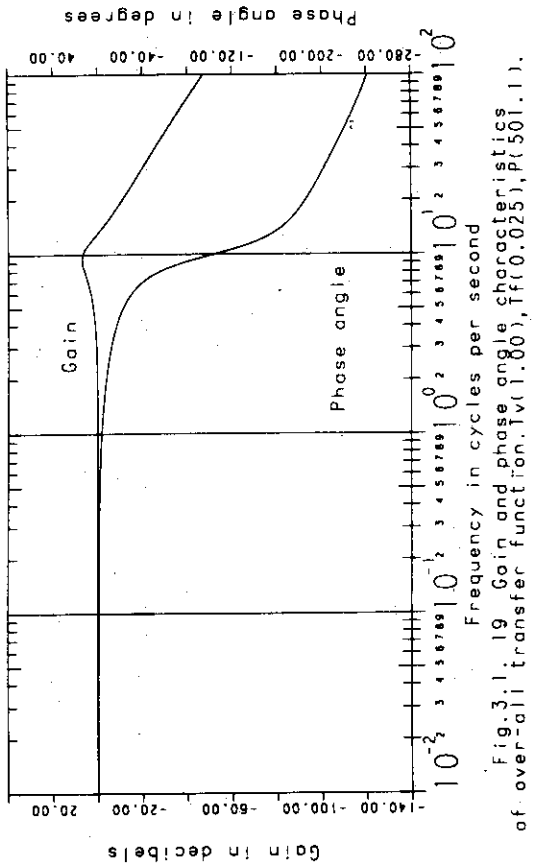

Fig.3.1.19 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(501.1).

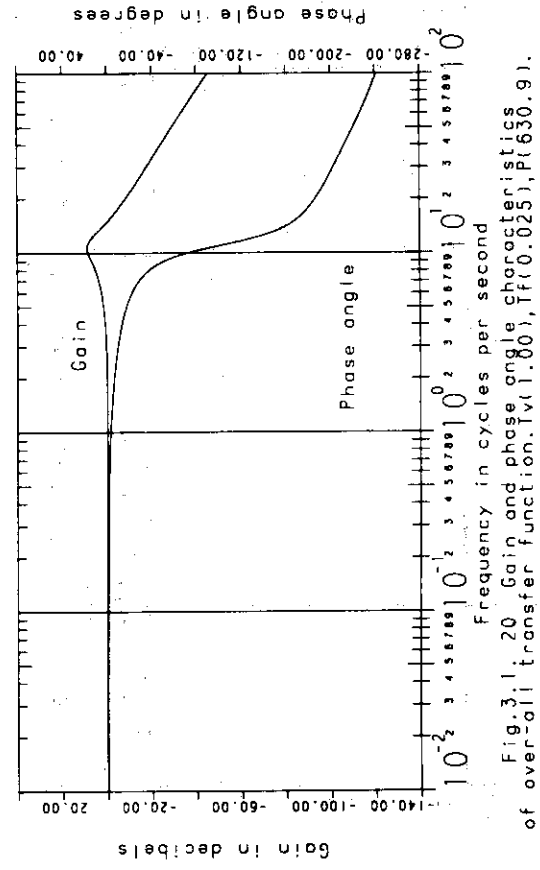

Fig.3.1.20 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(630.9).

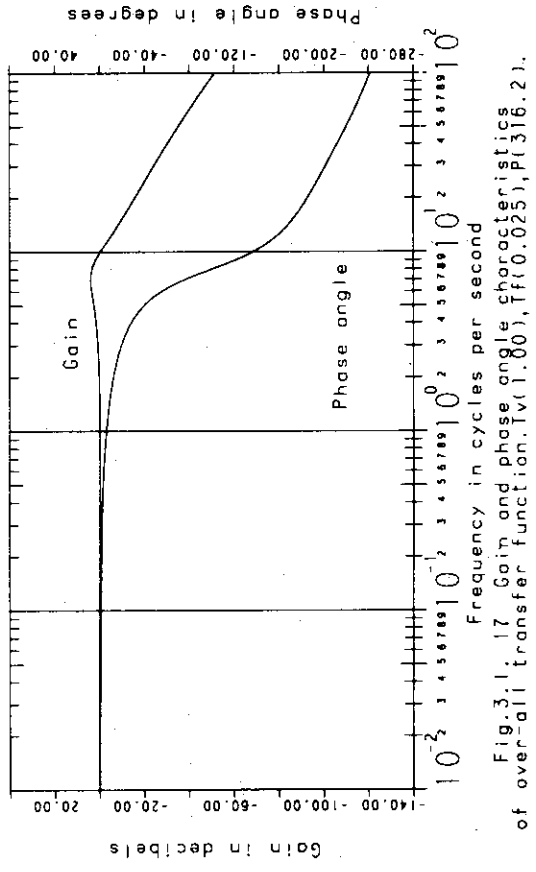

Fig.3.1.17 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(316.2).

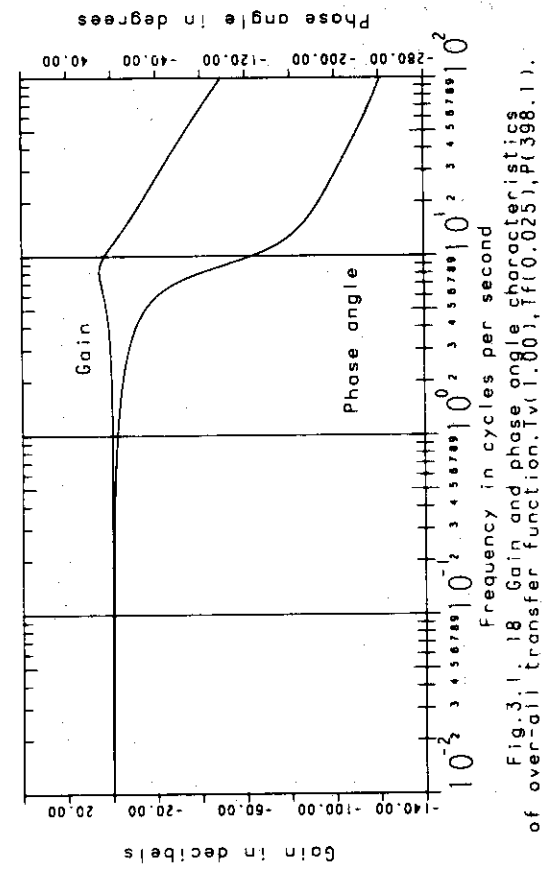

Fig.3.1.18 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(398.1).

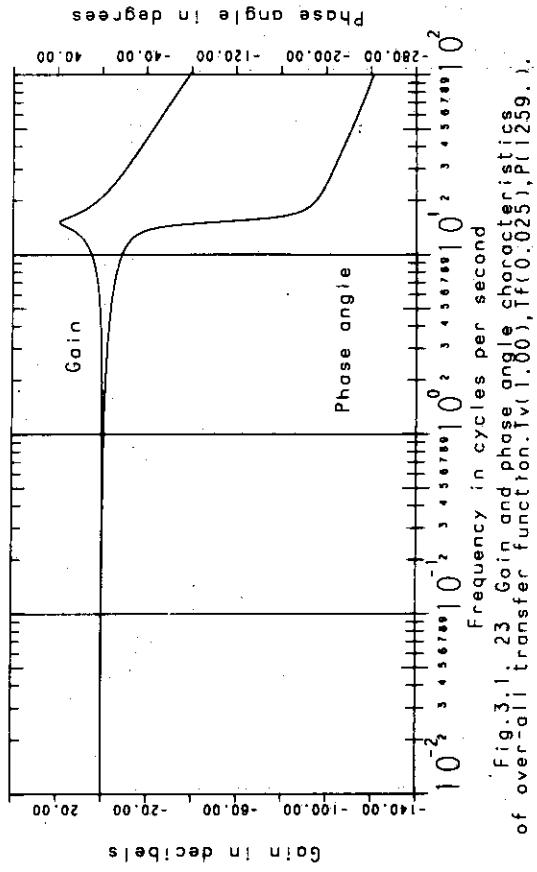

Fig.3.1.23 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(1259.).

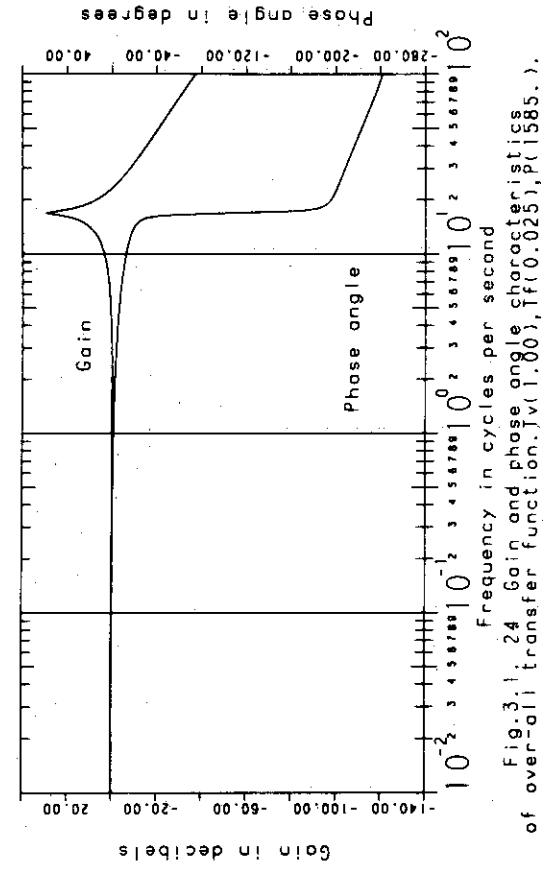

Fig.3.1.24 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(1585.).

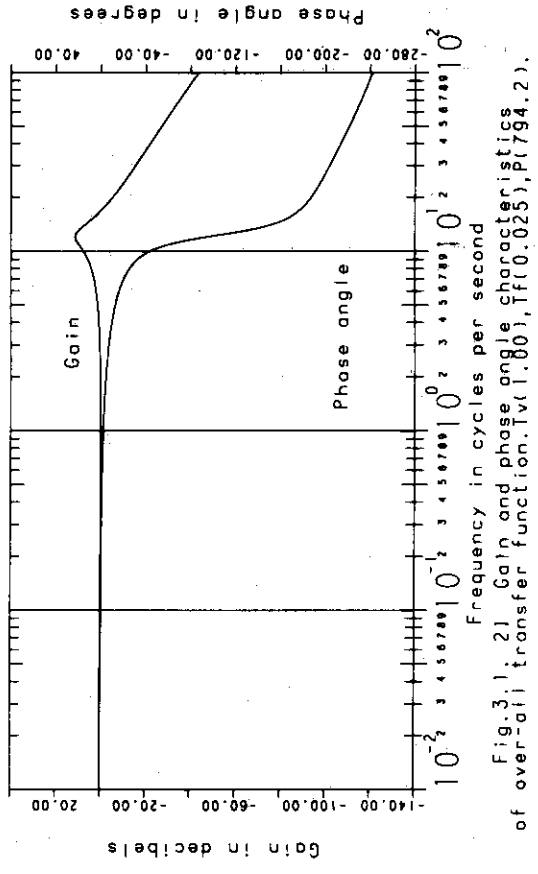

Fig.3.1.21 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(794.2).

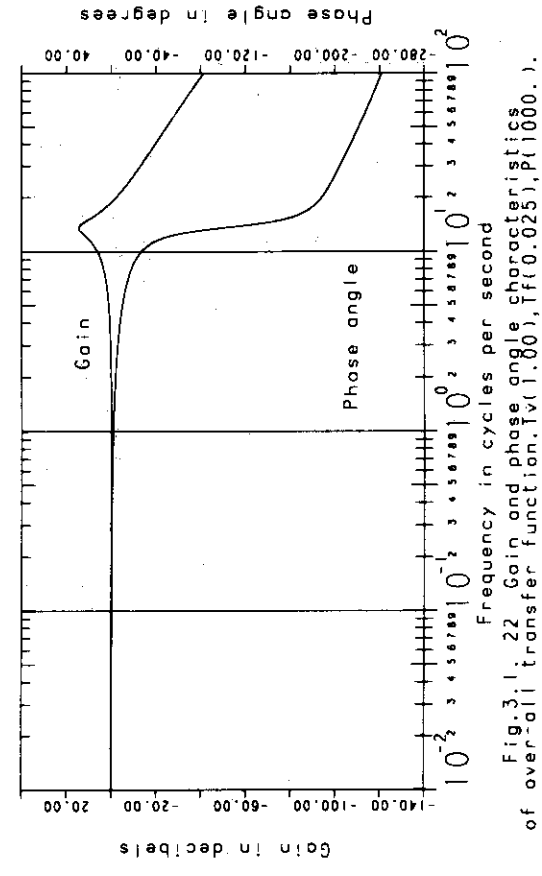

Fig.3.1.22 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.025),P(1000.).

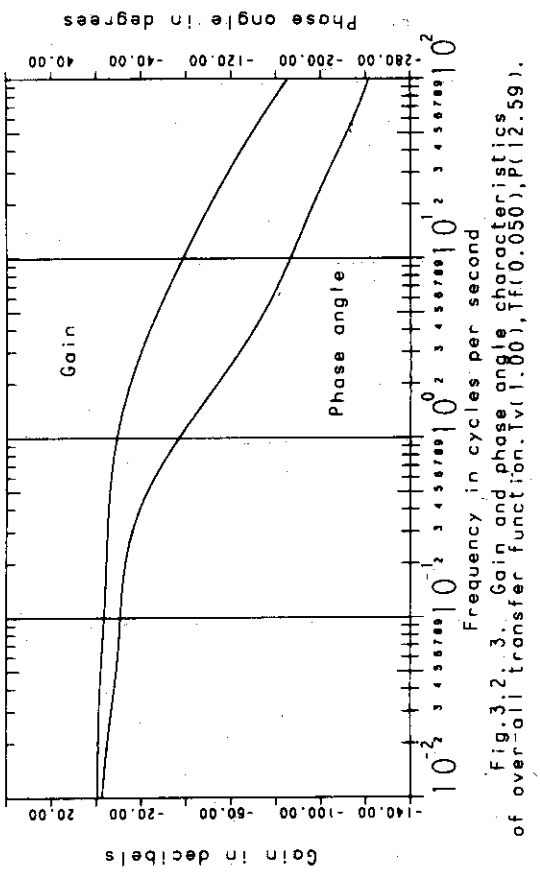

Fig.3.2. 3. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),Pi(12.59).

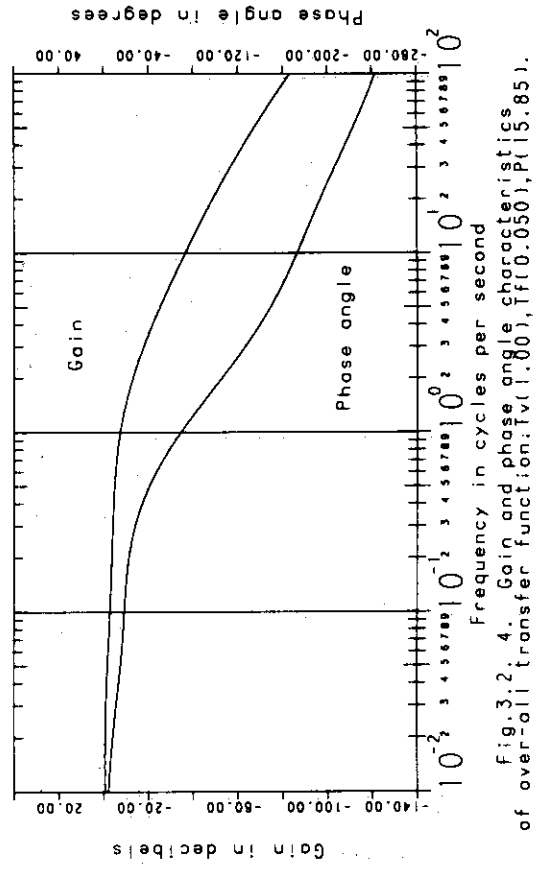

Fig.3.2. 4. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),Pi(15.85).

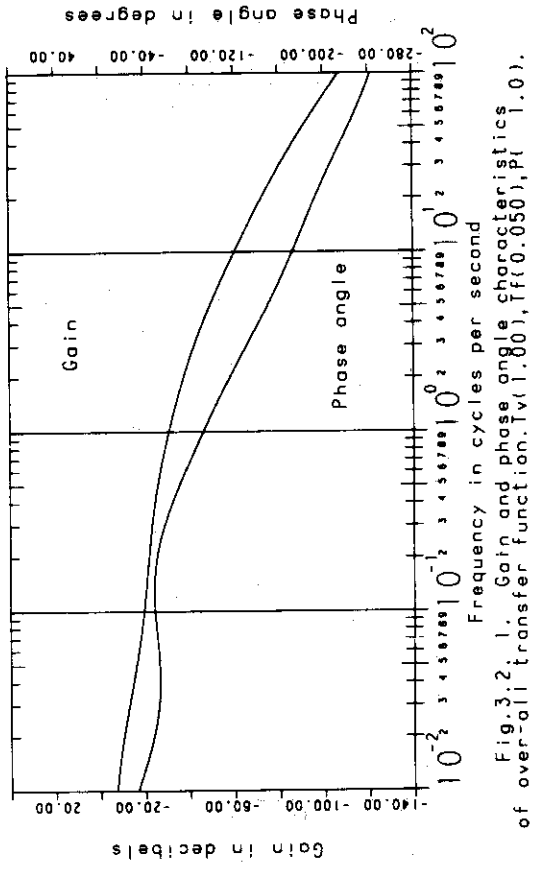

Fig.3.2. 1. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),Pi(1.0).

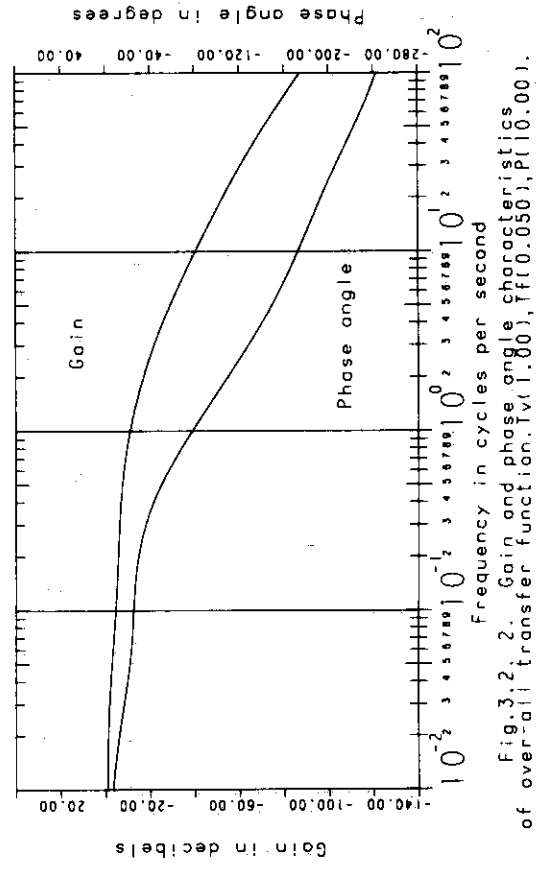

Fig.3.2. 2. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),Pi(10.00).

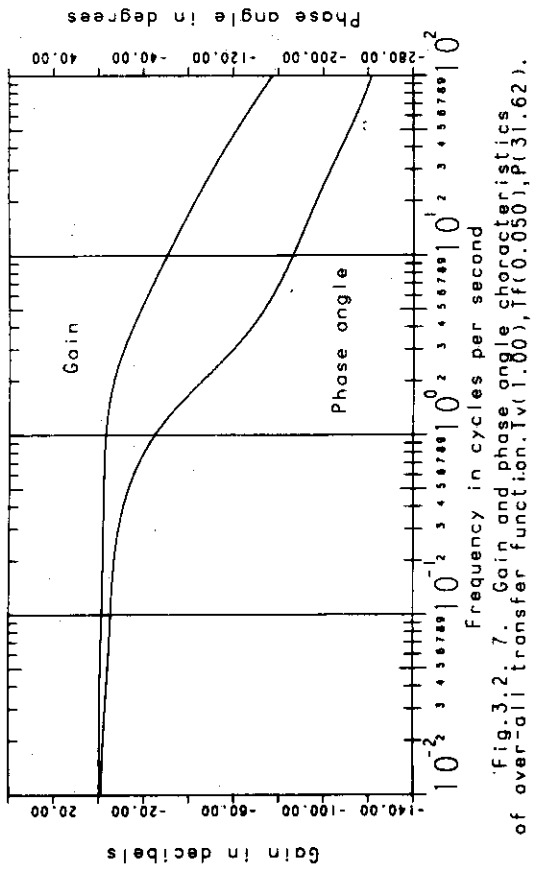

Fig.3.2.7. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(31.62).

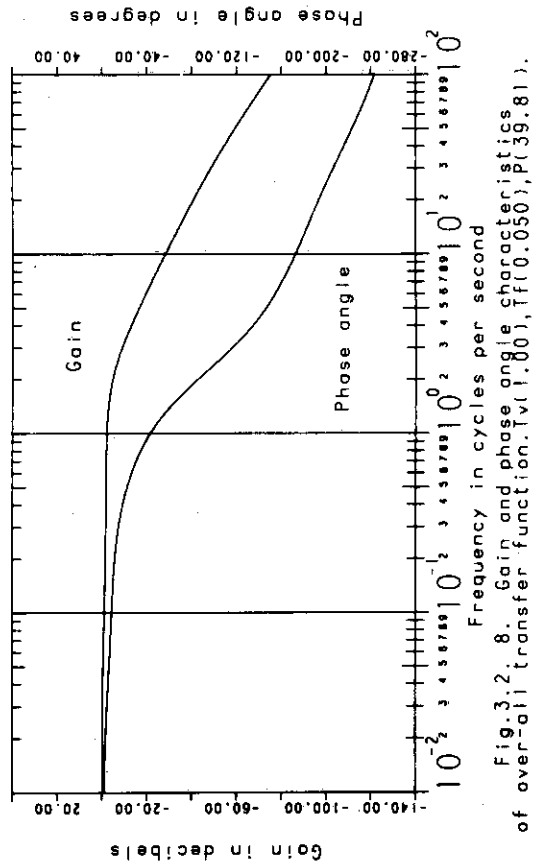

Fig.3.2.8. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(39.81).

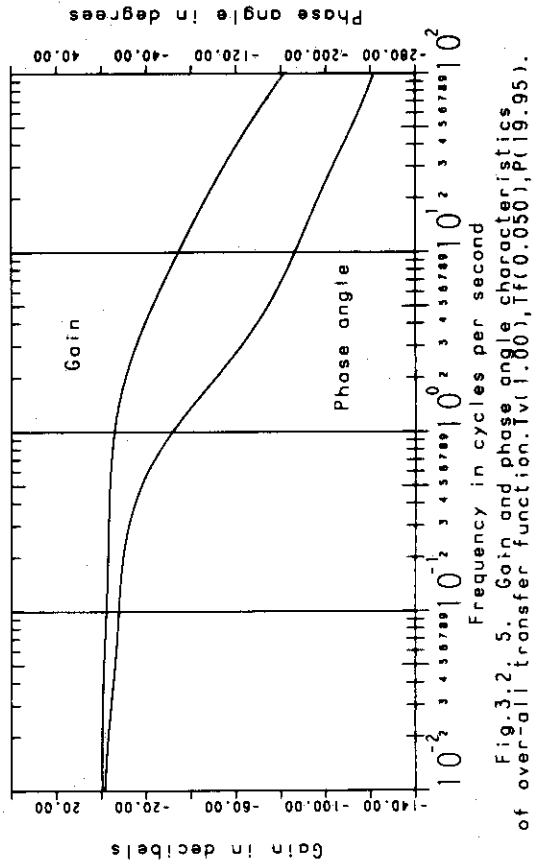

Fig.3.2.5. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(19.95).

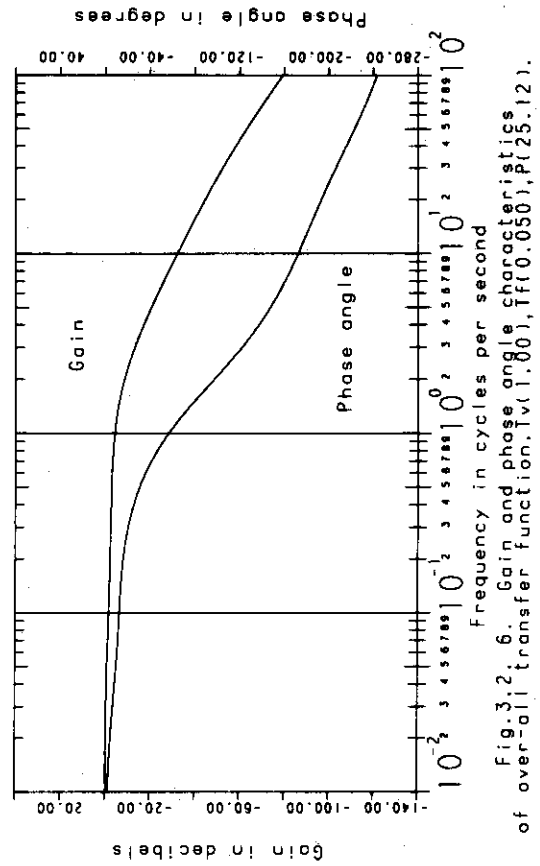

Fig.3.2.6. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(25.12).

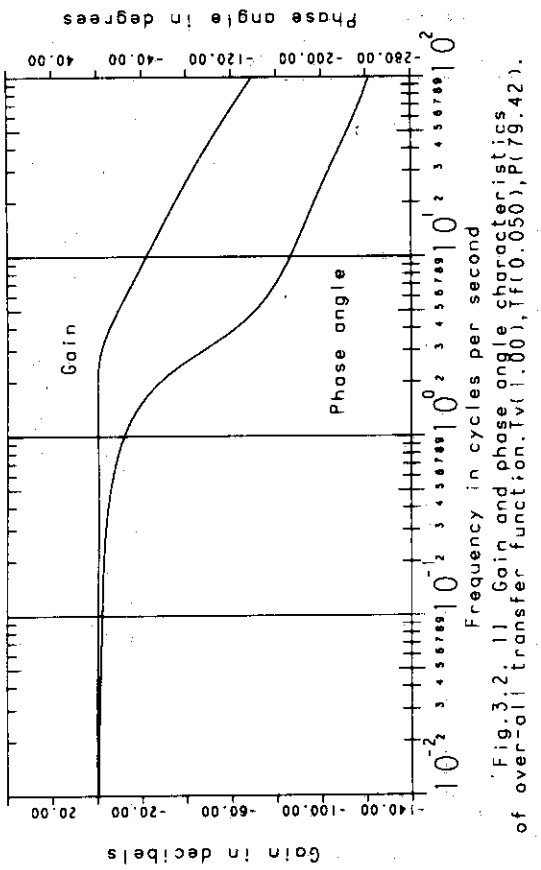

Fig.3.2; 11 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.050),P(79.42).

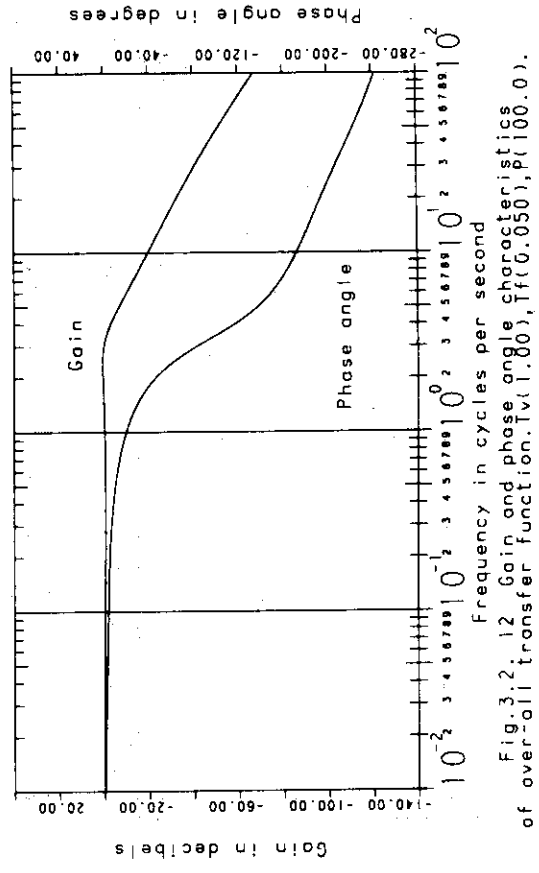

Fig.3.2; 12 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.050),P(100.0).

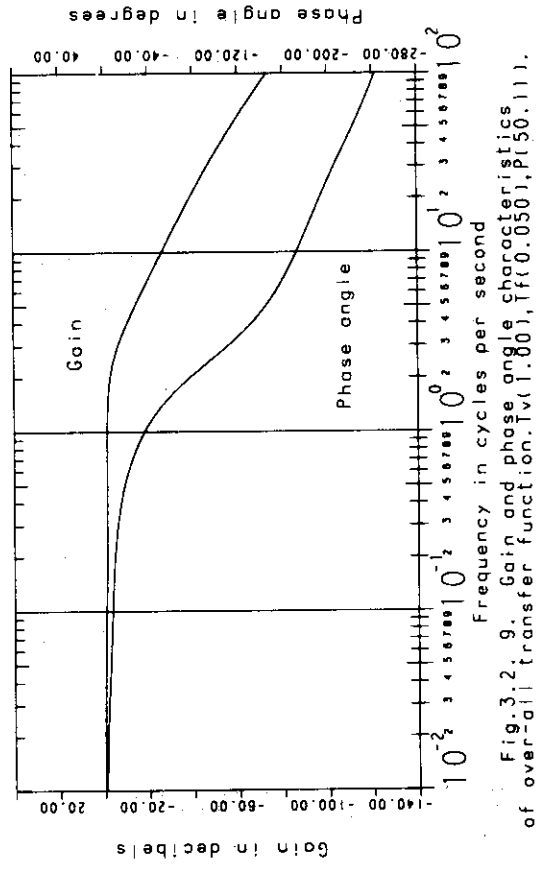

Fig.3.2; 9 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.050),P(50.11).

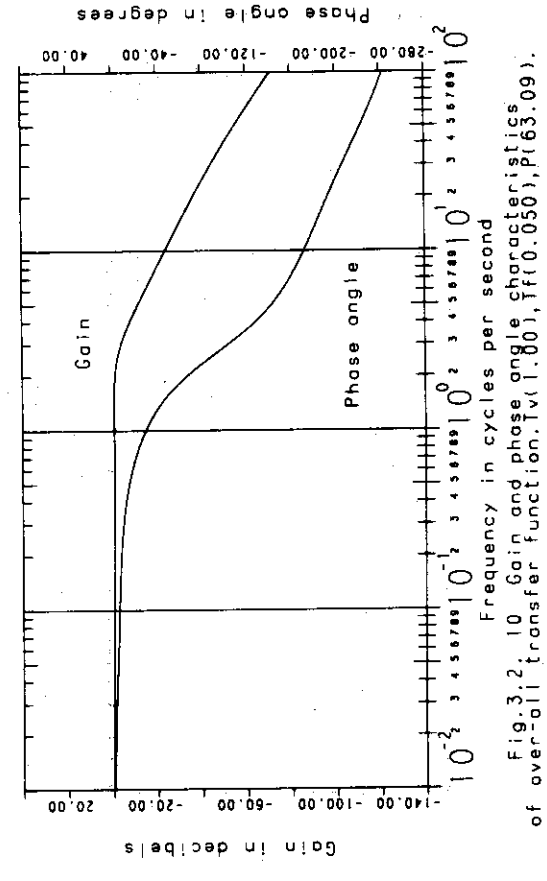

Fig.3.2; 10 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.050),P(63.09).

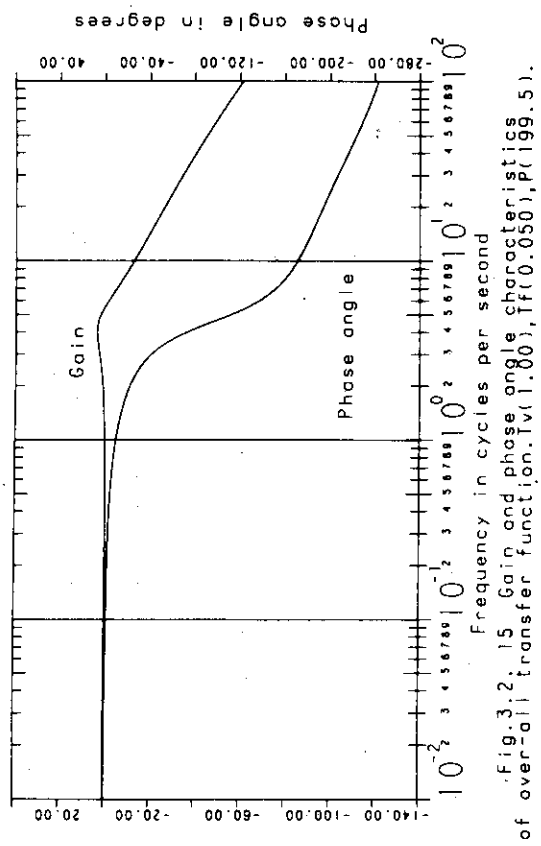

Fig.3.2.13 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(125.9).

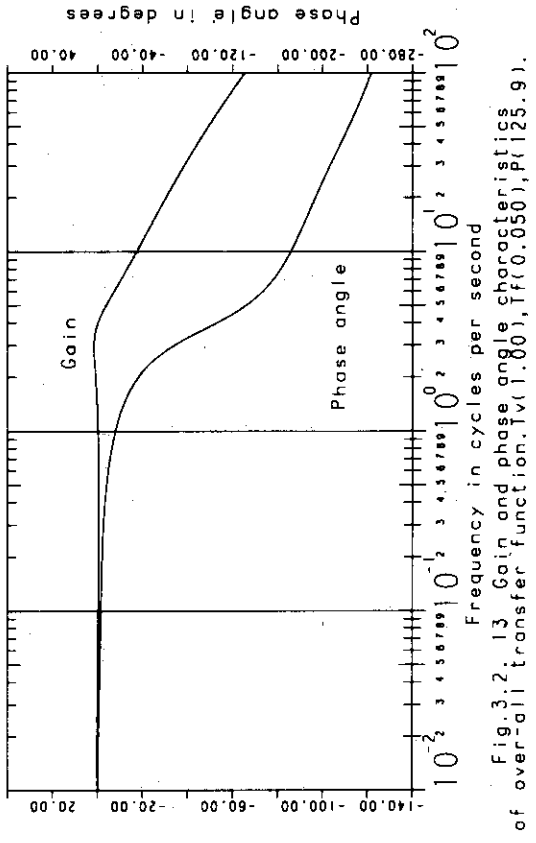

Fig.3.2.14 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(158.5).

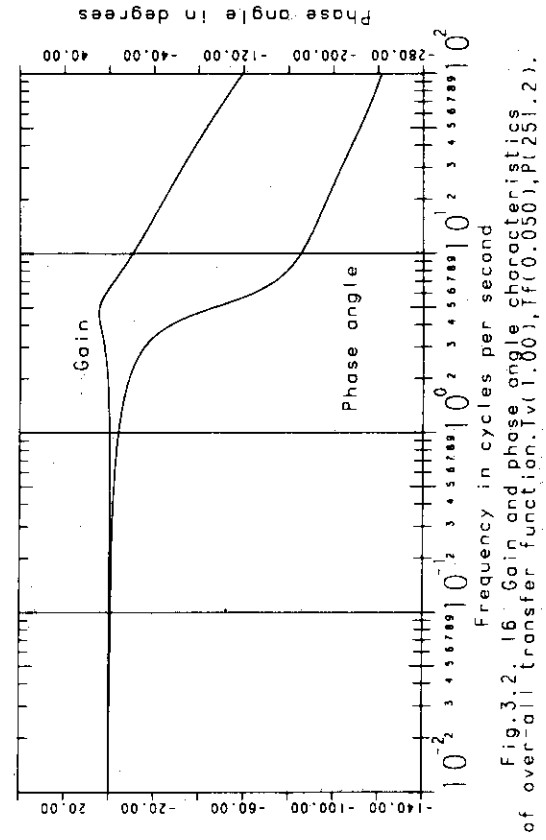

Fig.3.2.15 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(199.5).

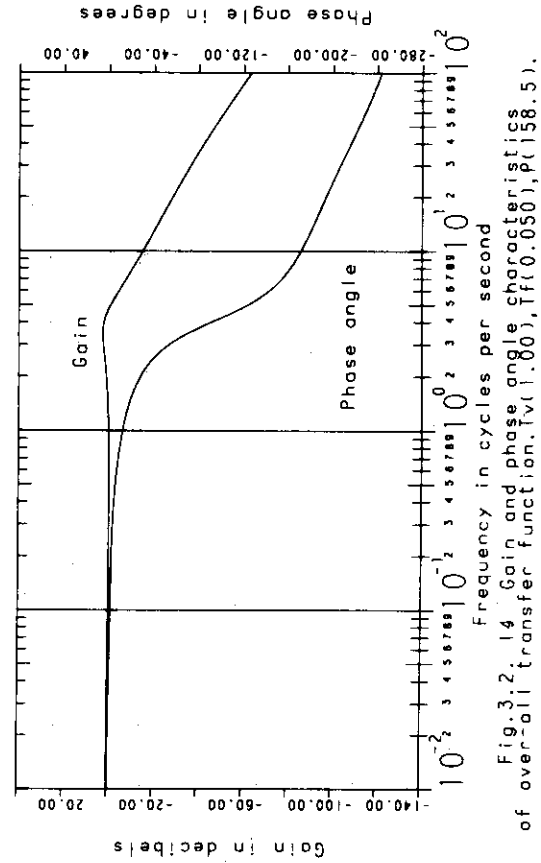

Fig.3.2.16 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(251.2).

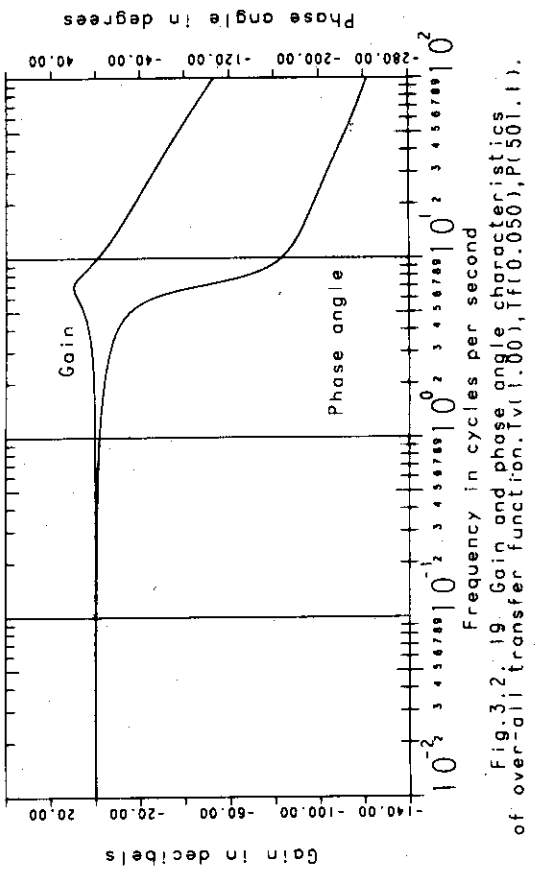

Fig.3.2; 19 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(501.1).

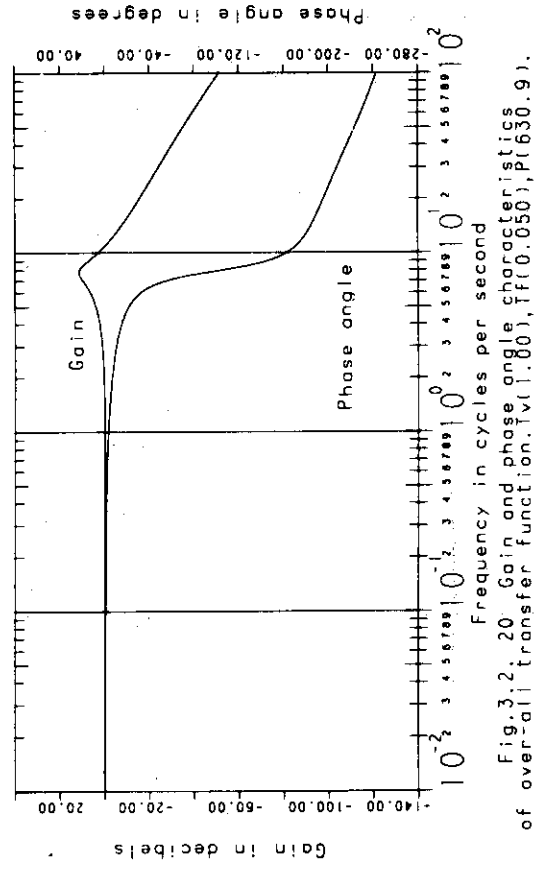

Fig.3.2; 20 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(630.9).

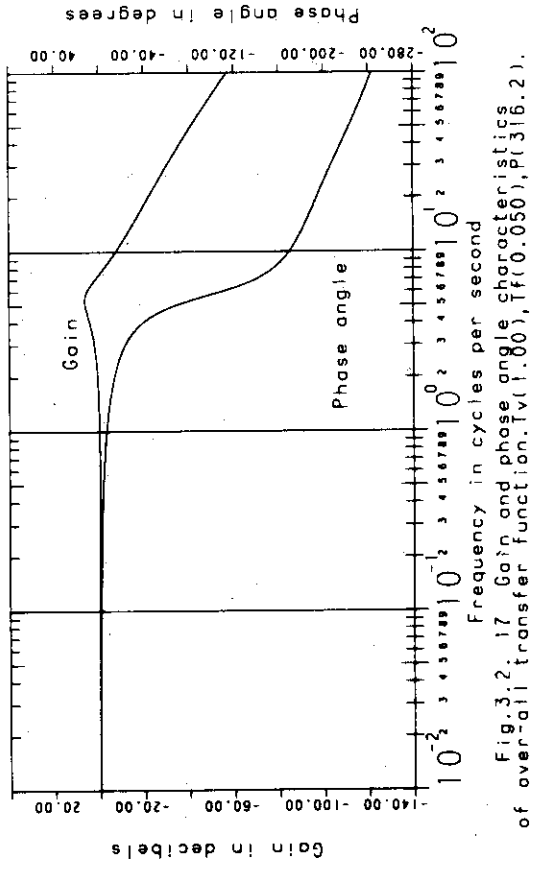

Fig.3.2; 17 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(316.2).

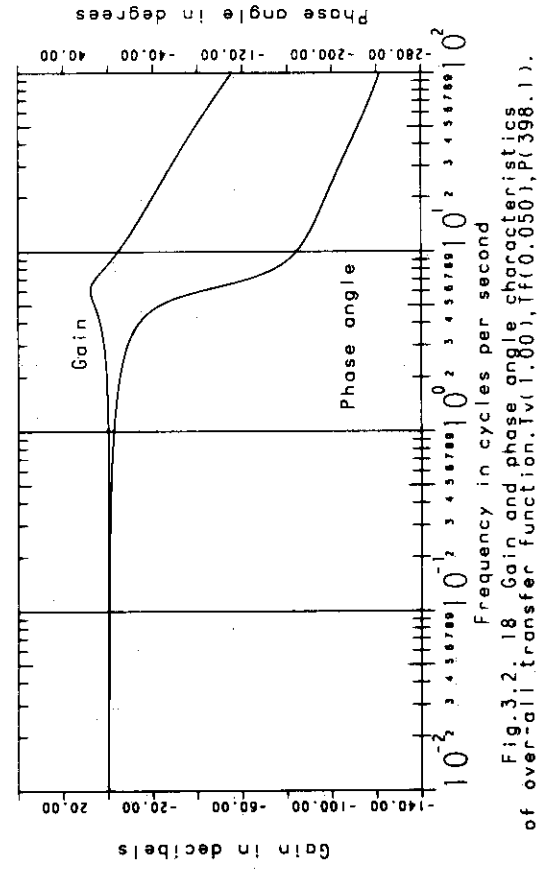

Fig.3.2; 18 Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.0501),P(398.1).

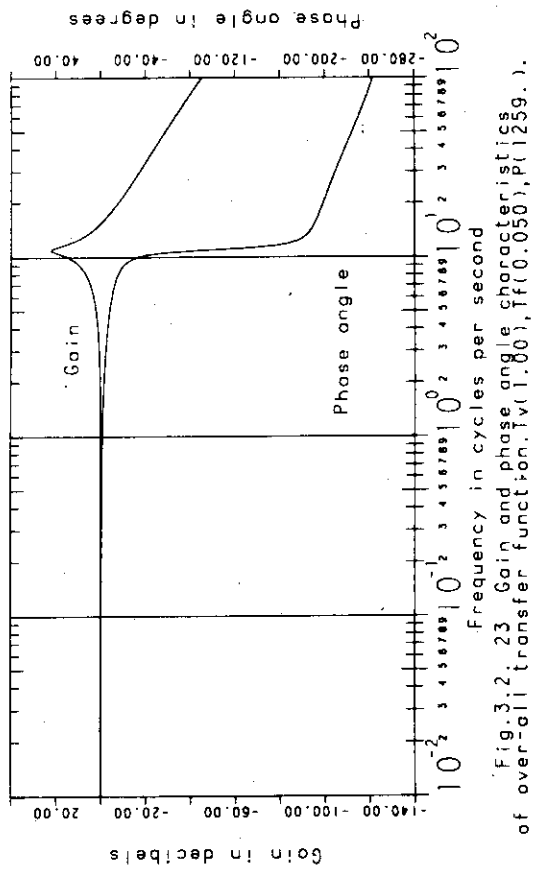

Fig.3.2.23 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(1259.).

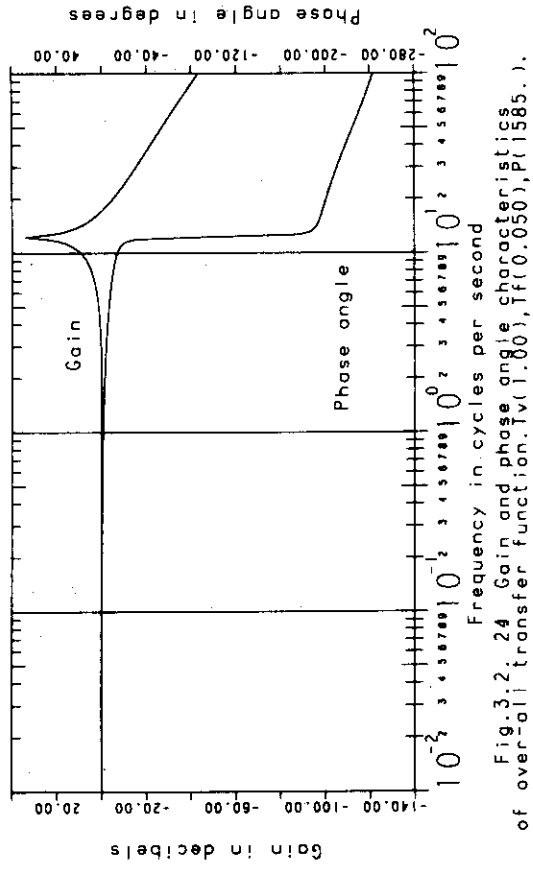

Fig.3.2.24 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(1585.).

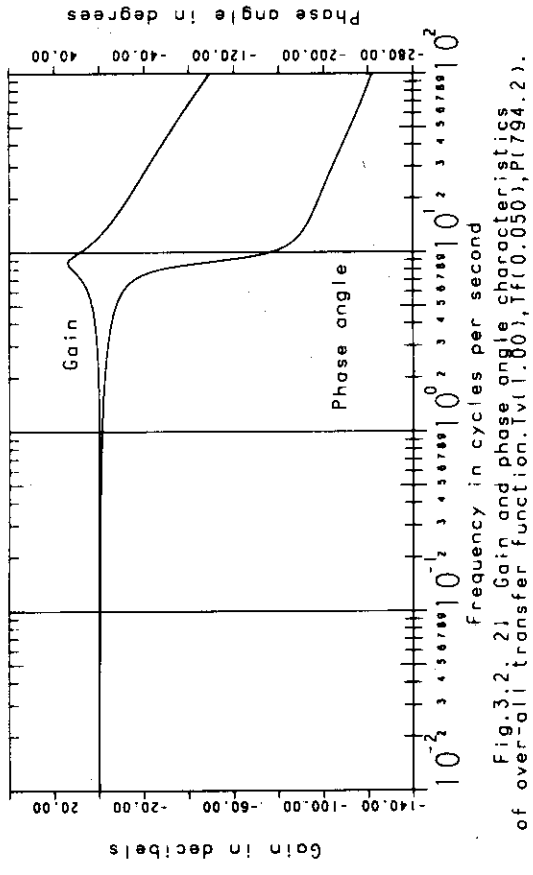

Fig.3.2.21 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(794.2).

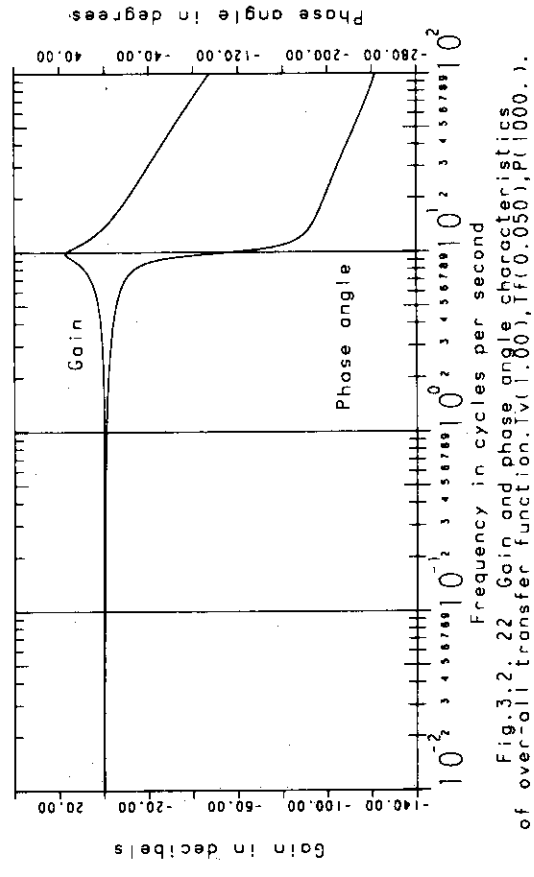

Fig.3.2.22 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.050),P(1000.).

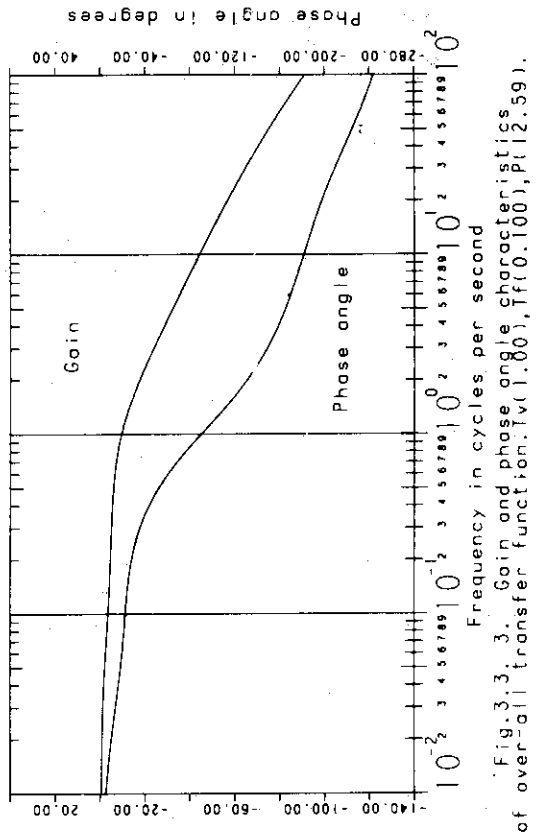

Fig.3.3.1. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),Pi(1.0).

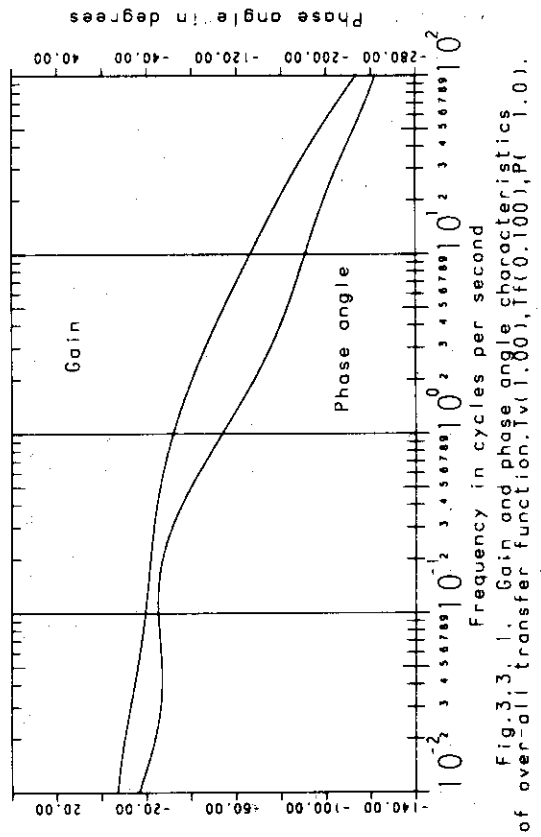

Fig.3.3.2. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),Pi(10.00).

Fig.3.3.3. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),Pi(12.59).

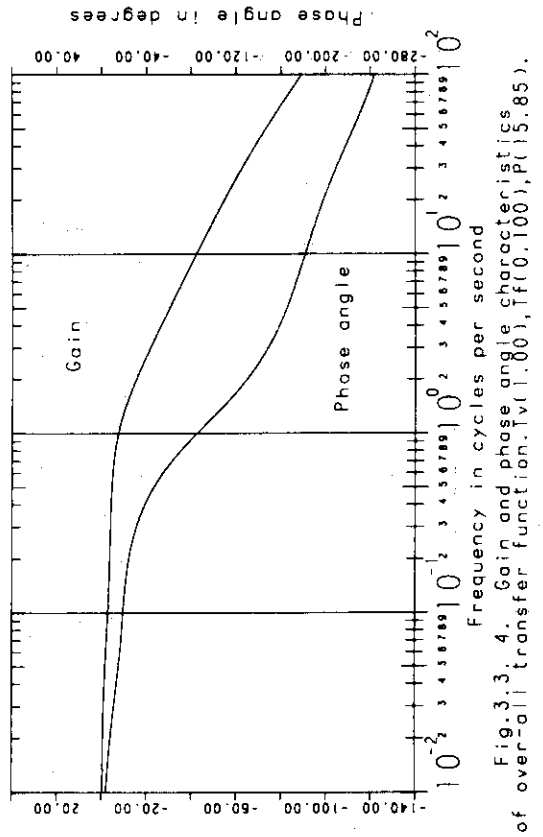

Fig.3.3.4. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),Pi(15.85).

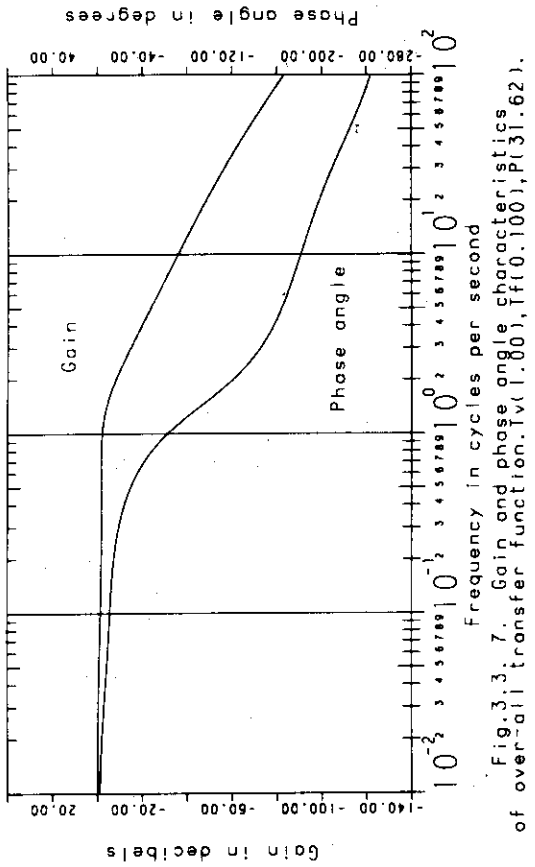

Fig.3.3.7. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),P(31.62).

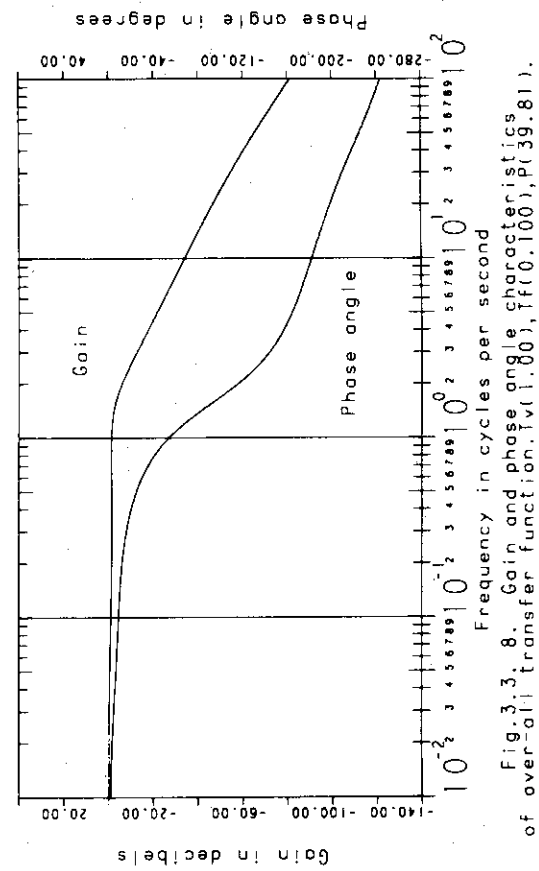

Fig.3.3.8. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),P(39.81).

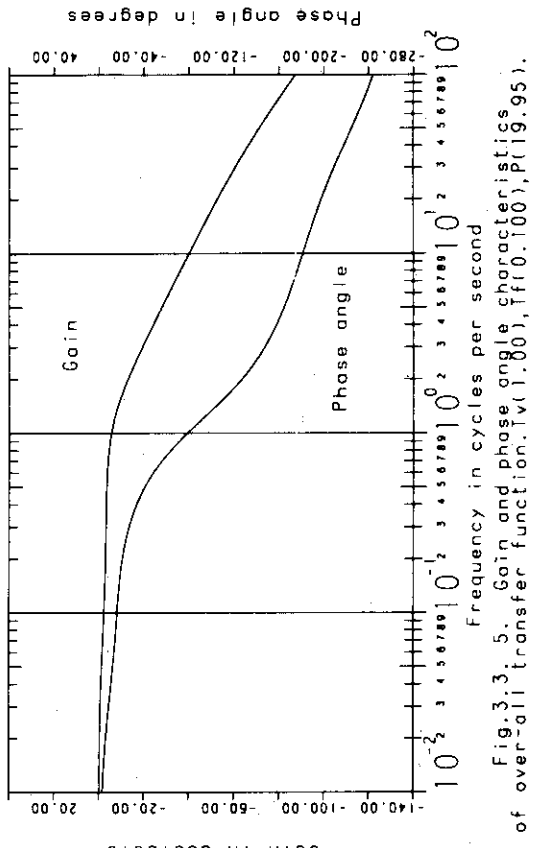

Fig.3.3.5. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),P(19.95).

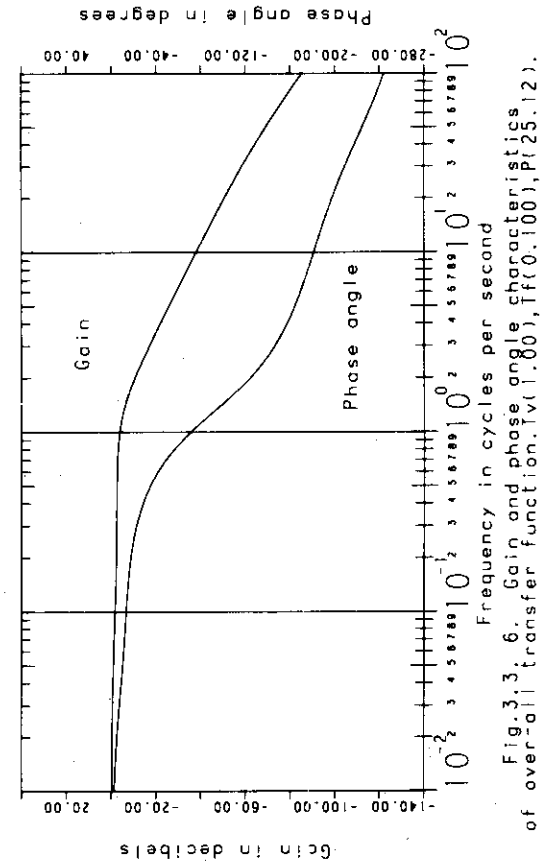

Fig.3.3.6. Gain and phase angle characteristics of over-all transfer function.Tv(1.001),Tf(0.100),P(25.12).

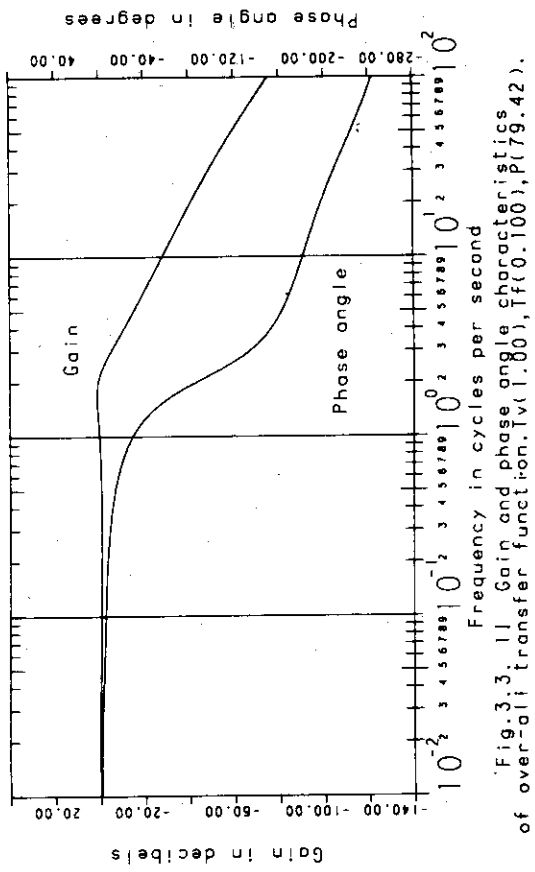

Fig.3.3; 11 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(79.42).

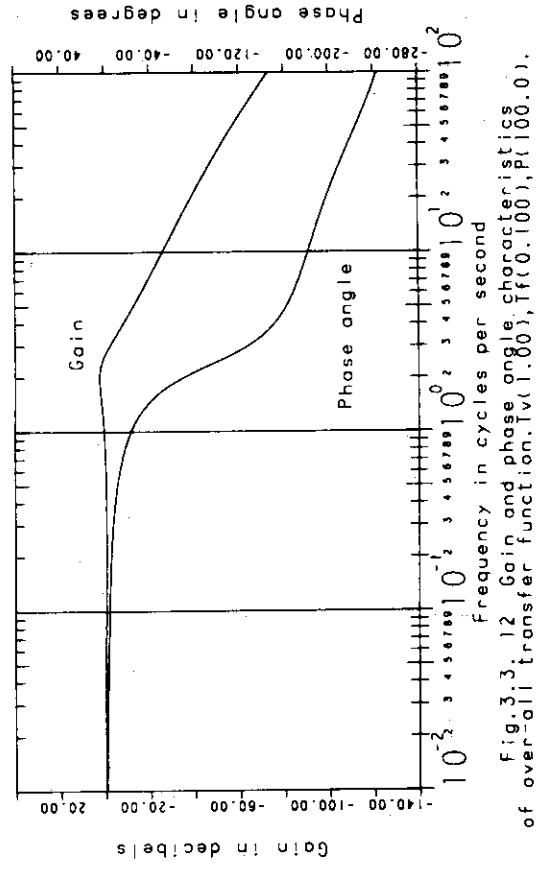

Fig.3.3; 12 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(100.0).

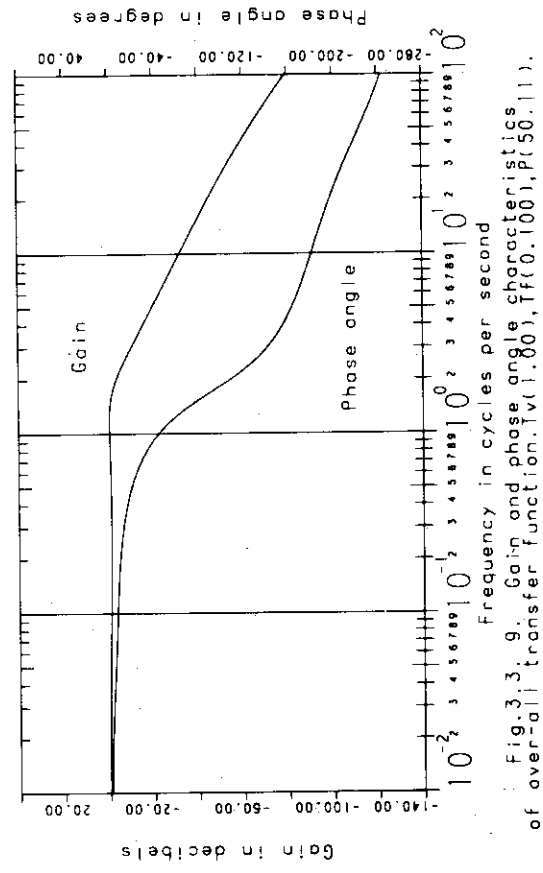

Fig.3.3; 9. Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(50.11).

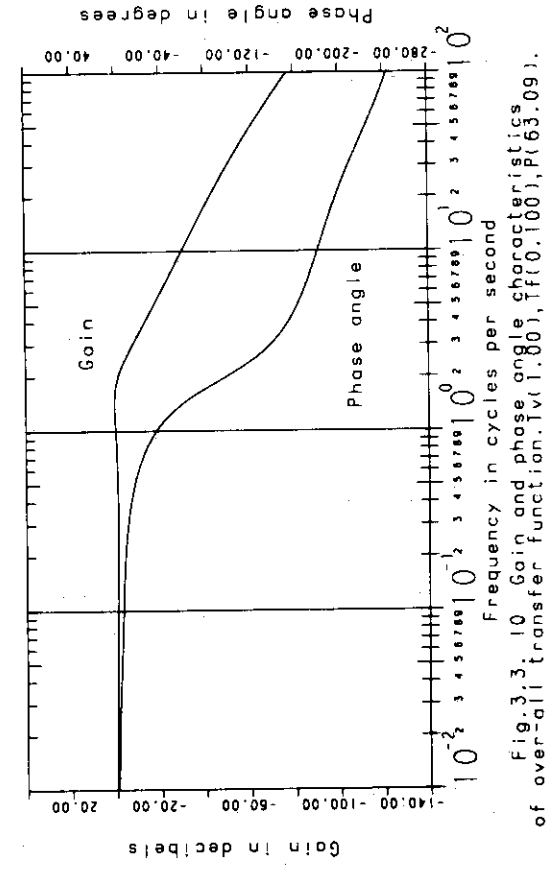

Fig.3.3; 10 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(63.09).

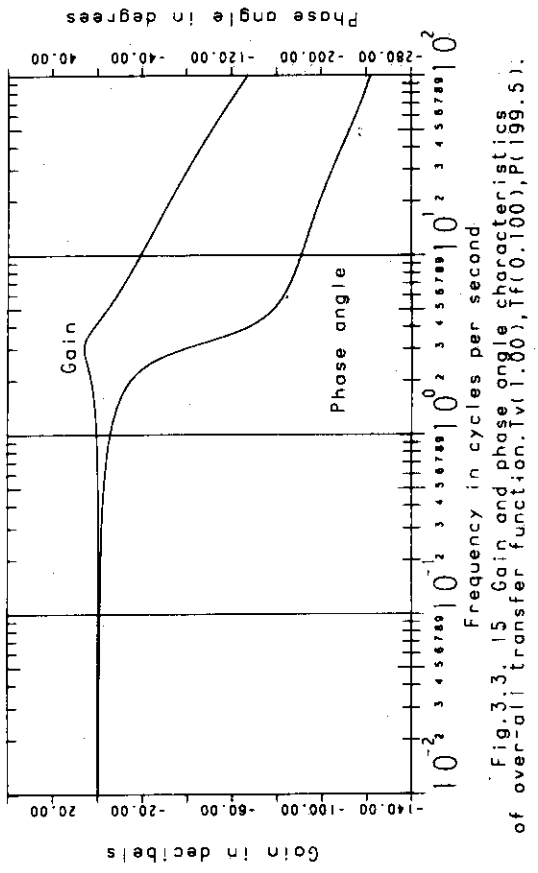

Fig.3.3. 15 Gain and phase angle characteristics of over-all transfer function.Tv(1.800),Tf(0.1000),P(199.5).

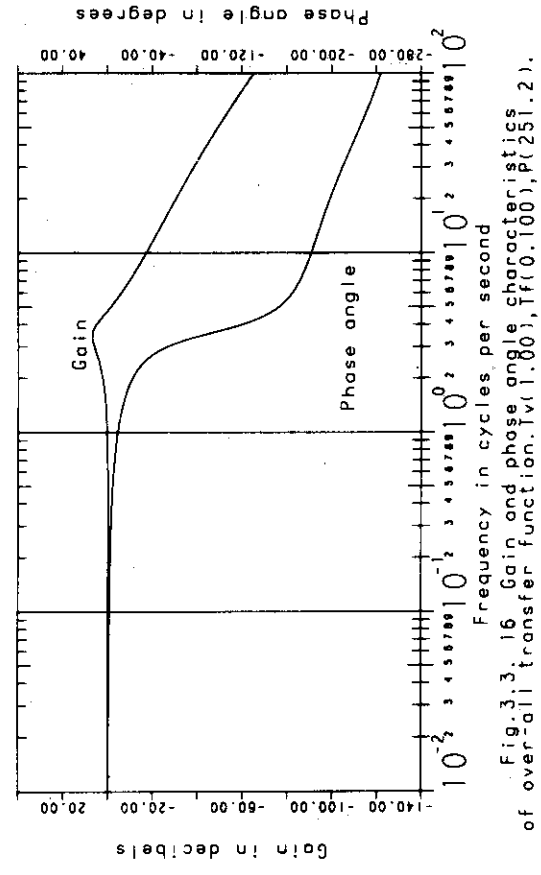

Fig.3.3. 16 Gain and phase angle characteristics of over-all transfer function.Tv(1.800),Tf(0.1000),P(251.2).

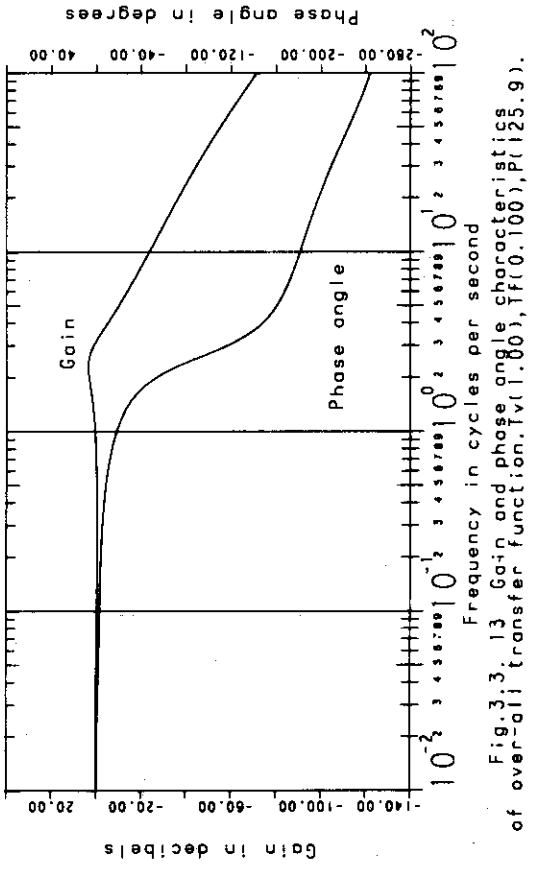

Fig.3.3. 13 Gain and phase angle characteristics of over-all transfer function.Tv(1.800),Tf(0.1000),P(125.9).

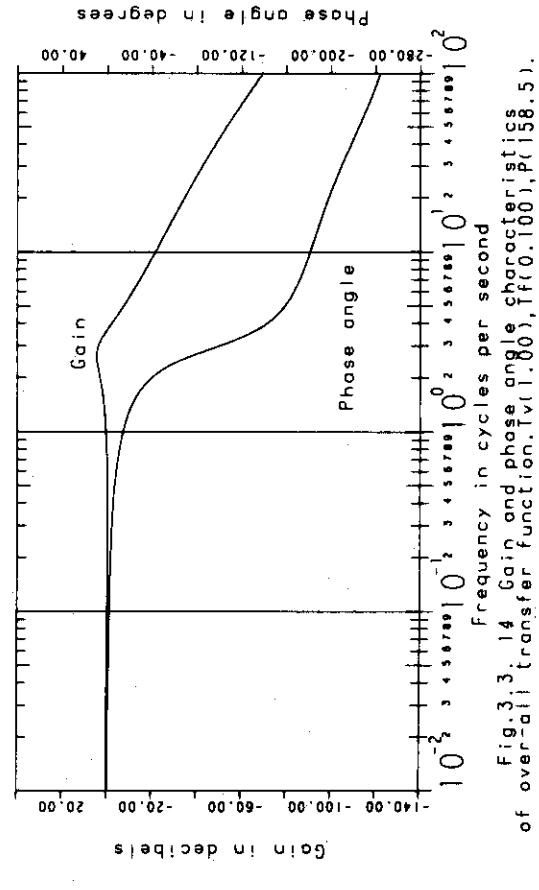

Fig.3.3. 14 Gain and phase angle characteristics of over-all transfer function.Tv(1.800),Tf(0.1000),P(158.5).

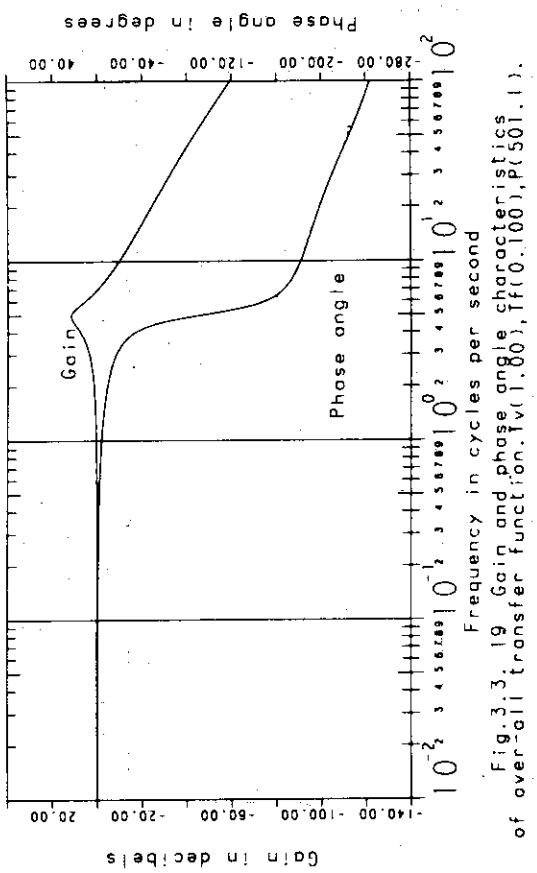

Fig.3.3.19 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(501.1).

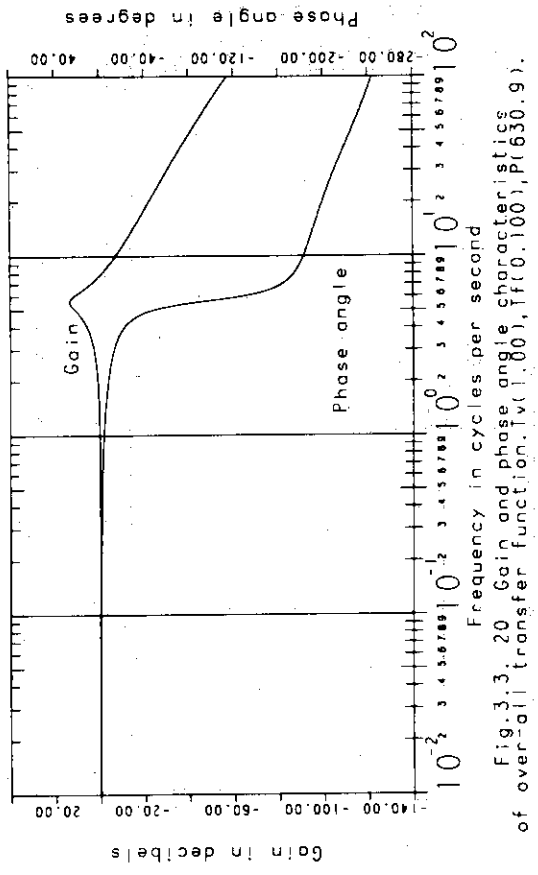

Fig.3.3.20 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(630.9).

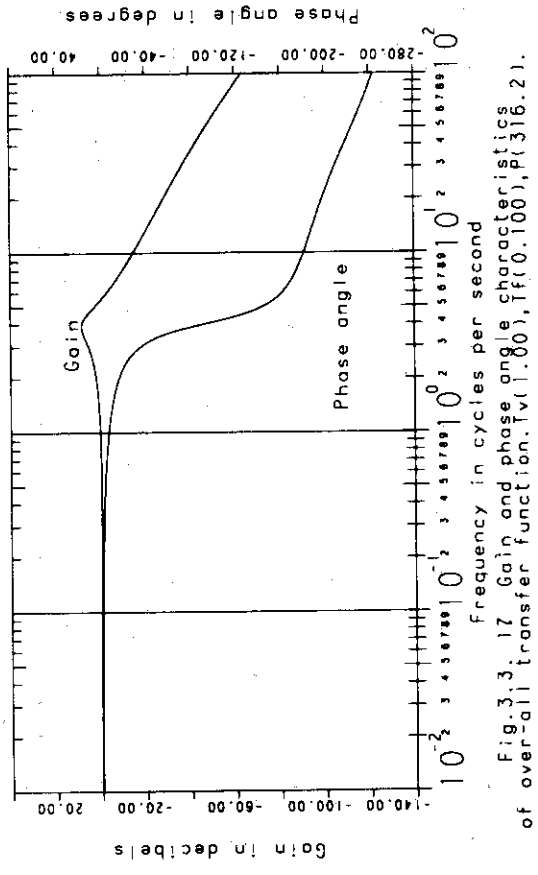

Fig.3.3.17 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(316.2).

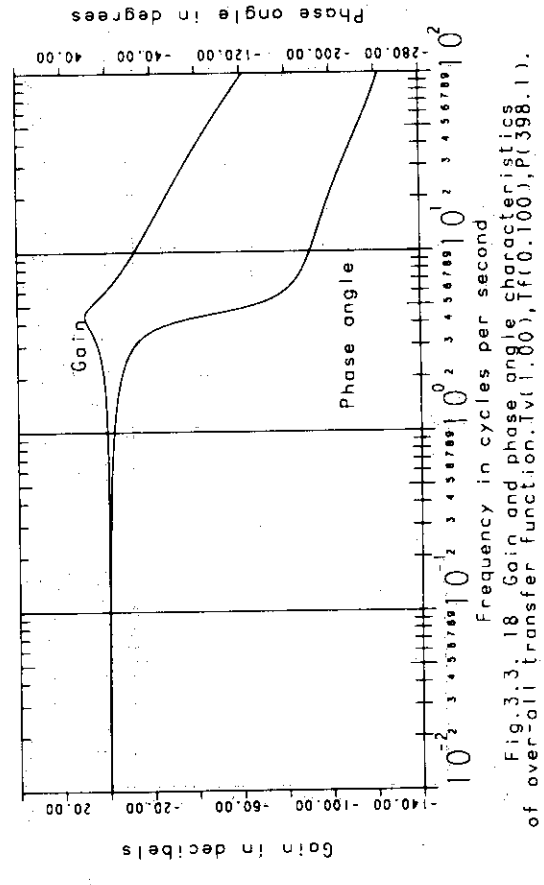

Fig.3.3.18 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(398.1).

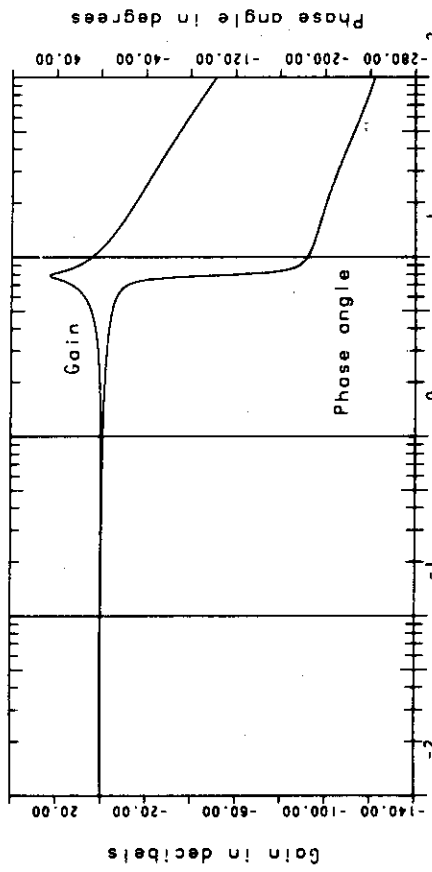

Fig.3.3. 23 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(1259.).

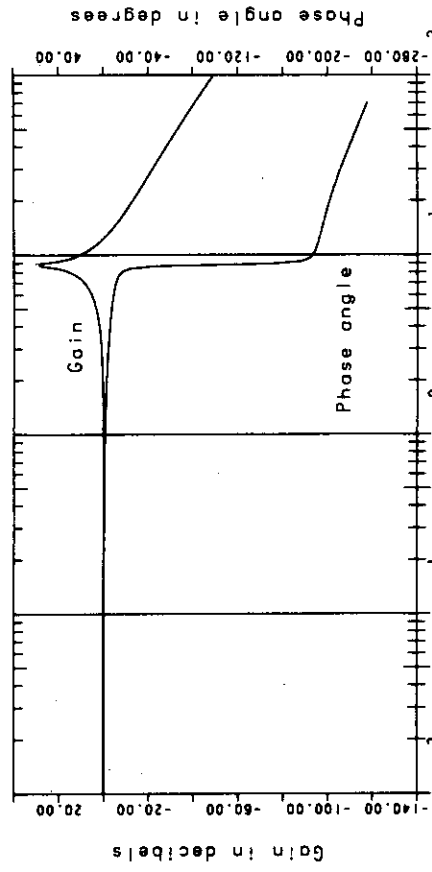

Fig.3.3. 24 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(1585.).

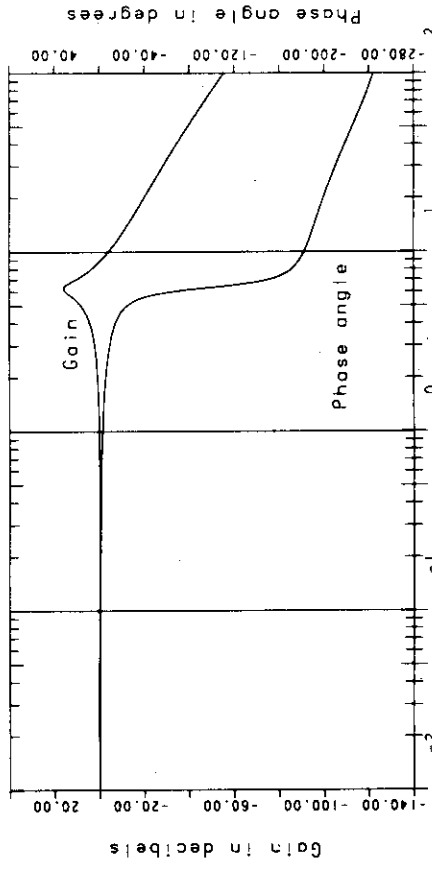

Fig.3.3. 21 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(794.2).

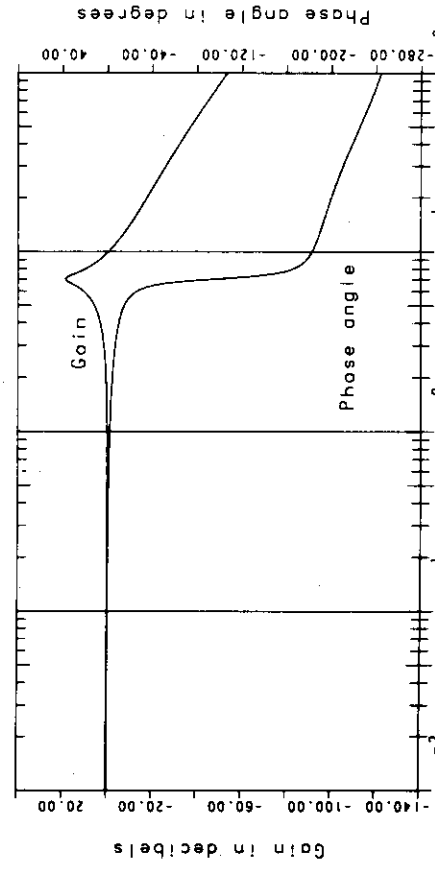

Fig.3.3. 22 Gain and phase angle characteristics of over-all transfer function.Tv(1.00),Tf(0.100),P(1000.).