



5.19 (a)  $s = \frac{1800 - 1890}{1800} = -0.05$

Induction machine operates in the generating mode

(b)  $\frac{R_2'}{s} = \frac{0.35}{-0.05} = -7.0 \Omega$

$Z_1 = (0.25 + j0.55) + \frac{j38(-7 + j1.1)}{-7 + j(38 + 1.1)} = 6.75 \angle 155.8$

$I_1 = \frac{208/\sqrt{3}}{6.75 \angle 155.8} = 17.8 \angle -155.8$

(c)  $P_m = \sqrt{3} \times 208 \times 17.8 \cos(155.8) = -5849.2 \text{ W}$  (delivered to supply)

$Q_m = \sqrt{3} \times 208 \times 17.8 \sin(155.8) = 2628.7 \text{ VAR}$  (draws from supply)

(d)  $P_{ag} = 5849.2 + 3 \times 17.8^2 \times 0.25 = 6086.83 \text{ W}$

$P_{cu2} = s P_{ag} = 0.05 \times 6086.83 = 304.34 \text{ W}$

(e)  $P_{mech} = (1 - s) P_{ag} = 1.05 \times 6086.83 = 6391.2 \text{ W}$

$P_{shaft} = 6391.2 + 225 = 6616.2 \text{ W}$

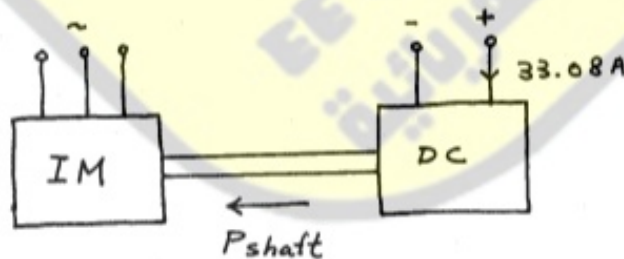
$E_a I_a = 6616.2 + 225 = 6841.2 \text{ W}$

$V_t = E_a + I_a R_a$

$220 = \frac{6841.2}{I_a} + I_a (0.4)$  (quadratic equation)

$I_a = 33.08, 516.9$

$I_a = 33.08$  flows into the dc machine



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