LABORATORY MANUAL

Computer Aided Electric Machines Design Lab

EE-326-F

(VIth Semester)

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	ratio of window height to window width is 3 and the ratio of core depth to width of central limbs is 2.5, the stacking factor is 0.9.			
5	Using simulation find the primary winding, secondary winding and area of conductor of single phase transformer of a 10KVA, 2000/400 V, 50 Hz, single phase shell type oil immersed self cooled transformer. Assume voltage per turn 10V,flux density 1.1 wb/ m^2, current density 2 A/mm^2, window space factor 0.33, the ratio of window height to window width is 3 and the ratio of core depth to width of central limbs is 2.5, the stacking factor is 0.9.			
6	Using MATLAB write a program to design a 11 KW, 3 phase, 440 volt, 50 Hz, 1000 synchronous rpm, squirrel cage induction motor having a full load efficiency of 0.86 and a power factor of 0.86. The temperature rise should not exceed 50 °C.			
7	Using matlab write a program to find main dimension of 75000 KVA,13.8KV,50Hz , 62.5 rpm, 3 phase star connected alternator also find number of stator slot, conductor per slot. The peripheral speed should be about 40m/sec assume average gap density 0.65 wb/m^2 and conductor per meter is 40000 and current density is 4A /m^2.			
8	Using Simulation find the main dimension of 75000 KVA,13.8KV,50Hz , 62.5 rpm, 3 phase star connected alternator also find number of stator slot, conductor per slot. The peripheral speed should be about 40m/sec assume average gap density 0.65 wb/m^2 and conductor per meter is 40000 and current density is 4A /m^2.			
9	Using Matlab write a program to calculate the mmf required for the air gap of a machine having core length 0.32m including 4 ducts of 10 mm each, pole are 0.1m, slot pitch 65.4mm; slot opening is 5mm; air gap length 5mm; flux per pole 52 Wb/m. Given Carter’s co-efficient is 0.18 for opening /gap 1; and is 0.28 opening/gap equal to 2			

10	Using Simulation calculate the mmf required for the air gap of a machine having core length 0.32m including 4 ducts of 10 mm each, pole are 0.1m, slot pitch 65.4mm; slot opening is 5mm; air gap length 5mm; flux per pole 52 Wb/m. Given Carter's co-efficient is 0.18 for opening /gap 1; and is 0.28 opening/gap equal to 2			

EXPERIMENT NO-1

Aim: - Introduction of Matlab software

Introduction:-Matlab integrates mathematical computing, visualization, and a powerful language to provide a flexible environment for technical computing. MATLAB includes tools for:

Data acquisition

Data analysis and exploration

Visualization and image processing

Algorithm prototyping and development

Modeling and simulation

Programming and application development

Run demos in the following categories to see MATLAB at work.84

Category	Description
Desktop Environment	The MATLAB desktop is a graphical user interface that transforms MATLAB into an integrated environment for exploration and development. These playback demos show you how easy the desktop is to use.
Matrices	MATLAB works with scalars, vectors, and matrices. A scalar is really just a 1-by-1 matrix, and a vector is nothing more than a long, thin matrix given as either a row or a column. In this sense, everything that MATLAB operates on is a matrix.Since matrices are the basis for all of MATLAB, this section contains demos that describe simple matrix operations and some of the basic MATLAB functions, the foundation upon which many of the more complex functions are built.
Numeric	This section contains some demos of numeric calculation in MATLAB. It includes demos illustrating curve fitting, solving differential equations, and fast Fourier transform (FFT).
Graphics	These demos illustrate graphics functions that create 2-D and 3-D plots of data, and introduce visualization techniques.
Language	MATLAB is both an environment and a programming language that allows you to build your own reusable tools. You can write programs as either scripts or functions using data types, operators, expressions, and statements that are similar to programming languages such as C. You can also create object-oriented classes and objects in MATLAB or use its built-in Java interface to

Introduction of Toolbox:-Toolboxes are **s**pecialized collections of M-files (MATLAB language programs) built specifically for solving particular classes of problems. Our toolboxes represent the efforts of some of the world's top researchers in fields such as controls, signal processing, system identification, and others. The following toolboxes have demos to browse through. Try these demos to see which toolboxes might be appropriate for the work you do. Note that this is a comprehensive list of toolboxes.

Your particular installation of Math Works products will likely include only some of these products.

Toolbox	Description
Communications	Design and analyze communications systems
Control System	Design and analyze feedback control systems
Curve Fitting	Perform model fitting and analysis
Data Acquisition	Acquire and send out data from plug-in data acquisition boards
Database	Exchange data with relational databases
Filter Design	Design and analyze advanced floating-point and fixed-point filters
Financial	Model financial data and develop financial analysis algorithms
Fuzzy Logic	Design and simulate fuzzy logic systems
Image Processing	Perform image processing, analysis, and algorithm development
Instrument Control	Control and communicate with test and measurement instruments
LMI Control	Design robust controllers using convex optimization techniques
MATLAB Link for Code Composer Studio	Use MATLAB with RTDX-enabled Texas Instruments digital signal processors
Mapping	Analyze and visualize geographically based information
Model Predictive Control	Control large, multivariable processes in the presence of constraints
Mu-Analysis and Synthesis	Design multivariable feedback controllers for systems with model uncertainty
Neural Network	Design and simulate neural networks
Optimization	Solve standard and large-scale optimization problems
Partial Differential Equation	Solve and analyze partial differential equations
Robust Control	Design robust multivariable feedback control systems
Signal Processing	Perform signal processing, analysis, and algorithm development
Spline	Create and manipulate spline approximation models of data
Statistics	Apply statistical algorithms and probability models
Symbolic Math	Perform computations using symbolic mathematics and variable-precision arithmetic
System Identification	Create linear dynamic models from measured input-output data

Introduction of Simulink

Simulink is a tool for modeling, analyzing, and simulating physical and mathematical systems, including those with nonlinear elements and those that make use of continuous and discrete time. As an extension of Matlab, Simulink adds many features specific to dynamic systems while retaining all of general purpose functionality of Matlab. Run demos in the following categories to see Simulink in action.

Category	Description
Features	Simulink provides many features for powerful and intuitive modeling. Some major features are illustrated in these demonstration models.
General	Simulink has the ability to simulate a large range of systems, from very simple to extraordinarily complex. The models and demonstrations that you will see in this section include both simple and complex systems. Although the complex systems are nowhere near the limits of what can be done, they hint at the level of sophistication that you can expect.
Automotive	Simulink, Stateflow and the Real-Time Workshop represent the industry standard toolset in the automotive field. The models that you will see in this area showcase the use of MathWorks tools in various automotive applications.
Aerospace	Simulink, Stateflow and the Real-Time Workshop represent the industry standard toolset in the aerospace field. The models that you will see in this area showcase the use of MathWorks tools in various aerospace applications.

EXPERIMENT NO.:-2

Aim: - Using MATLAB writes a program to design single phase transformer which have output 200 KVA 50 Hz core type. A cruciform core is used with distance between two adjacent limbs equal to 1.6 times the width of core lamination. Assume voltage per turn 14. Maximum flux density 1.1 Wb/m^2, windows space factor is 0.32, current density 0 amp/mm^2, stacking factor is 0.9. The net iron area is $0.56d^2$ in a cruciform core where d is diameter of circumscribing circle. Also the width of largest stamping is 0.85d

Software used:- Matlab version 9

Program:-

f=input ('enter the value of frequency in Hz');

B=input ('enter the value of flux density');

J=input ('enter the value of current density');

K_w=input ('enter the value of window space factor');

E_t=input ('enter the value of voltage per turn');

Q=input ('enter the value of output power');

Net iron area =A_i=E_t / (4.44*f*B)

Diameter of circumscribing circle=d= (A_i/0.85)^1/2

Width of largest stamping=a=0.85*d

Distance between core centre=D=1.6*a

Width of window=W_w=D-d

Area of window=A_w=Q/ (2.22*f*Ai*K_w*J*10^3)

Height of wind0w=H_w=A_w/W_w

Depth of window=D_y=a

Height of yoke=H_y=a

Height of frame= H_y=2*H_y+H_w

Width of frame=W=D+a

Design observation table:-

Table 1:- Input parameter

Frequency (f)	Flux density (B)	Current density (J)	window factor(K_w)	Voltage per turn (E_t)	output power(Q)

Table 2:-output:-

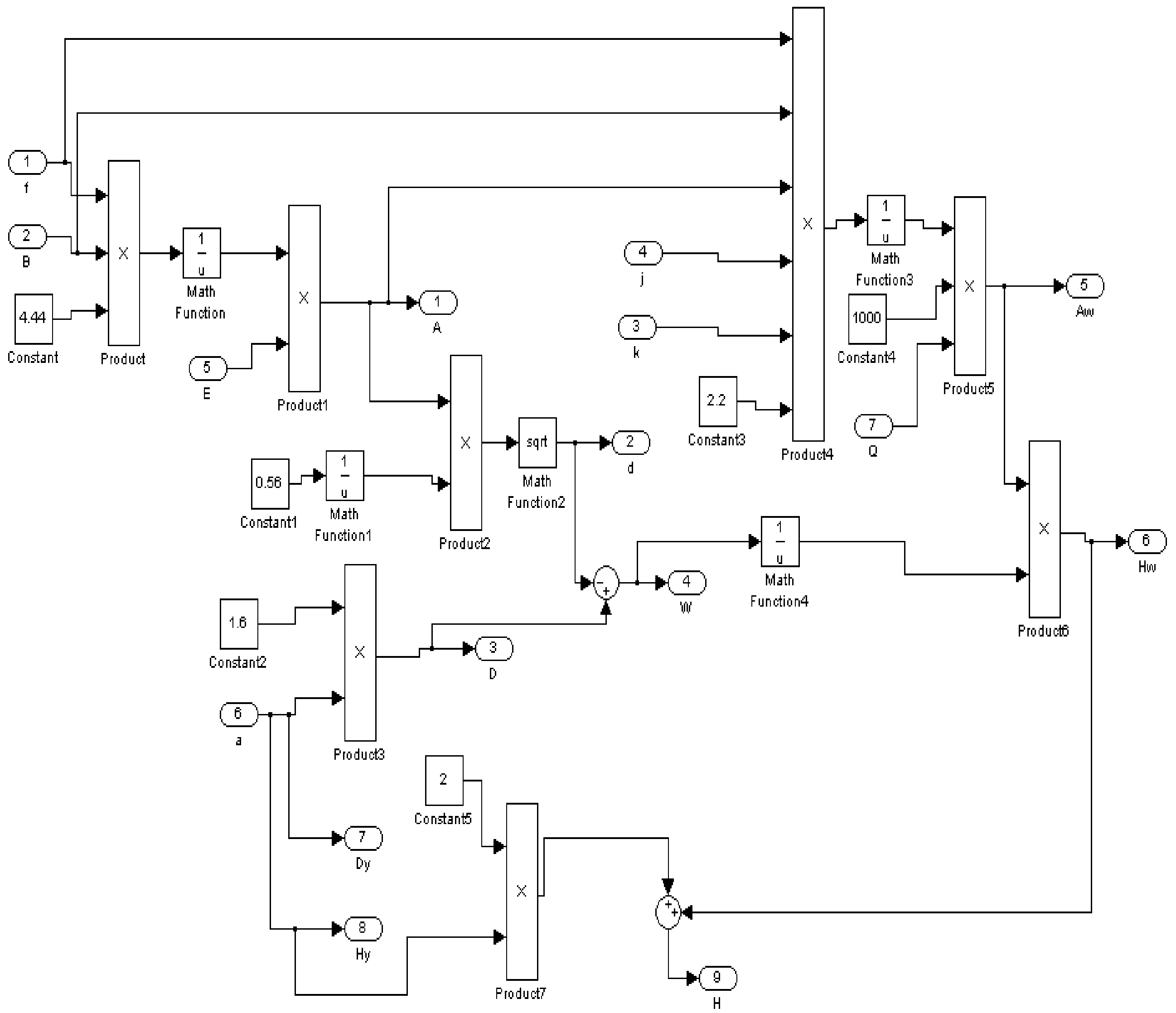
A_i	d	a	D	W_w	A_w	H_w	D_y	H_y	H	W

EXPERIMENT NO:-3

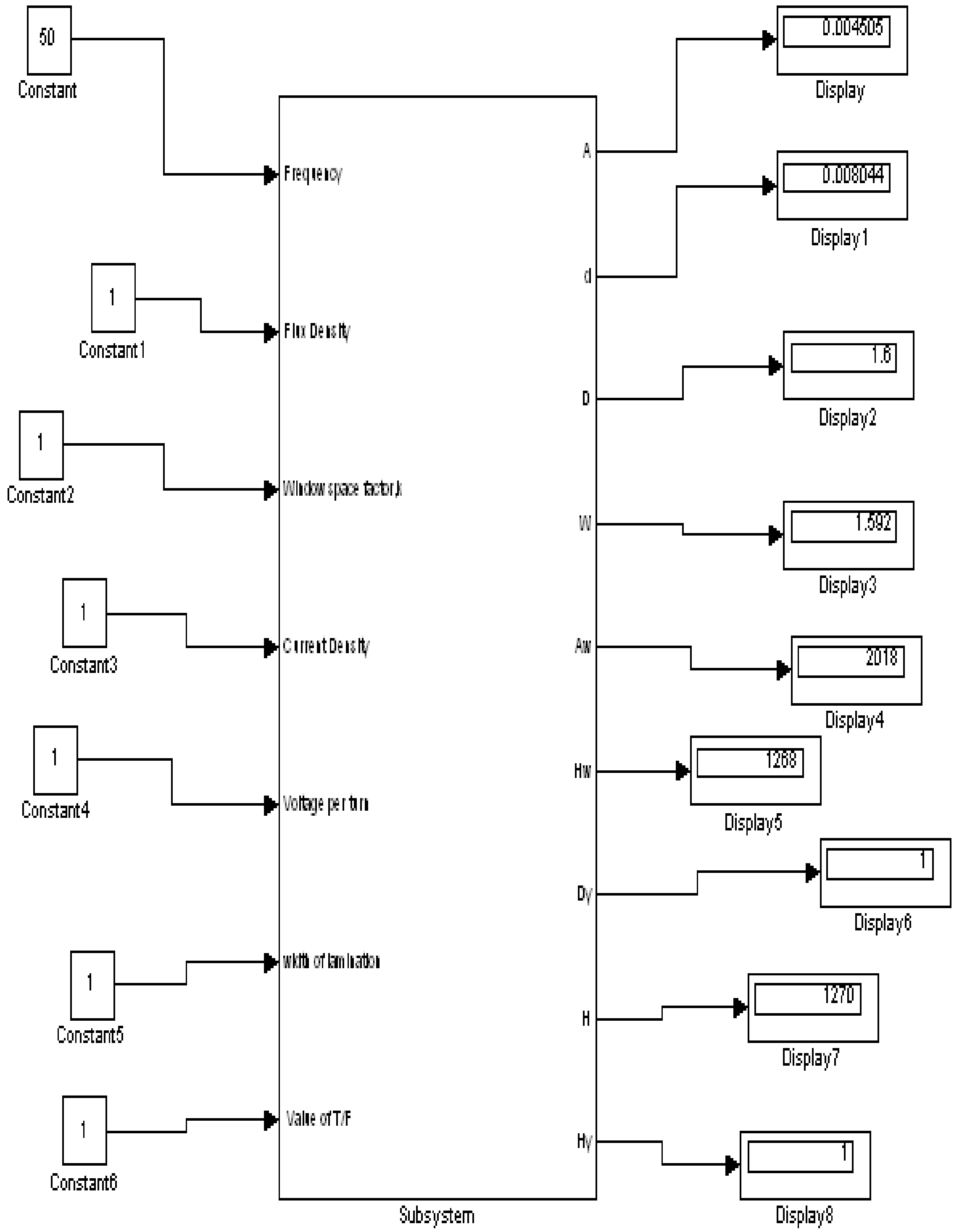
Aim:- Using simulation design single phase transformer which have output 200 KVA 50 Hz core type. A cruciform core is used with distance between two adjacent limbs equal to 1.6 times the width of core lamination. Assume voltage per turn 14. Maximum flux density 1.1 Wb/m^2, windows space factor is 0.32, current density 0 amp/mm^2, stacking factor is 0.9. The net iron area is $0.56d^2$ in a cruciform core where d is diameter of circumscribing circle. Also the width of largest stamping is 0.85d

Software used: -Matlab version 9

Internal simulation block



Simulation result:-


50
Constant
1
Constant1
1
Constant2
1
Constant3
1
Constant4
1
Constant5
1
Constant6
Frequency
Flux Density
Window space factor,k
Current Density
Voltage per turn
width of lamination
Value of T/F
Subsystem
A
d
D
W
Aw
Hw
Dy
H
Hy
0.004605
Display
0.008044
Display1
1.6
Display2
1.592
Display3
2018
Display4
1268
Display5
1
Display6
1270
Display7
1
Display8

EXPERIMENT NO.:- 4

AIM:- Using MATLAB calculate the main dimension detail of a 10KVA, 2000/400 V, 50 Hz, single phase shell type oil immersed self cooled transformer. Assume voltage per turn 10V,flux density 1.1 wb/ m^2, current density 2 A/mm^2, window space factor 0.33, the ratio of window height to window width is 3 and the ratio of core depth to width of central limbs is 2.5, the stacking factor is 0.9.

Program:-

F=input ('Enter the value of frequency in Hz');

Q=input ('Enter the value of output power in VA');

V_1=input ('Enter the value of primary voltage');

V_2=input ('Enter the value of secondary voltage');

E_t=input ('Enter the value of voltage per turn');

B=input ('Enter the flux density in wb/m^2');

j=input ('Enter the value of current density');

S=input ('Enter the value of stacking factor');

K=input ('Enter the value of window space factor');

R=input ('Enter the value of ratio of core depth to central limb');

H_r=input ('Enter the value of ratio of height and width of window');

Net iron area= $A_i=E_t/(4.44*F*B)$

Gross iron area=$A_{gi}=A_i/S$

Width of central limb=a= $(A_{gi}/10)$^1/2

Core depth=b=2*a*R

Gross area of yoke=$A_y=A_{gi}/2$

Depth of yoke=D_y=b

Height of yoke=$H_y=A_y/D_y$

Area of window=A_w=Q/(2.22*F*B*K*j*A_i*10^-3)

Height of window=H_w=(A_w*H_y)^1/2

Width of window=$W_w=A_w/H_w$

Height of frame=H=H_w+2*H_y

Overall length of frame=2*H_w+4*a

H.V winding turns=T_p=V_1/Et

L.V winding turns=T_s=V_2/Et

H.V winding current =I_p=Q/V_1

L.V winding current=I_s=Q/V_2

H.V winding conductor area=A_p=I_p/j

L.V winding conductor area=As=$_{Is}$/j

L.V winding conductor diameter =d_s=(As/3.14)^1/2

H.V winding conductor diameter=d_p=(A_p/3.14)^1/2

Design observation table:-

Table 1:- Input parameter

F	Q	V_1	V_2	E_t	B	J	S	K	R

Table 2(a):-output:-

A_i	A_{gi}	b	a	W_w	A_w	H_w	d_s	d_p	H_y	H

Table 2(b):-output

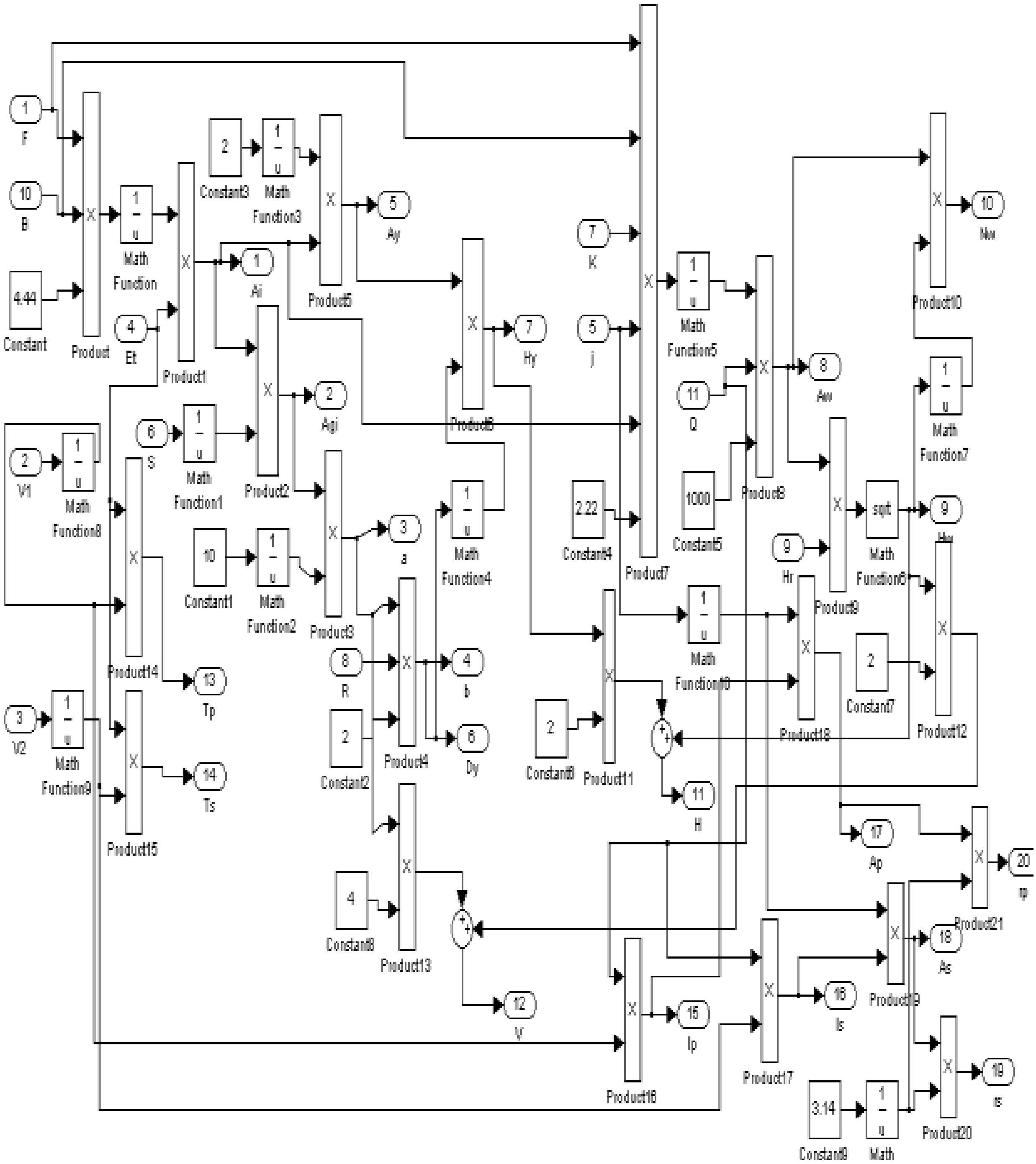
W	T_p	T_s	I_p	I_s	A_p	A_s	D_y

EXPERIMENT NO.:- 5

AIM: -Using simulation find the primary winding, secondary winding and area of conductor of single phase transformer.

Software used: - Matlab version 9

Internal simulation block



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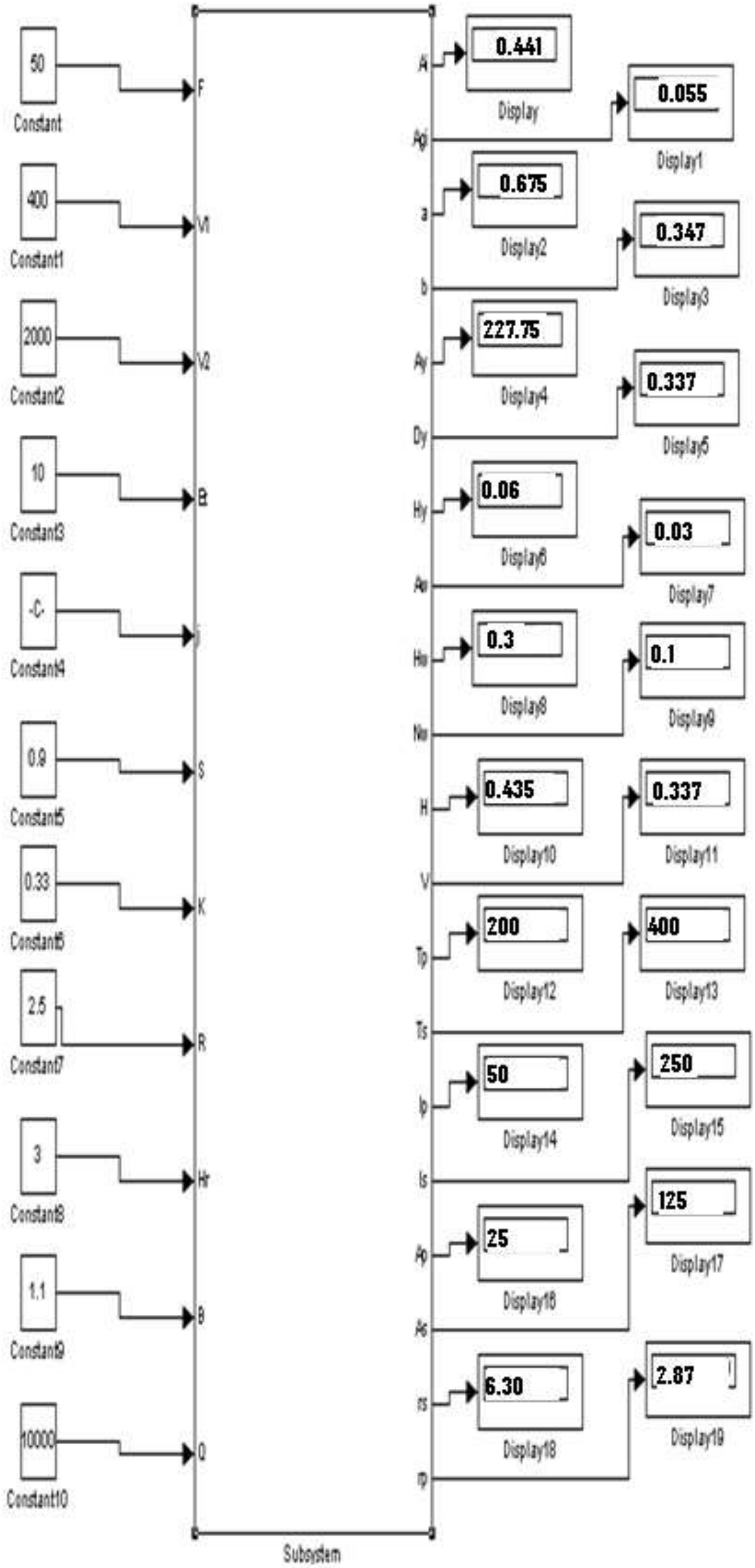
Simulation result:-


50
Constant
400
Constant1
2000
Constant2
10
Constant3
-C-
Constant4
0.9
Constant5
0.33
Constant6
2.5
Constant7
3
Constant8
1.1
Constant9
10000
Constant10
F
V1
V2
Et
j
S
K
R
Hr
B
Q
Subsystem
Al
Agi
a
b
Ay
Dy
Hy
Aw
Hw
Nw
H
V
Tp
Ts
Ip
Is
Ap
As
rs
rp
0.441
Display
0.055
Display1
0.675
Display2
0.347
Display3
227.75
Display4
0.337
Display5
0.06
Display6
0.03
Display7
0.3
Display8
0.1
Display9
0.435
Display10
0.337
Display11
200
Display12
400
Display13
50
Display14
250
Display15
25
Display16
125
Display17
6.30
Display18
2.87
Display19

EXPERIMENT NO.:- 6

AIM:-Using MATLAB write a program to design a 11 KW, 3 phase, 440 volt, 50 Hz, 1000 synchronous rpm, squirrel cage induction motor having a full load efficiency of 0.86 and a power factor of 0.86. The temperature rise should not exceed 50 °C.

Software used: - Matlab version 7.1
Program:-

Ns=input (‘enter the value of synchronous speed’);

V=input (‘enter the value of input voltage’);

f=input (‘enter the value of frequency in hertz’);

P=input (‘enter the value of output power in kw’);

P_f=input (‘enter the value of power factor’);

E=input (‘enter the value of efficiency’);

B_{avg}=input (‘enter the value of flux density’);

ac=input (‘enter the value of specific magnetic loading);

n_d = input (‘enter the value of radial ventilating duct);

q_s= input (‘enter the value of slot per pole per phase);

W_d= input (‘enter the value of width of duct);

Poles=P=120*f/Ns

KVA input=Q=P/(E*p_f)

Output coefficient=C_o=1.11*P*B_{avg}*ac*10^-3

Diameter=D= (Q/ (C_o*Ns*0.52)) ^1/3

Pole pitch= τ =3.14*D/6

Length =L=0.52*D^3

Net iron length=L_i= (L-n_d*W_d)

Flux per pole= f_p = τ *B_{avg}* L

Stator turns per phase=T_S=V/(4.44*f*f_p*.095)

Total stator conductor= $T_{n=}$6*T_S

Total conductor used=T_u=28*54

Design observation table:-

Table 1:- Input parameter

Ns	f	V	P	P_f	E	pf	B_{avg}	n_d	q_s

Table 2(a):-output:-

Q	C_o	D	τ	L_i	L	f_p	T_S	T_n	T_u

EXPERIMENT NO.:- 7

AIM: Using mat lab write a program to find main dimension of 75000 KVA,13.8KV, 62.5 rpm, 3 phase star connected alternator also find number of stator slot, conductor per slot. The peripheral speed should be about 40m/sec assume average gap density 0.65 wb/m^2 and conductor per meter is 40000 and current density is 4A /m^2.

Software used: - Matlab version 7.1

Program:-

q=input('enter the value of power');

n_s=input('enter the value of speed')

b_{av}=input('enter the value of average gap density');

ac=input('enter the value of ac input');

j=input('enter the value of current density');

k_w=input('enter the value of winding factor');

n_p=input('enter the value of peripheral speed');

e=input('enter the value of voltage per phase);

f=input('enter the value of frequency');

y_s=input('enter the value of slot per pitch');

Speed in r.p.s=N=ns/60

Number of pole=p=2*f/N

Diameter with a peripheral speed=D=n_p/3.14*N

Output coefficient=C_o=11*b_{av}*ac*10^-3

Length=L=q/ C_o *N*D^2

Pole pitch=τ=3.14*D/p

Voltage per phase=e_{ph}=e/3^1/2

Flux per pole=φ=b_{av}* τ *L

Turn per phase=t_{ph}=eph/4.44*f* φ *k_w

Total conductors=z=6*t_{ph}

Number of stator slot=s=3*p*y_s

Conductor per slot=Z_s=z/s

Current per phase=i_{ph}=q/3*e_{ph}

Area of each conductor=a_s=i_{ph}/j ,

Design observation table:-

Table 1:- Input parameter

q	n_s	b_{av}	ac	j	k_w	n_p	e	f	y_s

Table 2(a):-output:-

N	p	D	C_o	L	τ	e_{ph}	φ

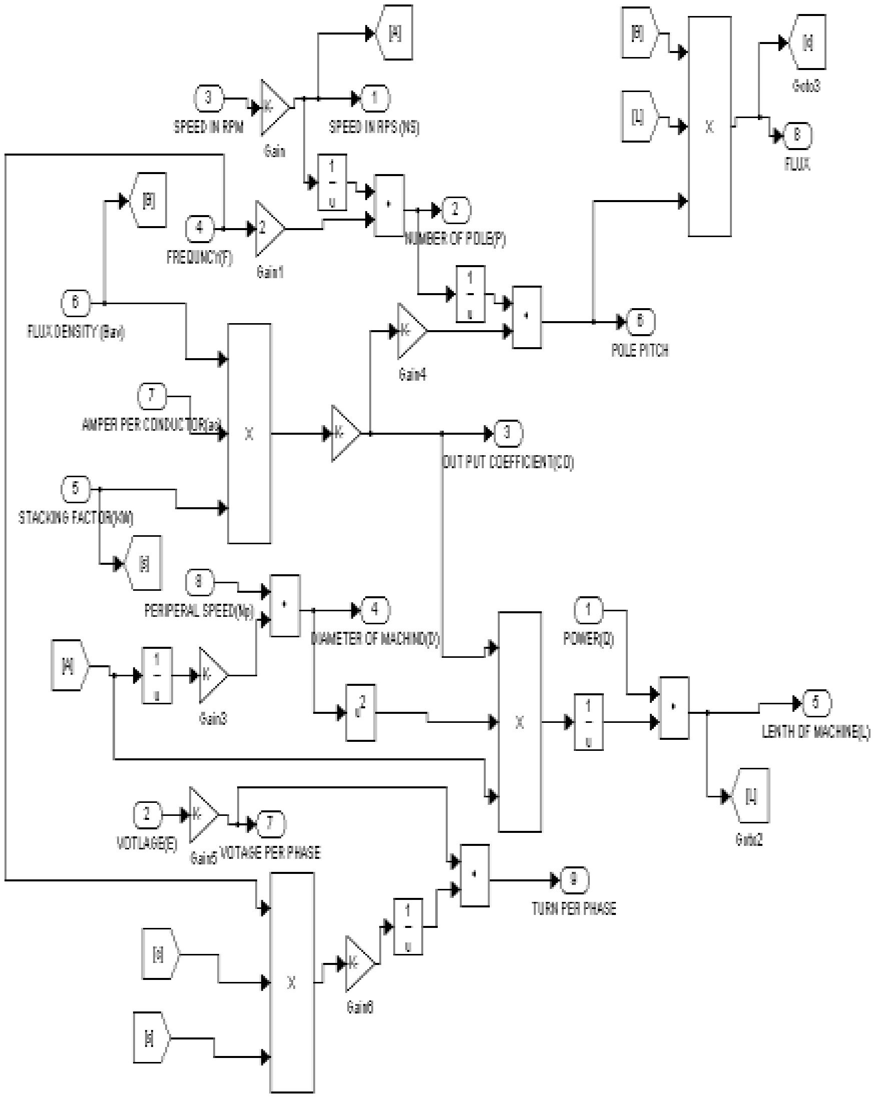
Table 2(b):output

t_{ph}	z	s	Z_s	i_{ph}	a_s

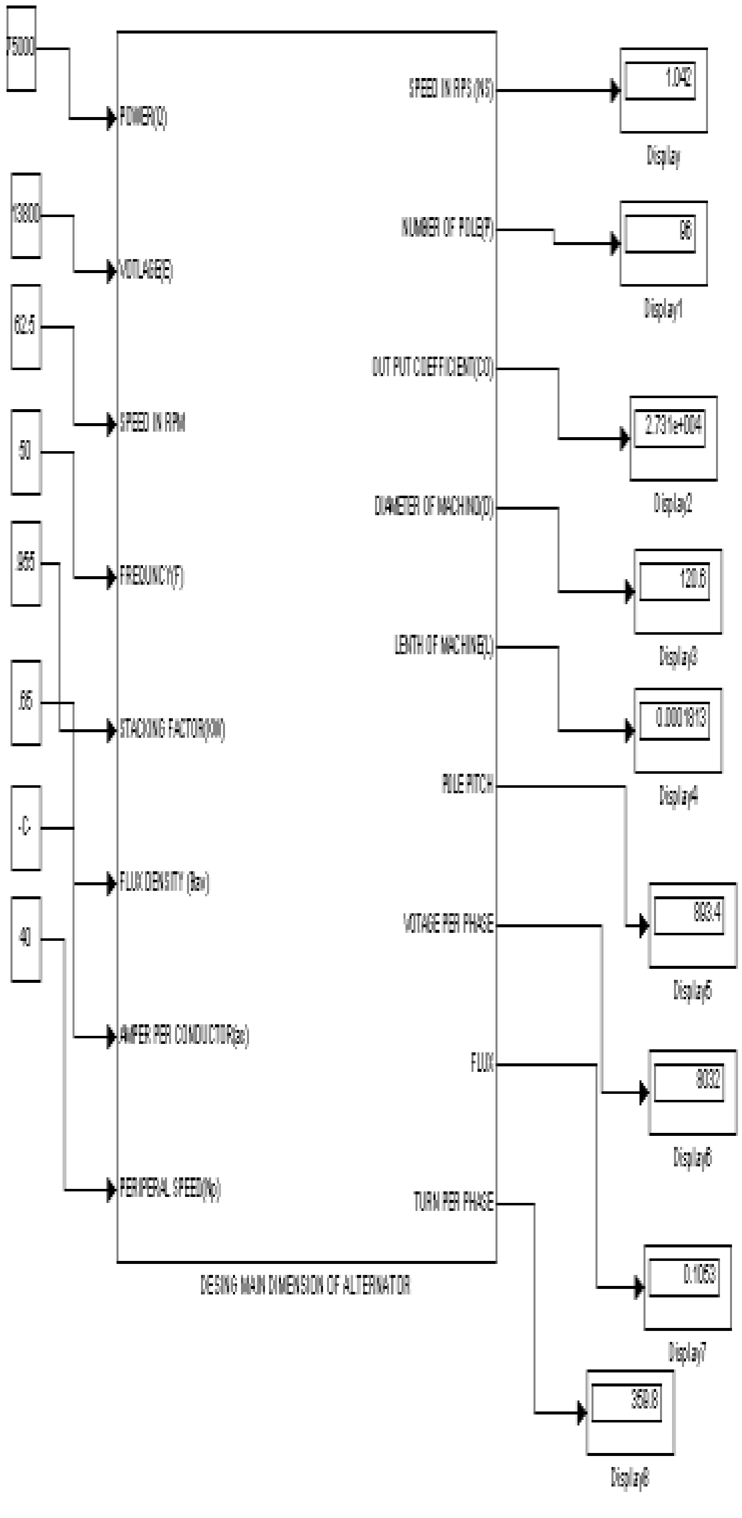
EXPERIMENT NO.:- 8

AIM:-Using simulation to find main dimension of 75000 KVA,13.8KV,50Hz , 62.5 rpm, 3 phase star connected alternator also find number of stator slot, conductor per slot. The peripheral speed should be about 40m/sec assume average gap density 0.65 wb/m^2 and conductor per meter is 40000 and current density is 4A /m^2.

Internal simulation block



Simulation result:-



75000
13800
62.5
50
.955
.65
-C-
40
POWER(Q)
VOTLAGE(E)
SPEED IN RPM
FREQUNCY(F)
STACKING FACTOR(KW)
FLUX DENSITY (Bav)
AMPER PER CONDUCTOR(ac)
PERIPERAL SPEED(Va)
SPEED IN RPS (NS)
NUMBER OF POLE(P)
OUT PUT COEFFICIENT(CO)
DIAMETER OF MACHINE(D)
LENTH OF MACHINE(L)
POLE PITCH
VOTAGE PER PHASE
FLUX
TURN PER PHASE
DESING MAIN DIMENSION OF ALTERNATOR
1.042
Display
96
Display1
2.731e+004
Display2
120.6
Display3
0.0001813
Display4
893.4
Display5
8032
Display6
0.1053
Display7
359.8
Display8

EXPERIMENT NO.:- 9

AIM: -Using Matlab write a program to calculate the mmf required for the air gap of a machine having core length 0.32m including 4 ducts of 10 mm each, pole are 0.1m, slot pitch 65.4mm; slot opening is 5mm; air gap length 5mm; flux per pole 52 Wb/m. Given Carter's co-efficient is 0.18 for opening /gap 1; and is 0.28 opening/gap equal to 2

l= input ('enter the value of core length');

W_d=input ('enter the value of width of duct');

r=input('enter the value of pole arc');

y_s=input('enter the value of slot pitch');

f_b=input('enter the value of flux per pole');

k_{cs}=input('enter the value of carter coefficient of slot');

k_{cd}=input('enter the value of carter coefficient of duct');

l_g=input('enter the value of air gap length');

n_d=input('enter the value of number of duct');

w_s=input('enter the value of width of slot');

Carter coefficient for slot=k_{gs}=ys/(y_s-k_{cs}*w_s)

Carter coefficeitent for duct=k_{gd}=l/(l-n_d*w_d*k_{cd})

Total gap contraction factor=k_g=k_{gs}*k_{gd}

Flux density=B_g=f_b/(r*l)

MMF required for air gap=at=(k_g*l_g*b*800000)

Observation table:-

Table 1:- Input parameter

l	W_d	r	y_s	b	at	k_{cs}	k_{cd}	l_g	n_d

Table 2(a):-output:-

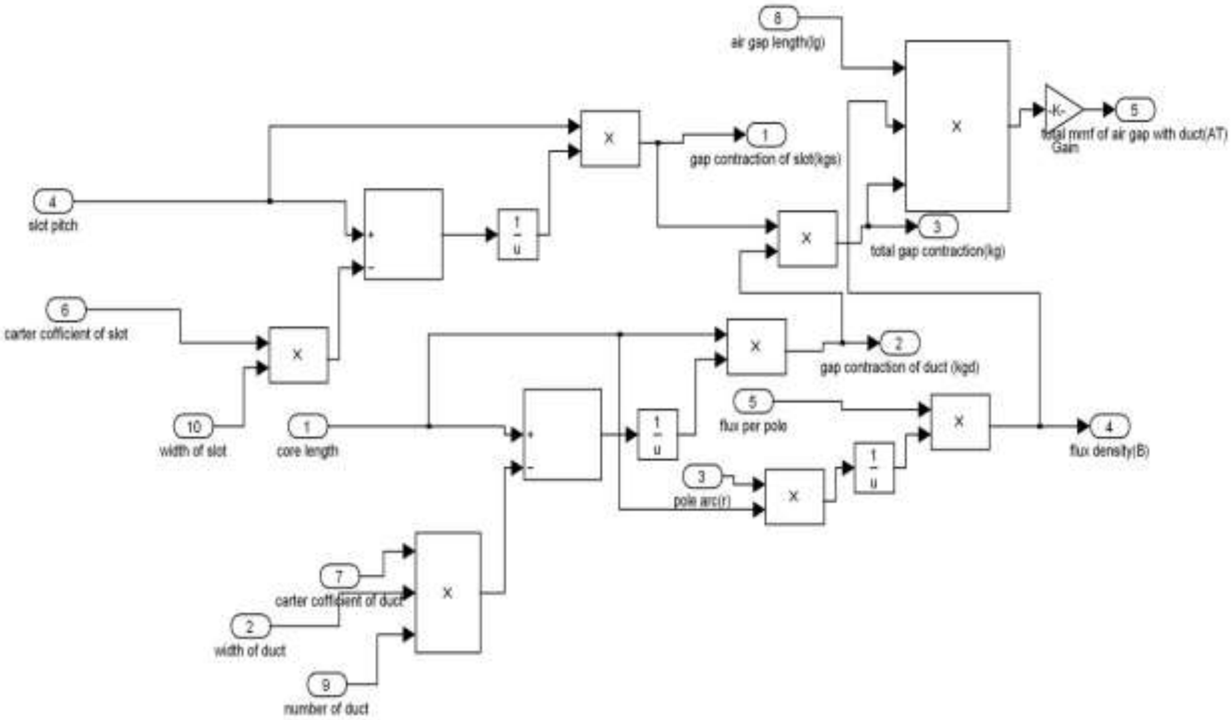
K_{gs}	K_{gd}	K_g	b	at

EXPERIMENT NO.:- 10

AIM: - Using Simulation calculate the mmf required for the air gap of a machine

having core length 0.32m including 4 ducts of 10 mm each, pole are 0.1m, slot pitch 65.4mm; slot opening is 5mm; air gap length 5mm; flux per pole 52 Wb/m. Given Carter's co-efficient is 0.18 for opening /gap 1; and is 0.28 opening/gap equal to 2

Internal simulation block



Simulation result:-