Assignment

The schematic diagram of a steel-rolling process is shown in figure. The steel plate is fed through the rollers at a constant speed V. The distance between the rollers and the point where the thickness is measured is d ft. The rotary displacement of the motor, \( \theta_m(t) \), is converted to the linear displacement \( y(t) \) by the gear box and linear-actuator combination \( y(t) = n\theta_m(t) \), where \( n \) is a positive constant in ft/rad. The equivalent inertia of the load that is reflected to the motor shaft is \( J_L \).

(a) Draw a functional block diagram for the system.

(b) Derive the forward-path transfer function \( Y(s)/E(s) \) and the closed-loop transfer function \( Y(s)/R(s) \).