جامعة بيرزيت

BIRZEIT UNIVERSITY

Electrical and Computer Engineering Department

Electrical Machines ENEE 2408

Short Exam #1 (10*mins*)

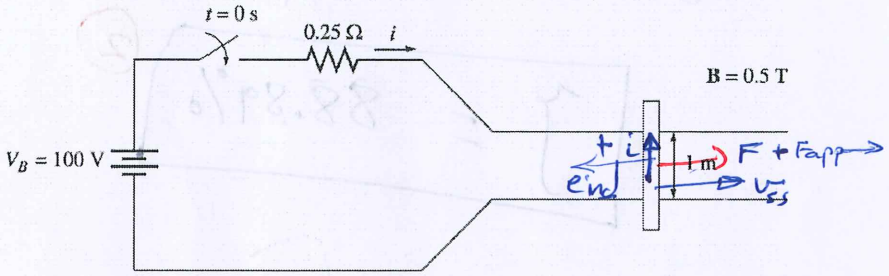
Student Name: **ID:** **October 2, 2024**

A linear machine has a magnetic flux density of 0.5 T directed into the page, a resistance of 0.25 Ω, a bar length l = 1.0 m, and a battery voltage of 100 V.

(a) What is the initial force on the bar at starting? What is the initial current flow?

(b) What is the no-load steady-state speed of the bar?

(c) If a force of 25N is somehow applied to the bar in the direction of motion, what is the new steady-state speed? What is the efficiency of the machine under these circumstances?



a) $i_{st} = \frac{100}{0.25} = 400A$ (2)

$F = ilB = 400(1)(0.5) = 200N$ (right) (2)

b) $v_{ss} = \frac{V_B}{BL} = \frac{100}{0.5(1)} = 200\ m/s$ (2)

c) in new ss. $F_{app} = F_{ind}$

$= i'lB$

$i' = \frac{25}{1(0.5)} = 50A$ (0.5) (opposite to assumed current)

$e_{ind}' = V_B + i'R$

$= 100 + 50)(0.25)$

$e_{ind} = 112.5V$ (0.5)

$$\therefore \quad e_{ind}' = v_{ss}' B\ell$$

$$v_{ss} = \frac{e_{ind}'}{B\ell}$$

$$= \frac{112.5}{(0.5)(1)} = \boxed{225 \text{ m/s} = v_{ss}'} \quad (1)$$

$$\eta = \frac{P_{out}}{P_{in}} \times 100$$

$$= \frac{V_B}{e_{ind}'} \times 100\% = \frac{100}{112.5} \times 100\%$$

$$\boxed{\eta = 88.89\%} \quad (2)$$