MGM's
Jawaharlal Nehru Engineering College

Laboratory Manual

Electric Drives

For

BACHELOR OF ENGINEERING

(Electrical, Electronics and Power)

FOREWORD

It is my great pleasure to present this laboratory manual for Final year **ELECTRICAL ELECTRONIC & POWER** engineering students for the subject of Electric Drives. Keeping in view the vast coverage required for visualization of concepts of Electrical Drives with simple language.

As a student, many of you may be wondering with some of the questions in your mind regarding the subject and exactly what has been tried is to answer through this manual.

Faculty members are also advised that covering these aspects in initial stage itself, will greatly relive them in future as much of the load will be taken care by the enthusiasm energies of the students once they are conceptually clear.

H.O.D. (EEP)

INDEX

1. DOs and DON'Ts in Laboratory:

1. Do not handle kit without reading the instructions/Instruction manuals.

2. Refer Help for Difficulties

3. Go through Manual Carefully.

4. Strictly observe the instructions given by the teacher/Lab Instructor.

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2 Instruction for Laboratory Teachers:

1. Lab work completed during prior session should be corrected during the next lab session.

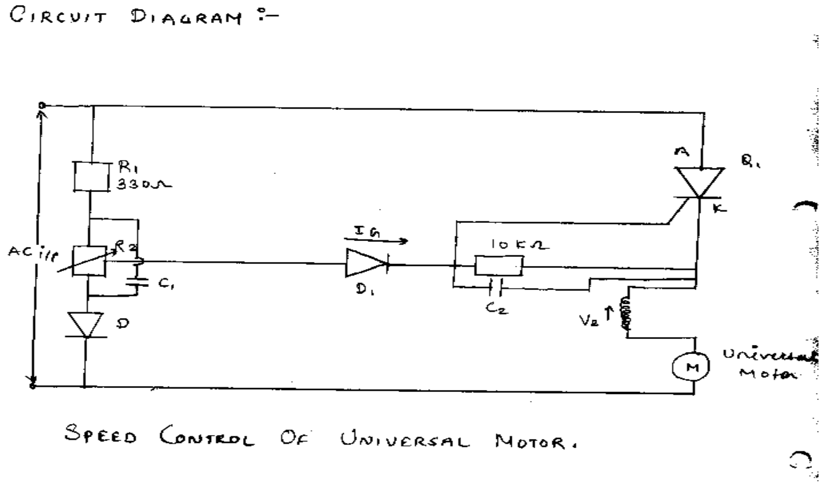
2. Students should be guided and helped whenever they face difficulties.

4. The promptness of submission should be encouraged by way of marking and evaluation patterns that will benefit the sincere students.

EXPERIMENT NO.:- 1

AIM: - Speed control of universal motor using SCR/TRIAC/IGBT

Circuit Diagram:-



Apparatus: Universal motor kit, connecting wires, CRO

Procedure:

1) Connect 3-pin power chord from the isolation transformer to the socket marked as input from isolation transformer
2) Short the terminals marked as low and the cathode of diode D.
3) Plug in potentiometer designated as in minimum position i.e. fully anticlockwiase position.
4) Now connect the input power chord of isolation transformer to the mains supply (230v , 50Hz).
5) A neon lamp will glow on the front panel.
6) Adjust the speed control potentiometer and observe the motion of motor.
7) Observe the waveform across the terminal marked motor input anode to cathode and gate to cathode.

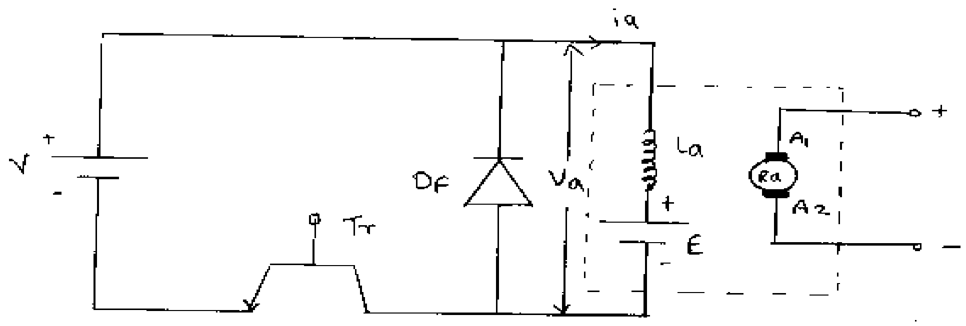
Output:-

Conclusions

EXPERIMENT NO.:- 2

AIM: - Speed control of DC shunt motor using chopper

Circuit Diagram:-



Chopper control of DC shunt excited motor.

Procedure for Motoring Control:-

A transistor chopper controlled separately excited motor drive is shown in figure. Trransister Tr is operated periodically with period T and remains on for a duration Ton. Present day choppers operate at a frequency which is high enough to ensure continues conduction.

During on period of the transistor 0<t<ton, the the motor terminal voltage is v. The operation is described by

$$RaIa + Ca\ diq / dt + E = V$$

Motor operation during the interval ton< t< T known as freewheeling interval is described by

$$Raia + La\ diq/dt + E = 0$$

Ratio of duty cycle ton to chopper period T is called duty ratio or duty cycle (del)

$$del = Duty\ interval/ T = ton/T$$

Regenerative Braking is given by

$$del = duty\ interval/ T = T-ton/ T$$

$$Wm = del\ V/K – Rq/ k*k\ .\ T$$

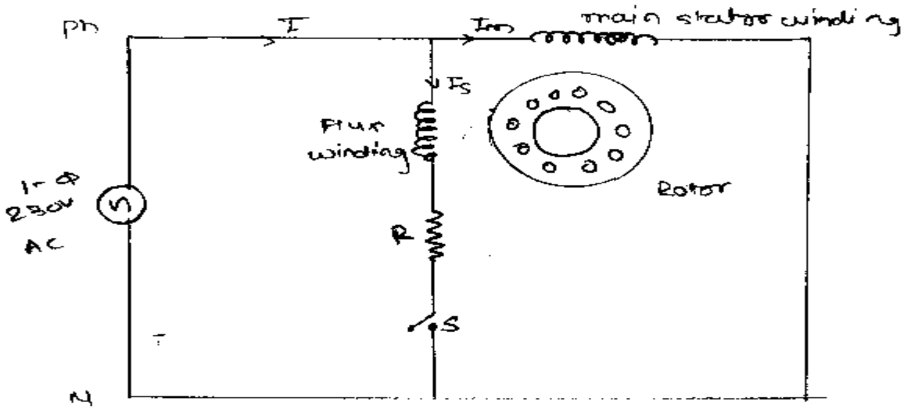
Output:

Conclusions:

EXPERIMENT NO.:- 3

AIM: - Speed control of single phase induction motor.

Circuit diagram:-



Split phase IM.

Procedure:

1) In split phase induction induction motor, the main windings have low resistance and high reactance.
2) These starting windings has high resistance may be increased by connecting R in series with it or by using high resistance fine copper wire for winding purpose. Hence as shown in figure the Is drawn by starting winding lags behind the applied voltage V by a small angle whereas the Im taken by the main windings lags V by a very large angle.
3) The phase angle between currents Im and Is is made as large as possible, because the starting torque of a split phase motor is proportional to sine of the function of centrifugal switch s is to disconnect the starting winding when gets 70-80 % of its normal running speed.
4) The direction of these motors can be reversed by reversing the connections of one of the two stator winding (not both).

Output:-

Conclusions:-

EXPERIMENT NO.:- 4

AIM: - Speed control of three phase induction motor.

Apparatus:- Invert kit, CRO, connecting wires, probes, etc.

Circuit Diagram:-

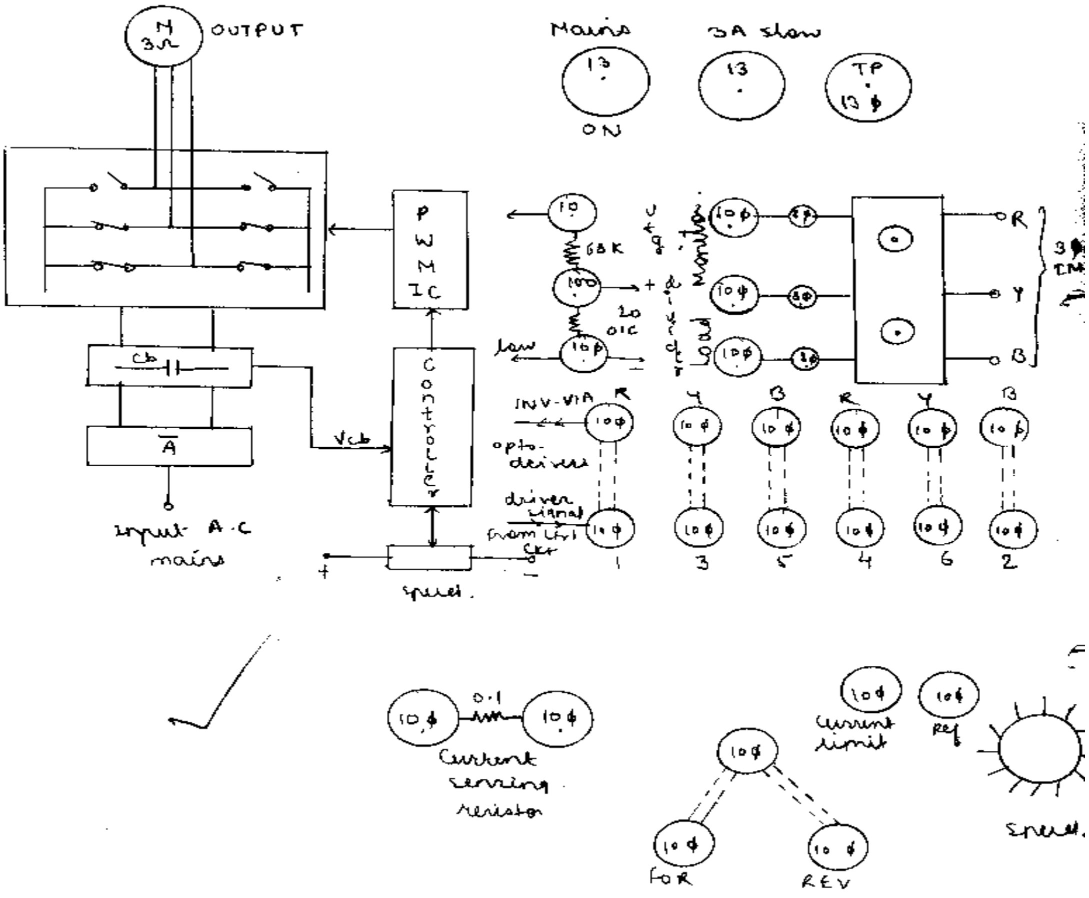


Fig. 3φ Induction motor

Procedure:-

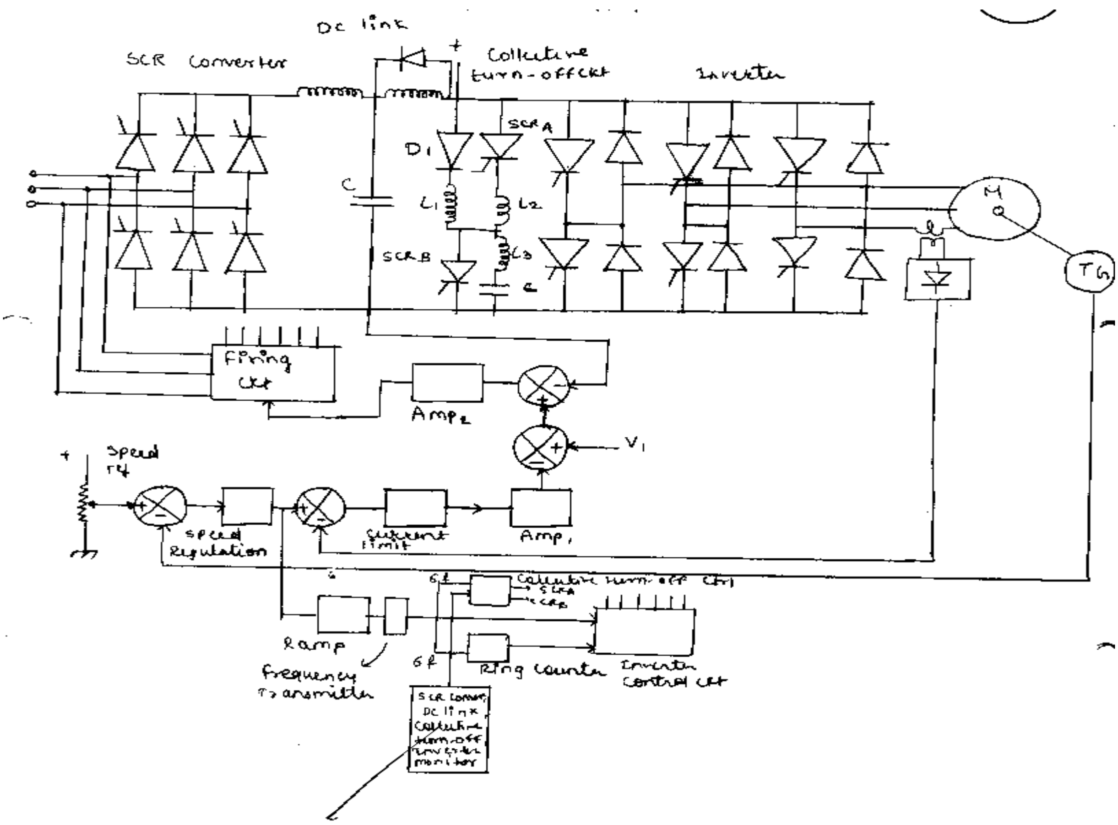
1) Connect CRO and 4 lines associated with drive signals.
2) Connect shorting link between the output sockets.
3) Connect motor between the output sockets.
4) Connect there output points across the voltage divider and oscillator across the 1 K Ohm resistor.
5) Switch on and observe the waveforms. Observe the motor slowly picking up the speed indicating presence of softstart.
6) Keep speed helipod maximum clockwise. This will reduce the desired signal frequency. Note frequency and speed and calculate percentage slip.
7) Repeat for 2 to 3 readings till maximum speed is reached.

Conclusion:-

EXPERIMENT NO.:- 5

AIM: - Study of closed loop speed control of AC motor.

Circuit Diagram:-



Schematic diagram of closed-loop control of variable dc link inverter for speed control of an ac motor

Theory:-

A variable voltage mode is quite satisfactory for the long term steady state diagram operation. However if the operating conditions demand rapid acceleration and de-acceleration, the open loop control becomes unsatisfactory. Because the objective of the closed loop speed control system varying speed and this motor torque can be constantif rotor current and flux are kept constant.

In closed loop system it is easy to achieve the optimum operating conditions of voltage and frequency, so that the motor speed can be controlled with high torque power factor and efficiency.

In closed loop system, it is easy to monitor the air gap flux. If the rotor frequency f and the air gap flux are maintained constant if the rotor current also remains constant. Hence stator current also remains constant.

Therefore if f and phi are kept constant then a feedback control system, the stator current consequently remains constant developing a constant torque at all the speed of the motor. On the other hand if the stator current and air gap flux are controlled the rotor frequency automatically adjusts itself. Again if the stator current and rotor frequency then the air gap flux controlled automatically. The system in which rotor frequency controlled directly is called as controlled sub system. Schematic sine state variable frequency C link inverter with feedback control is shown in diagram. In above scheme convertor is Dc link three phase controlled rectifier.

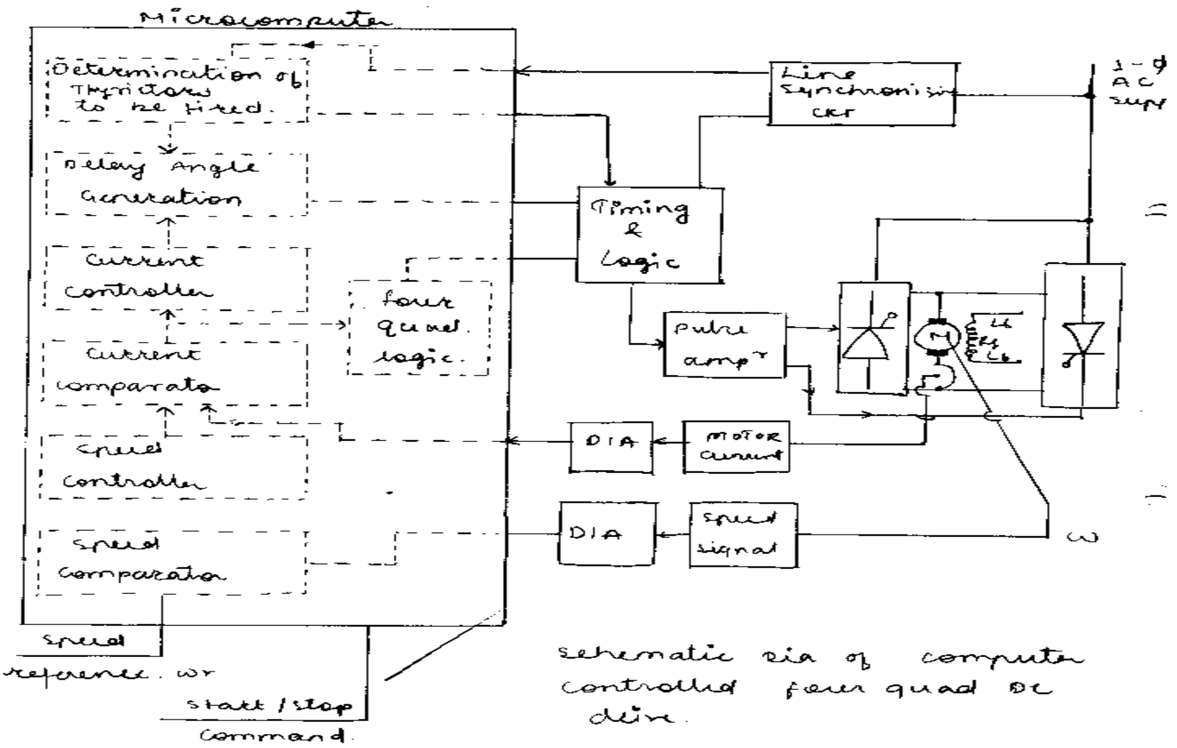
The variable voltages are smoothed by an LC filter. An inverter is fed from a variable voltage of the convertor. The same purpose may be achieved by using uncontrolled bridge convertor in conjunction with the chopper in place of the controlled rectifier.

Conclusion:-

EXPERIMENT NO.:- 6

AIM: - Microcomputer based speed control of DC motor

Circuit Diagram:-



Theory:-

A microcomputer control reduces the size and cost of hardwired electronics, improving reliability and control performance. This control scheme is implemented in the software and is flexible to change the control strategy to meet different or to add extra control features.

A microcomputer control system can also perform various desirable functions. On and off of the main power supply, start and stop of the drive, speed control, current control, monitoring the control variables indicating perfections and trip circuit, diagnostics for built in fault findings and communication with a supervisory control computer. Figure shows a schematic diagram for a microcomputer control of a convertor fed four quadrant DC drives.

The speed signal is fed into a microcomputer using an analog to digital signal convertor. To limit the armature current of the motor an inner current control is used. The armature current signal can be fed into the microcomputer through an ADC or by sampling the armature current. The line synchronizing circuit is required to synchronized the generation of the firing pulses with the supply line frequency. Although the microcomputer can perform the functions of gate pulse generator and logic circuit, these are shown outside the microcomputer. The pulse amplifier provides the necessary isolation and produces gate pulses of required magnitude and duration. A microprocessor controlled drive has become a norm and analog control has become absolute.

Conclusion:-

EXPERIMENT NO.:- 7

AIM: - Study of traction for trolley/ train/ bus.

Circuit Diagram:-

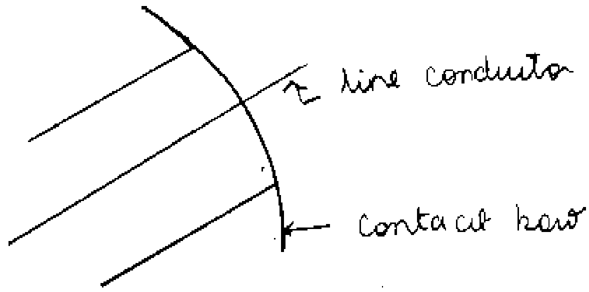


fig current collector for an electric bus.

Theory:-

Electric traction services can be broadly classified as-

1) Electric Trains
2) Electric buses, train and trolleys
3) Battery driven and solar powered vehicles.

A) Main Line Trains :-

Intercity passenger and goods trains which come under this category have trailer coaches carrying men and materials driven by locomotives carrying driving motors. Since driving motors travel with locomotives, power supply to the motors is arranged in two ways: From overhead transmission line is electrical locomotive and from diesel generator set mounted on the locomotive in a diesel electric locomotive.

In electric locomotive, driving motor and power modulators are housed in the locomotive. An overhead transmission line is laid along or above the track. Acurrent collector mounted over the locomotive has a conductor strip which slides against the supply conductor and this maintain continues contact between the supply and the locomotive. The supply conductor is commonly known as contact wire.

B) Suburban Trains:-

They are employed for transporting men within a city located at small distances. The main difference being that the distance between connective stops is much smaller for suburban trains than the main line trains. The suburban trains are also known as local trains. Because of shortage of land in cities, they are often run through underground tunnels and are called subway trains or metros or underground trains. Suburban trains are driven by motor coaches, instead of locomotives. Reason for this arrangement is power connectivity. Each motor coach is equipped with an electric drive with its control in drives cabin and a pentagraph collector. Usual pattern is to use motor coaches trailer coaches' ratio 1:2. In high speed train the ratio may be increased to 1:1.

C) Electric buses, trains and trolleys:-

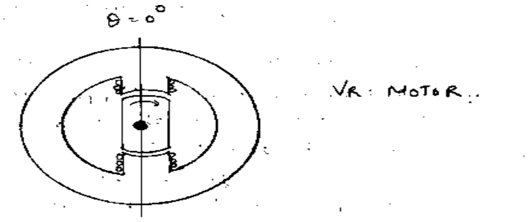
Because of lower running expenses and complete absence of pollution, electric buses are preferred over diesel engine driven buses for city services and the road. As the currents are usually small, the collector consists of a rod carrying at its end a grooved wheel or two carrying at its end a grooved bridge by a contact bow collector and supply conductor. Arrangement has also to be provided for additional conductor for the returns of the current.

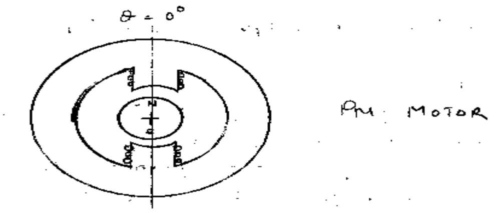
Conclusion:-

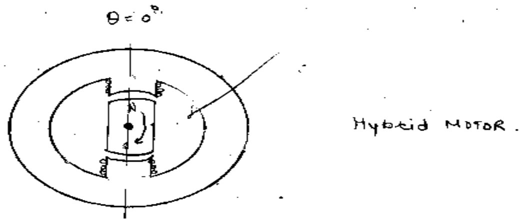
EXPERIMENT NO.:- 8

AIM: - Speed control of stepper motor.

Circuit Diagram:-







Theory:-

These motors rotate through a fixed angular step in response to each input current pulse required by its controller.

The angle through which the motor shaft rotates for each command pulse is called the step angle Beta. Smaller the step angle, greater the number of steps per revolution and higher the resolution and accuracy of positioning obtained.

Therefore Resolutions= no. Of steps / resolutions= 360 deg / beta

Conclusion:-