⇒ Mathematical Modeling of BLDC motor-

1) Electrical part :-

$$U_d(s) = (r_a + L_a s) I(s) + k_e \Omega(s) \quad \text{——— (1)}$$

where

U_d = DC Bus voltage
r_a = winding resistance
L_a = winding Equivalent line inductance
k_e = back emf coefficient
Ω = mechanical angular
I = winding phase current in steady state.

$$T_e(s) = K_T I(s) \quad \text{——— (2)}$$

where

T_e = Electromagnetic torque
K_T = motor torque coefficient

2) Mechanical Part -

$$T_e(s) - T_I(s) = (Js + Bv)\, \Omega(s) \quad \text{——— (3)}$$

where

T_I = load Torque
J = moment of Inertia of rotor.
Bv = coefficient of viscous friction.

Electrical part: Transfer function is

$$\frac{I(s)}{U_d(s) - k_e \Omega(s)} = \frac{1}{(r_a + L_a s)} \quad \text{——— from eqn (1)}$$

mechanical part :- Transfer function is

$$\frac{\Omega(s)}{T_e(s) - T_I(s)} = \frac{1}{(Js + Bv)}$$ ——— from eqn (3)