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	PRACT	FICAL INSTRUCTION	ON SHEET			
	EXPER	IMENT TITLE: To s	tudy the performance char	racter	istics of D.C motor speed	
UNIVERSITY	control with open loop and close loop.					
	EXPER	IMENT NO.:	ISSUE NO. :	ISS	UE DATE :	
	REV. NO.		REV. DATE: 01/08/2016	PA	GE /	
DEPTT. : Electrical Engineering		LABORATORY : Control System EA5220			SEMESTER : V	

Objective: To study the performance characteristics of D.C motor speed control with open loop and close loop.

Apparatus Used:

FEATURES AND SPECIFICATIONS:

- Speed control of a 12V, 4W permanent magnet D.C motor.
- Speed range to 0 to 3000 rpm.
- Opto-interrupter based speed sensing.
- 4-digit speed display in rpm.
- Electronic tachometer for feedback.
- Separate unit for motor in a see- through cabinet.
- Smooth, non- contact eddy current brake for loading.
- Built-in 3/2 digit DVM for signal measurements.
- Built-in TC regulated interval power supply.

THEORY:

Accurate speed control is a requirement in many industrial and process control systems. The main characteristics of such a system are its steady state error and disturbance rejection properties. Speed control of a D.C motor is also one of the basic systems covered in a first course on automatic control system. Facilities are available to directly measure the principle performance factors of the speed control system, viz. steady state error and load disturbance rejection as a function of the forward path gain.

An important feature of the unit is the built-in absolute speed measurement through optical pickup from a slotted disk followed by a frequency counter. Variable loading of the motor is achieved by a built-in eddy current brake. The motor unit, housed in a cabinet with transparent panels, provides a good view of the mechanical arrangements.

In order to evaluate the system performance, it is necessary to compute the overall transfer in terms of the different blocks.

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$$\frac{\theta(s)}{V(S)} = \frac{km}{s(sT+1)}$$

Where km is the motor gain constant and T is the time constant. Considering motor speed ω rad/sec (=d θ /dt) as the output variable, the forward path transfer function may be written as,

$$G(s) = \frac{\omega(s)}{Ve(s)} = Ka \frac{Km}{sT+1}$$

$$H(s) = \frac{V_t(s)}{\omega(s)} = K_T$$

This yields the closed loop transfer function of the complete system as,

$$\omega(s) = \frac{\kappa_A}{sT + ka + km + 1} \cdot K_m = \frac{\frac{\kappa_A \kappa_M}{\kappa_A \kappa_M \kappa_T}}{s \left[\frac{T}{\kappa_A \kappa_M \kappa_{T+1}}\right]} + 1$$

TRANSIENT RESPONSE:

For a step input $V_R(s) = R/S$,

$$\omega(s) = \frac{R}{S} \frac{\frac{K_A K_M}{T}}{S + K_A K_M K_T / T}$$

Taking inverse Laplace Transform,

$$\omega(t) = R. \frac{K_A K_M}{K_A K_M K_T + 1}$$

The transient r5esponse has an exponential character similar to capacitor charging through a resistor. Further, the effective time constant T_{eff} decreases with increasing K_A making the motor response faster.

The effective time constant may be determined from a recording of the step response using either pen recorder or a storage CRO.

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DISTURBANCE REJECTION:

One of the most important features of a feed back control system is its ability to reduce the effect of external disturbances. From fig, the disturbance transfer function for VR=0, may be written as

$$\frac{\omega(s)}{\omega_D} = \frac{1}{G(S)H(S)+1} = ST + \frac{1}{sT+1+K_AK_MK_T}$$

For unit step disturbance $\omega_{\mathcal{D}(\mathcal{S})} = \omega_{\mathcal{D}(\mathcal{S})}$, the steady state output speed is given by

$$\omega_s = \frac{\Omega}{K_A K_M K_T + 1}$$

Figure:

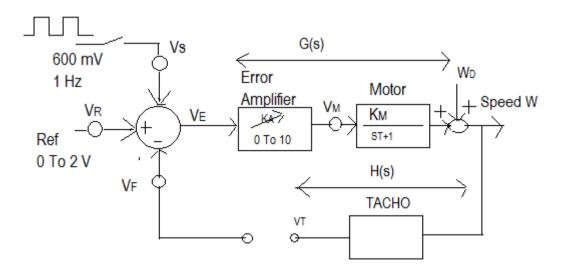


Fig: Bloch Diagram

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OBSERVATIONS:

- $V_R = 1 \ volt$
- FOR OPEN LOOP SYSTEMS:

S.NO.	K_A	N_{rpm}	V_T (volt)	V_{M}	$K_A = V_M/V_R$

• FOR CLOSED LOOP SYSTEM:

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S.NO.	K_A	N_{rpm}	V_T (volt)	V_{M}

RESULT:

Graph is plotted between the speed (N) and motor voltage V_M and between the tachogenerator and speed (N).

PRECATIONS:

- 1. Amplifier gain must adjust properly.
- 2. Multimeter should be in D.C mode before taking the voltage readings.
- **3.** Readings must be taken properly.

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