EEC-432 Assignment
Prof. JCB sir

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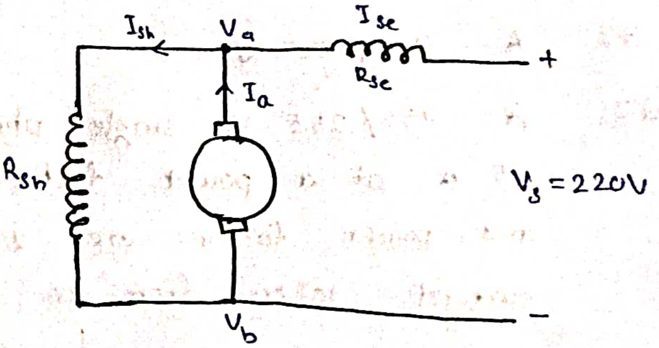
Q-1. A short shunt dc compound generator supplies a current of 100 A at a voltage of 220 V. If the resistance of shunt field is ~~50 Ω~~ 51.1 Ω, of the series field is 0.0261, of the armature is 0.061 Ω, the total brush drop is 2V and the iron friction losses amount to 1 kW, find (a) The generated e.m.f.
(b) The copper loss
(c) The output power of the prime mover driving generator
(d) The generator efficiency

Sol) Given,



$I_{se} = 100$ A
$R_{se} = 0.0261\ \Omega$
$R_a = 0.061\ \Omega$
$R_{sh} = 51.1\ \Omega$

Now,
$$V_a - V_b = V = 220 + I_{se} R_{se}$$
$$V = 220 + 100 \times 0.0261$$
$$V = 222.61\ V$$

Now,
$$V = I_{sh} \times R_{sh}$$
$$I_{sh} = \frac{V}{R_{sh}} = \frac{222.61}{51.1} = 4.35\ A$$

and
$$I_a = I_{sh} + I_{se} = 4.35 + 100 = 104.35$$
$$\boxed{I_a = 104.35\ A}$$

a) generated emf. $E_g = V + I_a R_a + 2V$
$$= 222.61 + 104.35 \times 0.061 + 2V$$
$$E_g = 230.97\ V$$

b) Copper losses $= I_{sh}^2 R_{sh} + I_{se}^2 R_{se} + I_a^2 R_a$
$$= 4.35^2 \times 51.1 + 100^2 \times 0.0261 + 104.35^2 \times 0.061$$
$$= 1892.16\ W$$

c) Output power of the prime mover

= Input power of generator

= output of generator + losses

= output of generator + copper losses + Iron or friction losses

= $220 \times 100 + 1892.16 + 1000$

= 24892.16 W

d) Efficiency $= \frac{\text{output}}{\text{Input}} \times 100$

$= \frac{100 \times 220}{24892.16} \times 100$

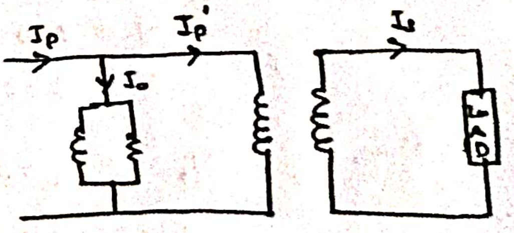
$= 88.38$ %

Q2. A ~~400/1200 V~~

Q2. A 455/255 V single phase transformer is supplying a load of 25 A at a power factor of 0.866 lagging. On no-load current and power factor are; 2 A and 0.208 respectively. Calculate the current taken from the supply.

Sol) Given,

turn ratio $= \frac{455}{255} = 1.78$



Acc. to ques.

$I_s = 25 \angle -\cos^{-1}(0.866)$

$I_s = 25 \angle -30°$ Amp

Now, $\frac{I_s}{I_p'} = 1.78$

$I_p' = \frac{I_s}{1.78} = \frac{25}{1.78} \angle -30° = 14.04 \angle -30°$ Am

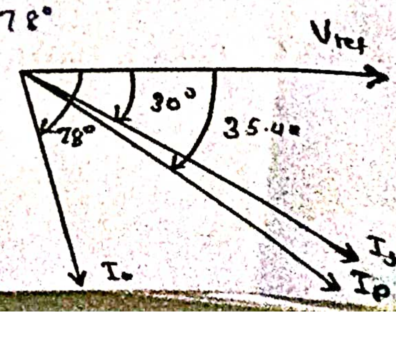
At no-load

$I_0 = 2 \angle -\cos^{-1} 0.208$

$I_0 = 2 \angle -78°$ Amp

Now, $I_p = I_p' + I_0 = 14.04 \angle -30° + 2 \angle -78°$

$\therefore I_p = 15.46 \angle -35.44$ lagging



Q3. A 4 pole, 3 phase, 50 Hz, 400 V induction motor has a delta connected stator and a star connected rotor. Each phase of rotor winding carries one-fourth of the number of turns on each phase of stator winding. The full load speed is 1455 rpm. The rotor resistance 0.41 Ω and rotor standstill reactance is 1.11 Ω per phase. The stator and rotor windings are similar. Stator losses equal to 100 W. Friction and windage losses are equal to 50 W. Calculate.

i> blocked rotor voltage per phase
ii> rotor current per phase at full load
iii> total power input at full load
iv> rotor power loss at full load
v> Efficiency.

Sol> Given,

pole $P = 4$, $\frac{N_2}{N_1} = \frac{1}{4}$

$f = 50\ Hz$

$V_1 = 400\ V$

$R_2 = 0.41\ \Omega$

$X_2 = 1.11\ \Omega$

Stator loss = 100 W , Friction and windage loss = 50 W.

i> Stator induced emf. –

$$E_1 = V_1 = 400$$

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} = 4$$

$$E_2 = \frac{E_1}{4} = \frac{400}{4} = 100\ V$$

ii>

$$N_s = \frac{120 f}{P} = \frac{120 \times 50}{4} = 1500\ rpm$$

Now, slip (s) $= \frac{N_s - N_r}{N_s} = \frac{1500 - 1455}{1500} = 0.03$

∴ Rotor current $I_2 = \frac{s E_2}{\sqrt{R^2 + (s X_2)^2}}$

~~$I_2 = 9.95\ A$~~

$$I_2 = \frac{0.03 \times 100}{\sqrt{0.41^2 + (1.11 \times 0.03)^2}}$$

$I_2 = 7.299\ Amp$

$I_2 = 7.3\ Amp$

iv> Rotor copper loss $= 3 \times I_2'^2 R_2 = 3 \times 7.3^2 \times 0.41$

$= 65.54$ W

iii> Power input to rotor $= \frac{\text{Rotor copper loss}}{\text{Slip}} = \frac{65.54}{0.03}$

$= 2184.89$ W

Power input to motor = Rotor input loss + stator loss

$= 2184.89 + 100$

$= 2284.89$ W

Now,

Output at the shaft = Rotor input − Rotor copper loss − friction and windage loss

$= 2184.89 - 65.54 - 50$

$= 2069.35$ W

v> Efficiency $= \frac{\text{Output}}{\text{input}} \times 100 = \frac{2069.35}{2284.89} \times 100 = 90.56\ \%$.