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Bsee 19047

Machines A4

Q:-1

$R_A = 0.18\,\Omega$, $R_F = 20\,\Omega$, $V_F = 120\ V$

$N_F = 1000$, $R_{adj} = 0$ to $40\,\Omega$, $n = 1800\ rm^{-1}$

(a) For no load, $V_T = E_A$

$$I_f = \frac{V_F}{R_F + R_{adj}} = \frac{120}{20+0} = 6A \quad :- R_{adj} = 0\,\Omega$$

$$I_f = \frac{120}{20+40} = 2A \quad :- R_{adj} = 40\,\Omega$$

from the curve

$V_{T(R_{adj}=0)} = 135\ V$, $V_T(R_{adj}=40) = 80\ V$

(b) $R_{adj} = 0$ to $30\,\Omega$, $n = 1500$ to 2000 rpm

$$I_F = \frac{V_F}{R_F + R_{adj}} = \frac{120}{20+0} = 6A \quad :- R_{adj} = 0$$

$$= \frac{120}{20+30} = 2.4A \quad :- R_{adj} = 30\,\Omega$$

$V_T(0) = 135\ V$ at 1800 rpm

for 2000 rpm

$$E_A = \frac{2000}{1800} \times 135 = \boxed{150\ V}$$

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$V_T(30) = 93\ V$ for 1800 rpm

For 1500 rpm

$$E_A = \frac{1500}{1800} \times 93 = \boxed{77.5\ V}$$

Q:-2

$I_A = 50A$, $n = 1700$ rpm, $V_T = 106\ V$

$I_F = ?$

$$E_A = V_T + I_A R_A = 106 + (50)(0.18) = 115\ V$$

at 1800 rpm

$$E_A = \frac{1800}{1700} \times 115 = 121.7\ V$$

$$I_F = 4A$$

Q:-3

$F_{AR} = 400$ A turns, $I_F = 5A$,
$I_A = 50\ A$, $V_t = ?$, $n_m = 1700$ rpm

Solve

$$F_{net} = F_F - F_{AR} = N_F I_F - F_{AR} = (1000)(5) - 400$$

$$F_{net} = 4600 \text{ A turns}$$

$$I_{F_{new}} = \frac{F_{net}}{N_F} = \frac{4600}{1000} = 4.6A$$

from the graph $E_{A_0} = 126\ V$ at 1800 rpm for 1700 rpm

$$E_A = \frac{n_m \times E_{A0}}{n_m} = \frac{1700}{1800} \times 126 = \boxed{119V}$$

$$V_T = E_A - I_A R_A = 119 - (50)(0.18) = \boxed{110V}$$

Q:-4

$R_{adj} = 10\,\Omega$, $n = 1800$ rpm.

(a) $$I_f = \frac{V_f}{R_f + R_{adj}} = \frac{120}{20+10} = 4A$$

from the graph :- $V_T = 121V$

(b) $I_A = 20A$

$$V_T = E_A - I_A R_A$$
$$= 120 - (20)(0.18) = 117.4V$$

$$I_A = E_A - I_A R_A = 121 - (40)(0.18) = 113.8V$$

(c) $f_{AR} = 300$ A turns

$I_A = 20A$

$$f_{net} = f_F - f_{AR} = (1000)(4) - 300 = 3700 \text{ A turns}$$

$$I_{f\,new} = \frac{3700}{1000} = 3.7A$$

from graph :- $E_A = 116V$

$$V_T = 116 - (20)(0.18) = 112.4V$$

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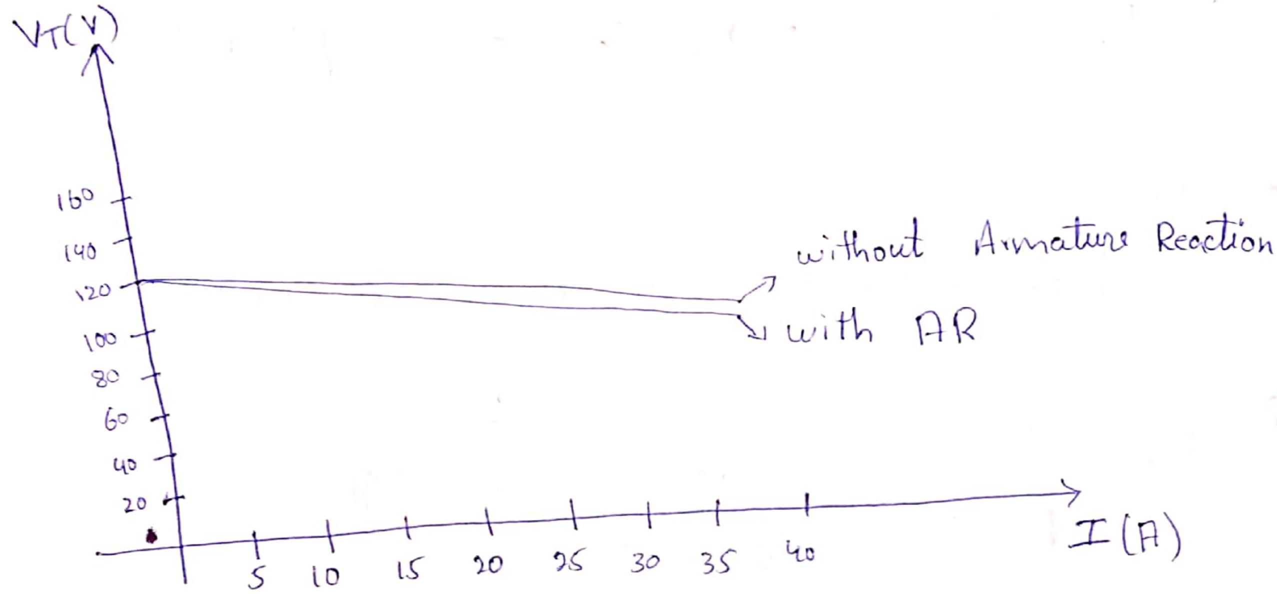
for $I_A = 40A$

$$V_T = 116 - 40(0.18) = 108.8V$$

(d)



Q:-5

$n = 1800\,rpm$, $R_{adj} = 10\,\Omega$

$I_A = 25A$, $E_A = 121\,V$ (using from Q:-4)

$$V_T = E_A - I_A R_A = 121 - (25)(0.18) = 116.5\,V$$

$R_F = 5.0\,\Omega$

$$I_F = \frac{V_F}{R_F + R_{adj}} = \frac{120}{5+10} = 8\,A$$

from the graph, $E_A = 147.5$

$$V_T = 147.5 - (25)(0.18) = 143\,V$$

Q:- 6

$R_A + R_S = 0.21\,\Omega$, $R_F = 20\,\Omega$

$R_{adj} = 0$ to $30\,\Omega$, $N_{SE} = 25$ turns

$n_m = 1800$ rpm , $N_F = 1000$ turns

(a) $R_{adj} = 10\,\Omega$

$$I_F = \frac{V_F}{R_F + R_{adj}} = \frac{120}{20+10} = 4A \quad \text{and} \quad V_T = 121V$$

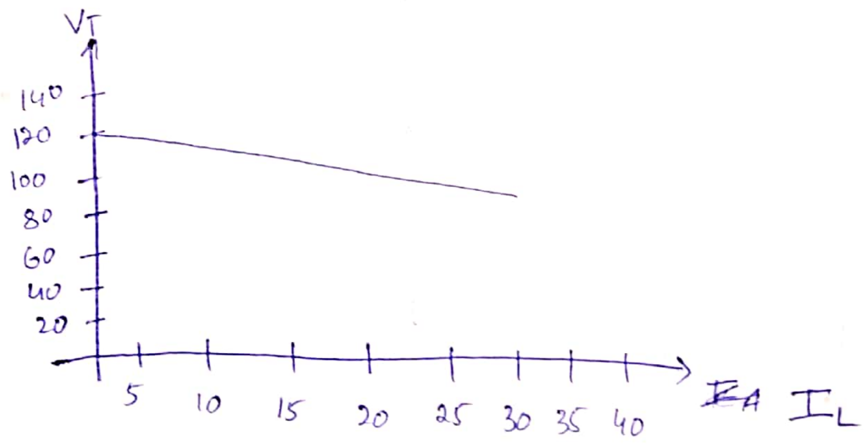
(b) $I_A = 20A$

$$V_T = E_A - I_A R_A = 121 - (20)(0.21) = 116.8\,V$$

(c) $I_A = 40A$

$$V_T = 121 - (40)(0.21) = 112.6V$$

(d) armature current increase causes the increase in $I_A(R_A + R_S)$ and decreases (V_T)



Question no 7:

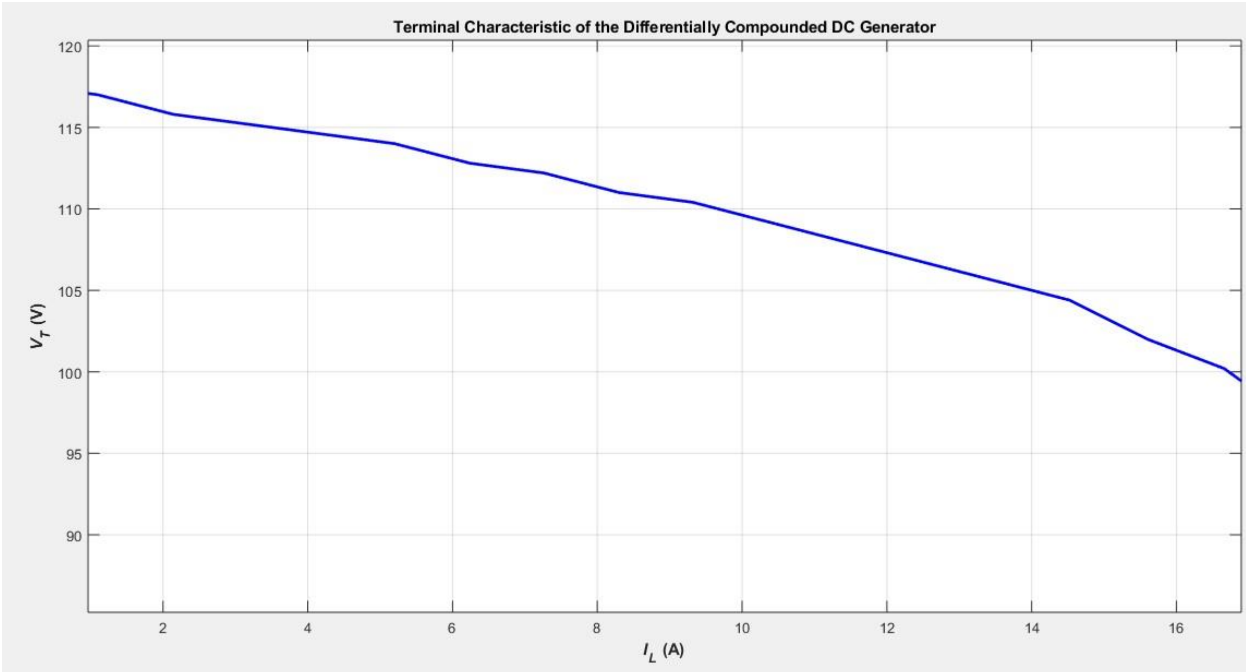
If the machine described in Problem 6 is reconnected as a differentially compounded dc generator, what will its terminal characteristic look like? Derive it in the same fashion as in Problem 6.

Solution:

Matlab Code for finding the Characteristics Curve.

```
%Question no 7:
% This function of the code is to plot the Terminal Characteristics Curve
% of the Commulatively Compounded DC Generator
load p87_mag.dat;% Loading the file contains that data points of the
Magnetization Curve
if_values = p87_mag(:,1);% First Coloumn of the data file
ea_values = p87_mag(:,2);% Second Coloumn of the data file
rf = 20; % Variable for the Field Resistance  radj =
10; % Variable for the Adjustable Resistance ra = 0.21; %
Variable for the Armature Resistance If = 0:0.02:6; %
Variable for the Field Current n = 1800; % Variable for
the Speed n_f = 1000; % Variable for the Shunt field
turns n_se = 25; % Variable for the Series field turns
% Calculate Ea versus If
Ea = interp1(if_values,ea_values,If);
% Calculate Vt versus If
Vt = (rf + radj) * If;
%For finding the point and also for getting stable value
ia = 0:1:21; for i = 1:length(ia)
% Calculate the Ea values modified by mmf due to the
% armature current
Ea_a = interp1(if_values,ea_values,If - ia(i)*n_se/n_f);% in this it is
subtracted because of Differentially Compounded
% Get the voltage difference
difference = Ea_a - Vt - ia(i)*ra;
% This code prevents us from reporting the first (unstable) %
location satisfying the criterion.
temp = 0;
    for j = 1:length(If)          if
difference(j) > 0            temp = 1;
end         if ( difference(j) < 0 && temp
== 1 )             break;          end
end
% for computing the terminal voltage vt(i)
= Vt(j);
il(i) = ia(i) - vt(i) / ( rf + radj);
end
% for plotting the Graph plot(il,vt,'b-','LineWidth',2.0)
xlabel('\bf\itI_{L} \rm\bf(A)'); ylabel('\bf\itV_{T} \rm\bf(V)');
title ('\bfTerminal Characteristic of the Differentially Compounded DC
Generator'); hold
off; axis([ 0 15 0
110]); grid on;
```

Graph:


Terminal Characteristic of the Differentially Compounded DC Generator
V_T (V)
120
115
110
105
100
95
90
2
4
6
8
10
12
14
16
I_L (A)