clc;

clear all;

close all;

f=50;

phase=3;

HV=6600;

LV=220;

k=1/40;

ki=0.88;

ks=0.92;

Bm=1.7;

delta=2.5;

u0=4\*3.14\*10^-7;

fprintf(' Enter the KVA of the transformer : ');

KVA=input(' ');

s=(KVA\*10^3)/phase;

Et=k\*sqrt(s);

fprintf(' Voltage per turn,Et = %0.3f volts/turn\n',Et);

Ai=(Et\*10^6)/(4.44\*Bm\*f);

Ai=round(Ai\*1e2)/1e2;

d=sqrt((4\*Ai)/(3.14\*ki\*ks));

if (d<100 && d>95)

d=100;

elseif (d<105 && d>100)

d=105;

elseif (d<110 && d>105)

d=110;

else

d=round(d);

end

fprintf(' Diameter of the circumscribing circle for the core,d = %0.3f mm\n',d);

Ai=(3.14\*d^2\*ki\*ks)/4;

Ai=round(Ai);

fprintf(' Cross sectional area of the core,Ai = %0.2f mm^2\n',Ai);

Bm=(Et\*10^6)/(4.44\*f\*Ai);

Bm=round(Bm\*1e2)/1e2;

fprintf(' Maximum flux density,Bm= %0.2f Wb/m^2\n',Bm);

kw=10/(30+(HV\*1e-3));

kw=round(kw\*1e2)/1e2;

fprintf(' Window space factor,kw= %0.3f\n',kw);

Aw=(KVA\*10^3\*10^6)/(3.33\*Ai\*kw\*delta\*Bm\*f);

Aw=round(Aw);

fprintf(' Input the value of window width about the dia of the core in percent = ');

Ww=input(' ');

Ww=(Ww/100)\*d;

Ww=round(Ww);

fprintf(' Window width= %0.2f mm\n',Ww);

Hw=Aw/Ww;

if (Hw<240 && Hw>235)

Hw=240;

elseif (Hw<235 && Hw>230)

Hw=235;

elseif (Hw<230 && Hw>225)

Hw=230;

elseif (Hw<245 && Hw>240)

Hw=245;

elseif (Hw<250 && Hw>245)

Hw=250;

else

Hw=round(Hw);

end

fprintf(' Height of the window= %0.2f mm\n',Hw);

Aw=Hw\*Ww;

fprintf(' Window area,Aw= %0.2f mm^2\n',Aw);

d1=0.95\*d;

d1=round(d1);

fprintf(' With a 7 steps core, the largest width of the core = %0.2f mm\n',d1);

D=d1+Ww;

fprintf(' Distance between the centers of the adjacent limbs = %0.2f mm\n',D);

H=Hw+48;

TW=(3\*d1+2\*Ww);

TH=H+2\*d1;

fprintf(' Total width = %0.2f mm\n',TW);

fprintf(' Total height = %0.2f mm\n',TH);

T2=(LV/(sqrt(3)))/Et;

T2=round(T2);

if rem(T2,2)==0

T2=T2;

else

T2=T2+1;

end

fprintf(' Turns per phase on L.V. winding, T2 = %0.2f turns\n',T2);

T1=round(HV/Et);

fprintf(' Turns per phase on H.V. winding at normal connection, T1 = %0.2f turns\n',T1);

T12=T1\*1.05;

fprintf(' With +5 percent tapping, T1= %0.2f turns\n',T12);

T13=T1\*1.025;

fprintf(' With +2.5 percent tapping, T1= %0.2f turns\n',T13);

T14=T1\*0.975;

fprintf(' With -2.5 percent tapping, T1= %0.2f turns\n',T14);

T15=T1\*0.95;

fprintf(' With -5 percent tapping, T1= %0.2f turns\n',T15);

T1max=T12;

IL=(KVA\*10^3)/(sqrt(3)\*LV);

IL=round(IL\*1e2)/1e2;

fprintf(' Current per phase in low voltage winding = %0.3f A\n',IL);

a2=IL/delta;

a2=round(a2\*1e1)/1e1;

fprintf(' Area of LV conductor, a2= %0.2f mm^2\n',a2);

fprintf(' Choosing rectangular conductor strips forming the conductor of LV winding,\n');

fprintf(' Input the thickness of the LV conductor in mm,t=');

t=input(' ');

fprintf(' Input the diameter of the LV conductor in mm,d=');

d2=input(' ');

a2=2\*t\*d2;

fprintf(' Area of LV conductor with the chosen dia & thickness, a2= %0.2f mm^2\n',a2);

IH=(KVA\*10^3)/(3\*HV);

IH=round(IH\*1e2)/1e2;

fprintf(' Current per phase in high voltage winding = %0.3f A\n',IH);

a1=IH/delta;

d3=sqrt((4\*a1)/3.14);

d3=round(d3\*1e1)/1e1;

fprintf(' The diameter of the round HV conductor = %0.2f mm\n',d3);

a1=(3.14\*d3^2)/4;

a1=round(a1\*1e3)/1e3;

fprintf(' Area of HV conductor, a1 = %0.3f mm^2\n',a1);

Ac=2\*(a1\*T1max+a2\*T2);

fprintf(' Copper area in window = %f mm^2\n',Ac);

kw2=Ac/Aw;

fprintf(' Calculated window space factor= %0.2f\n',kw2);

diff=abs(kw2-kw);

if (diff>0.02)

fprintf(' ERROR! The calculated window space factor is way far from the chosen one.\n');

else

fprintf(' which is near about 0.27 as chosen.\n');

t=t+0.25;

d2=d2+0.25;

fprintf(' With paper insulation of 0.25 mm,\n');

fprintf(' Thickness of the LV conductor,t= %0.3f\n',t);

fprintf(' Diameter of the LV conductor,d= %0.3f\n',d2);

N=T2/2;

fprintf(' Turns per layer of LV = %0.0f turns\n',N);

HL=round(N\*d2);

TL=round(t\*2\*2);

IDL=d+(2\*3.5);

ODL=IDL+2\*TL;

MDL=0.5\*(IDL+ODL);

MLTL=3.14\*MDL;

fprintf(' Height of LV winding in window = %0.2f mm\n',HL);

fprintf(' Thickness of LV coil = %0.2f mm\n',TL);

fprintf(' Inside diameter of LV coil = %0.2f mm\n',IDL);

fprintf(' Outside diameter of LV coil = %0.2f mm\n',ODL);

fprintf(' Mean diameter of LV coil = %0.2f mm\n',MDL);

fprintf(' Mean length turn of LV coil = %0.2f mm\n',MLTL);

IDH=ODL+2\*12;

turn=round(T1max/4);

d3=d3+0.25;

fprintf(' Enter the number of layers for HV coil :');

layer=input('');

N1=turn/layer;

N1=round(N1\*1e2)/1e2;

fprintf(' Turns per layer of HV = %0.0f turns\n',N1);

height=round(N1\*d3);

thickness=layer\*d3;

ODH=IDH+2\*thickness;

MDH=0.5\*(IDH+ODH);

MLTH=3.14\*MDH;

HH=height\*4+8\*3;

fprintf(' Height of HV winding in window = %0.2f mm\n',HH);

if (HH>Hw)

fprintf(' ERROR! Height of HV winding is greater than window height.\n');

else

fprintf(' Inside diameter of HV coil = %0.2f mm\n',IDH);

fprintf(' Outside diameter of HV coil = %0.2f mm\n',ODH);

fprintf(' Mean diameter of HV coil = %0.2f mm\n',MDH);

fprintf(' Mean length turn of HV coil = %0.4f mm\n',MLTH);

HW=HH+26\*2;

fprintf(' Height of window with proper spacing = %0.0f mm\n',HW);

MLTav=0.5\*(MLTL+MLTH);

AT=IL\*T2;

Hav=0.5\*(HL+HH);

a=12;

b1=thickness;

b2=TL;

X=round(((2\*3.14\*f\*u0\*MLTav\*AT\*(a+(b1+b2)/3)\*100)/(Hav\*Et\*1e3))\*1e2)/1e2;

fprintf(' Percentage reactance, X= %0.4f percent\n',X);

p20=0.01724;

a20=0.00393;

fprintf(' Enter the temperature in degree celcius = ');

theta=input('');

p=p20\*(1+a20\*(theta-20));

p=round(p\*1e3)/1e3;

fprintf(' Resistivity at the given temperature = %0.4f ohm/mm^2/m\n',p);

RL=round(((p\*MLTL\*T2)/(a2\*1e3))\*1e3)/1e3;

fprintf(' Resistance of LV winding = %0.4f ohm\n',RL);

RH=round(((p\*MLTH\*T1)/(a1\*1e3))\*1e2)/1e2;

fprintf(' Resistance of HV winding = %0.4f ohm\n',RH);

k=round((HV/(LV/3^0.5))\*1e2)/1e2;

Req=round((RH+RL\*k\*k)\*1e2)/1e2;

fprintf(' Equivalent resistance referred to HV winding = % 0.4f ohm\n',Req);

R=round(((IH\*Req\*100)/HV)\*1e2)/1e2;

fprintf(' Percentage resistance, R= %0.4f percent\n',R);

Z=(R^2+X^2)^0.5;

Z=round(Z\*1e2)/1e2;

fprintf(' Percentage impedence, Z= %0.3f percent\n',Z);

if (Z>4.5 || Z<3.5)

fprintf(' ERROR! Percentage impedence is beyond the limit.\n');

else

V=Ai\*(HW\*3+TW\*2);

wc=round(((V\*7.85)/(1e6))\*1e2)/1e2;

fprintf(' Weight of the core & yoke = %0.3f kg\n',wc);

plc=wc\*1.2;

fprintf(' Core loss= %0.3f watts,',plc);

if (KVA<26 && plc>155)

fprintf(' \nERROR! The core loss is beyond the limited.\n');

elseif (KVA<41 && plc>200)

fprintf(' \nERROR! The core loss is beyond the limited.\n');

elseif (KVA<64 && plc>260)

fprintf(' \nERROR! The core loss is beyond the limited.\n');

elseif (KVA<101 && plc>355)

fprintf(' \nERROR! The core loss is beyond the limited.\n');

else

fprintf(' which is within the limit.\n');

VA=round((9.8\*wc)\*1e1)/1e1;

fprintf(' Magnetising volt-ampere= %0.2f VA\n',VA);

wlw=round((8.89\*a2\*T2\*MLTL)/1e6);

fprintf(' Weight of LV winding per limb= %0.2f kg\n',wlw);

whw=round(((8.89\*a1\*T1\*MLTH)/1e6)\*1e2)/1e2;

fprintf(' Weight of HV winding per limb with normal turns= %0.2f kg\n',whw);

TWC=3\*(wlw+whw);

fprintf(' Total weight of copper in transformer= %0.2f kg\n',TWC);

plcu=round(3\*IH^2\*Req\*1e2)/1e2;

pll=round(plcu\*1.07\*1e2)/1e2;

fprintf(' Load loss= %0.3f watts,',pll);

if (KVA<26 && pll>700)

fprintf(' \nERROR! The load loss is beyond the limited.\n');

elseif (KVA<41 && pll>975)

fprintf(' \nERROR! The load loss is beyond the limited.\n');

elseif (KVA<64 && pll>1400)

fprintf(' \nERROR! The load loss is beyond the limited.\n');

elseif (KVA<101 && pll>2000)

fprintf(' \nERROR! The load loss is beyond the limited.\n');

else

fprintf(' which is within the limit.\n');

Tloss=plc+pll;

fprintf(' Total loss = %0.2f watts\n',Tloss);

output=KVA\*1e3;

eff=round(((output\*100)/(output+Tloss))\*1e2)/1e2;

fprintf(' Efficiency on full load at unity power factor= %0.3f percent\n',eff);

Tloss=plc+(pll\*(3/4)^2);

output=KVA\*1e3\*0.75;

eff=round(((output\*100)/(output+Tloss))\*1e2)/1e2;

fprintf(' Efficiency on 3/4th full load at unity power factor= %0.3f percent\n',eff);

Tloss=plc+(pll\*(1/2)^2);

output=KVA\*1e3\*0.5;

eff=round(((output\*100)/(output+Tloss))\*1e2)/1e2;

fprintf(' Efficiency on 1/2 full load at unity power factor= %0.3f percent\n',eff);

E=((1+R/100)^2+(X/100)^2)^0.5;

regulation1=(E-1)\*100;

fprintf(' Reguation on full load at unity power factor= %0.3f percent\n',regulation1);

regulation2=R\*0.8+X\*0.6;

fprintf(' Reguation on full load at 0.8 power factor lagging= %0.3f percent\n',regulation2);

Ic=plc/(3\*HV);

fprintf(' Core loss current= %f A\n',Ic);

Im=VA/(3\*HV);

fprintf(' Magnetising current= %f A\n',Im);

I0=(Ic^2+Im^2)^0.5;

fprintf(' No load current per phase= %0.4f A\n',I0);

In=(I0\*100)/IH;

fprintf(' No load current= %0.2f percent of full load current.\n',In);

end

end

end

end

end