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O-5.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING [2018-22 Batch]

Name of the Lab : CONTROL SYSTEM AND SIMILATION (15A02405) Year : II-II Brancl EEE Section: A Name of the faculty:

S.NO	Roll.NO	5					2					3					4					5				
		A	V	O	R	T	A	V	O	R	T	A	V	O	R	T	A	V	O	R	T	A	V	O	R	T
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Tabular Column:—

Time Domain Specifications	Theoretical Values	Practical Values
Delay time (T_d)	16.85 μsec	11.40 μsec
Rise time (T_r)	33.7 μsec	22.80 μsec
Peak time (T_p)	0.056 msec	0.04 msec
Storage time (T_s)	0.24 msec	0.42 msec

Theoretical Calculations :—

Normal frequency = $\omega_n = \frac{1}{\sqrt{LC}}$

$= \frac{1}{\sqrt{3\times10^{-3}\times100\times10^{-3}\times10^{-12}}}$

$\omega_n = 57.7$ kHz

Damping ratio = $\xi = \frac{R}{2}\times\sqrt{\frac{C}{L}}$

$= \frac{100}{2}\times\sqrt{\frac{100\times10^{-3}\times10^{-12}}{3\times10^{-3}}}$

$\xi = 0.2886$

Rise time = $t_r = \frac{\pi - \tan^{-1}\left(\frac{\sqrt{1-\xi^2}}{\xi}\right)}{\omega_n\sqrt{1-\xi^2}}$

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$t_r = \frac{\pi - \tan^{-1}\left(\frac{\sqrt{1-\xi^2}}{\xi}\right)}{\omega_n\sqrt{1-\xi^2}}$

Theory :—

Frequently the performance characteristics of a control system are specified in terms of the transient response to a unit step input, since it is easy to generated and is succenfully drastic. If the response to a step input is known it is mathematically possible to compute to response of the input.

The transient response system of a unit step depends on the initial conditions for convenience is comparing the common practice to use the output and will time derivates there of zero the response characteristics of many systems can be easily compared.

The transient response of a practical control system often exhibits damped oscillations before reaching steady state in specifying the transient response characteristics of a control system to a unit step input.

The speed of a decay of the transient response depends on the value of the time constant ξ, ω_n for given ω_n. The value settling time is a function of a damping ratio ξ from that for the same ω_n and for a range of a between 0 and 1.

S V ENGINEERING COLLEGE

Karakambadi road, Tirupati-517507, A.P
(Affiliated to J.N.T.U, Anantapur)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

(15A02405) CONTROL SYSTEMS AND SIMULATION LAB

Year: B.Tech. II - II Sem. (EEE)

LIST OF EXPERIMENTS

Any Eight of the following experiments are to be conducted:

1. Time Response of Second Order System
2. Characteristics of Synchros
3. Programmable Logic Controller – Study and Verification of Truth Tables of Logic Gates, Simple Boolean Expressions and Application of Speed Control of Motor.
4. Effect of Feedback on DC Servo Motor
5. Transfer Function of DC Machine
6. Effect of P, PD, PI, PID Controller on Second Order Systems
7. Lag and Lead Compensation – Magnitude and Phase Plot
8. Temperature Controller Using PID
9. Characteristics of Magnetic Amplifiers
10. Characteristics of AC Servo Motor

Any two simulation experiments are to be conducted:

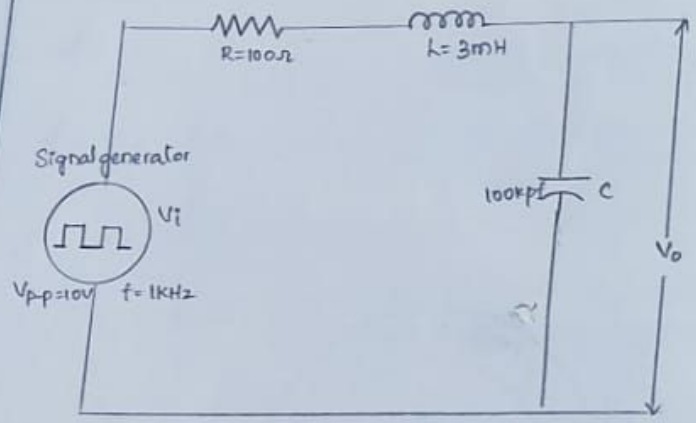
1. PSPICE Simulation of Op-Amp Based Integrator and Differentiator Circuits.
2. Linear System Analysis (Time Domain Analysis, Error Analysis) Using MATLAB.
3. Stability Analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant System Using MATLAB
4. State Space Model for Classical Transfer Function Using MATLAB – Verification.

Index

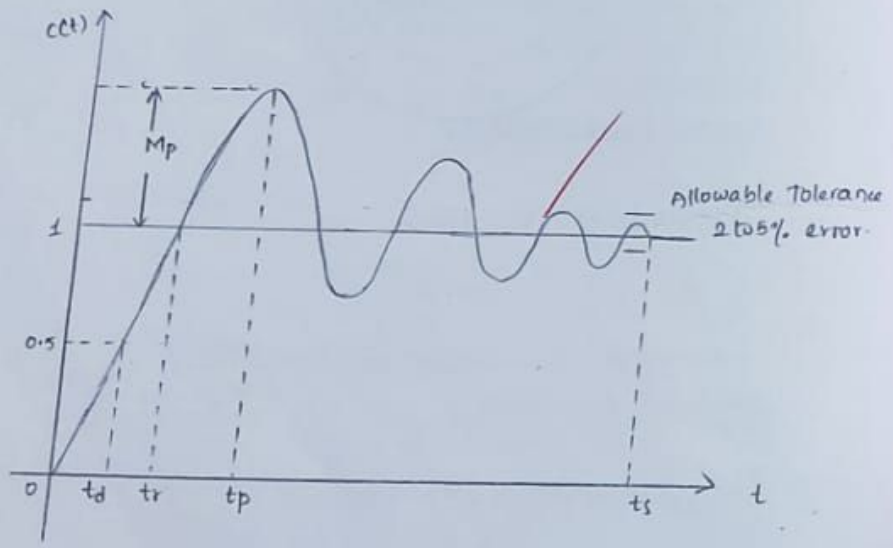
S.No.	Date	Name of the Experiment	Page No.	Marks Awarded	Remarks/ Initial's
1.	25/01	Time Response of Second Order System	01-06	10	
2.	01/02	Characteristics of Synchros.	07-11	10	
3.	23/01/20	Transfer function of DC Machine	14-19	10	
4.	18/11/20	Stability analysis of linear time invarient system using MATLAB.	20-24	10	
5.	14/11/20	Effect of P, PD, PI, PID controllers.	25-28	10	
6.	13/11/20	Characteristics of Magnetic amplifier	29-34	10	
7.	21/11/20	Determination of Steady-state Error using MATLAB.	35-39	10	
8.	13/11/20	Temperature Controller using P- controller.	40-43	10	
9.	06/02/20	Conversion of Transfer function to State Space Model.	44-48	10	
10.	23/11/20	Programmable Logic Controllers.	49-51	10	

Completed

CIRCUIT DIAGRAM :—



MODEL WAVEFORM :—



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Exp. No. : 01	TIME RESPONSE OF SECOND ORDER SYSTEM	Page No. 02
Date : 25/01/2020		

Aim :— To draw the time response of second order system and obtain the time response on the specifications.

Apparatus :—

S.No	Apparatus	Range	Quantity
1.	Decade Resistance Box	(0-100) Ω	01
2.	Decade Capacitance Box	(0-50) μF	01
3.	Decade Inductance Box	(0-1) H	01
4.	Function Generator	(0-2M) Hz	01
5.	Digital Multimeter	(0-10) A	01
6.	CRO	(0-2M) Hz Dual Trace Oscilloscope	01
7.	Patch Cards	—	Some
8.	BNC Adaptors	—	01

$$= \frac{\pi - \tan^{-1}\left(\frac{\sqrt{1-(0.2886)^2}}{0.2886}\right)}{57.73\times10^{3}\sqrt{1-(0.2886)^2}}$$

$t_r = 3.37\times10^{-5}$ sec

$t_r = 33.7$ Msec

Peak time $= t_p = \frac{\pi}{\omega_n\sqrt{1-\xi^2}}$

$= \frac{\pi}{57\times10^{3}\sqrt{1-(0.2886)^2}}$

$= 5.683\times10^{-5}$

$t_p = 0.056$ msec

% peak overshoot $= e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}}\times100$

$= e^{-0.2886\pi/\sqrt{1-(0.2886)^2}}\times100$

%Mp $= 38.79\%$

Settling time $= t_s = \frac{4}{\xi\omega_n}$

$= \frac{4}{0.2886\times57.73\times10^{3}}$

$t_s = 0.24$ msec

Exp. No. :
Date :

Page No. 04

Procedure :—

1. Connected as per circuit Diagram.
2. Applied input to the 1KHz circuit
3. Observed output across the capacitor in CRO.
4. From the plot in the CRO, Noted the time domain specifications.
5. Compare the theoretical and Practical values.

Viva- Questions :—

1. What is control System ?

The System in which the output quantity is controlled by varying the input quantity is called "control System".

2. What are the time domain specifications ?

Rise time, peak time, peak overshoot, settling time etc.,

3. What is Rise time ?

It is the time taken for the response to reach 100% at very first time.

4. What is Delay time ?

It is the time taken for the response to reach 50% of the desired value.

Delay time = $t_d = \frac{t_r}{2}$

$= \frac{33.4 \times 10^{-5}}{2}$

$t_d = 16.85\ \mu sec$

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5. What is characteristic Equation of second order system ?

$s^2 + 2\xi\omega_n s + \omega_n^2$

6. What is Maximum peak overshoot ?

It is defined as ratio between peak value to final value is explained below

$$\%\ M_p = \frac{c(t_p) - c(\infty)}{c(\infty)} \times 100$$

7. What is Settling Time ?

It is the time taken to settle down while reaching over desired value there is a limit for each and every system i.e allowable tolerance is 2 to 5%

8. What is Settling Time with 2% tolerance band ?

The Settling Time for 2% of tolerance band is $4T$, where $T = \frac{1}{\xi\omega_n}$.

9. what is relation between rise time and bandwidth ?

Rise time is usually specified as the transistion time for a signal to go from the 10% to 90% level.

10. What are various types of control systems ?

* Single Input Single output control system
* Multiple Input multiple output control system.
* Lumped and Discrete control system.

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Date :

* Time Varient and Time Invarient control system
* Linear and Non- Linear control systems.

Result :—

Hence, the time response of second order system was obtained and time domain specifications were calculated from the response.

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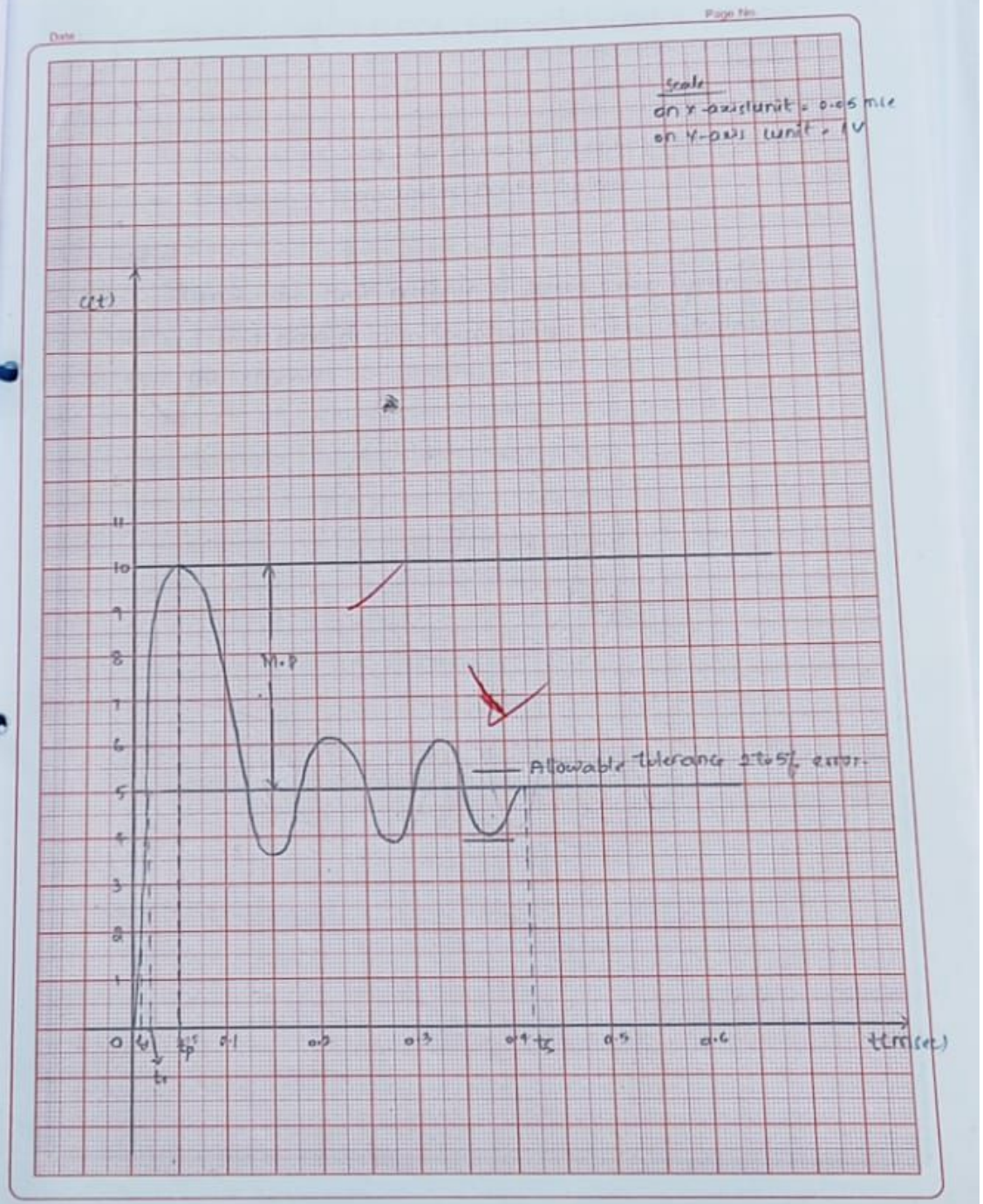
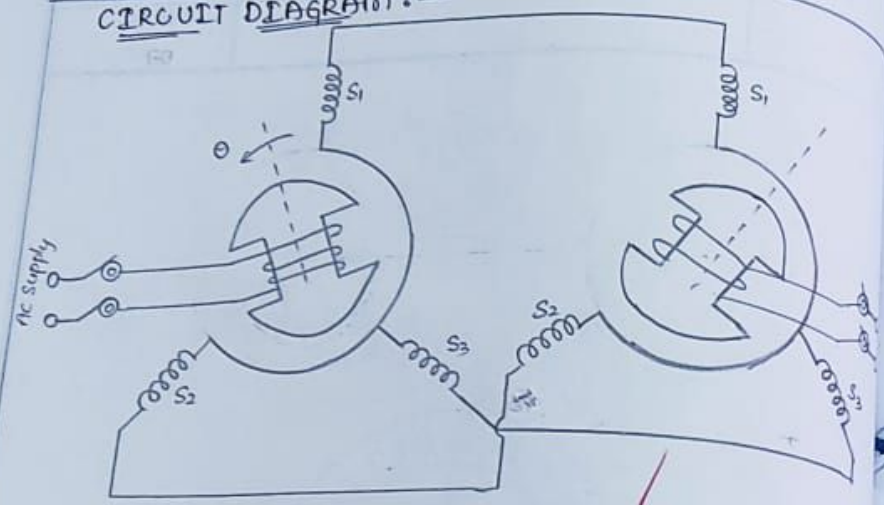
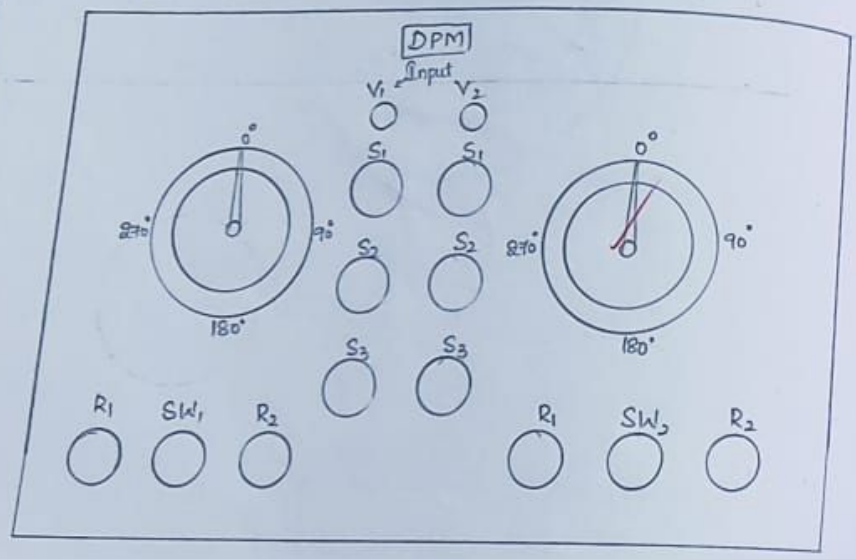

scale
on x-axis unit = 0.05 sec
on y-axis unit = 1 V
c(t)
M.P
Allowable tolerance ±5% error.
0
0.1
0.2
0.3
0.4
0.5
0.6
t(sec)
td
tr
tp
ts

CIRCUIT DIAGRAM :—



FRONT PANEL :—



S.V. ENGINEERING COLLEGE FOR WOMEN- TIRUPATI

Exp. No. : 2	CHARACTERISTICS OF SYNCHROS	Page No. 01
Date : 01/02/2020		

Aim :— To study the Synchro Transmitter and Receiver pair and draw its characteristics

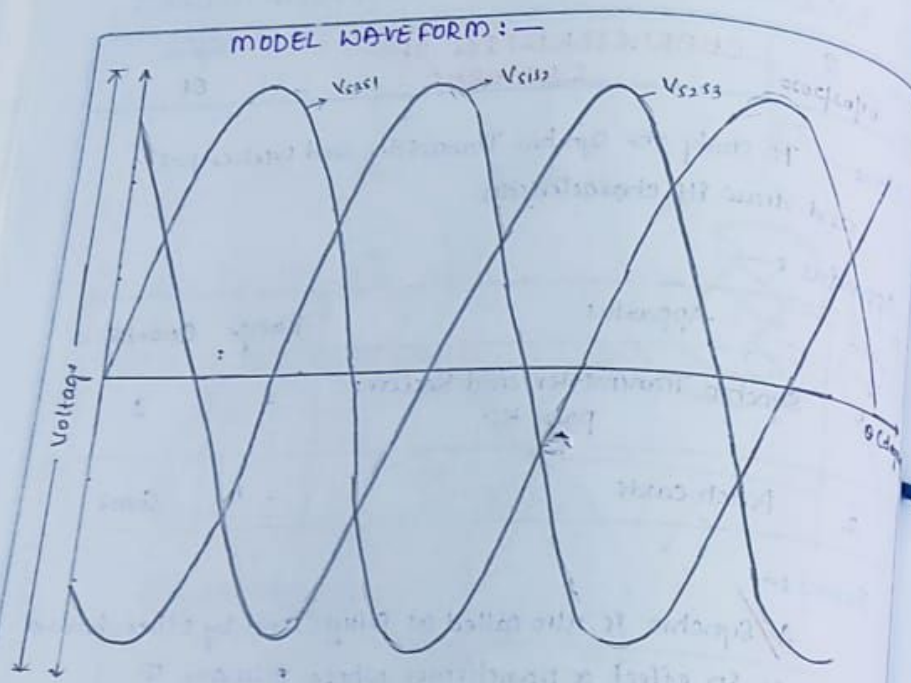
Apparatus :—

S.NO	Apparatus	Range	Quantity
1.	Synchro Transmitter and Reciever pair Kit	—	1
2.	patch cards	—	Some.

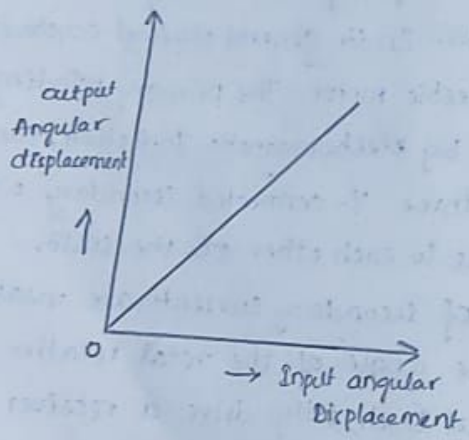
Theory :—

A Synchro is also called as Selsyn and by other brand names is in effect a transformer whose primary to secondary coupling may be varied by physically changing the relative orientation of the two windings Synchros are often used for measuring the angle of the rotating machine such as an antenna platform. In its general physical construction, it is much like an electric motor. The primary winding of the current, which by electromagnetic Induction, causes current to flow in three Y-connected secondary windings fixed at 120 degrees to each other on the stator. The relative magnitudes of secondary currents are measured and to determine the angle of the rotat relative to the currents can be used to directly drive a receiver that

MODEL WAVE FORM :—



MODEL GRAPH :—



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will rotate in uniform with the synchro transmitter.

Procedure :—

(i) Synchro Transmitter :—

* Connected the main supply to the system with the help of cable provided. Do not connectedany patch cords to terminals masked S_1, S_2 and S_3.
* Switched the main supply for the unit.
* Started from zero position, note down the voltage between Stator winding terminals i.e V_{S1S2} & V_{S2S3} & V_{S3S1} in a sequential manner.
* Entered readings in tabular columns and plotted graph of Angular position of rotor voltage for all 3-phases.
* Noted that zero position of the stator rotor coincides with V_{S3S1} voltage equal to zero voltage. Do not disturb this condition.

(ii) Synchro Transmitter and Receiver pair :—

* Connected the supply cable
* Connected the S_1 S_2 and S_3 terminals of transmitter to S_1, S_2 and S_3 terminals of synchro receiver by patch cords.
* Switched SW_1, SW_2 and also switch on the main supply
* Moved the pointer i.e rotor position of synchro transmitter in steps of 30° and observe the new rotor position.

TABULAR COLUMNS :—

Stator voltages for 3-φ (V_{S1S3}, V_{S1S2}, V_{S2S3})

Rotor voltage = V_R = 25.7 V

S.No	Position Rotor (in degrees)	Stator terminal voltage (rms)		
		V_{S3S1}	V_{S1S2}	V_{S2S3}
1.	0	0	13.7	13.8
2.	30	7.4	15.9	8.5
3.	60	13.5	14.9	1.3
4	90	16.0	9.9	5.6
5.	120	14.7	2.7	12.0
6.	150	9.4	5.4	15.8
7.	180	1.8	13.1	14.5
8.	210	6.1	16	7.9
9.	240	13.1	13.5	0.3
10	270	16.0	7.1	8.2
11.	300	13.0	6.9	14.1
12.	330	8.0	7.7	15.9

* Enter the input angular position and output angular position in the tabular form and plot the graph.

Precautions :—

* Handle the pointer for both the rotors in a gentle manner.
* Do not attempt to pull out the pointer.
* Do not short rotor (or) stator terminals.

Viva-Questions :—

1. What is meant by synchros?

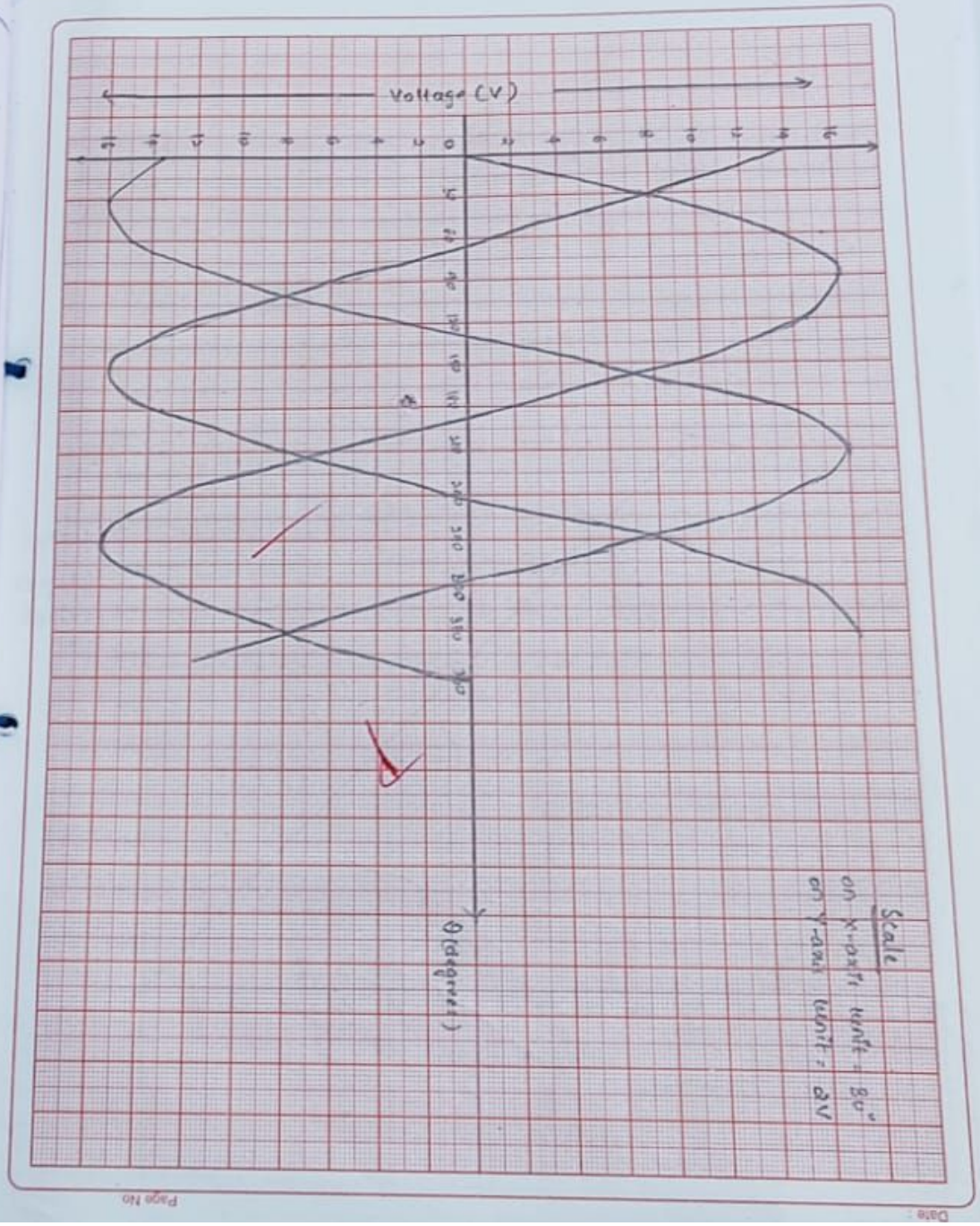
The synchros is the type of transducer which transforms the angular position of the shaft into electrical signal.

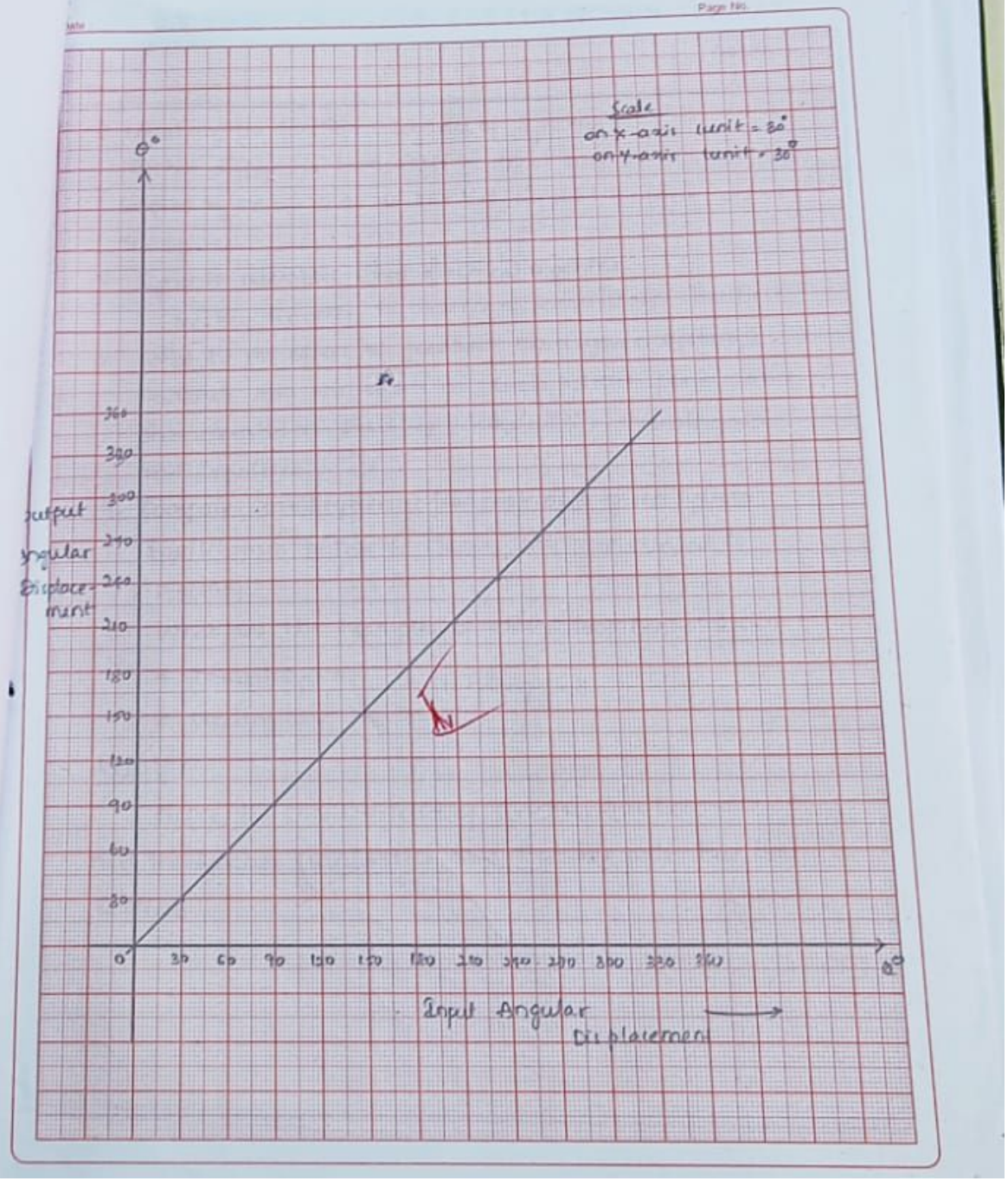
2. What are the applications of synchros?
   1. Control Differential.
   2. Control Transformer.
   3. Control Transmitter.
3. What are the types of synchros?
   1. control type synchros.
   2. Torque transmission type synchro.
4. What are the uses of synchros?
   1. Automatic control system.
   2. Fire control system.
5. Synchros are also called as?

   Selsyn, Autosyn, Syn.

SYNCHRO TRANSMITTER RECEIVER PAIR :—

S.NO	Angular position in degrees Synchro Transmitter (Input)	Angular Position in degrees Synchro Reciever (output)
1.	0°	0°
2.	30°	30°
3.	60°	60°
4.	90°	90°
5.	120°	120°
6.	150°	150°
7.	180°	180°
8.	210°	210°
9.	240°	240°
10.	270°	240°
11.	300°	300°
12	360°	330°




Scale
on x-axis 1unit = 30°
on y-axis 1unit = 30°
θ°
Output Angular Displacement
360
330
300
270
240
210
180
150
120
90
60
30
0°
30 60 90 120 150 180 210 240 270 300 330 360
θ°
Input Angular Displacement

6. What are the function categories of Synchros?

Control differential transmitter :- Input same as Tox but data supplied by ex o/p same as Tox but supplied to only a control Transformer.

7. Synchro resembles what electrical machine.

The key difference is absence of commutator brushes.

8. What is the effect of feedback on a given system?

Feedback also has effects on such systems performance, characteristics as stability, bandwidth, overall gain and Impedence.

9. Compare stability versus feedback of a given system.

Equilibrium points & Steady state are related to stability.

10. What are the examples of closed loop control system?

* Thermal System
* Steering car
* Standing still.

Result :-

Hence, the characteristics of synchros has been drawn and the Synchro transmitter and Receiver pair has been studied.

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O-5.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING [2018-22 Batch]

Name of the Lab : CONTROL SYSTEM AND SIMILATION (15A02405) Year : II-II Brancl EEE Section: A Name of the faculty:

S.NO	Roll.NO	5					2					3					4					5				
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18	189E1A0218	5	10	5	10	30	4	9	5	8	25	4	7	5	8	24	5	9	5	8	26	5	10	5	10	30
19	189E1A0219	5	8	4	10	28	5	7	4	10	26	4	9	5	9	27	5	9	4	8	26	5	10	4	9	28
20	189E1A0220	4	8	4	8	24	4	9	5	9	27	5	10	5	10	30	5	9	5	7	26	5	10	5	8	28
21	189E1A0221	4	9	5	8	25	5	7	4	10	26	5	9	5	10	29	5	10	4	7	26	5	8	5	9	27
22	189E1A0222	5	7	4	10	26	5	9	4	10	28	5	10	5	9	29	5	9	5	8	27	5	9	4	10	28
23	189E1A0223	5	10	5	10	30	4	9	5	8	25	5	9	4	9	27	5	10	5	8	28	5	8	5	9	27
24	189E1A0224	4	9	5	9	27	4	9	5	9	27	5	10	4	9	28	5	9	4	9	27	5	8	5	10	28
25	189E1A0225	5	9	4	10	28	4	8	5	9	26	5	10	4	8	27	5	10	4	9	29	5	8	5	10	28
26	189E1A0226	5	10	5	10	30	5	8	4	8	25	4	7	5	8	24	5	10	4	10	29	5	10	5	10	30