Scilab Textbook Companion for Utilization Of Electric Energy by E. Openshaw Taylor[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Electric Drive

Scilab code Exa 1.1 calculation of tapping

```
//Example 1_1 page no:15
clc;
//given
line_voltage = 400;//in V
phase_voltage = line_voltage/sqrt(3);//in V
Starting_current = 75;//in A
impedance = 1.54;//in ohm
full_load_current = 30;//in A
slip = 0.04;//in percent
tapping = sqrt((Starting_current*impedance*100^2)/
    phase_voltage);
disp(tapping,"the tapping provided is(in percent)");
start_current = Starting_current * 100 / tapping;
ratio = (start_current/full_load_current)^2*slip;
disp(ratio,"starting torque in terms of full load
    torque is(no unit)");
```

Scilab code Exa 1.2 calculating current and kw input

```
//Example 1_2 page no:23
clc;
//given
//solving a sub part
voltage = 500;//in v
current = 32;//in A
arm_res = 0.4;//in ohm
fl_win_res = 250;//in ohm
rpm = 450;
field_current = 2;
input_pow = (voltage*current)/1000;
arm_current = current - field_current;
//when running at 600rpm
rpm1 = 600;
k_phi = (voltage - 12)/rpm1;
//when running at 450rpm
R = -(k_phi*rpm-voltage)/arm_current;
R = R - arm_res;
disp("To decrease the speed to 450 rev/min");
disp(R,"the resistance added with the armature is (in ohm)");
disp(current,"the current is (in A)");
disp(input_pow,"the kw-input taken from the supply is(in kW)");
//solving b sub part
disp("To increase the speed to 700 rev/min");
flux_ratio = 600/700;
res_added = (fl_win_res/flux_ratio)- fl_win_res;
disp(res_added,"the resistance to be added is (in ohm)");
arm_current = arm_current*(1/flux_ratio);
fld_current = 1.25;
tot_current = arm_current + fld_current;
pow = tot_current * voltage/1000;
disp(arm_current,"the armature current is (in A)");
disp(fld_current,"the field current is (in A)");
disp(tot_current,"the total current is (in A)");
disp(pow,"the kw-input taken from the supply is(in
```

```
kW)");
//the resistance value is rounded off in text book so armature current , total current , input power vary slightly with text book
```

Scilab code Exa 1.3 calculation of torque

```
//Example 1_3 page no:42
clc;
//given
armature_resitance = 0.086//in ohm
fl_arm_current = 150;
volt = 220;
power = 30;//in kiloWatt
ini_brk_current = 200;
full_ld_speed = 535;// in rev/min
back_emf = volt - (fl_arm_current * armature_resitance);
tot_volt = volt + back_emf;
resistance_req = tot_volt / ini_brk_current;
res_added = resistance_req - armature_resitance;
disp(res_added,"the resistance to be added is (in ohm)");
full_ld_torque = (power*1000*60)/(%pi*2*full_ld_speed);
ini_brk_torque = full_ld_torque * ini_brk_current / fl_arm_current;
back_emf = 208/2;//back emf at half speed
current = (volt + back_emf)/resistance_req;
ele_brk_torque = full_ld_torque * current / fl_arm_current;
disp(ele_brk_torque,"Electric braking torque at half speed is (in Nm)");
//the value vary slightly with textbook hence values are rounded off in text book
```

Scilab code Exa 1.4 calculation of speed

```
//Example 1_4 page no:47
clc;
//given
//In text book the answers are rounded off so result vary slightly with text book
power = 15*1000;//in W
I = 60;
rpm = 450;
E = 322;
I = 41.2;
full_load_torque = (power*I)/(2*%pi*rpm);
output = E*I;
disp(output,"the output from the machine is (in W)");
mac_input = (2*%pi*rpm*318)/60;
disp(mac_input,"the mechanical input to the machine from the load if it were running at 450 rev/min would be(in W)");
//rpm at 500;
rpm = 500;
mac_input = (2*%pi*rpm*318)/60;
disp(mac_input,"the mechanical input to the machine at 500 rev/min is (in W)");
```

Scilab code Exa 1.5 calculation of rating

```
//Example 1_5 page no:68
clc;
//given
```

```
original_losses = 18.5;//in KW
theta_f = 45;//in degree C
time_constant = 90;//in minutes
P = sqrt((theta_f/((1-exp(-30/90))*theta_f))*(original_losses^2));
disp(P,"the hour rating of the motor for this temperature rise is (in KW)");
//the result vary slightly with text book hence values are rounded off in text book
```

Scilab code Exa 1.6 calculation of rating

```
//Example 1_6 page no:69
clc;
//given
avg_value = 42*10^4;
//the rating of the motor is
rating = sqrt(avg_value);
disp(rating,"the kilowatt rating for the motor is (in kW)");
```

Scilab code Exa 1.7 time taken for starting motor

```
//Example 1_7 page no:74
clc;
//given
power = 75;//in kW
rpm = 500;
energy = 5400;
fl_load_torque = (power * 1000 * 60)/(2 * %pi * rpm);
str_torque = 2145;
acc_torque = 715;
```

```
stored_energy = energy * power;
omega = rpm *(2*%pi/60);
I = (2 * stored_energy)/(omega^2);
alpha = acc_torque / I;
t = omega / alpha;
disp(t,"the time taken to start the motor if the load torque is equal to full load torque is (in s)");
//the result vary slightly hence values are rounded off in text book
```

Scilab code Exa 1.8 estimating time taken and number of revolutions made before motor stopped

```
//Example 1_8 page no:75
clc;
//given
voltage = 2200;//in V
power = 110;//in kW
rpm = 750;// rotation per minute
inertia = 62;//in kg.m^2
resistance = 13;//in ohm
efficiency = 0.93;//93% converted to decimal
fl_load_torque = (power * 1000 * 60)/(2*%pi*rpm);
fl_ld_line_current = (power * 1000)/(sqrt(3)*voltage * efficiency);
ln_current = 2000/(sqrt(3)*resistance);
ele_brk_torque = 4200;//in Nm
tot_brk_torque = ele_brk_torque + 1400;
omega = (rpm * 2* %pi)/60;
Te = 4200;//in Nm
K = Te/omega;
t = ((60/K)*log(5600/1400));
disp(t,"the time taken is (in s)");
r = ((1.12*5600/(2*%pi*53.5))*(1-exp(-0.893*1.55))
```

```
+1.7)-((1400/(2*%pi*53.5))*1.95);
disp(r,"the number of revolution made before the motor stopped is (no unit)");//it is count it has no unit
```

Scilab code Exa 1.9 torque exerted by motor

```
//Example 1_9 page no:100
clc;
//given
T = 1400;
Tl = 1900;
k = 7.85/1400;
motor_rpm = 750;
//calculating load torque
Tm = Tl - (Tl/1.53);
slip = k * 660;
speed = motor_rpm - 35.2;
disp("After 5s");
disp(Tm,"the torque at the end of 5s is (in Nm)");
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
Tm = (Tl)-( Tl - 0)*exp(-0.085*10);
disp("After 10s");
disp(Tm,"the torque at the end of 10s is (in Nm)");
slip = k * 1088;
speed = motor_rpm - 58;
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
T_m = 1088;
Tm = 280 + ( T_m - 280)*exp(-0.085*15);
disp("After 15s");
disp(Tm,"the torque at the end of 15s is (in Nm)");
slip = k * Tm;
speed = motor_rpm - 27;
```

```
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
Tm = 280 + ( 1088 - 280)*exp(-0.085*30);
slip = k * 343;
speed = motor_rpm - 18.4;
disp("After 30s");
disp(Tm,"the torque at the end of 30s is (in Nm)");
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
Tm = Tl - (Tl - 280)*exp(-0.085*10)
slip = k * 1235;
speed = motor_rpm - 66;
disp("At the end of this period");
disp(Tm,"the torque at the end of this period is (in Nm)");
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
Tm = 280 + ( 1235 - 280)*exp(-0.085*30);
slip = k * Tm;
speed = motor_rpm - 19;
disp("At the end of second off-peak period");
disp(Tm,"the torque at the end of this period is (in Nm)");
disp(slip,"the slip is (in rad/s)");
disp(speed,"the speed is(rpm)");
//the result vary slightly hence values are rounded off in text book
```

Chapter 2

Electric Traction

Scilab code Exa 2.11 determining characteristics

```
//Example 2_11 page no:141
clc;
//given
speed1 = 37.5;//in km/h
speed2 = 48.2;//in km/h
tractive_effort = 4670;//in N
flux_speed = 100 * speed1/speed2;
//if current is reduced by 30% then new flux will
    from the magnetisation curve be 64%
flux = 64;//in percentage
speed = speed2*flux_speed/flux;
disp(speed,"the speed at new flux will be(in km/h)")
    ;
tractive_effort = tractive_effort * flux/70.7;//
    calculating new tractive effort
disp(tractive_effort,"the new tractive effort at 100
    A will be(in N)");
//the new tractive effort calculated is wrong in
    textbook. It is a calculation error
```

Scilab code Exa 2.12 calculating total energy supplied

```
//the examples are continuously numbered in textbook. This is the second example in chapter 2 as first example cannot be codded in scilab.
//Example 2_12 page no:146
clc;
//given
weight = 391000;//in kg
no_of_motor = 12;
no_of_motors_parallel = 6;
tot_tractive_effort = 171000;//in N
line_voltage = 600;//in V
avg_current = 380;//in A
speed = 41.8//in km/h
tot_res = 0.158;//in ohm
acceleration = tot_tractive_effort / (0.2778*weight);
time1 = speed/1.575;
//in full series position
back_emf_series = 300 - ( avg_current * tot_res);
//in full parallel position
back_emf_parallel = 600 - (avg_current * tot_res);
speed_parallel = 41.8;
speed_series = speed_parallel * back_emf_series/back_emf_parallel;
time2 = speed_series / 1.575;
time_parallel = time1 - time2;
disp("Total Energy Supplied during starting period is (in Wh)")
series = no_of_motors_parallel * line_voltage * avg_current * time2;
series = series / 3600;//converting to watt-hour
parallel = no_of_motor * line_voltage * avg_current
```

```
    * time_parallel;
parallel = parallel / 3600;//converting to watt-hour
disp(parallel+series);
disp("Energy lost in starting resistances(in Wh)");
series = no_of_motors_parallel * 0.5 *
    back_emf_series * avg_current * time_parallel;
series = series / 3600;//converting to watt-hour
parallel = no_of_motor * 0.5*300 * avg_current *
    time_parallel;
parallel = parallel / 3600;//converting to watt-hour
disp(parallel+series);
disp("Energy lost in motor resistance(in Wh)");
W = no_of_motor * avg_current^2 * tot_res * time1;
W = W / 3600;//converting to watt-hour
disp(W);
KE = 0.5 * (time1/3600)*(tot_tractive_effort * speed
     * 1000/3600);
disp(KE,"useful energy is (in Wh)");
//the result vary slightly hence values are rounded
    off in textbook
```

Scilab code Exa 2.13 calculating sags and tension

```
//Example 2_14 page no:188
clc;
//given
mass = 136000;//in kg
g = 9.81;
up_gradient = 1/600;
len = 1005;//in m
V = 1500;
comp_train_wg = mass * g * up_gradient;
net_tractive_effort = 104500 - 6675;
f = net_tractive_effort / (1.1* mass);
quantity = 1/f;
```

```
retarding_coasting = 4448/(1.1 * mass);
area_current_curve = 21300*V/3600;
energy_consumption = area_current_curve/(mass*len);
disp(energy_consumption,"the energy consumption of
    motor-coach train is (in Wh/kg-m)");
```

Chapter 3

Heating and Welding

Scilab code Exa 3.16 calculating width for strip

```
//Example 3_16 page no:210
clc;
//given
power_3ph = 30000;//in W
voltage = 400;//in V
thickness = 0.254;//in mm
wire_temp = 1100;//in C
charges = 700;//in C
emissitivity = 0.9;
rad_efficiency = 0.5;
power = power_3ph/3;//power per phase
R = voltage^2/(3*power);
lBYw = (R*1000*thickness)/1.016;
heat = 5.72 * 10^4 * emissitivity * rad_efficiency
    *((1373/1000)^4-(973/1000)^4);
wl = power/(2*heat);
l = sqrt(lBYw*wl);
w = wl/l
w = w*1000;//converting to mm
disp(w,"the suitable width of the strip is(in mm)");
T1 = 1000 * nthroot(((heat/(2.56*10^4))+0.0074),4);
```

```
disp(T1,"temperature of the wire when the charge is
   cold is(in K)");
//the result vary slightly with textbook hence
   values are rounded off in textbook
```

Scilab code Exa 3.17 estimating energy required

```
//the examples are continuously numbered throughout
   the textbook
//Example 3_17 page no:219
clc;
//given
spc_heat = 393.6;//in Jkg^-1C^-1
lat_heat = 163 * 10^3;// in J/kg
melting_pt = 920;//in C
eff = 70;//in percentage
mass = 500;//in kg
cold_temp = 20;//in C
heat_req_rise_temp = mass * spc_heat *(melting_pt -
   cold_temp);
heat_req_melt_charge = mass * lat_heat;
tot_joules_req = heat_req_rise_temp+
   heat_req_melt_charge;
tot_energy = tot_joules_req * 2.78 * 10 ^ -7;//
   converting to kwh
energy_input = tot_energy *100/eff;
power_input = energy_input/0.75;
disp(power_input,"the average power input to the
   furnace is (in kW)");
```

Scilab code Exa 3.18 determining power required

```
//Example 3_18 page no:225
```

```
clc;
//given
len = 0.3;//in m
wide = 0.15;//in m
thick = 0.025;//in m
temp = 160;//in C
t = 10;//in minutes
frequency = 30//in MHz
spc_heat = 1465;//in Jkg^-1C^-1
weight = 575;//in kgm^-3
permitivity = 5;
power_factor = 0.05;
vol_of_wood = len * wide * thick;
weight_of_wood = vol_of_wood * weight;
heat_req = weight_of_wood * spc_heat * 150;
heat_req = heat_req/(3.6*10^3);//converting to Wh
pow_req = heat_req * 60/t;
disp(pow_req,"the power required is (in W)");
c = (len * wide * permitivity * 1.113 * 10 ^ -10)/(4*%pi * thick);
cap_reactance = 1/ ( 2*%pi* frequency * 10 ^6 * c);
phi = acosd(0.05);
R = cap_reactance * tand(phi);
V= sqrt(290*R);
disp(V,"the voltage across the work is (in V)");
I = V/cap_reactance;
disp(I,"the current in the work is (in A)");
//the result vary with textbook hence capacitive reactance value is greatly rounded off which change result of resistance so voltage vary with textbook
```

Scilab code Exa 3.19 estimating heat requirements

```
//Example 3_19 page no:240
```

```
clc;
//given
vol = 3000;
t1 = 4.5;//in C
t2 = 18.5;//in C
h1 = 75;//in percentage
h2 = 60;//in percentage
eng_for_1cm = 1.22 * 10^3;
eng = eng_for_1cm *vol * 14;
eng = eng/(3.6*10 ^ 6);//converting to kW
moist = 0.00440;//in kgm^-3
latent_heat = 2450 * 10 ^ 3;
weight_of_moist = moist * vol;
heat_req = latent_heat * weight_of_moist;
heat_req = heat_req/(3.6*10^6);
tot_heat_req = eng + heat_req;
disp(tot_heat_req,"the total heat requirement is (in
    kW)");
```

Scilab code Exa 3.20 estimating heat requirements

```
//Example 3_20 page no:240
clc;
//given
floor_area = 6*6;//in m^2
ceiling_area = 6*6;//in m^2
temp = 18;//in C
wall_AB = 6*3;//in m^2
cavity = 0.4;//in m
win_len = 1.2;//in m
win_width = 1.8;//in m
external_temp = 1.5;//in C
//calculating heat losses from walls
ceiling_loss = ceiling_area * 12.288 * 10^3 * (temp
    - external_temp);
```

```
wall_AB_loss = 2*(temp - 2.16)*3.885*10^3*(temp -
   external_temp);
win_area_loss = 2 * 2.16 *23.1*10^3*(temp -
   external_temp);
wall_C_loss = 18*8.18*10^3*(18-12);
tot_heat_loss = ceiling_loss + wall_AB_loss +
   win_area_loss + wall_C_loss;
vol_air_perH = 6*6*3*1.5;
heat_loss_perH = 1.22 *10^3 * 162 * (18-1.5);
heat_loss_perH = heat_loss_perH/(776.19);
tot_vol = 108;
heat_perM = heat_loss_perH/tot_vol;
disp(heat_perM,"the heat required to maintain a
   temperature of 18C in an office is (in W/m^3)");
```

Chapter 4

Electrolytic Processes

Scilab code Exa 4.21 calculating electricity

```
//the examples are continuously numbered throughout
    the textbook
//Example 4_21 page no:261
clc;
//given
surf_area = 0.36;//in m^2
thickness = 0.0254;//in mm
mass_den = 8.96 * 10 ^ 3;//in kgm^-3
ece = 32.9 * 10^-8;//in kgC^-1
mass_cop = surf_area * thickness * 10^-3 * mass_den;
ece_cop = ece * 3600 * 1000;
amp_hr = mass_cop/ece_cop;
disp(amp_hr,"the ampere hours required is (in amp-
    hours)");
//the ampere hour calculation is wrong in textbook.
    The division between mass of copper and ece of
    copper is done wrongly in textbook
```

Chapter 5

Illuminating Engineering

Scilab code Exa 5.22 calculating number and size of lamps

```
//the examples are continuously numbered throughout
   the textbook
//Example 5_22 page no:313
clc;
//given
len = 12;//in m
wide = 7.5;//in m
high = 4.5;//in m
avg_lumen = 80;//in lumen per square meter
height = 0.75;//in m
coeff_uti = 0.3;
tot_area = len * wide;
tot_lumen = avg_lumen * tot_area;
lamp_lumen_req = tot_lumen /coeff_uti;
//suppose 100 watt lamps are used
no_of_lamps = lamp_lumen_req / 1340;
disp(no_of_lamps,"the number of lamps required would
    be ")
disp("this can be arranged in 6 rows of 3");
//suppose 200 watt lamps are used
no_of_lamps = lamp_lumen_req / 2880;
```

```
disp(no_of_lamps,"the number of lamps required would
    be ")
disp("this can be arranged in 3 rows of 3");
//suppose 80 watt lamps are used
no_of_lamps = lamp_lumen_req / 2400;
disp(no_of_lamps,"the number of lamps required would
    be ")
disp("this can be arranged in 3 rows of 4");
tot_energy = 12 * 80;
disp(tot_energy,"the total energy consumption with
   the fluorescent lamps is (in W)");
```

Scilab code Exa 5.23 estimating number and size of projectors

```
//Example 5_23 page no:330
clc;
//given
height = 15;//in m
area_ill = 15 * 45;//in m^2
waste_light_factor = 1.2;
coeff_uti = 0.4;
deprication_factor = 1.5;
tot_lumen = area_ill * 80;
lumen_output = tot_lumen * waste_light_factor *
   deprication_factor;
tot_lamp_lumens = lumen_output / coeff_uti;
lumen_output_each = 18.9;
tot_lumen_output = 1000 * lumen_output_each;
no_of_lamps = tot_lamp_lumens / tot_lumen_output;
disp(tot_lumen,"the total lumens required on surface
    is (in lm)");
disp(lumen_output,"the lumens output from the
   projector is (in lm)");
disp(tot_lamp_lumens,"the total lamp lumens is (in
   lumens)");
```

```
disp(tot_lumen_output,"the total lumens output is (
   in per lamp)");
disp(no_of_lamps,"the number of lamps is ");
disp("the no of lamps is rounded off to 15 or 16");
```

Chapter 6

Economic Aspects of Utilising Electrical Energy

Scilab code Exa 6.25 determining the value of plang

```
//the examples are continuously numbered throughout
   the textbook
//Example 6_25 page no:345
clc;
//given
beg_cost = 240000;//in rupees
salvage_val = 24000;//in rupees
t = 20;//in years
t1 = 10;//in years
tot_dep = beg_cost - salvage_val;
tot_dep_af10 = beg_cost - 108000;
val = beg_cost * (0.891)^10;
tot_sink_fund = 216000;//in rupees
annual_deposit = (0.08 * tot_sink_fund)/((1.08)^20
   -1);
annual_deposit_af10 = (annual_deposit *( 1.08^10-1))
   /0.08;
val_plant = beg_cost - annual_deposit_af10;
disp(tot_dep_af10,"the value calculated in straight
```

```
    line depreciation at the end of 10 years will be
    ( in rupees)");
disp(val,"the value calculated in reducing balance
    depreciation at the end of 10 years will be ( in
    rupees)");
disp(val_plant,"the value calculated in sinking fund
     depreciation at the end of 10 years will be ( in
     rupees)");
//the result vary slightly hence values are rounded
    off in textbook
```

Scilab code Exa 6.26 estimating annual energy cost

```
//Example 6_26 page no:348
clc;
//given
load1 = 200;//in kW
load2 = 150;//in kW
load3 = 50;//in kW
t1 = 1;//in hour
t2 = 7;//in hour
t3 = 8;//in hour
max_tarrif = 108;//in rupees
tarrif = 10;//in paise
max_demand_charge = load1 * max_tarrif;
total = (load1* t1 * 6 * 52) + (load2* t2 * 6 * 52)+
     (load3* t3 * 6 * 52);
annual_cost = total * 10;
annual_cost = annual_cost / 100;//converting to
    rupees
tot_annual_cost = annual_cost + max_demand_charge;
avg_cost = tot_annual_cost * 100 / total;
disp(tot_annual_cost,"the annual energy cost for the
     industry is (in rupees)");
disp(avg_cost,"the average cost per unit is (in
```

```
paise)");
```

Scilab code Exa 6.27 Improving power factor

```
//Example 6_27 page no:356
clc;
max_demand = 175;//in kW
pow_fac = 0.75;
max_tariff = 72;//in rupees
tariff = 10;//in paise
phase_adv = 120;//in rupees/kVA
loss = 20;//in percentage
kVA_demand = max_demand / pow_fac;
max_demand_charge = max_tariff * kVA_demand;
cos_phi = sqrt(1-((phase_adv * loss)/(max_tariff *
    100))^2);
disp(kVA_demand,"before installation of capacitors
    the kVA demand is (in kVA)");
disp(max_demand_charge,"the maximum demand charge is
     (in rupees)");
disp(cos_phi,"the power factor is ");
//the kVA_demand is rounded off in textbook so
    maximum demand charge vary slightly with textbook
```

Scilab code Exa 6.28 estimating the savings

```
//Example 6_28 page no:358
clc;
//given
con_req = 1000000;//in units per year
load_fac = 30;//in percentage
max_tariff = 120;//in rupees
tariff = 5;//in paise
```

```
imp_ld_fac = 100;//in percentage
//sol
avg_ld = con_req / 8760;
max_load = avg_ld * imp_ld_fac / load_fac;
mac_dmd_chc = max_load * max_tariff;
unit_charge = con_req * tariff / imp_ld_fac;
tot_charge = mac_dmd_chc + unit_charge;
avg_price_per_unit = tot_charge * imp_ld_fac /
    con_req;
max_load = avg_ld;
max_dmd_chc = max_load * max_tariff;
tot_charge = unit_charge + max_dmd_chc;
avg_price_perUnit = tot_charge * imp_ld_fac /
    con_req;
disp(avg_price_per_unit,"the average price per unit
    before improving the load factor is (in paise)");
disp(avg_price_perUnit,"the average price per unit
    after improving the load factor is (in paise)");
disp(avg_price_per_unit - avg_price_perUnit,"the
    total savings is (in paise)");
```

Scilab code Exa 6.29 comparing the costs

```
//Example 6_29 page no:362
clc;
//given
max_load = 250;//in kW
annual_load_fac = 40;//in percentage
voltage = 11;//in kV
max_tariff = 120;//in rupees
tariff = 4;//in paise
diesel_cost = 360;//in rupees per kW
oil_cost = 6;//in paise
dep_transformer = 8;//in percentage
dep_deisel_plant = 12;//in percentage
```

```
transformer_cost = 18;//in rupees per kVA
//sol
tot_no_units = max_load * annual_load_fac * 8760 /
    100;
//public supply
capital_cost = 3 * 150 * transformer_cost;
yearly_cost = capital_cost * dep_transformer / 100;
max_demand_charge = max_tariff * max_load;
unit_cost = tot_no_units * tariff / 100;
tot_yr_cost = yearly_cost + max_demand_charge +
    unit_cost;
//diesel plant
cost = 3 * 150 * diesel_cost;
yr_cost = cost * dep_deisel_plant / 100;
opp_staff_wage = 4800;
unit_cost = tot_no_units * oil_cost / 100;
tot_year_cost = yr_cost + opp_staff_wage + unit_cost
    ;
disp(tot_yr_cost,"the cost of public supply is ( in
    rupees)");
disp(tot_year_cost,"the cost of diesel plant is ( in
     rupees)");
```

Scilab code Exa 6.30 calculating the cost

```
//Example 6_30 page no:364
clc;
//given
power = 37;//in kW
motor_cost_a = 1440;//in rupees
eff_a = 88;//in percentage
motor_cost_b = 1920;//in rupees
eff_b = 89;//in percentage
opp = 3000;//in hours
tariff = 6;//in paise per kWH
```

```
dep = 10;//in percentage in per year
output = 37;//in kW
//motor A
cap_charge = motor_cost_a * dep / 100;
loss = ((1/0.88)-1) * output;
yr_cost_loss_a = loss * opp * tariff / 100;
disp(yr_cost_loss_a,"the yearly cost of motor A is (
    in rupees)");
//motor B
cap_charge = motor_cost_b * dep / 100;
loss = ((1/0.89)-1) * output;
yr_cost_loss_b = loss * opp * tariff / 100;
disp(yr_cost_loss_b,"the yearly cost of motor B is (
    in rupees)");
disp("the motor B gives the lower yearly cost");
//the value of cost vary with textbook hence values
    are rounded off in textbook but the result is
    same
```

Scilab code Exa 6.31 calculating the minimum cost

```
//Example 6_31 page no:366
clc;
//given
power = 75;//in kW
t1 = 1000;//in hours
t2 = 2000;//in hours
full_load_eff_a = 0.89;
full_load_eff_b = 0.90;
half_load_eff_a = 0.88;
half_load_eff_b = 0.89;
tariff = 7.5;//in paise
dep = 0.12;
motor_cost_a = 3120;//in rupees
full_load_output = 75;//in kW
```

```
half_load_output = 37.5;//in kW
//motor A
full_load_loss_a = full_load_output * ((1/full_load_eff_a)-1);
full_yearly_loss_a = full_load_loss_a * t1;
half_load_loss_a = half_load_output * ((1/half_load_eff_a)-1);
half_yearly_loss_a = half_load_loss_a * t2;
tot_yr_loss_a = full_yearly_loss_a + half_yearly_loss_a;
yr_cost_loss_a = tot_yr_loss_a * tariff / 100;
//motor B
full_load_loss_b = full_load_output * ((1/full_load_eff_b)-1);
full_yearly_loss_b = full_load_loss_b * t1;
half_load_loss_b = half_load_output * ((1/half_load_eff_b)-1);
half_yearly_loss_b = half_load_loss_b * t2;
tot_yr_loss_b = full_yearly_loss_b + half_yearly_loss_a;
yr_cost_loss_b = tot_yr_loss_b * tariff / 100;
yr_saving = yr_cost_loss_a - yr_cost_loss_b;
cap_value = yr_saving * 100/12;
disp(yr_saving,"the yearly savings in loss is ( in rupees)");
disp(cap_value,"the capitalised value is(in rupees)");
disp((cap_value+motor_cost_a),"if motor cost of B is less than this(in rupees)");
disp("motor B would be cheaper");
//the mathematical calculation in textbook is wrong
```

Scilab code Exa 6.32 determining the most economic cost arrangement

```
//Example 6_32 page no:367
```

```
clc;
//given
power = 75;//in kW
t1 = 4000;//in hours
cost = 3600;//in rupees
motor_eff = 0.91;
pow_fac = 0.89;
trans_cost = 18;//in rupees per kVA
dep = 0.8;
transformer_cost = 6000;//in rupees
trans_eff = 0.91;
trans_pow_fac = 0.89;
max_tariff = 108;
tariff = 4;
output = 75;//in kW
//sol
kVA_input = output/(pow_fac*motor_eff);
cost_of_trans = 100 * trans_cost;
tot_cap_cost = cost + cost_of_trans;
annual_cost = tot_cap_cost * 8/100;
ove_eff = trans_eff * 0.98;
loss = ((1/ove_eff)-1)*power;
yr_cost_loss = (loss * t1 * tariff)/100;
max_demand = power / (motor_eff*0.98*trans_pow_fac);
max_demand_chc = max_demand * max_tariff;
tot_cost = max_demand_chc + yr_cost_loss + annual_cost;
yr_cap_cost = transformer_cost * 12 /100;
loss = ((1/motor_eff)-1)*power;
yr_cost_of_loss = loss * t1 * tariff / 100;
max_dmd_chc = 92.5 * max_tariff;
total_cost = max_dmd_chc + yr_cost_of_loss + yr_cap_cost;
saving = tot_cost - total_cost;
disp(saving,"the total yearly saving is (in rupees)");
//the calculation for loss is wrong in textbook so the result of saving vary with textbook
```

Scilab code Exa 6.33 comparing the costs

```
//Example 6_33 page no:368
clc;
//given
lumen = 1000000;//in lumen-hours
power = 100;//in W
voltage = 230;//in V
voltage2 = 210;//in V
cost = 3;//in rupees
life = 1000;//in hours
enf_cost = 5;//in paise
lumen_output = 1160;
//sol
//210V lamps
no_of_hrs = lumen / lumen_output;
cost_of_lamp = no_of_hrs * cost / life;
cost_of_eng = no_of_hrs * power * enf_cost / ( power
    *life);
tot_cost = cost_of_eng + cost_of_lamp;
//230V lamps operating at 210V
lumen_output = 810;
life = 2750;
power = 87.5;
no_of_hrs = lumen / lumen_output;
cost_of_lamp = no_of_hrs * cost / life;
cost_of_eng = no_of_hrs * power * enf_cost / ( 100
   *1000);
total_cost = cost_of_eng + cost_of_lamp;
disp(tot_cost,"the total cost of 210V lamps is (in
   rupees)");
disp(total_cost,"the total cost of 230V lamps is (in
    rupees)");
disp("230V lamps are 2% cheaper than 210V lamps");
```