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Department Of Mechatronics Engineering

MR3361 - ELECTRICAL DRIVES AND ACTUATORS LABORATORY MANUAL

Prepared By

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VISION AND MISSION OF THE INSTITUTION

VISION
To become a world-class institution for engineering education by imparting quality education that meets global standards, cultivating students who are academically excellent, possess a positive attitude, are ethically sound and socially committed.
MISSION
❖ To enhance academic excellence by educating students in engineering principles, thereby upgrading their knowledge and skills
❖ To empower students with a positive attitude and creative thinking to develop innovative techniques in engineering
❖ To educate and cultivate dedicated learners with ethical values who are socially responsible

VISION AND MISSION OF MECHATRONICS ENGINEERING DEPARTMENT

VISION
To achieve excellence in Mechatronics Engineering through quality education and industry collaboration by integrating mechanical, electronics, computer, and control systems, thereby developing professionally competent, innovative, and socially responsible engineers to contribute in the field of automation, robotics, and smart manufacturing..
MISSION
❖ To strengthen a learner-centric and industry-integrated environment by imparting technical knowledge and practical skills in Mechatronics Engineering, including automation, robotics, IoT, and intelligent systems
❖ To equip learners with industry-relevant tools, problem-solving abilities, and innovative thinking to address real-world engineering challenges across interdisciplinary domains
❖ To nurture learners with professional ethics, leadership qualities, communication skills, and entrepreneurial skills ensuring lifelong learning and adaptability to evolving industrial demands.

MR3361 ELECTRICAL DRIVES AND ACTUATORS LABORATORY

L	T	P	C
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COURSE OBJECTIVES:

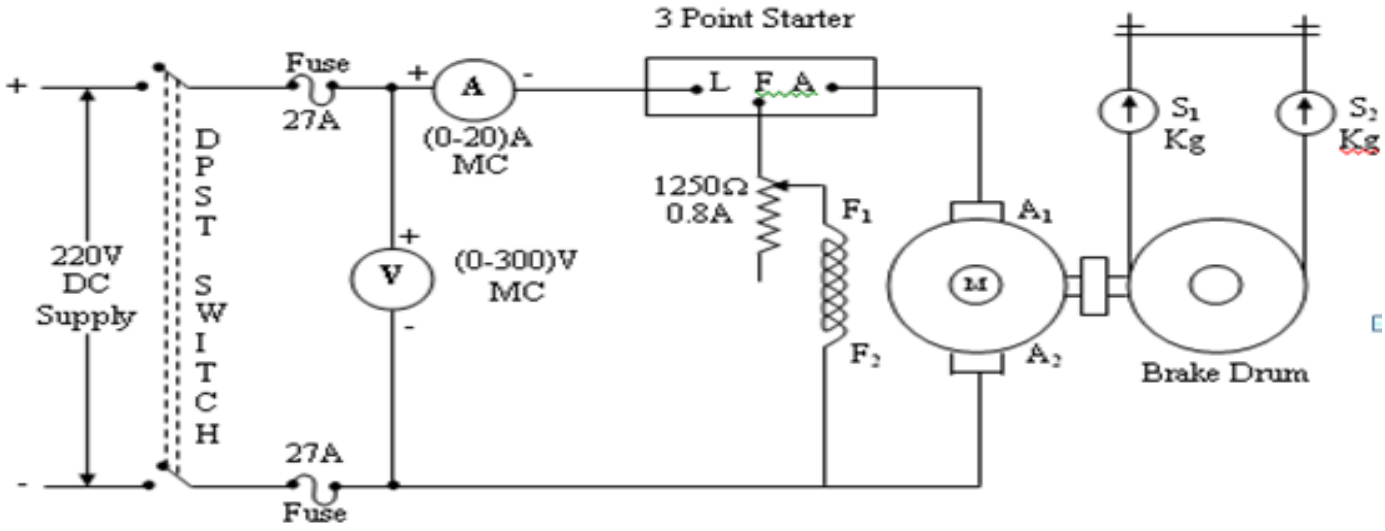
1. **To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics To impart industry oriented learning**
2. **To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation**

LIST OF EXPERIMENTS

1. **Load test on DC Motor**
2. **Load test on 3 Phase Induction Motor**
3. **Load test on 3 Phase Synchronous Motor.**
4. **Rheostat based Speed control of motors (AC and DC)**
5. **Switching circuits of MOSFET, IGBT, SCR and TRAIC.**
6. **Gate pulsation generation using PWM signals.**
7. **Speed control of DC motor using Power Electronic Drive.**
8. **Position and direction control DC servomotor using Power Electronic Drive.**
9. **Position, direction and speed control of BLDC and PMDC motors using Power Electronic Drive.**
10. **Position, Direction and speed control of stepper Motor.**
11. **Four quadrant operation of three-phase Induction Motor using Power Electronic Drive.**
12. **VFD control of single phase and three-phase induction motor using Power Electronic Drive.**
13. **AC servomotor position, direction and speed control using Power Electronic Drive.**

(Any 10 experiments)

CIRCUIT DIAGRAM FOR LOAD TEST ON DC SHUNT MOTOR:



Name Plate details

Circumference = 2 πr =_____cm

Rated Voltage : 220v

Rated current : 20A

Rated Speed : 1500RPM

EX.NO.: **LOAD TEST ON DC SHUNT MOTOR**

DT.:

AIM:

To conduct a direct load test on the given dc shunt motor and to plot the following performance characteristics: 1) Efficiency vs Output power (2) Torque vs Output power (3) Speed vs Output Power (4) Line current vs Output Power (5) Torque vs Speed.

APPARATUS REQUIRED:

S. No.	Apparatus	Range & Type	Quantity
1	DC Shunt Motor Set up	-	1 No
2	Voltmeter	(0-300 V), MC	1 No
3	Ammeter	(0-2 A), MC (0-20 A), MC	1 each
4	Rheostat	220 Ω, 1 A	1No
5	Tachometer, DPSTS	-	1each
6	Connecting wires & Fuse	-	As Required

PRECAUTIONS:

1. Remove the fuse carriers before wiring and start wiring as per the circuit diagram.
2. Check the position of the rheostat as specified in the procedure.
3. The load on motor must be released initially.
4. Fuse calculations: As this is a load test, the required fuse ratings are 120% of the rated current of the motor.
5. Replace the fuse carriers with appropriate fuse wires after the circuit connections are checked by the Staff-in-charge.

PROCEDURE:

1. The circuit connections are made as per the circuit diagram.
2. Keeping the motor field rheostat in its minimum position and the starter in its OFF position the main supply is switched ON by closing the DPSTS.
3. The motor is started using the three-point starter by slowly and carefully moving the starter handle from its OFF to ON position.
4. The motor is brought to its rated speed by gradually adjusting the field rheostat and checked with the help of a tachometer.

TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Spring Balance Reading		(S1-S2) Kg	Speed N (rpm)	Torque T (Nm)	Output Power Pm (Watts)	Input Power Pi (Watts)	Efficiency %
			S1 (Kg)	S2 (Kg)						
1.										
2.										
3.										
4.										
5.										
6.										

MODEL CALCULATION:

5.

5. Under this no load condition, one set of readings namely, applied voltage (VL), armature current (I_a), field current (If), the two spring balance readings ($F_1$and F_2) and motor speed (N) are noted down in the tabular column.
6. The load on the motor is increased in steps gradually and at each step, all the meter readings and the motor speed are recorded in the tabular column. The above procedure is repeated until the motor is loaded to 120% of its rated current.
7. After the experiment is completed, the load on motor is gradually decreased to minimum and the rheostat is brought back to its original position and then the main supply is switched OFF.
8. After completing the experiment, calculate the Torque, Armature current, Input power, Output power and Efficiency using the formulae given.
9. The plots of Efficiency vs Output Power, Torque vs Output Power, Line Current vs Output Power and Speed vs Output Power are plotted in the same graph sheet and also the Speed vs Torque response is plotted in a separate graph sheet.

FORMULAE:

$$R = \frac{\text{Circumference}}{100 \times 2\pi} \text{ m}$$

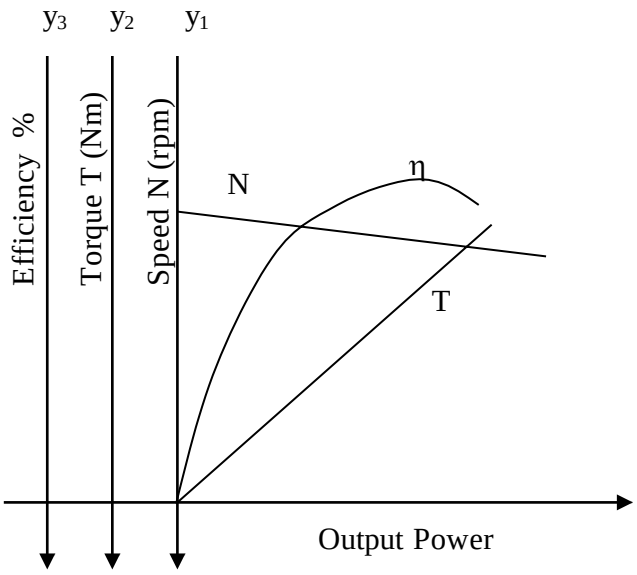
Torque T = $(S_1 - S_2) \times R \times 9.81$ Nm

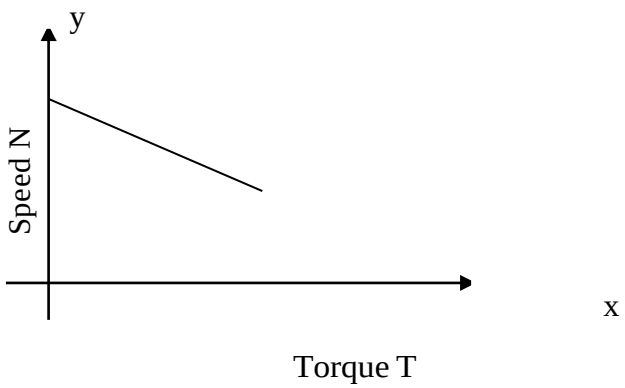
Input Power P_i = VI Watts

$$\textbf{Output Power } P_m = \frac{2\pi NT}{60} \text{ Watts}$$

$$\textbf{Efficiency \%} = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

MODEL GRAPHS:

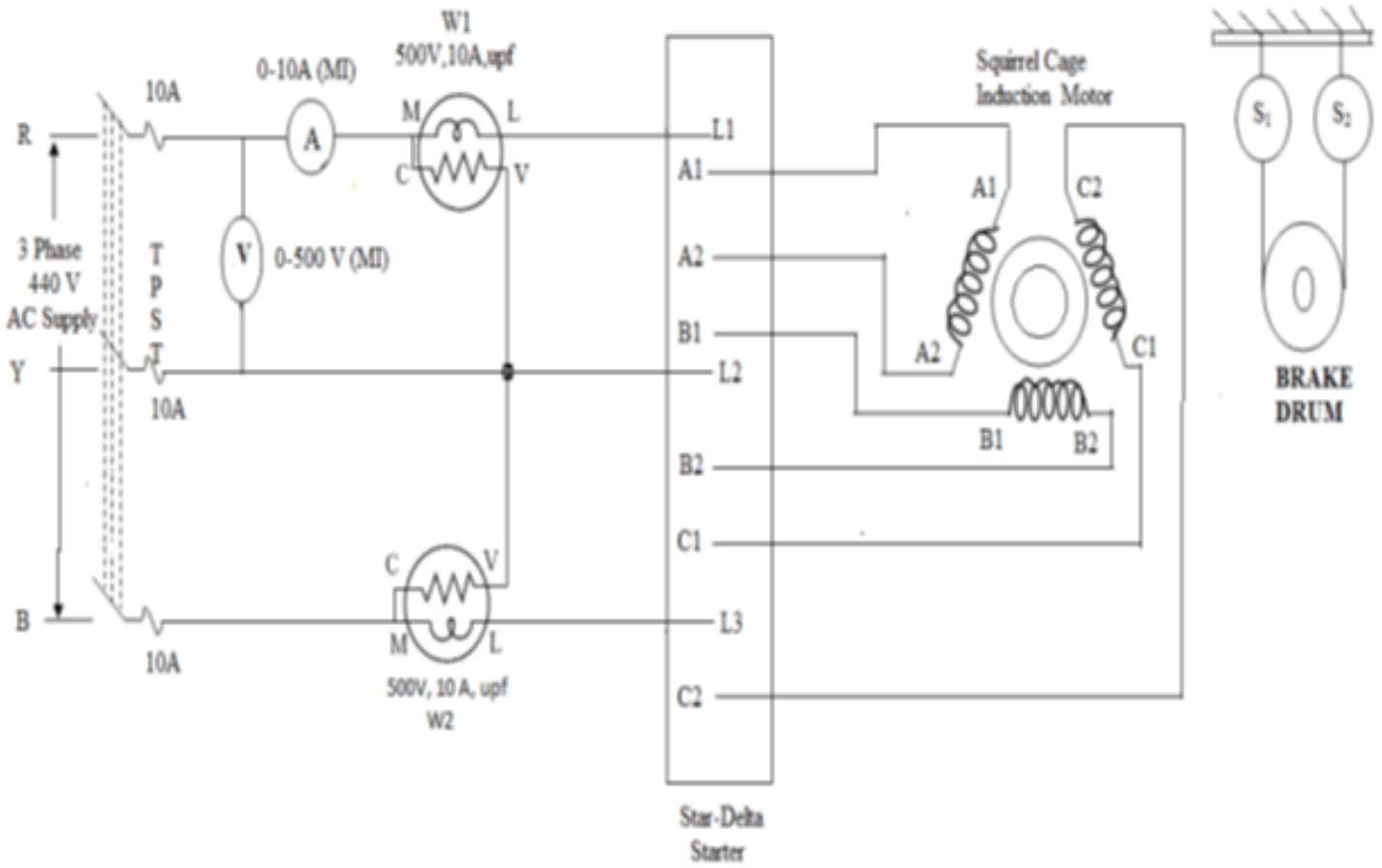




RESULT:

Thus load test on DC shunt motor is conducted and its efficiency is determined.

CIRCUIT DIAGRAM:



EX. NO.: **LOAD TEST ON THREE PHASE INDUCTION MOTOR**

DT.:

AIM:

To conduct load test on three phase squirrel cage Induction motor, 2 pole, 24 V, Δ-Connection

APPARATUS REQUIRED:

S. No.	Apparatus	Range & Type	Quantity
1	3 phase squirrel cage induction motor	415 V 3.6/4.8 A 1440 RPM with Drum Brake Loading Arrangement	1 No
2	Voltmeter	MI (0-50)V	1 No
3	Ammeter	MI (0-10)A	1 each
4	Wattmeter	75V/10A/300WUPF	2No
5	Tachometer, DPSTS	-	1each
6	Connecting wires & Fuse	-	As Required

PRECAUTIONS:

1. Remove the fuse carriers before wiring and start wiring as per the circuit diagram.
2. Check the position of the rheostat as specified in the procedure.
3. The load on motor must be released initially.
4. Fuse calculations: As this is a load test, the required fuse ratings are 120% of the rated current of the motor.
5. Replace the fuse carriers with appropriate fuse wires after the circuit connections are checked by the Staff-in-charge.

Radius of the brake drum =

Sl.no	Line voltage V_L (volts)	Line Current I_L (volts)	Power factor(cos ϕ)	W_1 Watts	W_2 Watts	(W_1+W_2) xM.F (watts)	S_1 KG	S_2 Kg	S_1-S_2 (kg)	Rotor speed (N) RPM	%Slip= (Ns-N) /N_S x100%	Torque	Output Power	Efficiency

Formula Used:

Torque = $9.81 \times (S_1-S_2) \times R$ Nm, where R is the radius of the brake drum in meter.

Output power, $P_o = 2\pi NT/60$ Watts

Input power, $P_i = W_1+W_2$ Watts

%Efficiency, $\%\eta$ = (output power/input power) $\times 100$

% Slip = $(Ns-N)/N \times 100$

Power factor = $\cos \varphi = W/VI$

PROCEDURE:

1.Connect the circuit as per fig.

2. Ensure that the motor is unloaded and the variac is set at zero output voltage.

3. Switch-on 3 phase ac mains and start the motor at reduced applied voltage. Increase the applied voltage, till its rated value.

4. Observe the direction of rotation of the motor. In case, it is reverse, change the phase sequence of the applied voltage.

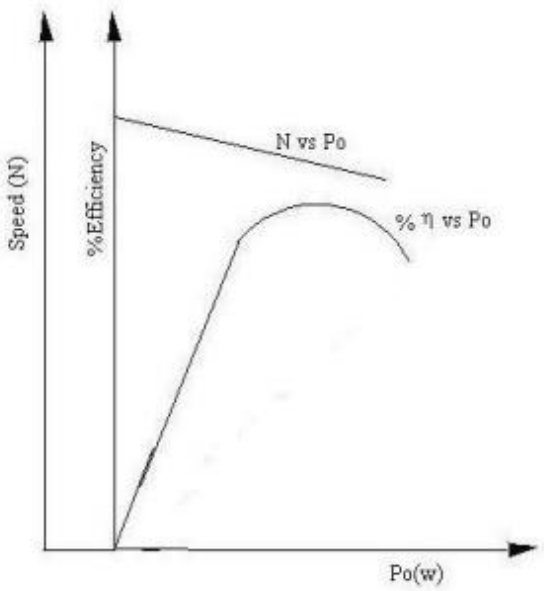
5. Take-down the readings of all the meters and the speed under no load running.

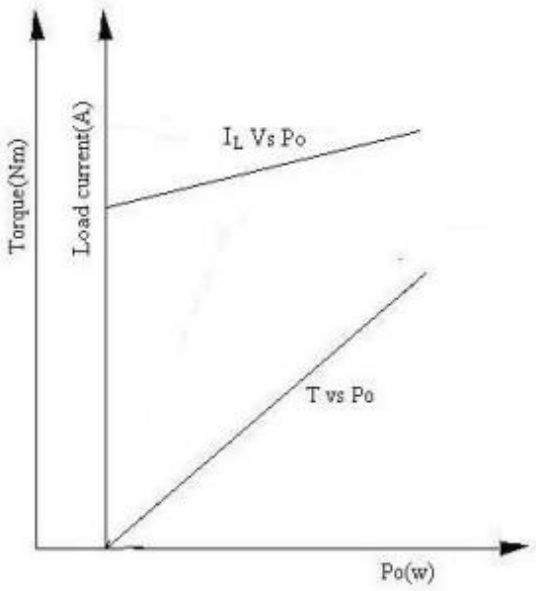
6. Increase the load on the motor gradually by turning of the hand wheels, thus tighting the belt. Record the readings of all the meters and the speed at every setting of the load. Observation may be continued upto the full load current rating of the motor.

7. Reduce the load on the motor and finally unload it completely. 8. Switch-off the supply to stop the motor.

9. Note-down the effective diameter of the brake drum

Model Graph:


Speed (N)
%Efficiency
N vs Po
% η vs Po
Po(w)


Torque(Nm)
Load current(A)
I_L Vs Po
T vs Po
Po(w)

RESULT:

Thus load test on the single phase induction motor has been conducted and its performance characteristics determined

EX.NO. : **LOAD TEST ON DC SERIES MOTOR**

DT.:

AIM:

To find performance characteristics of a DC series motor by conducting the load test

APPARATUS REQUIRED:

S. No.	Apparatus	Range	Type	Quantity
1	DC Series Motor Set up	-	1 No.	1
2	Voltmeter	(0-300 V), MC	1 No.	2
3	Ammeter	(0-20 A), MC	1 No.	1
4	Tachometer, DPSTS	-	1each	5
5	Connecting wires & Fuse	-	As Required	6

THEORY:

It is early observed that at no load the motor current and hence the flux per pole tends to zero and as a consequence the motor speed tends to increase to infinite. This is a dangerous situation and the centrifugal force will destroy the armature flux a series motor must never to allowed to run at no load torque increases the motor speed drops heavily there by the KW load on the motor of this type of speed torque characteristics and is ideally switched for function, cranes, etc., Application were as during starting a large accelerating torque is demanded by the load is at ways on the motor to there is no danger of under loading or no-loading.

FORMULAE

1. Torque (T)=S*9.81*R Nm
2. Input Power (Pi) = VL * IL watt
3. Output power (P_O) = $2\pi NT/60$ watt
4. Efficiency (η) = Output power / Input power X 100 %

where,

S - Load R – Radius of brake drum

VL – Line Voltage

IL – Line current

N – Speed in rpm

T – Torque in Nm

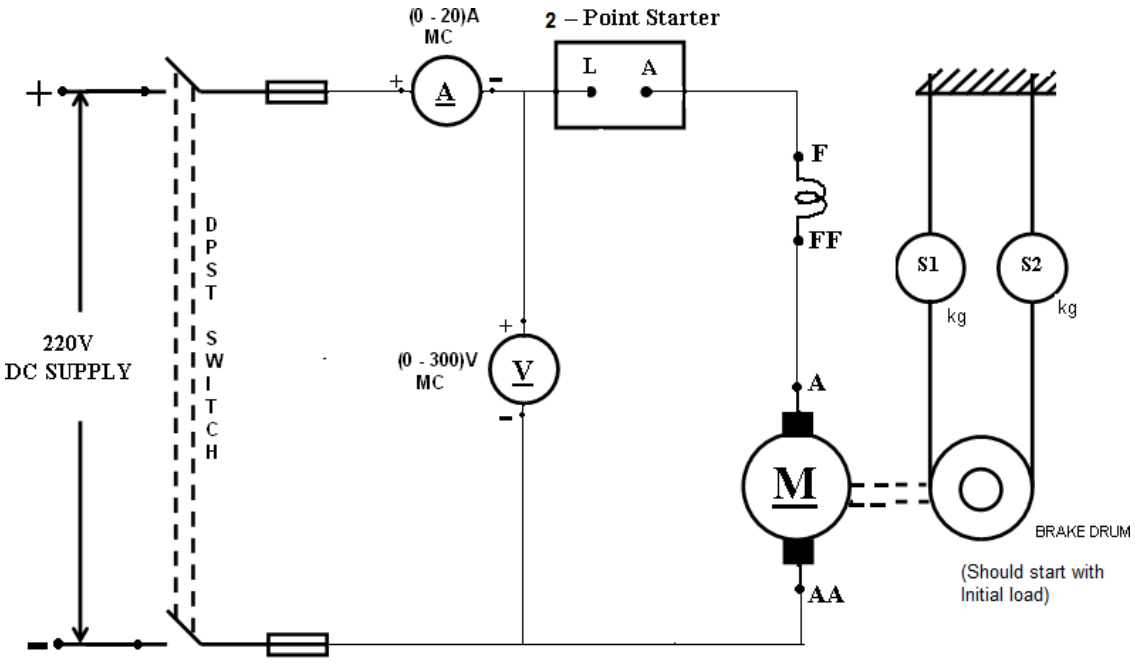
PRECAUTIONS:

1. DC series motor should be started and stopped with some load.
2. Brake drum should be cooled with water when it is under load.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the load condition, DPST switch is closed and start using 2-point starter. Ammeter, Voltmeter readings, speed and spring balance readings are noted on initialcondition.
3. The load is then added to the motor gradually and for each load, voltmeter, ammeter, spring balance readings and speed of the motor are noted up to 125% of the rated current.
4. The motor is then brought to low load condition then DPST switch is opened.

CIRCUIT DIAGRAM



TABULAR COLUMN:

Circumference of the Brake drum =_____m.

S. No.	Voltage V_L (V)	Current I_L (A)	Spring Balance Reading		$S=S_1 \sim S_2$ (Kg)	Speed N (rpm)	Torque T (Nm)	Input Power P_i (W)	Output Power P_o (W)	Efficiency η%
			S_1 (Kg)	S_2 (Kg)						
1										
2										
3										
4										
5										
6										
7										
8										

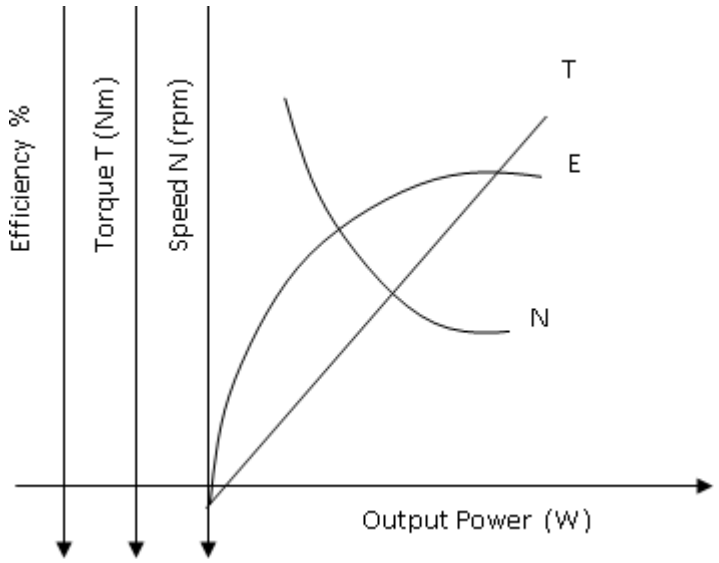
Radius of Brake drum

Circumference = 2 π R =

Radius = R=Circumference / (2 π)

=_____m

MODEL GRAPH



RESULT:

The performance characteristics of a DC series motor is conducted and plotted the characteristics curve.

EX.NO. **STUDY OF CHARACTERISTICS OF SCR, MOSFET AND IGBT**

DT.:

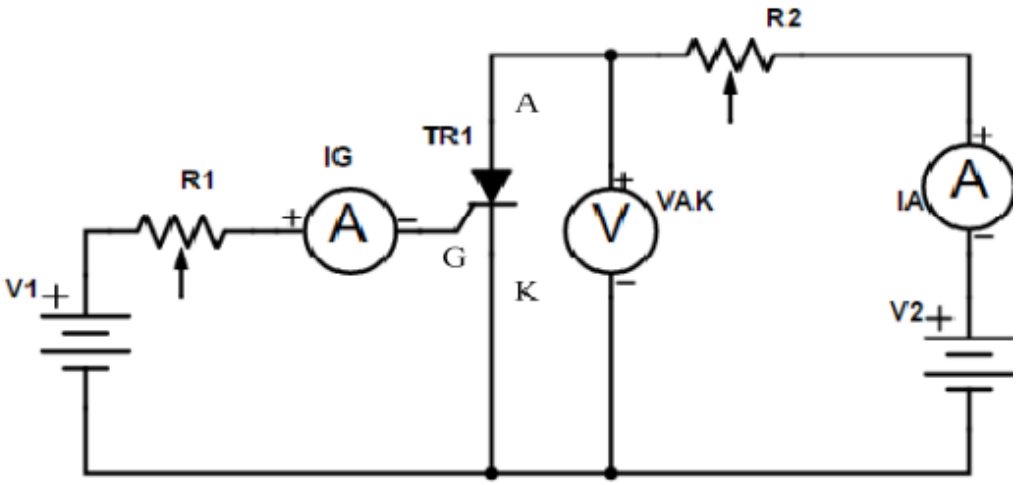
AIM:

To plot the V-I characteristics of SCR, MOSFET and IGBT.

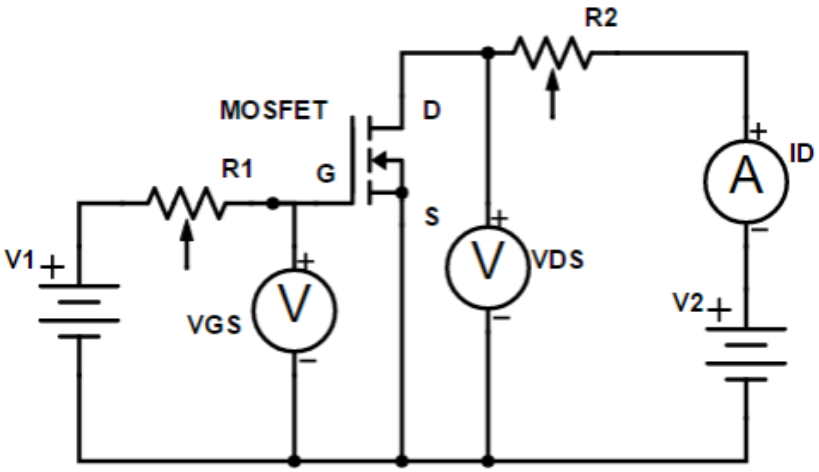
APPARATUS REQUIRED:

S. No.	Apparatus	Range & Type	Quantity
1	SCR, MOSFET & IGBT characteristic kit module	-220/10A	1 No
2	CRO	20MHZ	1 No
3	Patch Chord		Few
4	Multi Meter		1No
5	Ammeter	(0-1A, MC)	1No
6	RPS , Dual Channel	0-30 V	1No

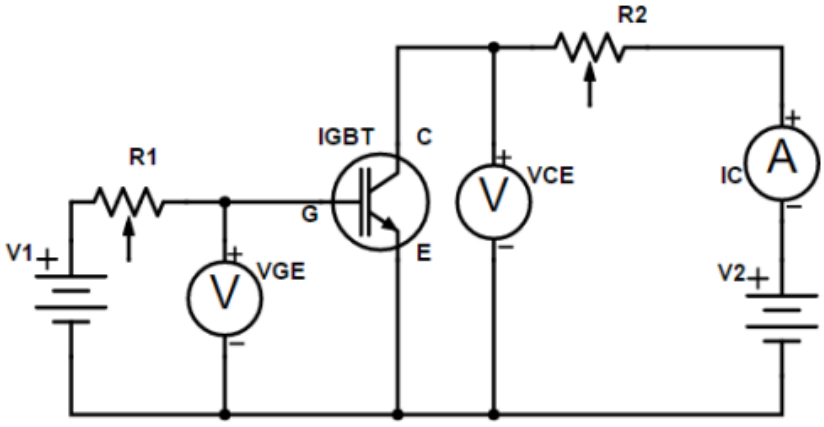
CONNECTION DIAGRAM



(a)



(b)



(c)

Fig.1.1. Connection diagram to plot V-I characteristics of (a) SCR, (b) MOSFET and (c) IGBT

PROCEDURE:

For plotting SCR characteristic curves:

1. Connections are made as per the circuit diagram given in Fig. 1.1 (a).
2. Set R_1 and R_2 to mid positions and V_1 and V_2 to minimum.
3. Set a finite gate current (I_{G1}) by varying R_1 and V_1.
4. Slowly vary V_2 (or R_2) and note down V_{AK} and I_A.
5. Repeat the steps 3 and 4 for second gate current (I_{G2})
6. Reverse the anode voltage polarity to find the reverse characteristics.

For finding holding current of SCR:

1. Ensure SCR is at ON state
2. Remove the gate voltage and start reducing V_{AK} ; simultaneously verify the state of SCR. If SCR is turned off, note the current (I_A) just before it comes to zero.

For finding latching current of SCR:

1. Ensure that the SCR is in the state of conduction.
2. Start reducing anode voltage (V_{AK}) slowly; simultaneously check the state of SCR by switching off gate supply. If SCR switches off just by removing gate terminal, and switches on by connecting gate supply, then the corresponding anode current (I_A) is the latching current for the SCR.

For plotting MOSFET static (Drain) characteristic curves:

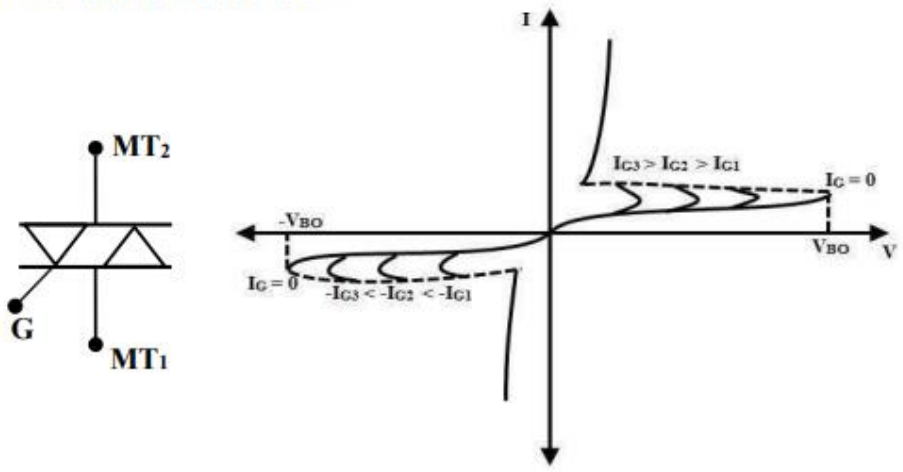
1. Connect the circuit as given in Fig. 1.1 (b).
2. Set a finite gate source voltage (V_{GS1}) by varying R_1 and V_1.
3. By varying V_2 (or R_2), note down V_{DS} and I_D.
4. Repeat the steps 3 and 4 for second gate source voltage (V_{GS2})

For plotting IGBT static (Collector) characteristic curves:

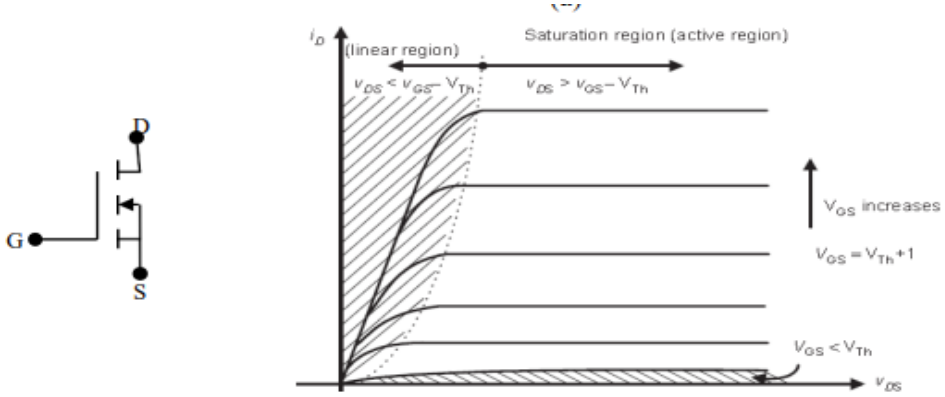
1. Connect the circuit as given in Fig. 1.1 (c).
2. Set a finite gate source voltage (V_{GE1}) by varying R_1 and V_1.
3. By varying V_2 (or R_2), note down V_{CE} and I_C.
4. Repeat the steps 3 and 4 for second gate source voltage (V_{GE2})

MODEL GRAPHS

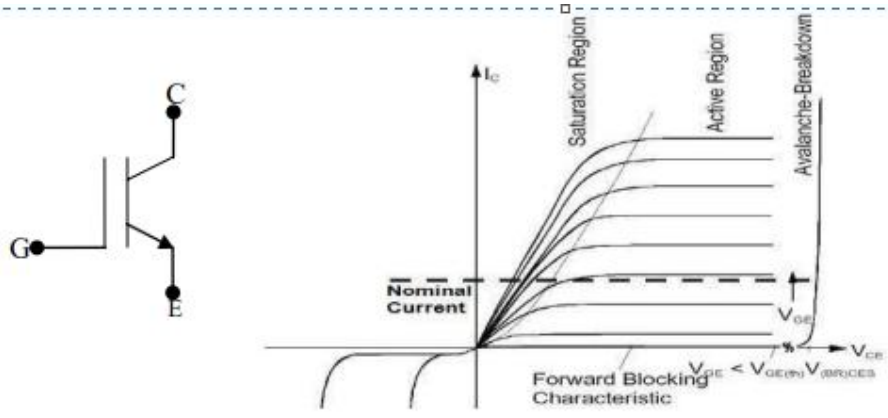
V-I Characteristics of SCR



(a)



(b)



(c)

Fig.1.2. V-I characteristics of (a) SCR (b) MOSFET (c) IGBT

TABULAR COLUMN :

I_{G1} = ___mA		I_{G2} = ___mA	
V_{AK} (Volts)	I_A (mA)	V_{AK} (Volts)	I_A (mA)

Observations of MOSFET

V_{GS} = __v		V_{GS} = ___v	
V_{DS} (Volts)	I_D (mA)	V_{DS} (Volts)	I_D (mA)

Observations of IGBT

V_{GE} = ___		V_{GE} = ___	
V_{CE} (Volts)	I_C (mA)	V_{CE} (Volts)	I_C (mA)

Result:

The static characteristics of the given **SCR, MOSFET AND IGBT** is plotted.

EX. NO. : **GATE PULSATION GENERATION USING PWM SIGNALS**

DT.:

AIM:

To obtain Single phase output wave forms for IGBT based PWM inverter

APPARATUS REQUIRED:

S. No.	Apparatus	Range & Type	Quantity
1	IGBT Based PWM inverter Kit	-220/10A	1 No
2	CRO	20MHZ	1 No
3	Patch Chord		Few
4	Load rheostat	50Ω/5A	1No

PROCEDURE :

1. Make the connection as per the circuit diagram.

2. Connect the gating signal from the inverter module.

3. Switch ON D.C 24V.

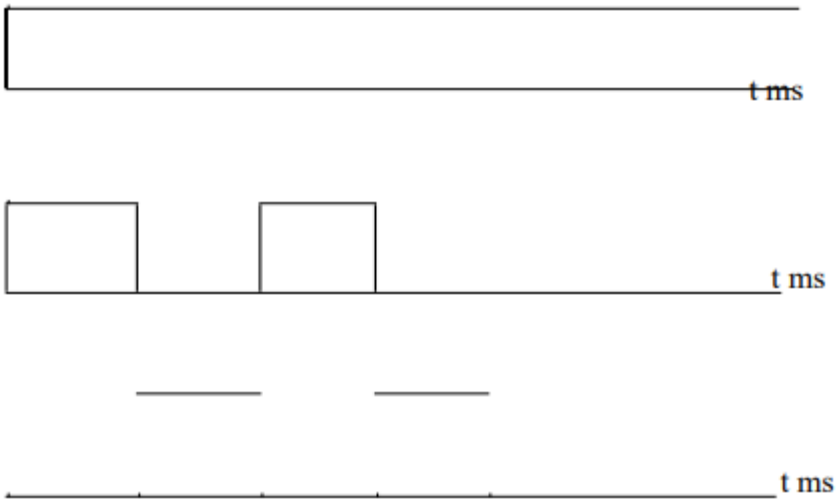
4. Keep the frequency knob to particulars frequency.

5. Observe the rectangular and triangular carrier waveforms on the CRO. 6. Obtain the output waveform across the load Rheostat.

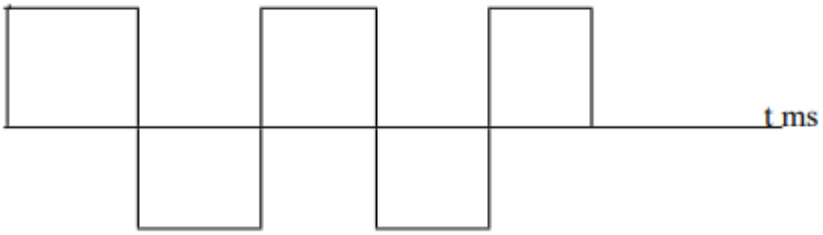
Formula used: T=Ton + Toff

Model Graph:

Vin(V)



Vo



RESULT:

Thus the output waveform for IGBT inverter (PWM) was obtained.

EX. NO. : **SPEED CONTROL OF DC SHUNT MOTOR USING POWER**

DT.: **ELECTRONICS DRIVE**

AIM:

To control the control of dc motor using 3power electronics drive and Plot armature voltage versus speed characteristics.

APPARATUS REQUIRED:

S. No.	Apparatus	Range & Type	Quantity
1	Three phase half controlled bridge converter	-220/10A	1 No
2	CRO	20MHZ	1 No
3	Patch Chord		Few
4	DC MOTOR		1No
5	Multimeter		1 No.

BASIC CONCEPT: A 3- phase half – wave converter drive consisting of two converter and a separately – excited dc motor is shown here. The armature circuit of the motor is fed through 3-phase half- wave converter whereas if field is energized through a 3-phase semi converter. This converter offers one-quadrant operation fig.(b) and may be used up to about 40 kW motor ratings. Two-quadrant operation can also be obtained from three- phase halfwave converter drive in case motor field winding is energized from single- phase or three-phase full converter.

CIRCUIT DIAGRAM:

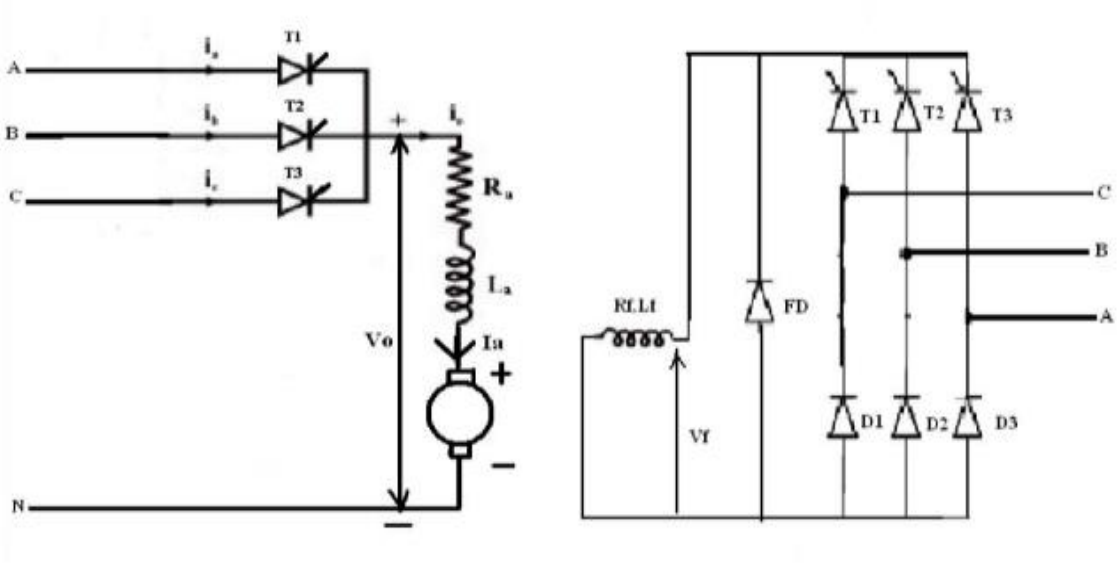


Fig: Three phase half wave converter drive

POT POSITION	OUTPUT VOLTAGE	SPEED(rpm)

PROCEDURE:

1.Connect three phase supply to the unit in proper R-Y-B-N Sequence.

.Keep the alpha/Speed pot at minimum position.

3.Connect two 40/60W lamps on back panel holder.

4. Switch on the 3 phase supply neon lamps glow.

5.Connect 4-pin plug dc motor to the unit lightly.

6. Press rockor switch & start button then output led glow.

7.Wait the motor response increase ALPHA/SPEED pot clockwise & observe the motor speed

8. Observe output voltage waveform Across TP10 and TP11

9.Plot Graph of speed Vs. armature voltage.

RESULT:

The control speed of dc motor using 3-phase half controlled bridge converter is verified.

EX.NO.: **SPEED MEASUREMENT & CLOSED LOOP CONTROL OF**

DT.: **PMDC MOTOR**

AIM:

To Construct chopper drive circuit and to control the speed of the PMDC motor.

APPARATUS:

Chopper PMDC motor control module, DC power supply 30V / 1A, CRO, patch cards, etc.

PROCEDURE:

1. Connect motor terminals to respective points in the power circuit & speed sensor to feedback terminals socket. Connect the voltmeter & ammeter to the respective points.
2. Circuit connections are made as shown in the circuit diagram. 3. Check the connections and conform the connections made are correct before switching on mains supply & DC power supply.
4. Connect suitable DC regulated voltage using regulated power supply 30V/1A.
5. Keeping all the knobs at minimum position switch on the DC power supply adjust the DC voltage to say 12V.
6. Keeping PID switches ON (down ward) position.
7. Switch on the POWER supply switch.
8. Set the rpm to suitable value through the knob SET RPM (say 1000rpm).
9. Using P, I, D knobs adjust the running rpm to set rpm by varying P gain, I timing, D gain.
10. Load the motor up to 250 grams load in steps of 50 grams. Note down the speed for different.
11. Loads. Observe the current & voltage waveforms using CRO.
12. Slowly reduce the DC voltage to zero switches off the unit, DC power supply & remove the connections. Note: While changing the set rpm vary the knob slowly

CIRCUIT DIAGRAM:

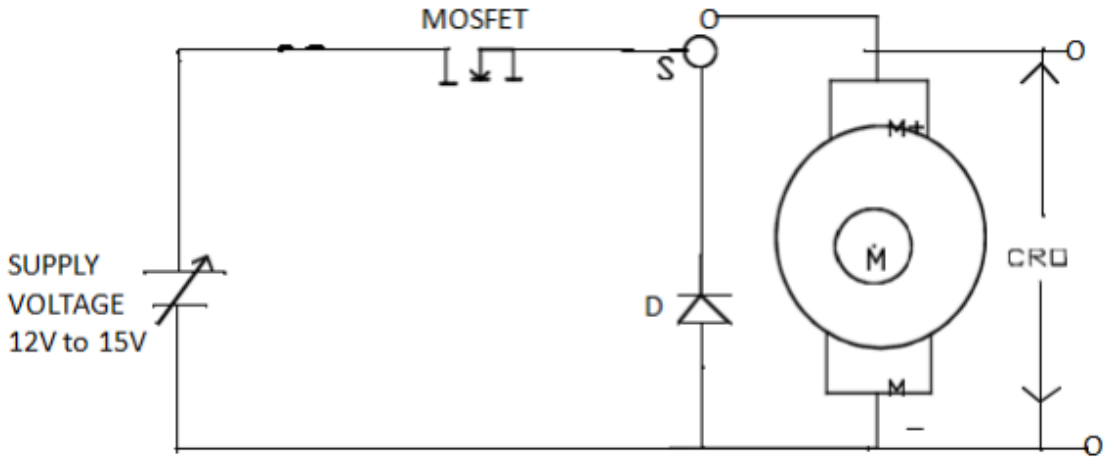


Fig – 3.1 Speed Measurement and Closed Loop Control of PMDC Motor Using MOSFET / IGBT Chopper Drive

TABULAR COLUMN

S. No	Load in grms	Running rpm
1		
2		
3		
4		

RESULT:

To Construct chopper drive circuit and to control the speed of the PMDC motor.

EX. NO. **RUN THE STEPPER MOTOR IN FORWARD AND REVERSE**

DT.: **DIRECTION**

OBJECTIVE:

To run a stepper motor in forward and reverse rotation using 8051 assembly language

PRE-REQUISITES:

1. Stepper Motor
2. Interface Board

TASK:

1. Switch ON the micro controller
2. Initialize the starting address
3. Enter the mnemonics code in the microcontroller
4. Reset the microcontroller
5. Execute the program

PROGRAM:

Address	Label	Instruction	Opcode
4100		ORG 4100H	
4100	START:	MOV R4, #33H	7C 33
4102	L2:	DPTR, #FORWARD	90 41 44
4105		L1	12 41 1C
4108		R4, L2	DC F8
410A		DELAY	12 41 3B
410D		R4, #33H	7C 33

410F	L3:	DPTR, #REVERSE	90 41 48
4112		L1	12 41 1C
4115		R4, L3	DC F8
4117		DELAY	12 41 3B
411A		START	80 E4
411C	L1:	R0, #04H	78 04
411E	LOOP :	A,@DPTR	E0
411F		83H	C0 83
4121		82H	C0 82
4123		DPTR, #OFFCOH	90 FF C0
4126		R2, #04H	7A 04
4128	L7:	R1, #05H	79 05
412A	L6:	R3, #OFFH	7B FF
412C	L4 :	R3, L4	DB FE
412E		R1, L6	D9 FA
4130		R2, L7	DA F6

4132		@DPTR ,A	F0
4133		82H	D0 82
4135		83H	D0 83
4137		DPTR	A3
4138		R0, LOOP	D8 E4
413A			22
413B	DELAY :	R5, #01H	7D 01
413D	L9 :	R2, #05H	7A 05
413F	L8:	R2, L8	DA FE
4141		R5, L9	DD FA
4143		RET	22
4144	FORWARD :	DB 09H,05H,06H,0AH	09 05 06 0A
4148	REVERSE :	DB 0AH,06H,05H,09H	0A 06 05 09

RESULT:

Thus the program to rotate the stepper motor in forward and reverse direction was derived using 8051 assemble language and was verified.

EX.NO.

CHARACTERISTICS OF AC SERVO MOTOR

AIM: To determine the speed torque characteristics of ac servomotor

APPARATUS:

1. Two phase AC servomotor trainer kit (PEC-00A).
2. Patch Chords.
3. Voltmeter (0-20v),mc

PROCEDURE:

1. Connect G1, K1 of pulse isolation output to G1, K1 of scr1.
2. Connect G2,K2 of pulse isolation output to G2,K2 of scr2
3. To operate open loop control mode using switch s1
4. 9pin d-connecter is connected from motor set up to backside of trainer (PEC-00A).
5. Keep speed indicator switch is in pv mode
6. Connect ac voltmeter(0-20v) or multi-meter across the control phase winding (c1,c2)

EXPERIMENTAL PROCEDURE:

1. Switch on the 230v ac supply to the reference winding.
2. Switch on the 230v ac supply to the motor set up.
3. Switch on the pulse on/off switch S2.
4. Vary the control voltage pot (c.v) and set the rated voltage (11.4v) to control phase winding.
5. Apply the load on the motor step by step up to motor will run at rpm.
6. For each step note down the readings (load, speed) as shown in table.
7. Calculate the torque value.
8. Plot the graph for speed vs torque.
9. The slope of speed torque curve given the motor constant k2

OBSERVATION TABLES:

S.No	Speed N (rpm)	Torque (N-m)	Load (Kg)

Model calculations:

Torque (T) =9.81*R*S

S = applied load in kg

R = radius of shat in m

MODEL GRAPHS:

Speed –Torque characteristics of A.C.Servo motor:

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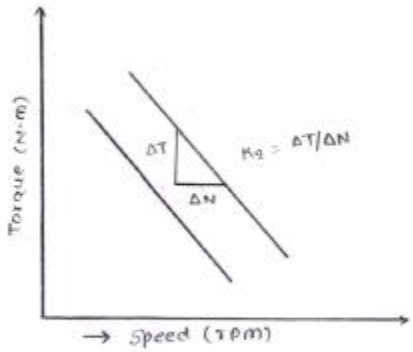
Speed –Torque characteristics of A.C.Servo motor:



PRECAUTIONS:

1. Avoid the loose connections.
2. Take the readings without parallelox error.

RESULT:

The speed torque characteristics of A.C servo motor is plotted

EX.NO.

CHARACTERISTICS OF DC SERVOMOTOR

AIM: To obtain torque Vs Ia , back emf Vs regular speed and torque Vs angular speed and V vs Ia characteristics

APPARATUS:

1. DC Servomotor kit
2. ITB-pecoos units
3. Digital multi meter/ CRO

PROCEDURE:

SPEED Vs VOLTAGE CHARACTERISTICS:

1. Before switch ON the unit
   i. EXT / INT switch shout in INT mode
   ii. Integral open / close switch in open (OL) mode
   iii. Signal conditioner switch is in open (OL) mode
   iv. Interface the motor supply sensor with module.
2. Initially pulse ON /OFF switch should be in off mould
3. Switch ON the unit & keep the pulse ON /OFF to ON mode.
4. Set the proportional gain K_p at minimum.
5. Set V_{ref}=1volt slowly increasing the gain K_p voltage by mean of the proportional gain adjustment pot, and find the voltage at which the motor just starts running.
6. Vary the reference voltage in steps note down the motor speed and armature voltage tabulate the readings as shown in fig.
7. Plot the ω Vs V_a characteristics it will be shown in fig.

SPEED Vs TORQUE & Ia Vs TORQUE CHARACTERISTICS:

1. The procedure is same from 1 to 4 points
2. Run the motor at 1500rpm by suitably adjusting the V_{ref} and K_p. Note down the armature voltage (V_a),; armature current(I_a) and speed(N) as shown in table.

3. Apply load by brake magnet close to the disc, Apply the load in steps. Such a way that the current is increased by 0.25A in each step tabulates the readings.
4. It may be noticed that the motor armature current may be increased when the speed drops below a certain value this is because the speed is low the eddy current induced in the disc becomes less, which reduces the load torque.
5. Decrease the load and reduce the gain to medium.
6. Switch OFF the power supply.
7. Calculate the torque as

   Torque= $K_f.I_a$

   Where K_f = Torque constant

   I_a = Armature constant
8. Plot the ω Vs Torque characteristics.
9. Plot the I_a Vs Torque characteristics.
10. Plot the V_a Vs I_a characteristics.

MOTOR GAIN CONSTANT Km AND TORQUE CONSTANT K_f PLOT E_b Vs T AND FIND K_b:

1. The procedure is same as from 1 to 4 points.
2. Vary the reference voltage in steps and armature voltage, tabulate the readings.
3. Plot the T Vs V_a characteristics.
4. Measure the armature resistance of the motor using a multi meter.
5. Calculate the bake emf as

   Output = $2\pi NT/60 = \omega T$

   ω= rad/sec

   T= Torque in N-m

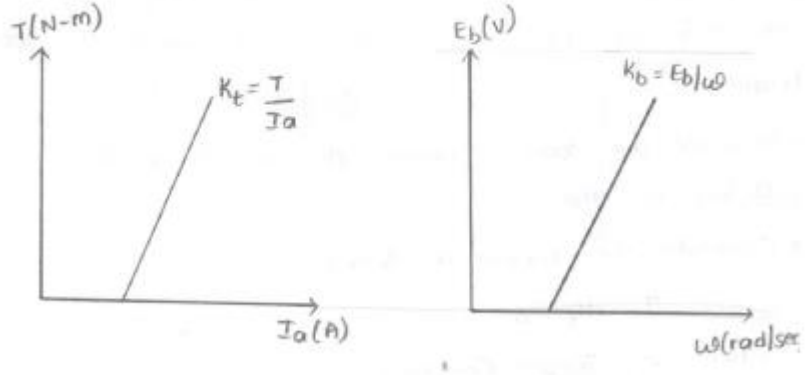
Neglecting losses, output power= Power losses

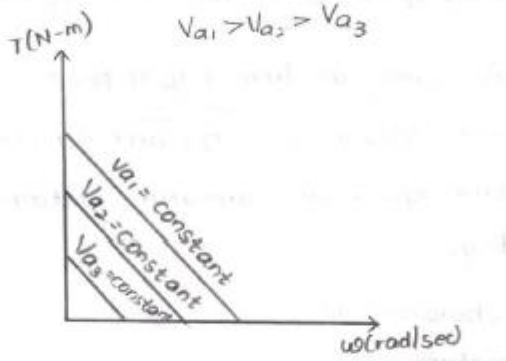
OBSERVATION TABLES

s.no.	V_{ref} (volts)	V_a (volts)	N(rpm)	ω (rad/sec)

s.no.	V_a (volts)	I_a(amp)	N(rpm)	ω (rad/sec)	$E_b=V_a-I_aR_a$ (volts)

MODEL GRAPHS:





PRECAUTIONS:

1. Do not release the pulse of amplifier without ensuring all the connections are tight and setting 1volt input to the circuit.
2. Connect integral controller to the ground
3. Load applying to the motor should not exceed rated value.

RESULT:

The speed torque characteristics of D.C servo motor is plotted