



Date: _____

$$\tau = RC = \frac{1}{2\pi fC}$$

Q3 Time required to charge 63% of supply voltage.

$$\tau = RC \text{ second} = 12 \Rightarrow \tau = RC$$

$$12 = R \times 4.7 \times 10^{-6} \quad \left| \begin{array}{l} R = \frac{10^6}{4.7} \times 12 \\ R = 17.73 \text{ k}\Omega \end{array} \right.$$

Q4 ~~63%~~ $\tau = 4 \text{ sec}$ $\left| \begin{array}{l} 4 = R \times 4.7 \times 10^{-6} \\ R = \frac{4 \times 10^6}{4.7} = 0.85 \text{ M}\Omega \end{array} \right.$

$$\tau = 6 \text{ sec} \quad 6 = R \times 4.7 \times 10^{-6} \quad R = 1.2 \text{ M}\Omega$$

Resonant $f_0 = \frac{1}{\sqrt{LC}} \Rightarrow 50 = \frac{1}{\sqrt{1.25 \times C}}$

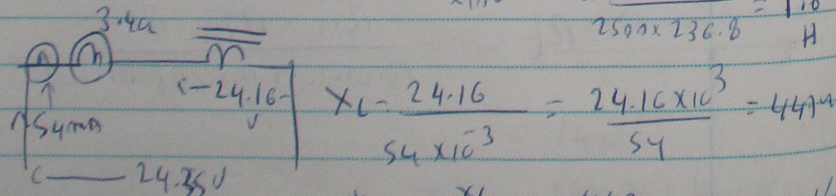
$$2500 = \frac{1}{1.25 \times C} \Rightarrow C = \frac{1}{2500 \times 1.25} = 3.2 \times 10^{-4}$$

$$C = 320 \times 10^{-6} = 320 \mu\text{F}$$

Total available capacitance = 236.8 pF

$$L = ? \quad 50 = \frac{1}{\sqrt{L \times 236.8 \times 10^{-12}}} \quad 2500 = \frac{1}{236.8 \times 10^{-12} \times L}$$

$$L = \frac{10^6}{2500 \times 236.8} = 1.6 \mu\text{H}$$



$$X_L = \frac{24.16}{54 \times 10^{-3}} = \frac{24.16 \times 10^3}{54} = 447 \Omega$$

$$X = \frac{X_L}{2\pi f} = \frac{447}{2 \times 3.1416 \times 50} = 1.42 \mu\text{H}$$

CAPACITANCE BANK

16
30
32
96
94

Total
94 + 142.8

236.8 pF



Date: _____

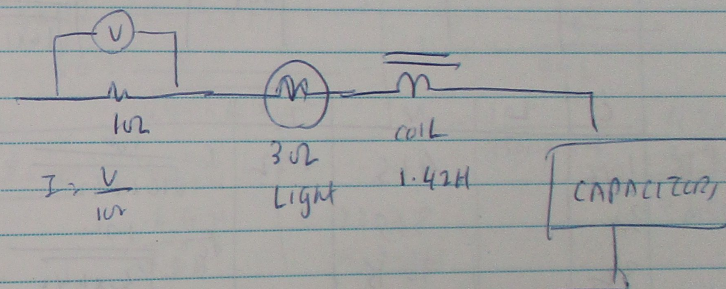
$$L = 1.42 \text{ H} \quad f_0 = ?$$

$$C = 236.8$$

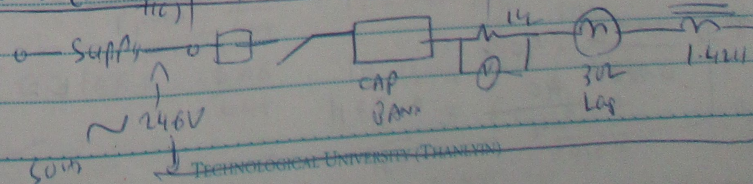
$$f_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{236.8 \times 10^{-6} \times 1.42}} = \frac{1000}{\sqrt{236.8 \times 1.42}} = \frac{1000}{18.33} = 54.6 \text{ Hz}$$

Supply frequency 50 Hz.

Assuming 10% fluctuation in resonance can occur at supply frequency. Then alter the capacitance value and plot the current.



C	L	f	I/V	I/L	
236.8 pF	1.42 H	54.6 Hz			
236.8	1.42	$f_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{236.8 \times 10^{-6} \times 1.42}}$	25.25	0.5042	✓
220.2	1.42	$\frac{1000}{\sqrt{220.2 \times 1.42}}$	25.3	0.5059	
190.2	1.42	$\frac{1000}{\sqrt{190.2 \times 1.42}}$	25.42	0.51	
152.8	1.42	$\frac{1000}{\sqrt{152.8 \times 1.42}}$	25.7	0.5141	
142.8	1.42	$\frac{1000}{\sqrt{142.8 \times 1.42}}$	25.8	0.517	



50 Hz

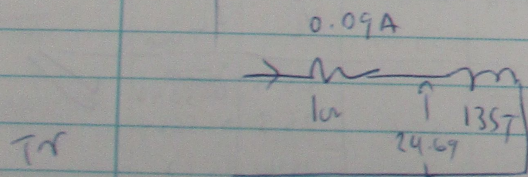


Date: _____

$$f_0 = \frac{1}{\sqrt{LC}} = \frac{10^6}{\sqrt{94 \times 1.42}} = \frac{10^6}{11.55} = 86.9 \text{ kHz}$$

C	L	V _L	T _L	
94	1.42	26.26	$\frac{26.26}{447}$	0.058
94-16	72	26.70	$\frac{26.70}{447}$	0.059
94-16+30	42	29.33	$\frac{29.33}{447}$	0.063
94-(16+30+31)	16	41.6	$\frac{41.6}{447}$	0.09

C	L	V _L	T _L	
16	16PF	41.5	0.92	$f_0 = \frac{10^6}{\sqrt{16 \times 1.42}} = 210 \text{ kHz}$
30		31.5		$f_0 = \frac{10^6}{\sqrt{30 \times 1.42}} = 185 \text{ kHz}$
32		30.75		



TR
426
135T → 0.2H
71T → $\frac{24.430}{0.09A} = 271.44$
 $\frac{40}{314} = 0.127H$

$X_L = \frac{24.69}{0.09A} = 274.3$
 $L = \frac{274.3}{314} = 0.87H$

$X_2 = \frac{24.71}{0.09A} = 274.7$

$L = \frac{274.7}{314} = 0.87H$



Date: _____

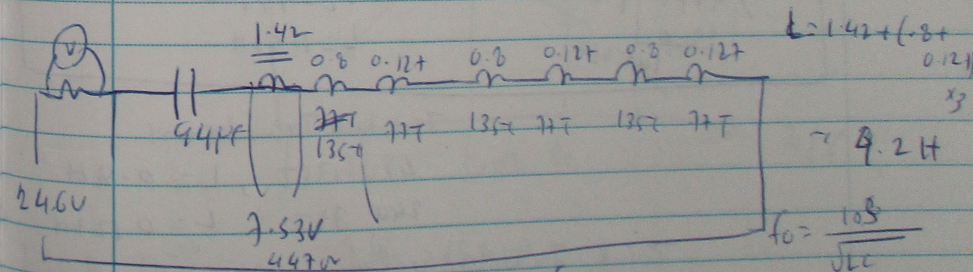
$$f_0 = \frac{1}{\sqrt{LC}} \quad S_{02} = \frac{1}{\sqrt{L \times 32 \times 10^6}} \rightarrow 2500 = \frac{1}{32L \times 10^6}$$

$$L = \frac{10^6}{2500 \times 32} = 12.5H$$

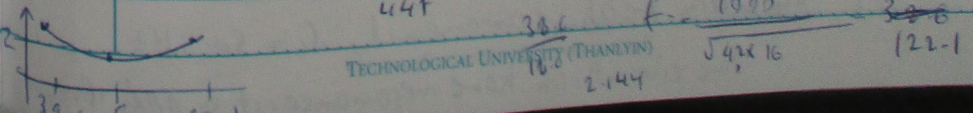
$0.754A$
 $94PF$
 $X_C = \frac{24.73}{0.754} = 32.93 \Omega$
 $\frac{1}{2\pi f C} = 32.93$
 $C = \frac{10^6}{314 \times 32.93} = 96.7PF$

$f_0 = 50kHz$ $C = 94PF$ $L = ?$
 $S_0 = \frac{1}{\sqrt{94 \times L \times 10^6}} \quad 2500 = \frac{10^6}{94L}$
 $L = \frac{10^6}{2500 \times 94} = 4.25H$

Available = 1.42H
 $\frac{2.4H}{3.8H} \quad 0.127 \times 3 = 0.381$



$94PF \quad 0.0168A = 16.8mA$
 $C = 30PF \quad \frac{7.73V}{447} = 17.2mA$
 $C = 16PF \quad \frac{8.06}{447} = 18.03mA$



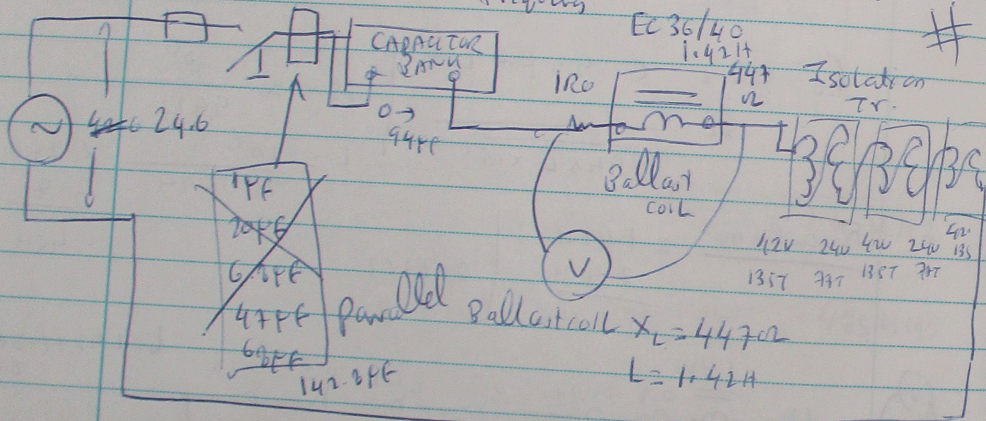


Date: _____

Supply freq	C	L	f ₀	I	I/I	I/I
50Hz	944F	L = 4.2H	50Hz	16.8	2.976	0.336
	304F	L = 4.2H	29.1	17.2	5.12	0.193
	164F	L = 4.2H	122.1	18.03	6.77	0.147

when the capacitance & Inductance values are close to sup the value to calculate $\frac{1}{\sqrt{LC}} = f_{\text{supply}}$

the ratio of current value is the highest



Isolation Transformer

42V 135T, L = 0.86H

24V 71T, L = 0.121H

Total Inductance values = 1.42 + 3(0.86 + 0.121)

Resonant frequency $f_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{4.2 \times 944 \times 10^{-6}}} = 50.3 \text{ Hz}$

By setting the above arrangement, $f_0 = 50.3 \text{ Hz}$

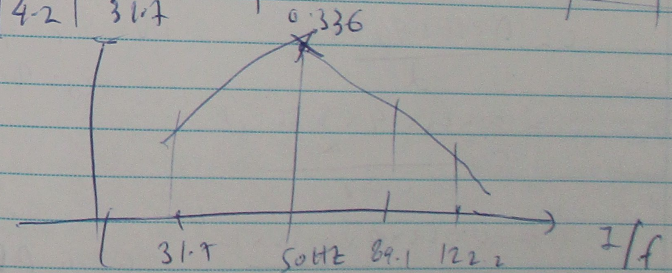
The circuit can have resonance at supply frequency



Date: _____

Alter the capacitance values to 30 pF & 16 pF calculate the resonant frequency value by using formula $f = \frac{1}{\sqrt{LC}}$ Note the circuit current, find current / frequency ratios

C PF	L	f	V _L	X _L = 447	I = $\frac{V}{X_L}$	I	I/f	I/f
94	4.2	$\frac{1}{\sqrt{94 \times 4.2}} = 50.3$	7.53	447	$\frac{7.53}{447} = 16.8 \text{ mA}$	16.8	$\frac{16.8}{50}$	0.336
30	4.2	$\frac{1}{\sqrt{30 \times 4.2}} = 89.1$	7.73	447	$\frac{7.73}{447} = 17.2 \text{ mA}$	17.2	$\frac{17.2}{89.1}$	0.193
16	4.2	$\frac{1}{\sqrt{16 \times 4.2}} = 122.1$	8.06	447	$\frac{8.06}{447} = 18.03 \text{ mA}$	18.03	$\frac{18.03}{122.1}$	0.147
236.2	4.2	31.7						



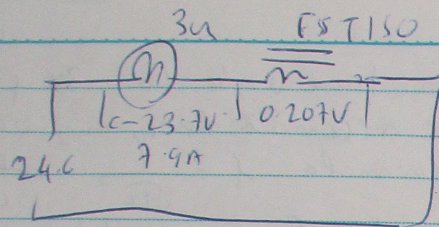
$I_L = 0.5642 \times \frac{7.53}{447} = 16.8 \text{ mA}$

$f = \frac{1}{\sqrt{236.2 \times 4.2}} = 31.7$ $I_f = \frac{0.5642}{31.7} = 0.0178$

$\frac{23.77}{3} =$

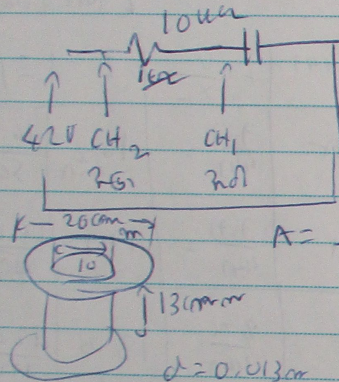


Date: _____



$$X_L = \frac{0.207}{7.9} = 0.026$$

$$L = \frac{0.026}{314} =$$



$$A = \frac{\pi (20^2 - 10^2)}{4} = 0.7854 \times 3.99$$

$$= 0.7854 [0.2^2 - 0.1^2]$$

$$d = 0.013m \Rightarrow 0.023m^2$$

$$C = \frac{A \epsilon_{eff} \epsilon_0 \epsilon_r}{d}$$

$$= \frac{0.023 \times 4 \times 8.85 \times 10^{-12}}{0.013}$$

$$= \frac{0.023 \times 4 \times 8.85 \times 10^{-12}}{0.013}$$

PVC $\epsilon_r = 4$

$$\epsilon_0 = 8.85 \times 10^{-12}$$

$$= 62.6 \text{ pF}$$

$$X_C = \frac{V}{I} = \frac{42}{8 \times 10^{-6}} = 5.25 \times 10^6 \Omega$$

$$C = X_C = \frac{1}{2\pi f C} \Rightarrow C = \frac{1}{2\pi f X_C} = \frac{1}{314 \times 5.25 \times 10^6}$$

$$= \frac{7.89 \times 10^{-6}}{314 \times 10} = 2.51 \times 10^{-6}$$

$$= 379 \times 10^{-6} = 379 \text{ pF}$$

$$75.6 \times 10^{-12} \text{ pF}$$



Date: _____

$$A = \frac{\pi}{4} \left[\left(\frac{20}{1000} \right)^2 - \left(\frac{10}{1000} \right)^2 \right] = 0.7854 \left[4 \times 10^{-4} - 1 \times 10^{-4} \right]$$

$$C = \frac{A \epsilon_{eff} \epsilon_0 \epsilon_r}{d} = \frac{2.35 \times 10^{-4} \times 4 \times 8.85 \times 10^{-12}}{\frac{13}{1000}} = 0.013$$

$$= \frac{0.1 \times 10^{-3}}{10 \times 10^3} = 0.01 \times 10^{-6} \text{ A}$$

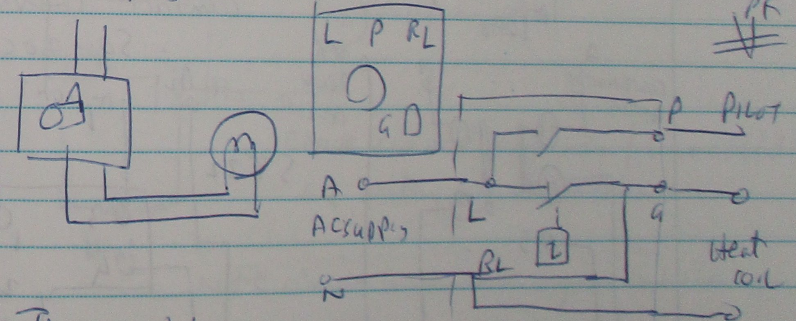
$$V = 2 \text{ mV at } 1000 \text{ Hz} = \frac{0.1 \times 10^{-3}}{10 \times 10^3} = 0.01 \times 10^{-6} \text{ A}$$

$$X_C = \frac{V}{I} = \frac{42}{8 \times 10^{-6}} = 5.25 \times 10^6 \Omega$$

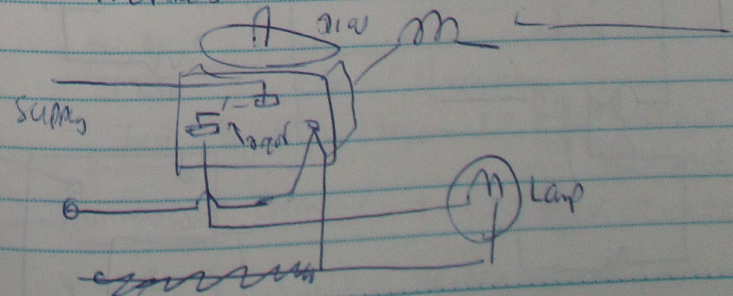
$$C = \frac{1}{2\pi f X_C} = \frac{1}{314 \times 5.25 \times 10^6} = 7.5 \times 10^{-6}$$

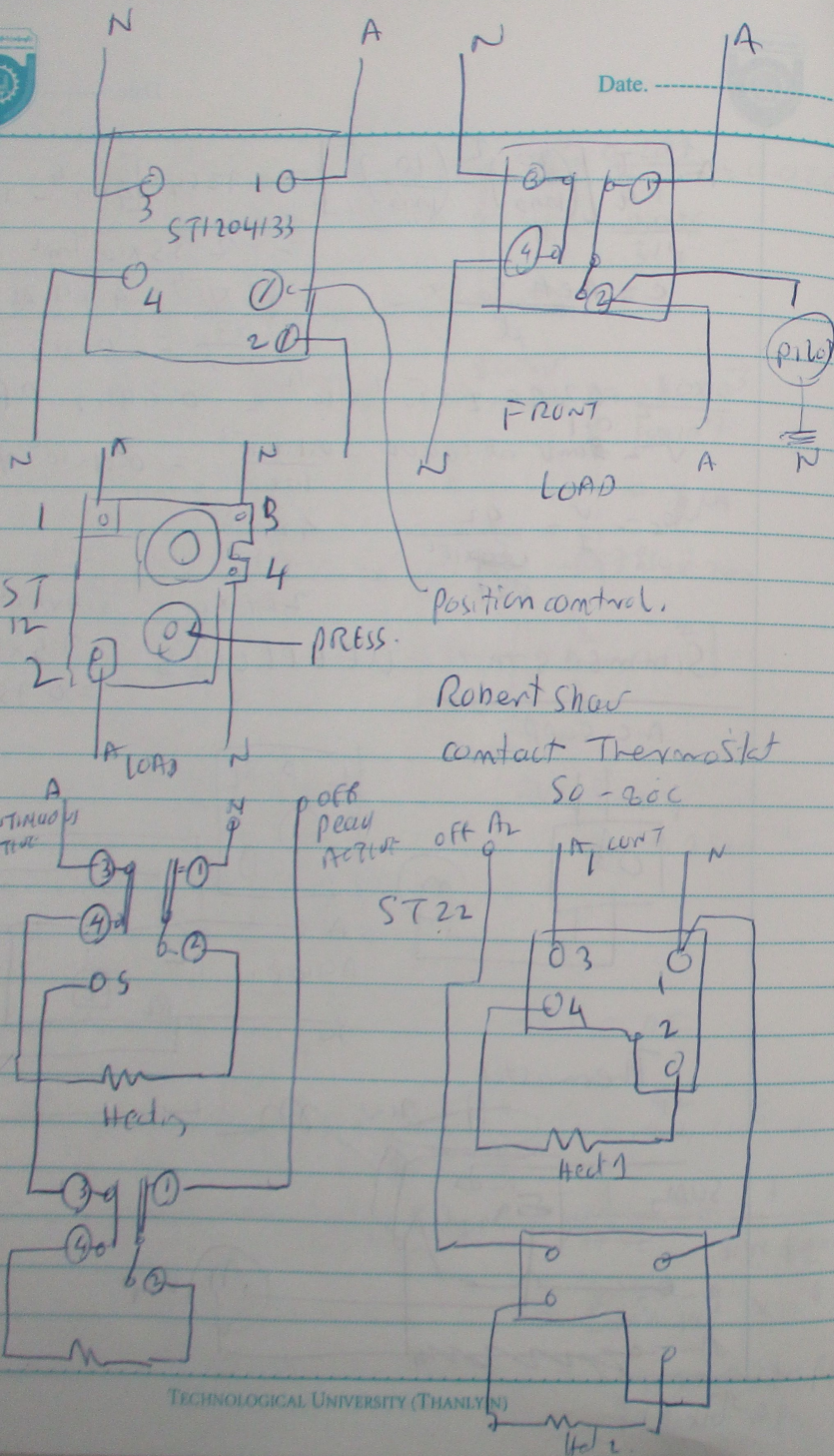
Simmerstat WEECLOG8 = $7.5 \times 10^{-6} = 0.75 \times 10^{-5} = 0.75 \text{ pF}$

A.C. supply



Thermostat





EL0008

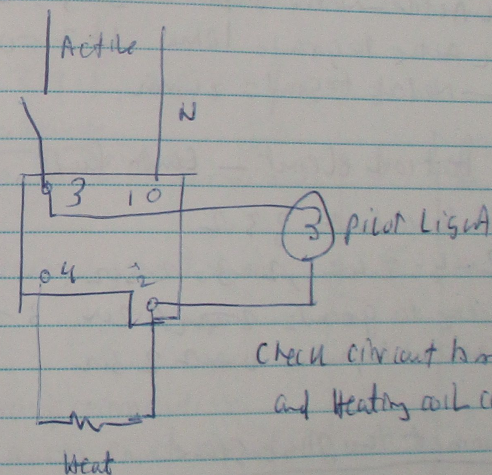
SIMMERSTAT OBSERVATION

Date: _____

1.3

- Connect the Simmerstat
- observe the circuit operation
- when the disc on Simmerstat is pressed observe the performance of light pilot light
- wire up the store by using the equipment provided.

4.2.1 Fault Finding



check circuit breaker / Simmerstat and Heating coil connection.

Note circuit breaker Type and its

operation.

Fault 1 connect the Take out the connection from circuit breaker.

Test, Supply voltage = 23.82V / voltage across signal led 22.5V

Simmerstat Terminal 1-3 = 23.12V, 3-4 = 0V, 1-2 = 0V

2-4 = 23.1V, Heating coil = 23.6V

Heating coil Active to ground = 23.32V / Heating coil to ground = 0.46V



Date: _____

off the / Take out the connection probe from C2.
Repeat the 1st test steps.

Fault 2 Heat coil element short circuit

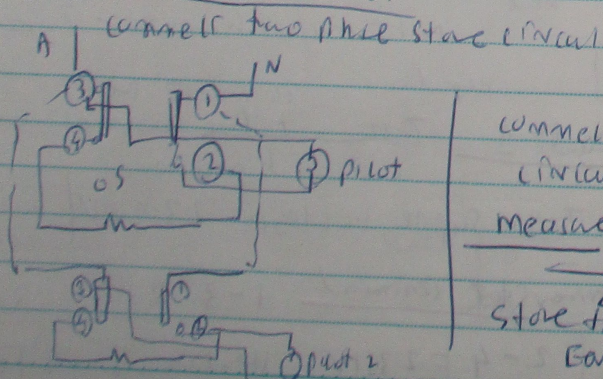
Take out all supply terminals / short circuit
Heat coil terminals

C2 out put to Neutral = 0.40Ω , $2 \rightarrow 4 = 0.1\Omega$
Heat coil Active - Neutral 0.1Ω , $2 \rightarrow 3 = 0.1\Omega$
Heat coil Active to ground = 10mA , $1 \rightarrow 2 = 0.1\Omega$ | $3 \rightarrow 4$
Neutral to ground = 29mA . OL

Fault 3 Heat coil element - Earth fault.

C2 out put to Neutral = 2.3Ω
Heat $2 \rightarrow 4 = 2.4\Omega$, $2 \rightarrow 3 = 2.3\Omega$, $1 \rightarrow 2 = 0.2\Omega$
Heat coil active to ground = 2.4Ω 0.2Ω , $3 \rightarrow 4 = 0.2\Omega$
Neutral to ground = 0.2Ω 2.3Ω

2.3 connect two phase store.



connect the circuit
measure Earth.

Store to Earth 0.2Ω

Active to Earth 0.40mA
Neutral to Earth 0.5mA



Date: _____

1st main C2 out put to
store Heat coil active = 0 (C2 out put - 3)
C2 out put to store Heat coil Neutral = 0
(C2 out put to - 4)

Active to Earth 20mA
Neutral to Earth 20mA | Earth - Earth = 0Ω
Bats $\uparrow$ Earth
continues

4.1 Combination of 2.3 + 4.2.1

3.3.1 3.3.2 | 4.2.2

<u>Hazards</u>			
Exposed Live Terminals	D	Risk #	do not touch any exposed terminal without testing
Burning by heating coil	G	m	use protective glove to handle thermal, wait for cooling
wrong connection causing short circuit	G	m	test the wires/stems before energizing. Always, check the connection

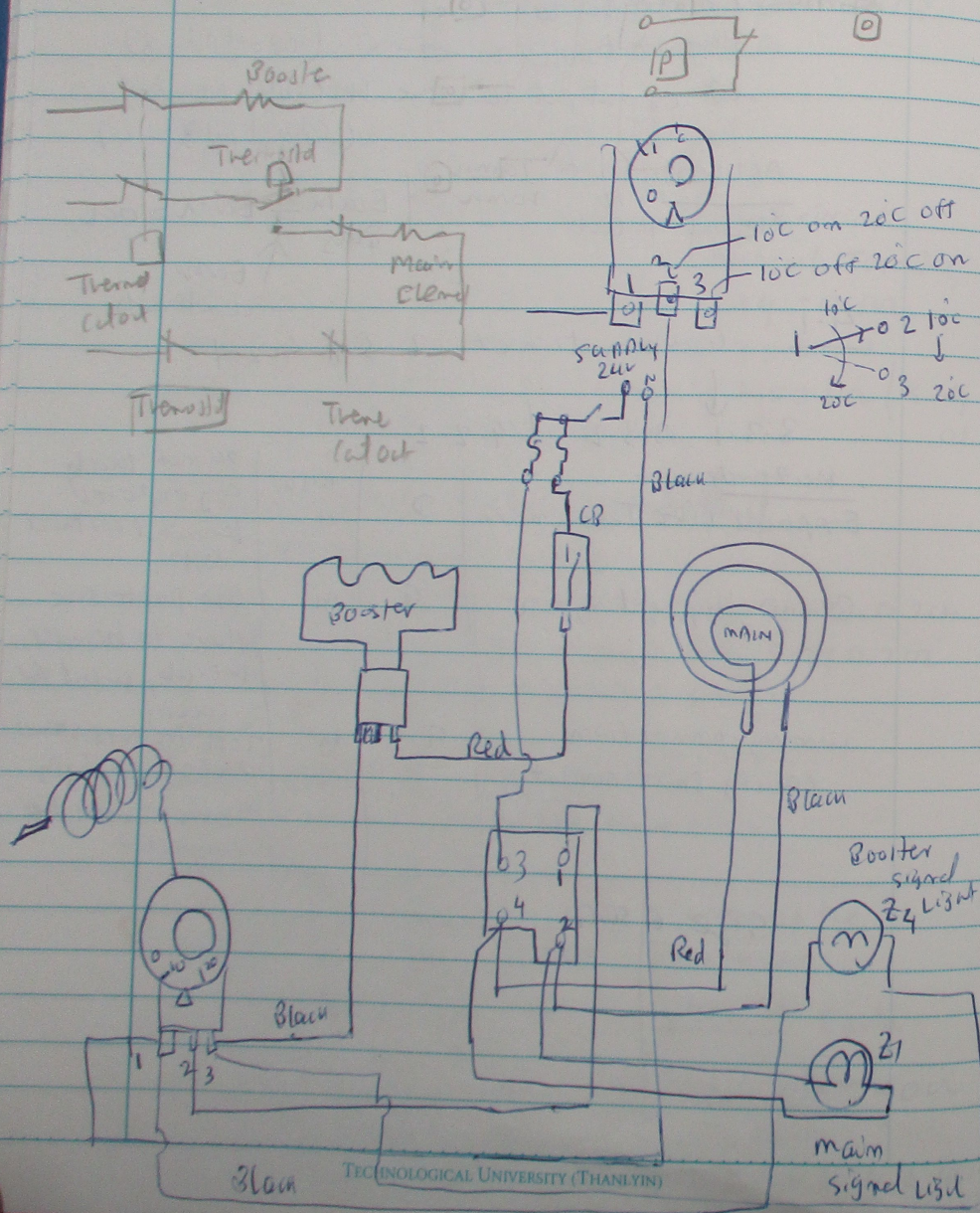
Size 6 ShG.



EL0008

3.3.1

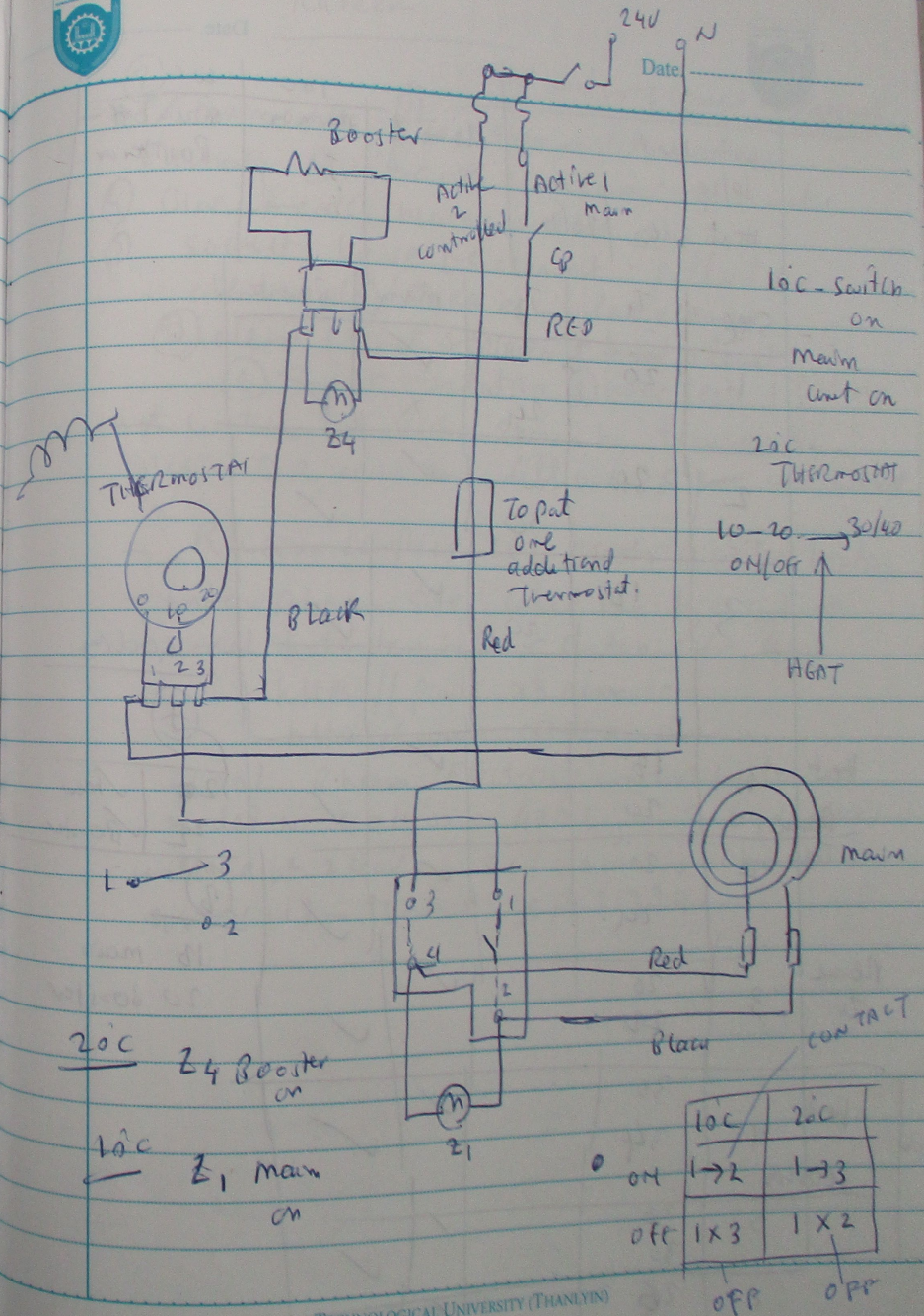
Date: _____



TECHNOLOGICAL UNIVERSITY (THANYIN)



Date: _____



TECHNOLOGICAL UNIVERSITY (THANYIN)

	loc	20c
ON	1→2	1→3
OFF	1X3	1X2
	OFF	OFF



Date: _____

without test
10/20

Heat 30/20

line 1

10°C
main on20°C
main off
Booster on

Step	T ₁	T ₂	main	Booster
1	20	24	✓	✓
2	20	30	✓	✓
3	18	20	✓	✓

loading

(3)

20 ✓ main
20 ✓ Booster

(2)

18 main
20 booster

Heat	1	18	✓	
Reheat		20		✓
T ₁	2	20	✓	
		24		✓
Reheat		26	✓	
T ₂	3	20		✓
		30	✓	
Heat	4	34	✓	
cooling				
	5	28	✓	
		30		✓
	6	26	✓	
		28		✓

TECHNOLOGICAL UNIVERSITY (THANYIN)



Rahem.

Date: _____

Hot water Element Replaced

- ② Off main switch ① Test thermostat voltage
 - Electrode ③ water off. unscrew earth cover
 ④ Blue wire off, black wire off.
 ⑤ socket, loose the element pull out the element. ⑥ Take equivalent element
 ⑦ clean ⑧ fit replacement element
 ⑨ Insulate insulation ⑩ cover test. | Test run
 watch the video shown by teacher by
 using QR code and fill out the worksheet

- Rheem compact 25L Electric water heater
 - Enter Rheem site, select the type and of
 model hot water heater suitable for 40L.

<https://pavis.rheem.com><https://www.rheem.com.au>

400L Rheem Electric water heater
 model no 49140 400L, 3.6, 4.8kW
 voltage at 240V → 3.6/4.8kW → choose
 4800(21) — select SP 213790

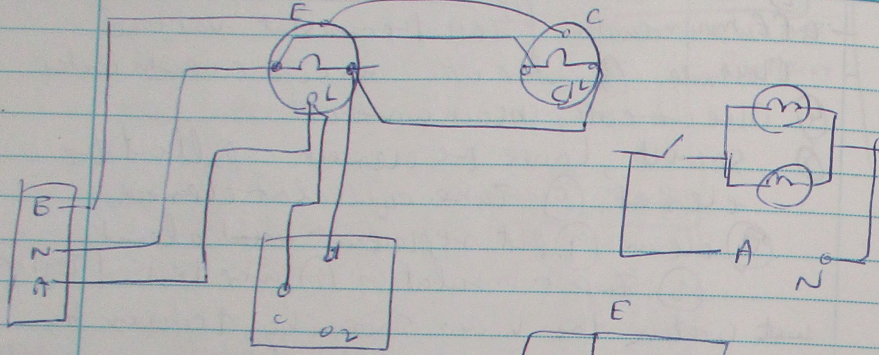
TECHNOLOGICAL UNIVERSITY (THANYIN)



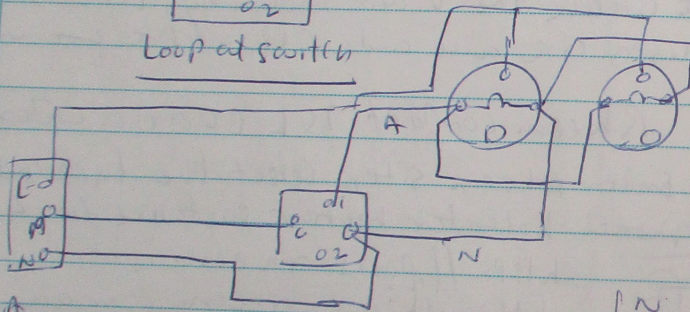
U E E L 0 0 0 9

Date: _____

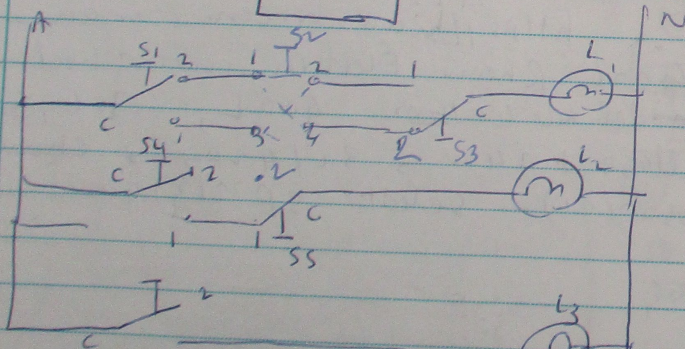
1.2.1 Loop at Light



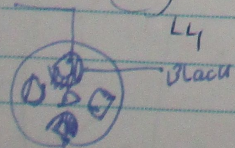
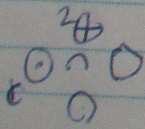
Loop at switch



Loop at switch



SWITCH



2 and c-1
up c-2

TECHNOLOGICAL UNIVERSITY (TIANJIN)



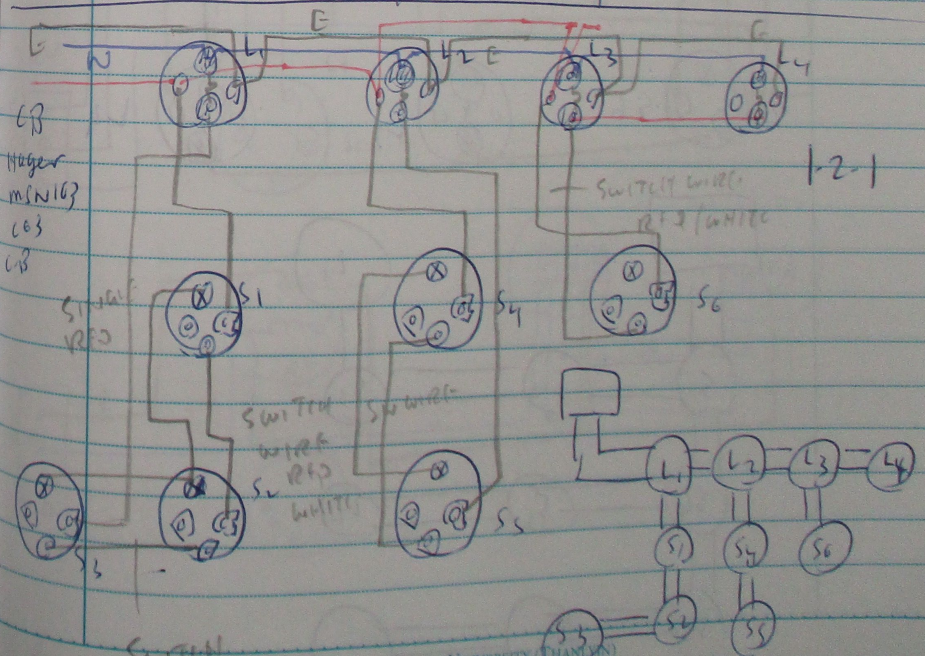
Wrong connection of 3φ wire causing energized earth
Loss of neutral wire causes imbalance

Neutral wire
imaging
system must be secured.

Date: _____

Hazards

Hazards	Risk	Test	Measure
① Exposed Terminals	D	IT	Do not touch any exposed terminal without Test
② Short circuit between live wires	D	II	Measure insulation Resistance
③ Transpose of wire causing electrical power at earthed Terminal	D	GM	Measure polarity
④ Wrong colour code of cable causing misinterpretation	G	M	Follow appropriate cable code standard



SWITCH WIRE

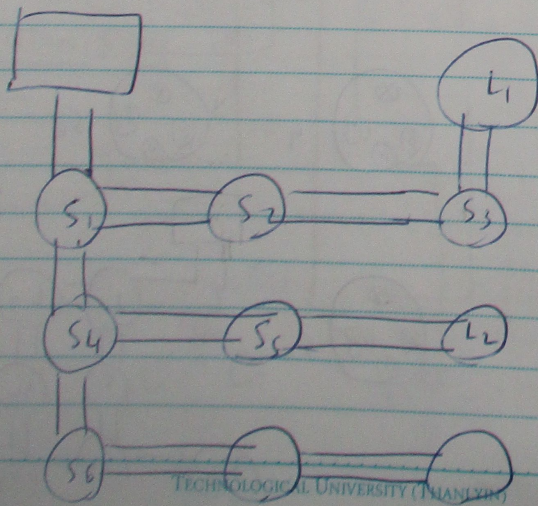
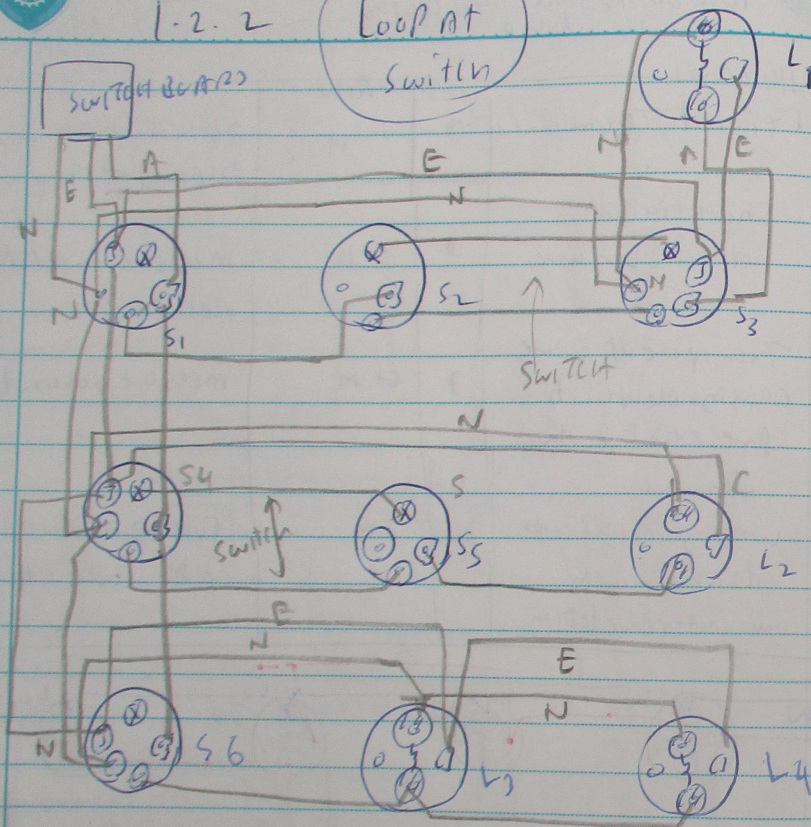
TECHNOLOGICAL UNIVERSITY (TIANJIN)



1.2.2

Loop at
Switch

Date. _____



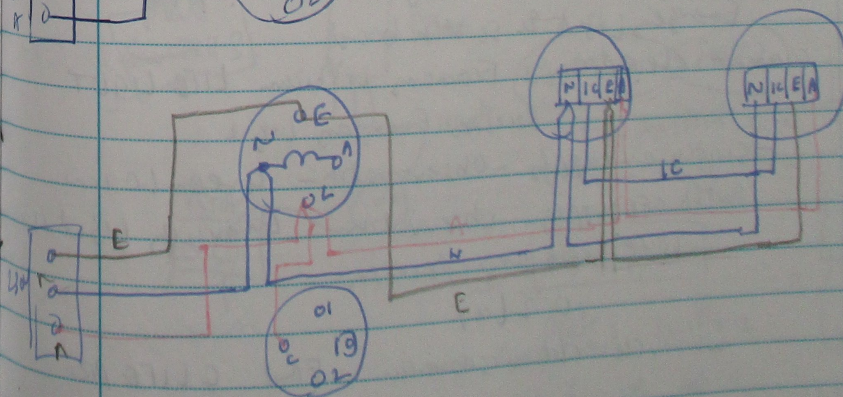
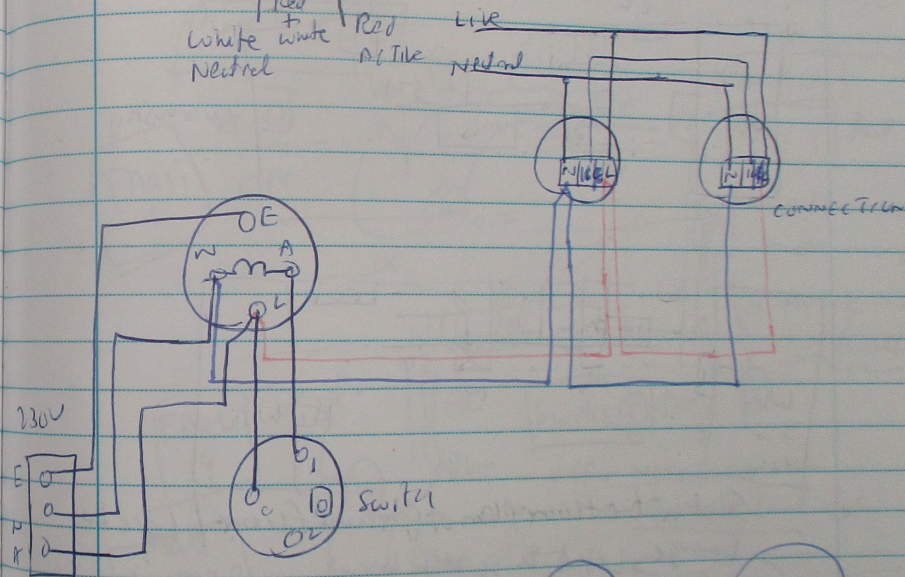
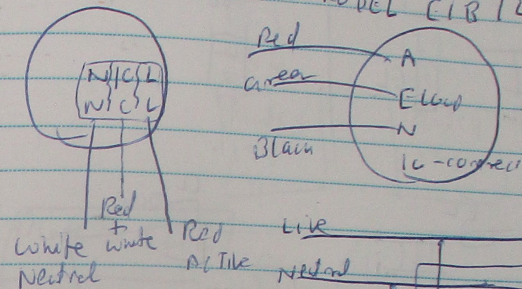
TECHNOLOGICAL UNIVERSITY (THANYINYAR)



2.2 Smoke Alarm

Date. _____

Brooks Australia model EIB144RC

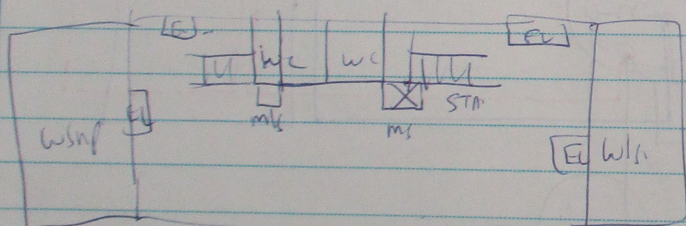
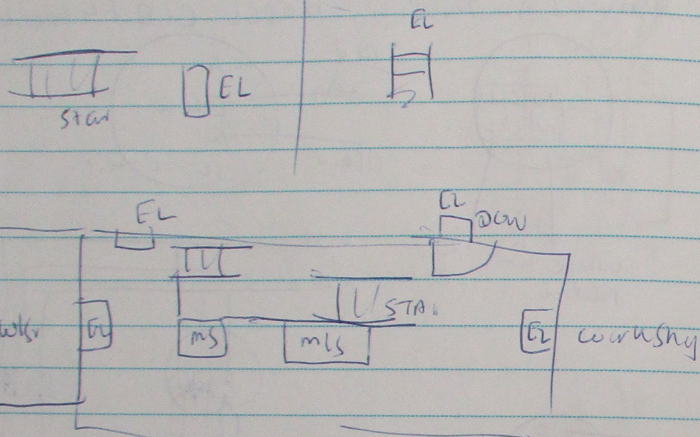


TECHNOLOGICAL UNIVERSITY (THANYINYAR)



Date: _____

up stair



Station below plan of ground floor / locate
Emergency Light & switch board
connect clevertronics Economy Lithium LIFE LIGHT
Recessed Emergency Light

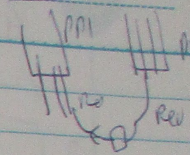
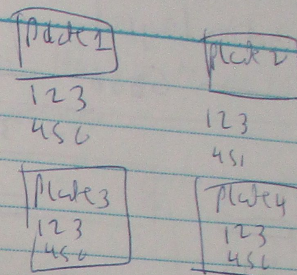
- Switch on supply - Observation - Green LED on
Switch off supply - Observation - Emergency Light on
Life Light prob Recessed
0.2 lux

www.clevertronics.com.au FMD CLIFE PRO

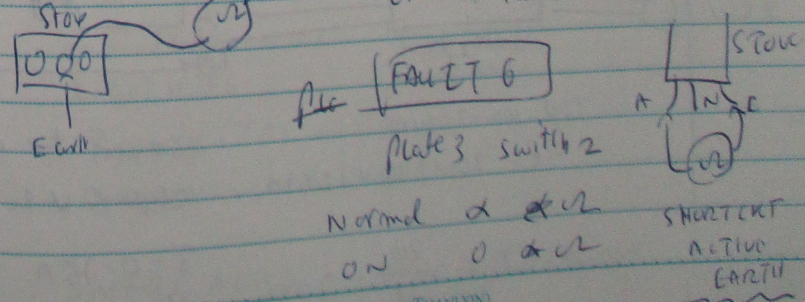
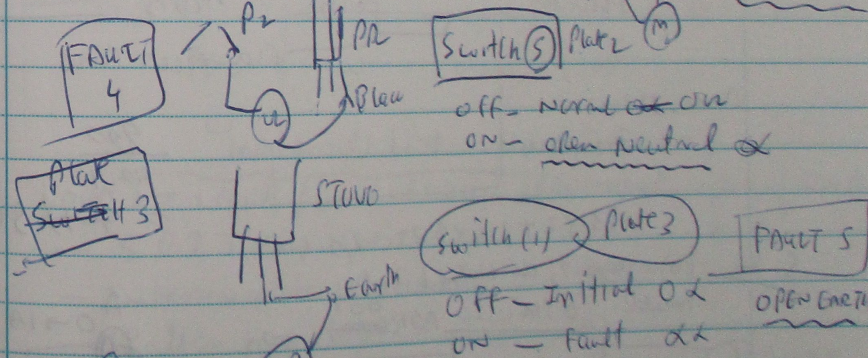
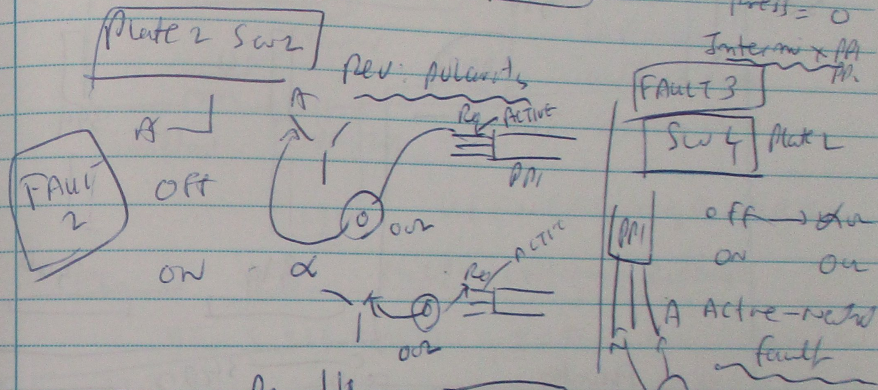


SGO Test

FAULT(1)
Date: _____



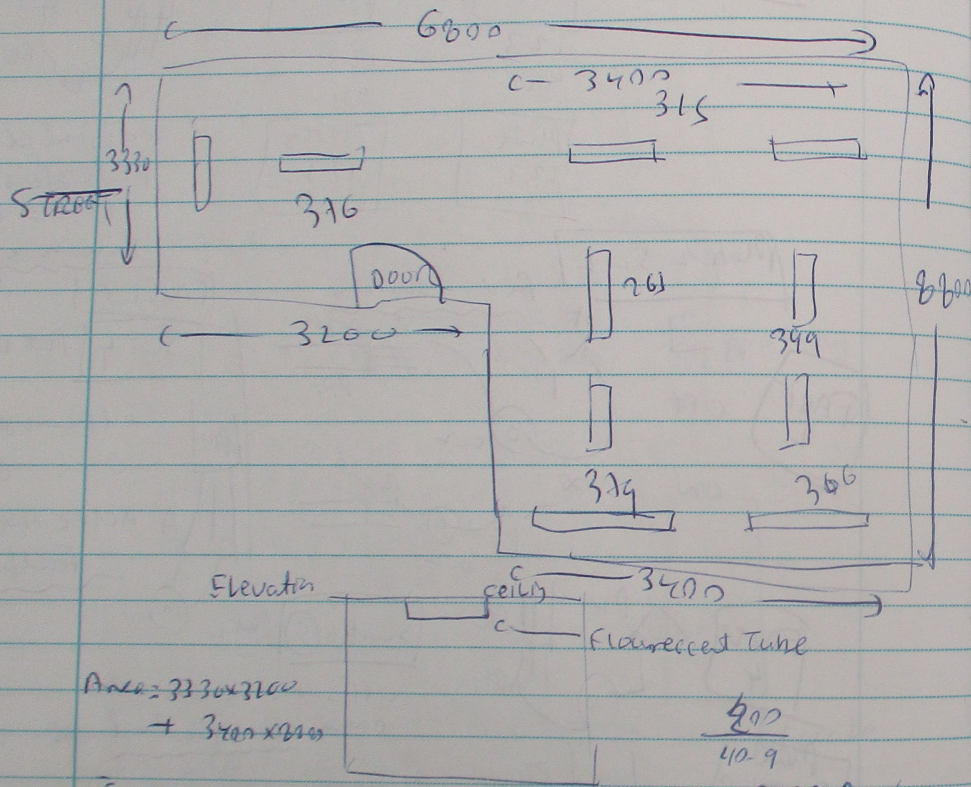
original of
Plate 2 / no 6
Press = 0
Interm x PA
PA



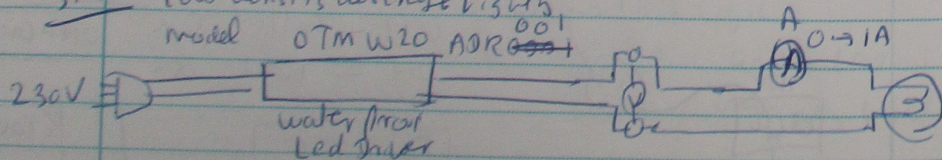


Date: 200 + 1600 / 2

4.3 Lighting layout



S.2 low density discharge lighting



IP 100-2500m

O/P = 20W / 12V / 1.67A

connect the ground
measure V & A

$$\text{no. of lights} = \frac{20}{4} = 5 \text{ no.}$$

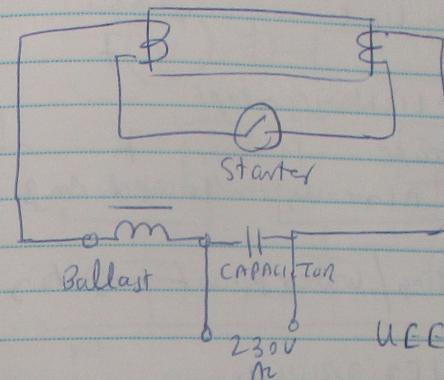
$$I = 0.76A$$

$$V = 12V$$



Date: _____

Circuit protection Hager MSN 103 C 63
circuit breaker



Power Rating
lamp type
lamp colour
ballast type
starter type.

UEENCEG104A BOARD

Fluorescent Ballast - Philips Electronic Ballast

HF-S 214 TLS II, 2 x TLS 14W warm start

U_m 230-240V I_m 0.14, 0.1A f_m 50Hz, 60Hz, 2

P_i = 2 x 14W U_{out} = 430V

material List UEENCEG104A

	Loop AT Light / Loop at switch / Per Group.	No of Group
1.2.1	Loop AT Light / Loop at switch / Per Group.	5 x 7
1.2	S P D T Switches	1
	Intermediate Light switch	4
	Ballen holders	10
	mounting blocks	
	light bulb	
	3 cores TPS cable	
	single core TPS cable	

Smoke Alarm

2



Date. _____

3.2
Emergency lighting

Cherletronics Recessed
Emergency Light 7

Lux meter 7

4.3 Fundamental of lighting concept

measuring tape 7

(Lux meter - Already included in 3.2)

5.2 Fluorescent Lighting / water proof lighting driver set.

water proof LED DRIVER

OTM 220, ADR 201 x 7

Input 250VAC output 12V, 20W
2.07A

6.1
HID
Lighting

HID discharge lighting fixture x 7

Sylvania Red Heat Lamp x 3

Screw type button holder 14

6.2
LED
Lighting

Tabular LED Lamp x 7

DIMMABLE LED Down Light kit x 7

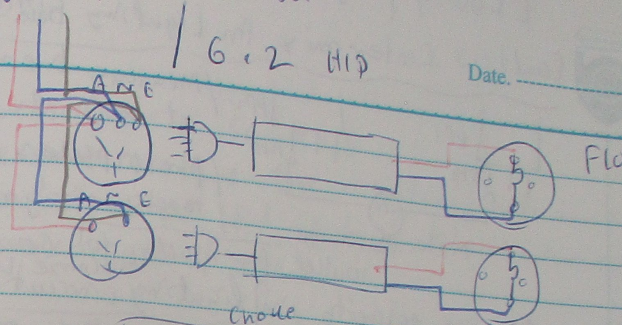


5.2

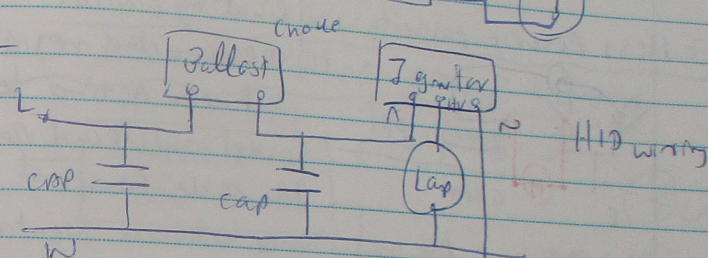
water proof lighting driver set

6.2 HID

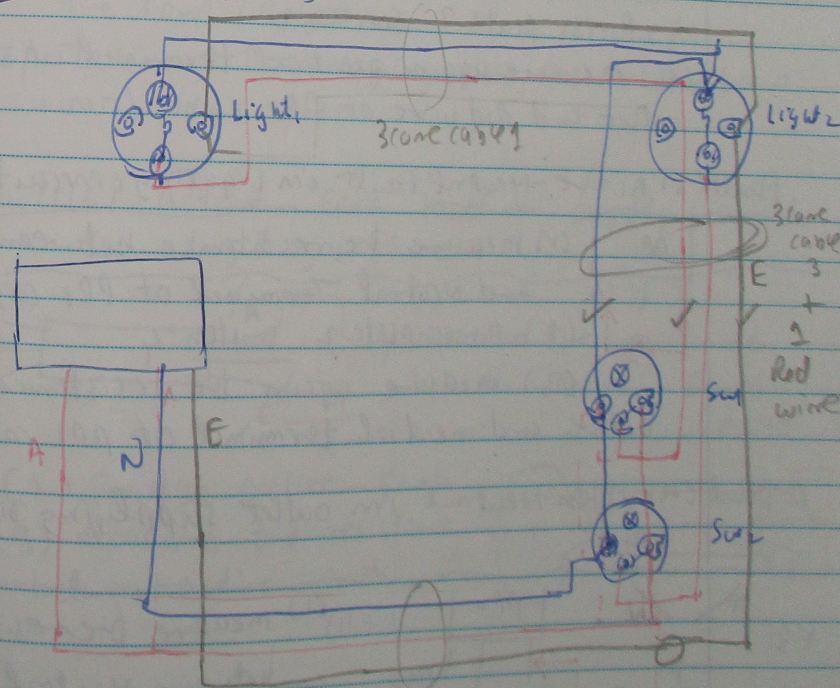
Date. _____



6.1



6.2 LED Lighting

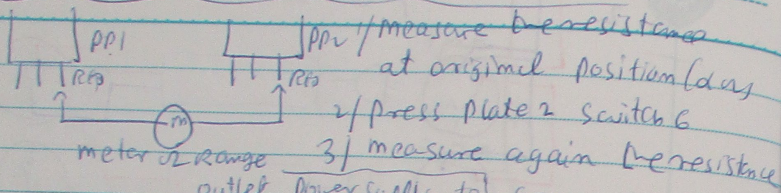
Loop at
switch

3-core cable

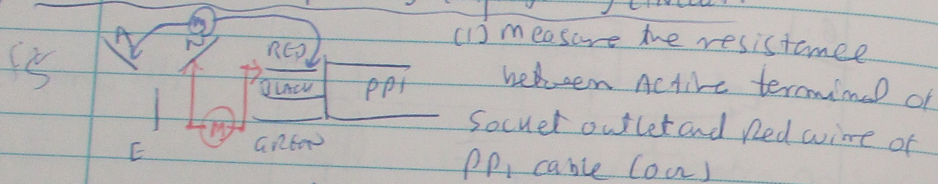


EL0009 / Skills Practice 7.2

Fault (1) Intermix in Lighting Circuit

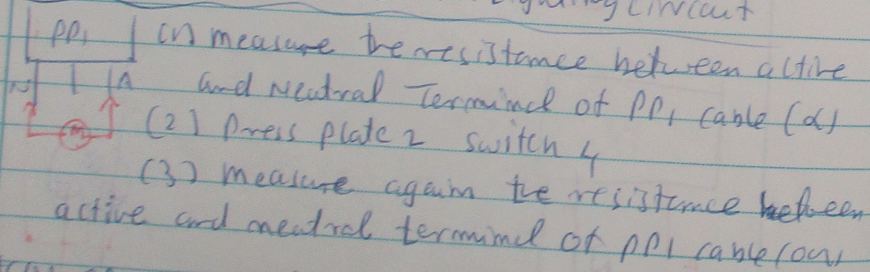


Faults Reverse polarity in lighting circuit.

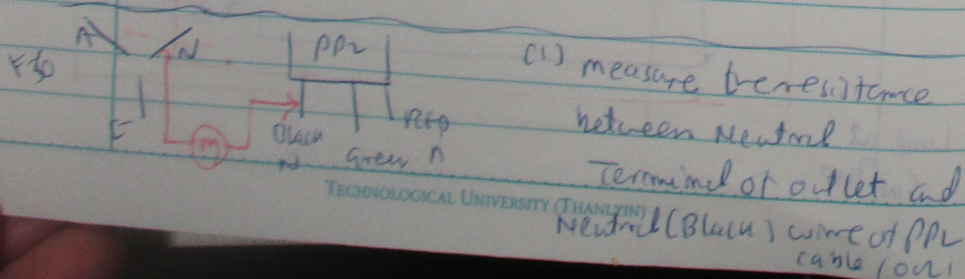


- (1) measure the resistance between Active terminal of socket outlet and Red wire of PP1 cable (on)
- (2) measure the resistance between Neutral Terminal of socket outlet and Red wire of PP1 cable (on)
- (3) Press plate 2 switch 2
- (4) measure again neutral terminal of socket outlet and Red wire of PP1 cable (on)

Fault (3) Active-Neutral Fault in Lighting Circuit



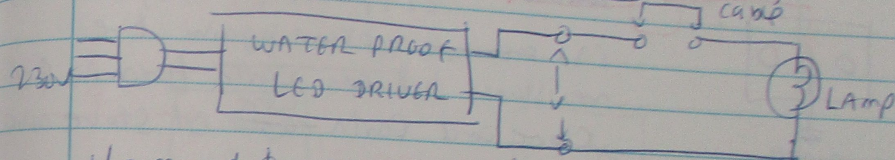
Fault (4) Open Neutral in outlet supplying discharge Lamp



Date: _____

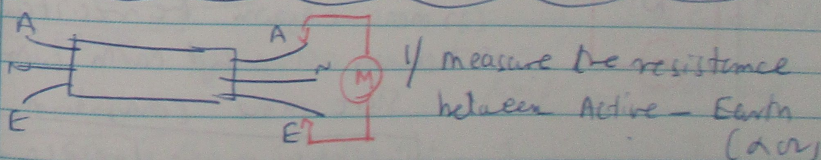
- (2) press plate 2 switch 5
- (3) ~~measure~~ measure the resistance between Neutral terminal of outlet and neutral black wire of PP2 cable again (on)

Fault (5) LED Driver open circuit Bridging cable

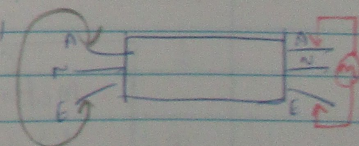


- 1/ connect the above circuit and switch on, observe the Lamp (Bright)
- 2/ Take out the bridging cable, observe the Lamp (Dark)

Fault (6) Active-Earth Fault in supply wire to Lighting Fixture

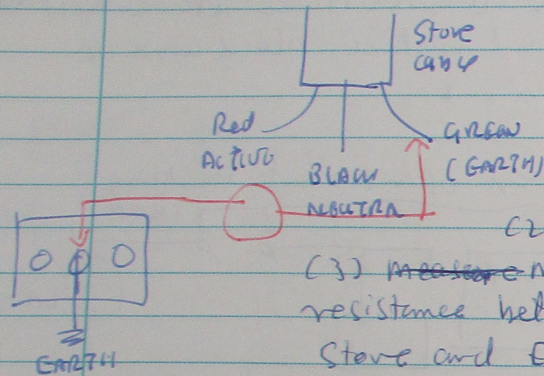


- (2) Bridge Active-Earth
- (3) measure the resistance between Active-Earth (on)





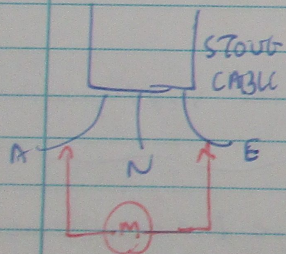
Date: _____

Fault (7) Open Earth

(1) measure the resistance between Earth terminal of stove and Earth cable of stove cable (don)

(2) Press plate 3, switch (1)

(3) ~~measure~~ measure again the resistance between Earth terminal of stove and Earth ~~cable~~ ^{wire} of stove cable (don)

Fault (8) Active - Earth fault

(1) measure the resistance between active and earth wire of stove cable (don)

(2) Press plate 3, switch 2 (don)

(3) measure again the resistance between active and earth wire of stove cable (don)

Material

1.2 + 2.1

- 14 single wire Red/Black/Green
- 14 2 core wire A-N
- 34 Screws
- 14 3 core wire
- sequence meter 1 x 7
- Neutral Bar - 1 x 7
- Earth Bar - 2 x 7

TECHNOLOGICAL UNIVERSITY (THANLYIN)



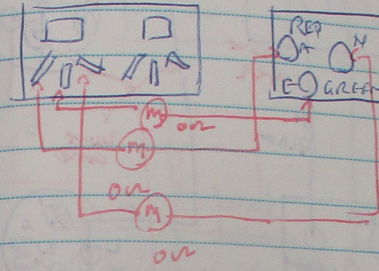
UUEEL0010

Date: _____

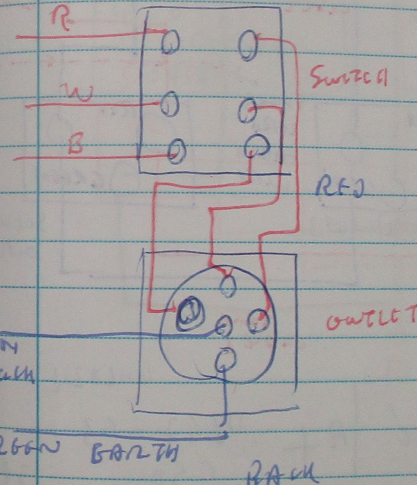
14 outlet

Socket outlet outlet

1.2



34 outlet



GREEN BARTH BACK

FRONT/Group

SCHEIDER ELECTRIC

EY 56 C 520

20A
500V
Soft

34 Socket outlet

No. of Group

1.2 material

Test Socket outlet

- | | | |
|-------------------------------|---|---|
| Single Phase Socket outlet | 1 | 7 |
| 34 socket outlet | | |
| SCHIEDER ELECTRIC EY 56 C 520 | 1 | 7 |
| IP 66 m450 500V, Soft | | |
| IR Tester | 1 | 7 |
| Phase Sequence meter | 1 | 7 |

D8 47-03 C 50 415V 34C7

Hager 34 ADM 4704 C 50 E 50

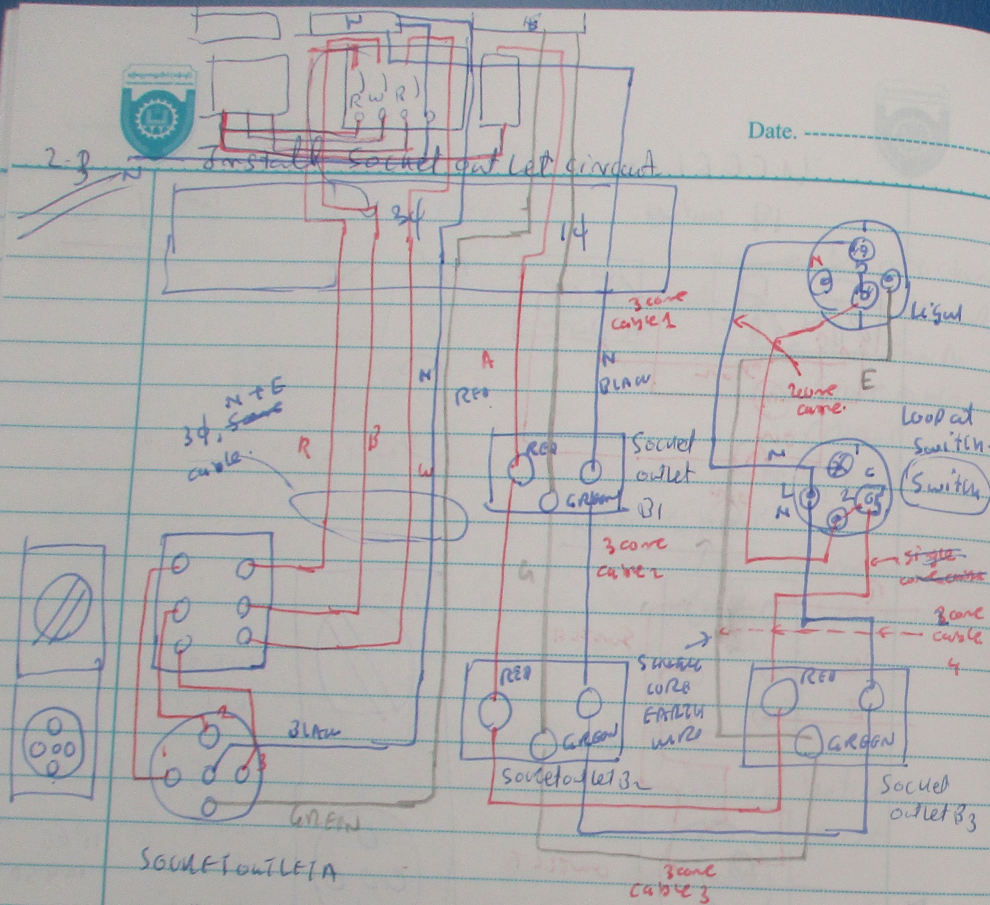
Hager msw 163 C 63

TECHNOLOGICAL UNIVERSITY (THANLYIN)



2-3 Install socket out let circuit

Date: _____



SOCKET OUTLET A

Circuit Protection device

3φ Hager ADM 420T C20
ADM 0.3A

Mixed circuit

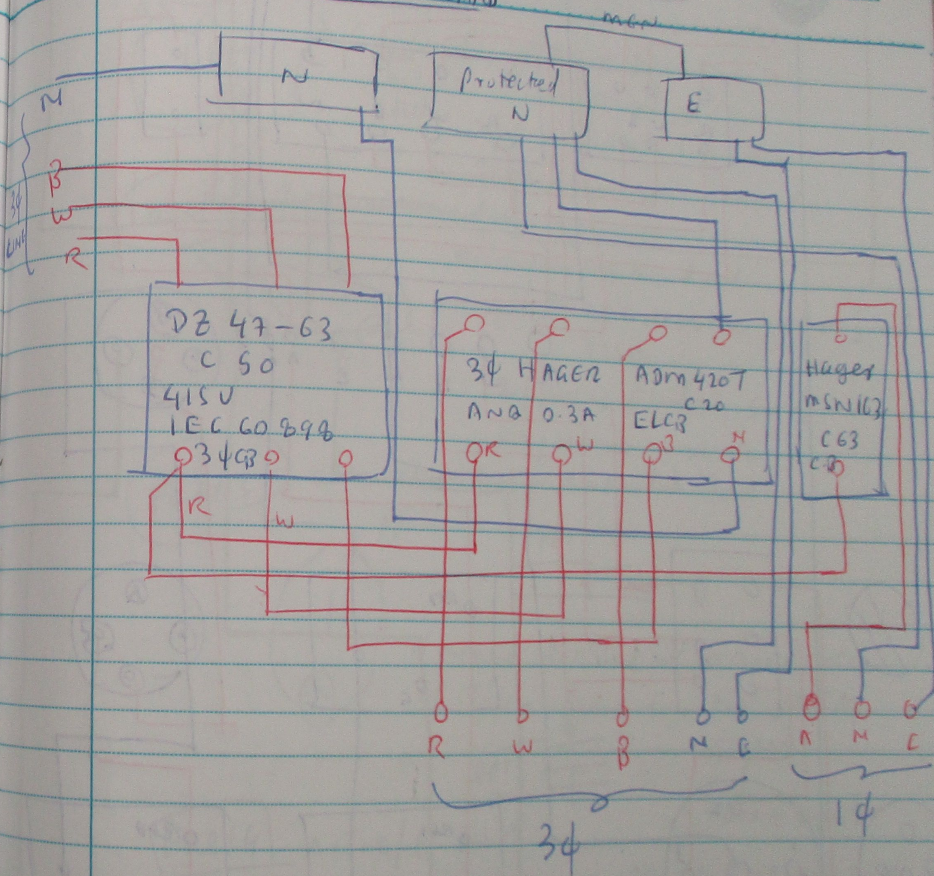
Hager ADM 420T
C20

DZ 47-63
C50
415V
IEC 60 898

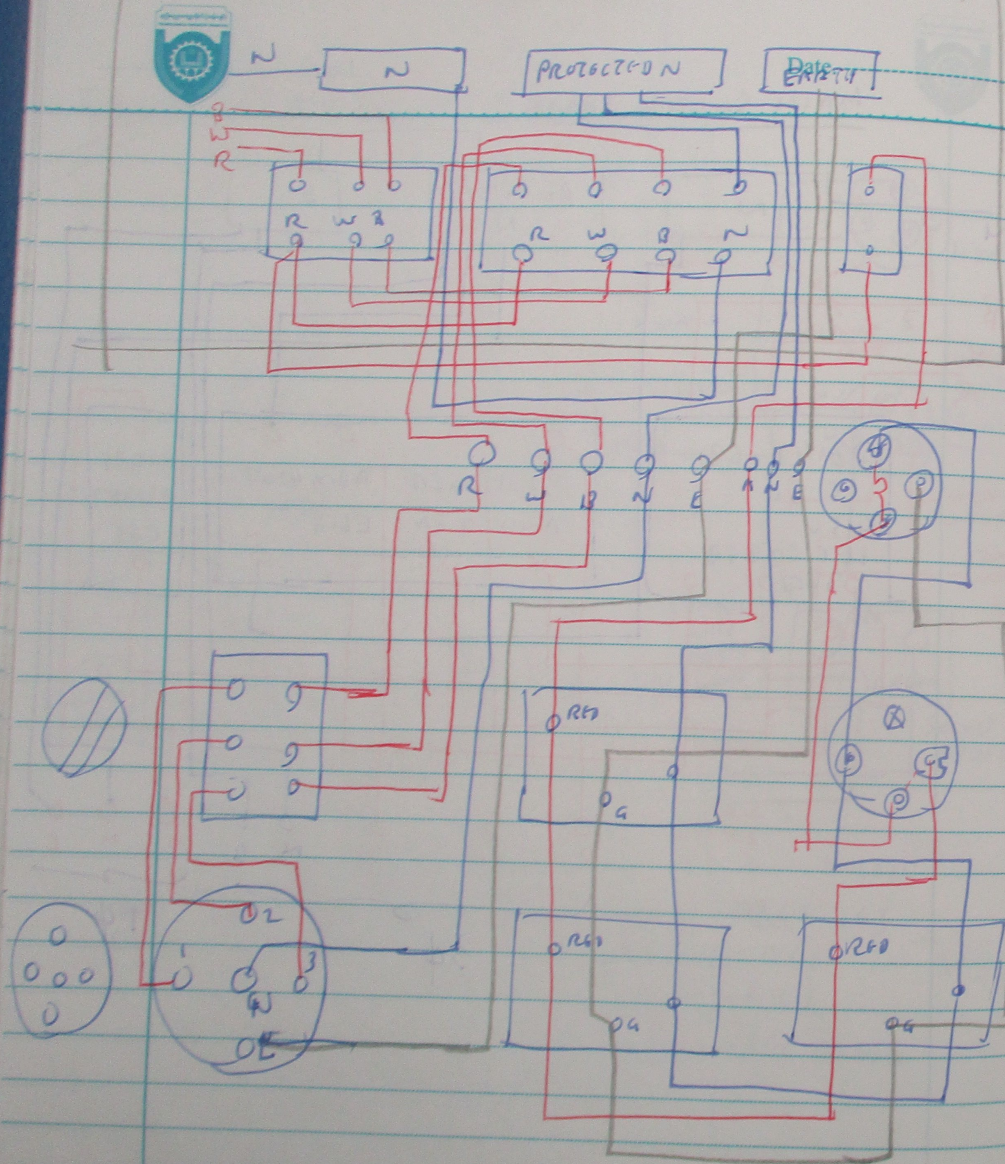


MAIN SWITCH BOARD

Date: _____



SWITCH BOARD

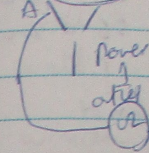


EL0000 / 3.2

Intermix Active

Date: _____

Fault 1



- 1/ measure Resistance at original α or
- 2/ Press Plate 2 Switch G
- 3/ measure again resistance α

Fault 2

- 1/ measure Resistance at original 315Ω
- 2/ Press Plate 4 Switch 3
- 3/ measure α or

Fault 3

- 1/ measure Resistance at original α
- 2/ Touch Active to neutral of PM
- 3/ measure again

Fault 4

- 1/ measure Resistance at original α
- 2/ Touch Active to Earth at PP1
- 3/ measure again α

Fault 5

- 1/ measure Resistance at original α

Fault 6

- 1/ measure Resistance at original α



FL 0019

Resistance

Date: _____

Series
 $S_1 - S_2 = 0.6\Omega$, $S_1 - S_3 = 0.9\Omega$, $S_4 - S_5 = 0.6\Omega$, $S_4 - S_6 = 0.9\Omega$
 Shunt $f_1 - f_2 = 1.5\Omega$ Armature 0.2Ω
 Inductor Series $S_1 - S_3 = 4.4\text{mH}$
 $f_1 - f_2 = 0.493\text{mH}$

Armature 3.22mH | $S_5 - S_6 = 0.9\text{mH}$ | 4.31mH
 $S_1 - S_2 = 0.9\text{H}$
 $S_2 - S_3 = 0.925\text{H}$
 $S_4 - S_5 = 0.299\text{mH}$

2.3 dc compound generator

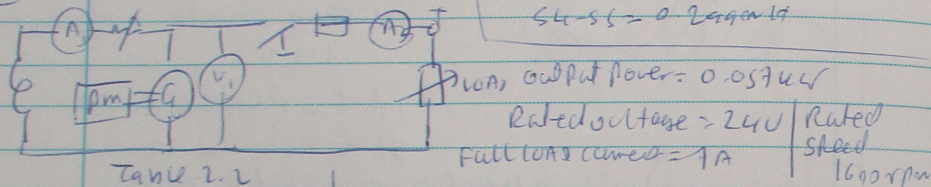
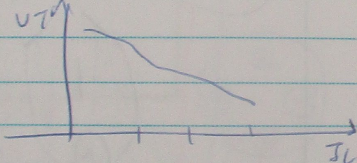


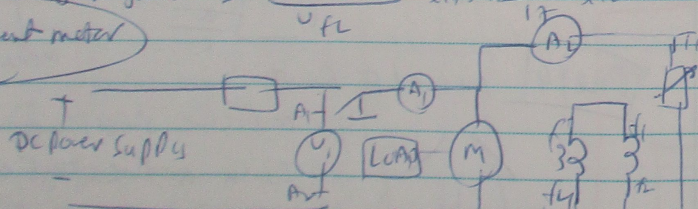
TABLE 2.2

Full load I_L	I_L	V_T (Terminal voltage)
Full load I_L	4A	9V
75% I_{FL}	3.2A	12V
50% I_{FL}	2.4A	13.5V
25% I_{FL}	1.75A	15V
I_{NL}	1A	17V



Voltage Regulation $\frac{V_{NL} - V_{FL}}{V_{FL}} \times 100 = \frac{17 - 9}{9} \times 100 = 88.8\%$

3.3.2 dc shunt motor



Full load I_L	I_L	V_T	I_A	I_{CH}	R_{AM}	Power
Full load I_L	4A	9V	3.6	1.05	1655	Rated output 24W
75% I_{FL}	3.2A	12V	4.2	1.05	1630	clockwise
50% I_{FL}	2.4A	13.5V	4.8	1.05	1605	M1-M2 change anticlockwise
25% I_{FL}	1.75A	15V	5.59	1.05	1571	
I_{NL}	1A	17V	5.8	1.05	153	

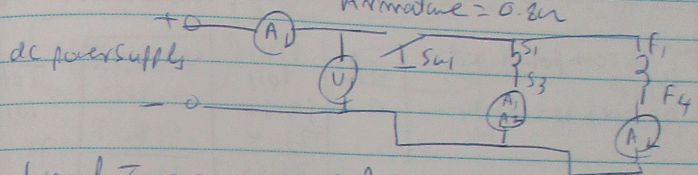


$P_0 = \frac{2T_{INT}}{G_0} = 273.14\text{W}$

4.2 DC compound motor losses / Efficiency

output power = 0.0574W $V_{Rated} = 24\text{V}$
 $I_{FL} = 7\text{A}$ $\text{Rated Speed} = 1600\text{rpm}$
 $\text{Watt} = \frac{2T_{INT}}{G_0} \Rightarrow T = \frac{\text{Watt} \times G_0}{2T_{INT}} = \frac{0.0574 \times 10^3 \times 1600}{2 \times 7} = 0.34\text{m}$

winding Resistance Series = 0.9Ω Shunt = 1.5Ω
 Armature = 0.2Ω



Load Torque	Terminal voltage	Line current	Armature current	I_{CH}	R_{AM}	P_0
%	V	A	A	A	Ω	Watt
No load	24.4	3.35	3.3	1.4	1400	0
25%	24.4	3.5	3.4	1.45	1385	$\frac{271335.02}{60} = 2.89$
50%	24.4	3.65	3.65	1.25	1340	$\frac{2713400.1}{60} = 14.2\text{W}$
75%	24.4	4.6	4.6	1.25	1280	$\frac{2712800.32}{60} = 42.27\text{W}$
100%	24.4	6.72	6.62	1.25	1200	$\frac{2711000.02}{60} = 52.37\text{W}$

Losses	Armature loss	Series field loss	Shunt field loss
%	$I_A^2 R_A$	$I_{CH}^2 R_{CH}$	$I_{CH}^2 R_{CH}$
No load	$3.3^2 \times 0.2 = 8.71\text{W}$	$3.3^2 \times 0.9 = 9.24\text{W}$	$1.4^2 \times 1.5 = 2.94\text{W}$
25%	$3.5^2 \times 0.2 = 9.2\text{W}$	$3.5^2 \times 0.9 = 11.025\text{W}$	$1.45^2 \times 1.5 = 3.15\text{W}$
50%	$3.65^2 \times 0.2 = 11.25\text{W}$	$3.65^2 \times 0.9 = 13.34\text{W}$	$1.25^2 \times 1.5 = 2.34\text{W}$
75%	$4.6^2 \times 0.6 = 16.06\text{W}$	$4.6^2 \times 0.9 = 19.04\text{W}$	$1.25^2 \times 1.5 = 2.34\text{W}$
100%	$6.6^2 \times 0.8 = 34.2\text{W}$	$6.6^2 \times 0.9 = 39.2\text{W}$	$1.25^2 \times 1.5 = 2.34\text{W}$

100% Load



Input Power = $V \times I = 24.4 \times 6.72 = 163.96W$

output = $52.3W \rightarrow$ Total losses = $163.96 - 52.3 = 111.54W$

Total copper losses = Armature loss + Series field loss + Shunt field loss
 $= 34.6 + 39.2 + 23.4 = 97W$

Total losses = Total copper losses + Total windage & friction losses

$111.54 = 97 + W_f \rightarrow W_f \text{ loss} = 111.54 - 97 = 13.54W$

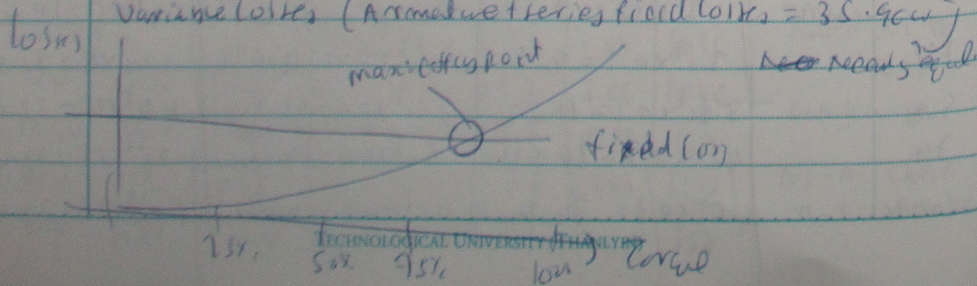
Load	Compound motor	o/p	Fixed loss	Variable loss	Total loss	% eff
25%	$24.4 \times 3.5 = 85.4W$	2.89	36.99	9.8 + 11.02 = 20.8	67.91	$\frac{2.89}{85.4} \times 100 = 3.38\%$
50%	$24.4 \times 3.8 = 92.72W$	14.02	36.99	11.81 + 15.19 = 27.0	75.0	$\frac{14.02}{92.72} \times 100 = 15.06\%$
75%	$24.4 \times 4.6 = 112.24W$	42.21	36.99	16.9 + 19.4 = 36.3	72.99	$\frac{42.21}{112.24} \times 100 = 37.19\%$
100%	$24.4 \times 6.72 = 163.96W$	52.3	36.99	34.6 + 39.2 + 44.6 = 118.4	111.54	$\frac{52.3}{163.96} \times 100 = 31.94\%$

At maximum efficiency fixed losses = variable loss

at 75% load effy = 32.19%

Fixed losses (windage/friction loss + Shunt field loss) = 36.99W

Variable losses (Armature + series field losses) = 35.96W



WHEEL 0021 Solve Problem in magnetic & electromagnetic circuits



13

Date: _____

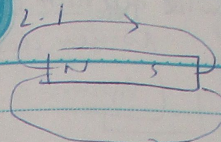


Fig 1-1

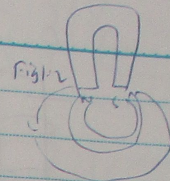


Fig 1-2

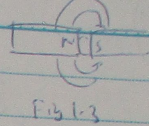


Fig 1-3

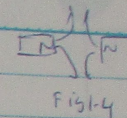


Fig 1-4

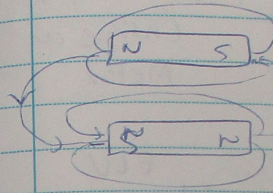


Fig 1-5

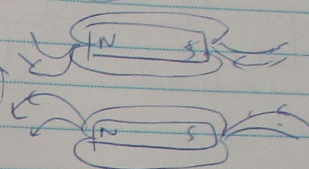


Fig 1-6

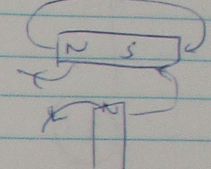


Fig 1-7

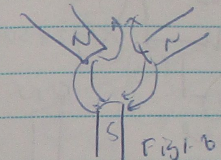


Fig 1-8

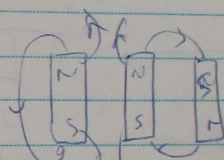


Fig 1-9

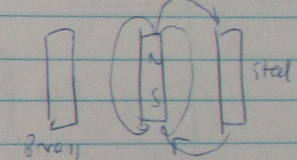


Fig 1-10

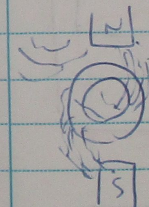


Fig 1-11

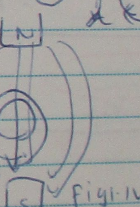


Fig 1-12

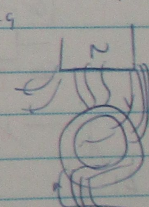


Fig 1-13

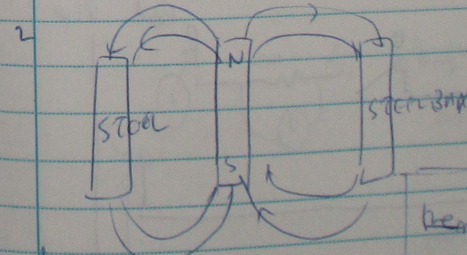
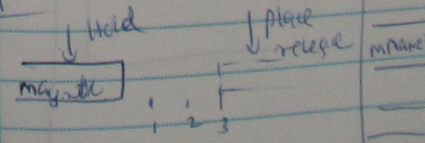


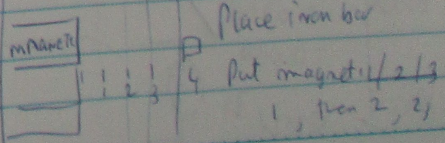
Fig 1-14

note the position when the other magnet was attracted or repelled by the magnetic field by hand

Practical



Place other magnet Position 3, 2, 1 when

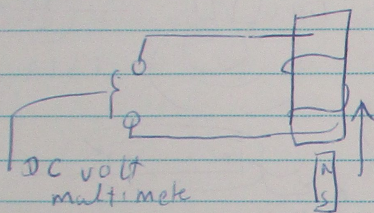


Place iron bar Put magnet 1/2/3 1, then 2, 3 when observe behavior

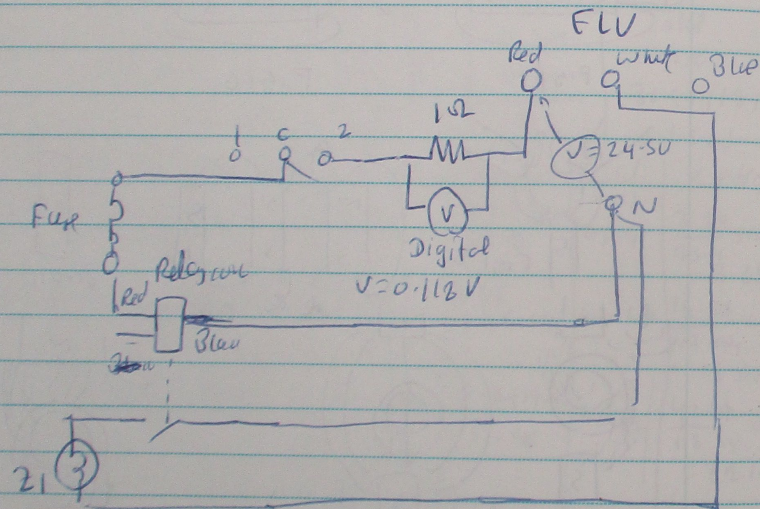


The closer the distance - The stronger magnetic force
 The more magnet → The more force - The iron core can be attracted from longer distance

(4.3)



(7.1)

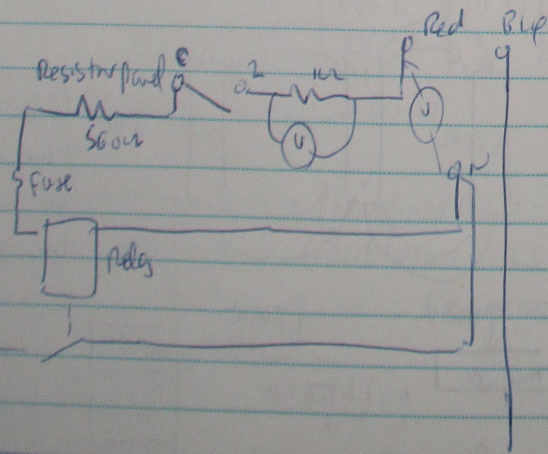


$$560\Omega = 0.045V \\ = 0.045A \quad \times$$

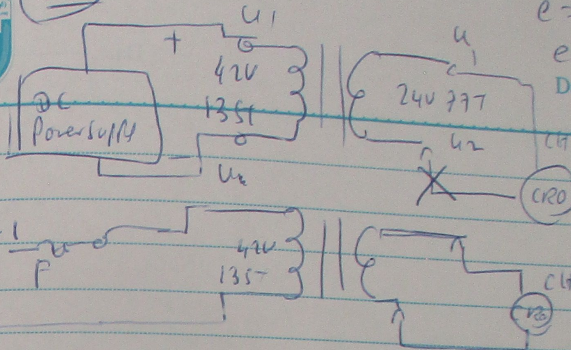
$$220 = 0.071V \\ = 0.071A \quad \times$$

$$100\Omega = 0.073V \\ = 0.073A \quad \checkmark$$

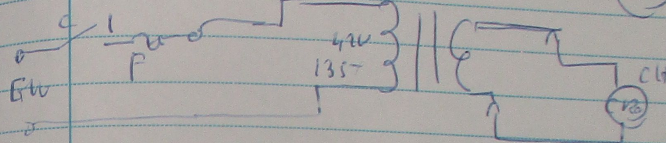
$$100\Omega = 0.106V$$



(5.2)



$$e = Blv \\ e = N \frac{dd}{dt} = e = l \frac{di}{dt}$$



$$I = 4.44 \mu A$$

