2.5 COMPUTER PROGRAM TO DESIGN TRANSFORMER MAIN DIMENSIONS

Aim:

To design the Transformer core using MATLAB coding.

Problem:

Calculate approximate overall dimension for a 200kVA, 6600/440 V , 50Hz, 3 – phase core type transformer.The following data is provided: emf per turn = 10V; maximum flux density = 1.3Wb/m2; current density = 2.5A/mm2;window space factor = .3 overall height = overall width; stacking factor = .9; 3 stepped core used. width of largest stamping = .9d and net iron area = .6d2 where obviously d is diameter of circumscribing circle.

Solution:

Net iron area Ai = Et/(4.44fBm) = 10/(4.44x50x1.3) = .0347m2

as given net iron area = .6d2 therefore d = √Ai/.6 = .24m

So as we have d so we also got

width of largest stamping a= .9 x .24 = .216m

As core type transformer therefopre Dy = Hy = a = .216m

Now in 3 phase equation

Q = 3.33fBmKwJAwAi x 10-3

Aw is unknown so finding Aw we get

Aw = Q/(3.33fBmKwJAi x 10-3) = .0355m2

As Aw = Hw x Ww = .0355m2

H = Hw + 2Hy = Hw + .432

Now W = 2D + a = 2(Ww + a) + a = 2Ww + .648

Given H = W we have

Hw + .432 = 2Ww + .648

substituting Hw = .0355/Ww

.0355 = 2Ww2 + .214Ww

or

$2Ww2 + .214Ww – .0355 = 0$

solving the quadratic equation we get

$Ww = .083m$

and $Hw = .0355/.083 = .428m$

Thus dimension of core $H = Hw + 2Hy = .8m$

$W = 2(Ww + a) + a = .8m$

So in the end we do get overall height = overall length

Program:

```
function determining_dimension_of_3_phasse_mesh_star_coreType( )
% Detailed explanation goes here
 % rating given Vrate is in kva
Vrate = 200;
% ratio 6600/400 V
f = 50;
max_flux_density = 1.3;
J = 2.5;
% given overall heigh = overall width
 % H = W
 % Aw = .25 Acore
 % overall dimesion of core needs to be found
 % 3 step core
 % width of largest core = .90
 % Ai = .6*(d^2);
 % for 3 phase
 % Q = 3.33*f*max_flux_density*Kw*J*Ai*Aw;
 % deriving Q = 3.33*f*max_flux_density*Kw*Ai*Ai*1.25;
 % Q = 3.33*f*max_flux_density*Kw*J*Ai*Ai*1.25;
Q = Vrate;
Kw = .3;
Ai = sqrt((Q*1000*(10^-6))/(3.33*f*max_flux_density*J*Kw*1.25));
```

```
fprintf('\nDersign of 3 phase Mesh star core type transformer');
fprintf('\n————————————————————————————————————');
fprintf('\nTherfore Area of iron core Ai = ');
disp(Ai);
fprintf('\nTherfore diameter of circumscribing circle d = ');
d = sqrt(Ai/.6);
disp(d);
% a = .9d
Aw = 1.25*Ai;
% Ww = Aw/Hw;
 % H = Hw + 2Hy
a = .9*d;
Hy = a;
Dy = a;
% Hw^2 – (1.1d)Hw – 2Aw;
a1 = 1;
b = 1.1*d;
c = 2*Aw;
Hw = (b + sqrt((b^2)+ (4*a1*c)))/2;
fprintf('\nHieght of Window Hw = ');
disp(Hw);
Hwmod = abs(Hw);
fprintf('\nHieght of Window Hw = ');
disp(Hwmod);
W = ((2*Aw)/Hwmod) + (2*d) + (.9*d);
fprintf('\nOverall width of window W = ');
disp(W);
H = Hwmod + (2*Hy);
fprintf('\nOverall height of window H = ');
disp(H);
end
```

Output:

Therfore Area of iron core Ai = 0.0314

Therfore diameter of circumscribing circle d = 0.2287

Hieght of Window Hw = 0.4329

Hieght of Window Hw = 0.4329

Overall width of window W = 0.8447

Overall height of window H = 0.8447