Power Electronics Laboratory (EE3P004)

EXPERIMENT-8

Speed Control of DC Motor using IGBT based Chopper

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Aim of the Experiment:

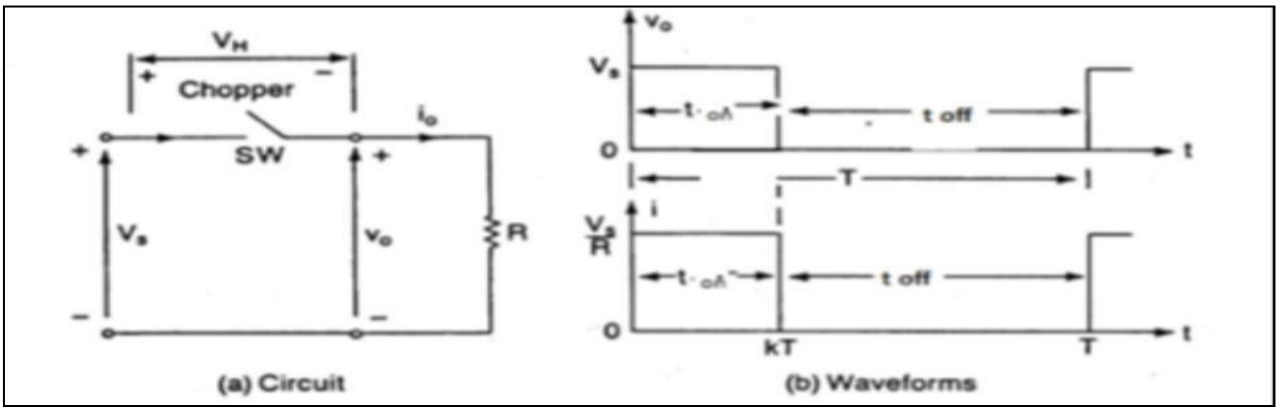
Speed control of DC motor using IGBT based chopper 220 V / 2 A (Single Quad- rant)

Apparatus required

- IGBT based chopper (Single Quadrant)
- Power Scope or CRO
- DC Shunt motor 0.5 HP/180 V with mechanical loading arrangement
- Rheostat - 100 Ω /2 A
- Digital Tachometer

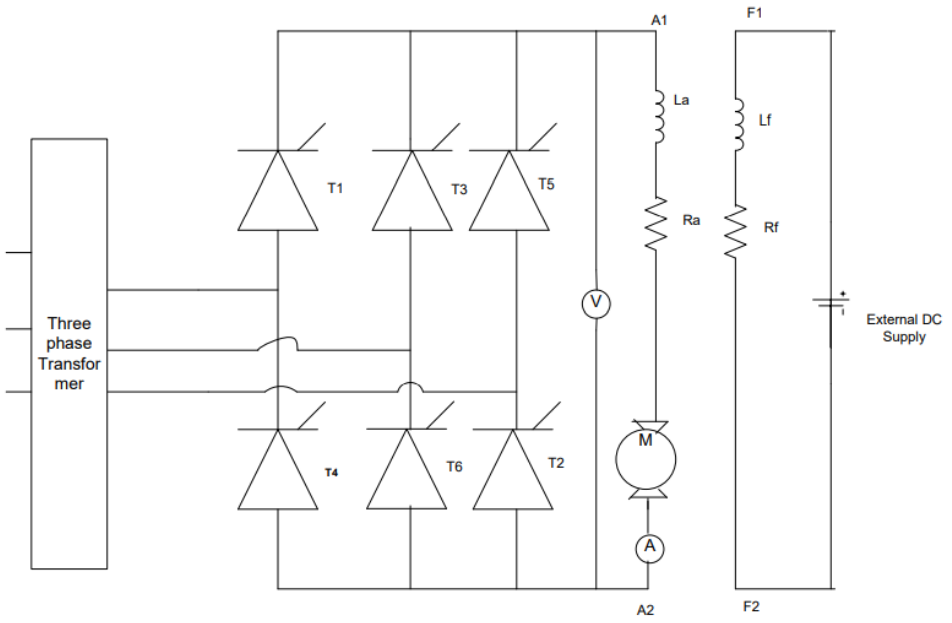
Theory:

A chopper is a static power electronic device that converts fixed dc input voltage to a variable dc output voltage. A Chopper may be considered as dc equivalent of an ac transformer since they behave in an identical manner. As chopper involves one stage conversion, these are more efficient. Choppers are now being used all over the world for rapid transit systems. The future electric automobiles are likely to use choppers for their



speed control and braking. Chopper systems offer smooth control, high efficiency, faster response and regeneration facility.

Circuit Diagram:



Observation Table:

R=100Ω load

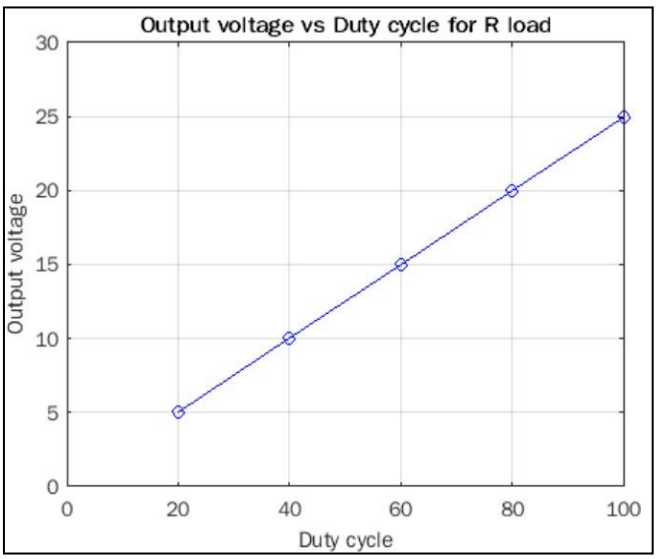
Vin (volts)	Frequency (Hz)	Duty cycle %	Vout(volts)	Io (amperes)
26	50	20	5	0.05
		40	10	0.1
		60	15	0.15
		80	20	0.2
		100	25	0.25

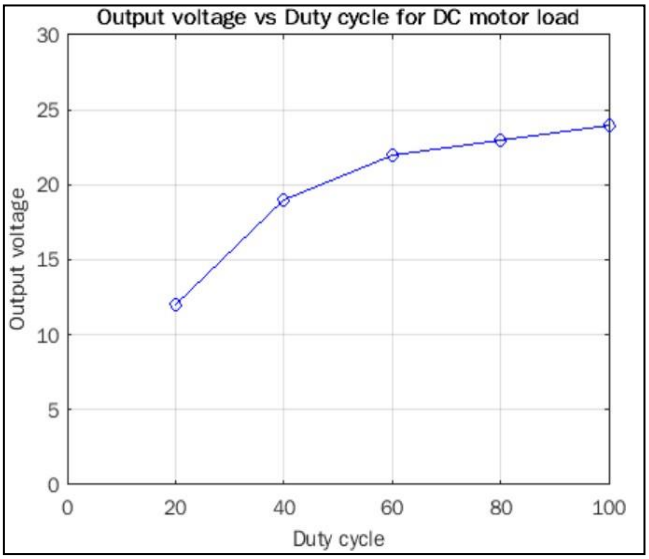
DC MOTOR

Vin (volts)	Frequency (Hz)	Duty cycle %	Vout(volts)	Io (amperes)	Ns (RPM)
25	50	20	12	0.31	75.6
		40	19	0.43	128.2
		60	22	0.48	141
		80	23	0.49	148.9
		100	24	0.5	152

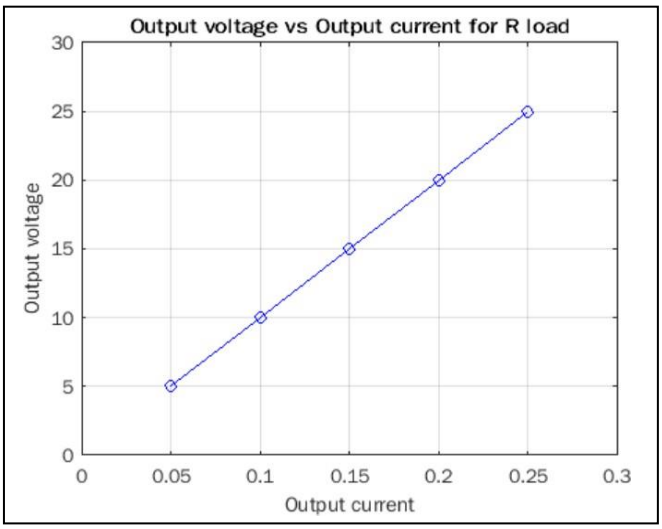
Waveforms:

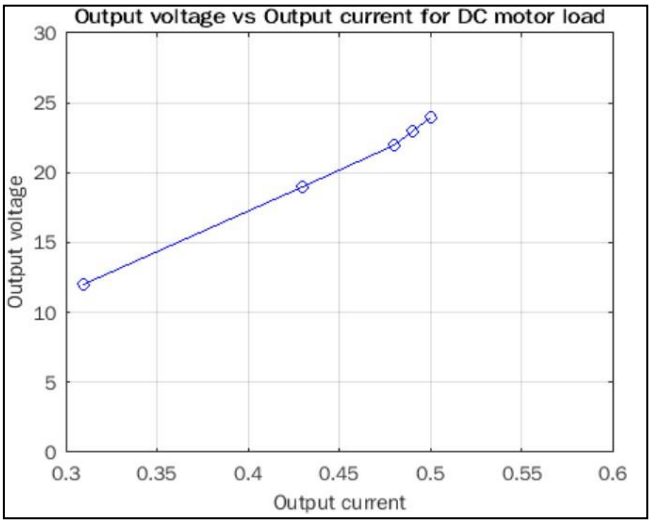
1. Vout vs Duty cycle



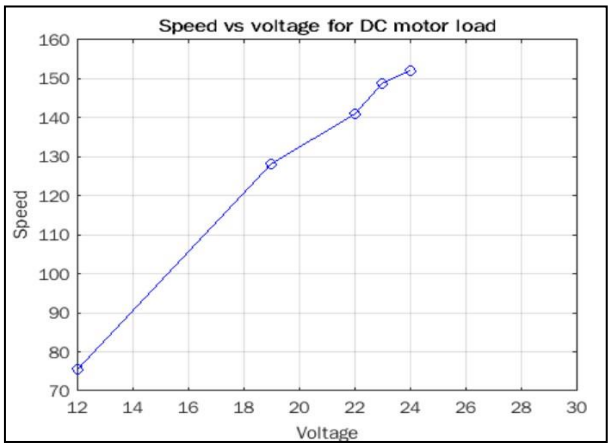


2. V out vs I out

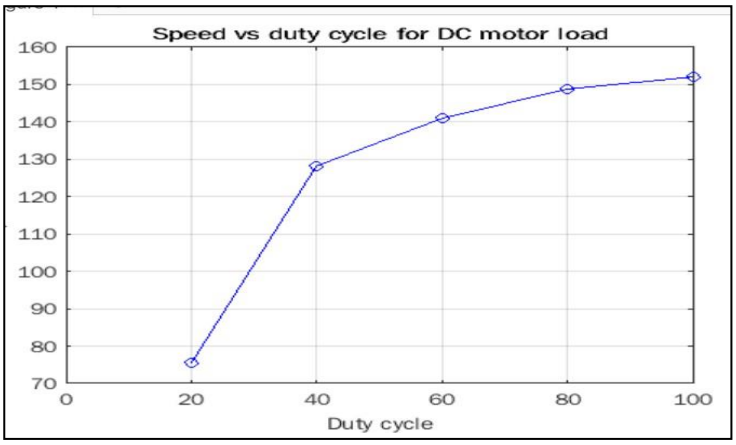




3. Speed vs voltage



4. Speed vs Duty cycle



CONCLUSION

We have successfully completed the experiment and observed that speed varies directly with armature voltage by keeping field voltage constant. Speed varies inversely with field voltage by keeping armature voltage constant. Armature voltage control gives the speed below the base speed whereas field control gives the speed control above the base speed. We observed that Armature current vs. Speed at constant flux gives a drooping characteristic. Though it should have been a straight line parallel to x-axis but due to saturation effect there is slight decrease in speed and shows a drooping characteristic.

DISCUSSION

Explain the motor voltage as shown on the oscilloscope (at 6.32 minutes). Identify different regions of the voltage with reason and explain why the waveforms looks like as on the oscilloscope

The voltage varies because of back emf caused by the motor. The back emf is produced because of the movement of armature in dc coils due to the driving torque. As the armature coils move through magnetic field an emf is induced in it thus resulting in back emf. This back emf will have effect on the output voltage and that is why the output voltage is more in this case compared to R load.

There are three regions

0 - T1: During the turn on process the voltage is almost constant with slight steep. This decrease in voltage is because the reverse voltage increases during this process.

T1 – T2: During this the IGBT’s turnoff. DC motor is an inductive load so the energy present in it is discharged through the freewheeling diode. The output voltage is negative.

After T2 the current becomes zero and the output voltage is zero till the IGBT’s turn ON again.