2019/2020 Semester I Exam

1a) $S = \frac{1800}{0.85} = 2117.6$ kVA

Voltage = 22kV

Phases = 3-phase

No. of wires = 3-wire

Earthing System = TNS

$I_{max} = \frac{1800 \times 10^3}{0.85 \times 22 \times 10^3 \times \sqrt{3}} = 55.57A$

1b) Isolating Transformer.
The neutral of the secondary side of the isolating transformer is not earthed.
It is the separation of neutral from earth.

2. Purpose of SOA
The basic purpose is to move the construction industry towards a more systematic approach in setting up of temporary electrical installation. This also applies to festive lighting, trade-fairs, mini-fairs and exhibition sites.

The SOA must be totally enclosed with all the live parts totally protected from direct contact.
Socket outlets must be equipped with MCB, RCCB. Fuses are not allowed.

110V – yellow.
230V – blue
400V – red

Daily for night market.

Q 3a)

A person can receive an elecric shock in two ways, firstly by coming into contact with live parts and secondly by touching metallic parts that have become live due to a fault.

Direct contact is by coming into contact with live parts.

Indirect contact is by touching metallic parts that have become live due to a fault.

Indirect contact

- Earthed Equipotential Bonding and Automatic Disconnection of Supply
- Double Insulation

b) $I_1 = I_2$

$$I_1 = \frac{230\ V}{23\ \Omega} = 10\ A$$

$I_2 = 10\ A$

Since $V_L = 400V$, $V_R = 400 - (I_2 \times 25)$

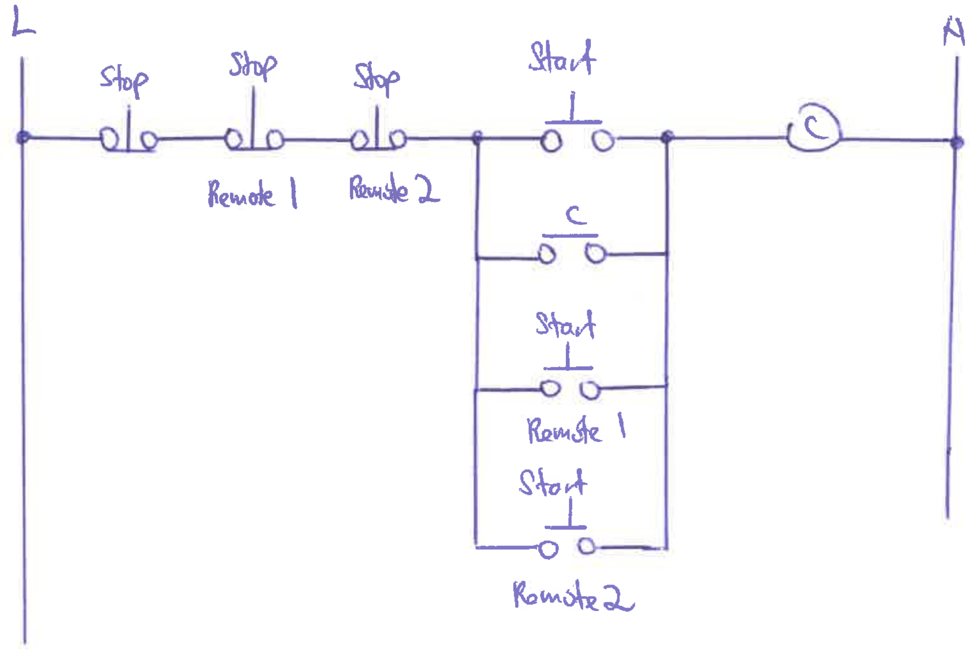
$= 400 - (10 \times 25)$

$= 150\ V$

$$R_X = \frac{V_R}{I_R} = \frac{150}{10}$$

$= 15\ \Omega$

*Q4.



Q5. i) 20s

Yes, discrimination is achieved since the tripping time of the 40A Type C MCB is 60s for overload current of 100A.

ii) 15s.

40A Type C MCB @ 165A → 33 s.

Yes, discrimination is achieved.

iii) 0.1s.

40A Type C MCB @ 320A → 7s.

Yes, discrimination is achieved.

6a) Minimum acceptable reading according to BS7671 is 1.0 MΩ.

The reading of 0.4 MΩ for 500 points is acceptable if the 500 points are split into about 5 sections of each 100 points, which will result in 0.4×5 = 2 MΩ for each of the phases.

b) Continuity of protective conductors

Continuity of Ring final circuit conductors.

Polarity check

Earth Fault Loop Impedance.

Earth electrode Resistance

Functional test of RCCB.

B1 :

Description	Connected Load	D.F.	Current Demand
30nos. 2×32 W Fluorescent lamps	$\frac{30\times2\times32\times1.8}{230} = 15.03\,A$	90%	13.53 A
13A SSO (Largest cct)	$\frac{4\times10^3}{230} = 17.39A$	100%	17.39A
13A SSO (Remainding ccts)	$\frac{3\times4\times10^3}{230} = 52.17A$	50%	26.09A
1st storage water heater	$\frac{1.2\times10^3}{230} = 5.217\,A$	100%	5.217 A
1st instaneous water heater	$\frac{2.5\times10^3}{230} = 10.87\,A$	100%	10.87 A
			73.097 A (1-ϕ)
multi-split air-conditioning, 15kW 3phase, 90% eff, pf = 0.85	$\frac{15\times10^3}{\sqrt{3}\times400\times0.9\times0.85} = 23.21A$	100%	23.21 A (3-ϕ)

i) Three phase max demand = $\frac{73.097}{3} + 23.21 = 47.58\,A$

ii) $47.58 \times 1.25 = 59.47\,A$.

$\therefore$ We can choose 63A TPN MCB.

iii) For motor, $I_N \geq 2\times I_B$

$I_N \geq 2\times 23.21A$

$I_N \geq 46.42A$

$\therefore$ We can choose 50A TPN MCB. Type B.

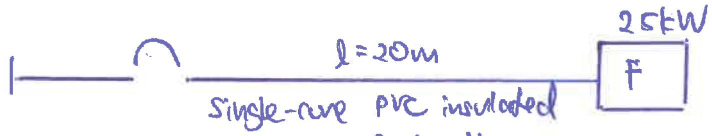
Automatic disconnection of supply and Earthed equipotential bonding.

B2 a)

i) $I_B = \frac{25 \times 10^3}{400 \times \sqrt{3} \times 1} = 36.08\,A$

Since $I_N \geq I_B$, we can choose 40A TPN MCB.

ii)



Single-core PVC insulated trunking, 2 circuits

ambient temp = 30°C

From Table 4C1, $C_a = 1.0$

From Table 4B1, $C_g = 0.8$

$C_i = 1$

$$I_t \geq \frac{I_N}{C_a \times C_g \times C_i}$$

$$I_t \geq \frac{40}{1.0 \times 0.8 \times 1.0}$$

$$I_t \geq 50A.$$

From Table 4D1A, we can choose $10mm^2$ single-core PVC insulated cables with a current carrying capacity of 50A.

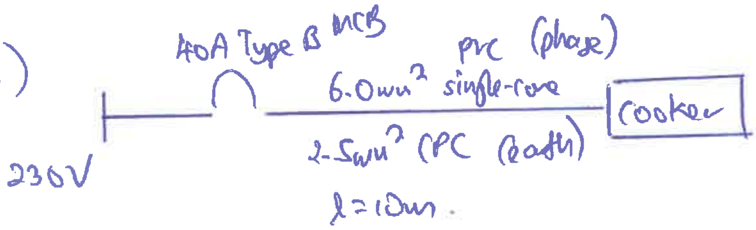
iii) $V_{drop} = \frac{V_{cc} \times I_B \times l}{1000}$

$V_{cc} = 3.8\,mV/A/m$ (from table 4D1B)

$\therefore V_{drop} = \frac{3.8 \times 36.08 \times 20}{1000} = 2.74V < 4\%$ of $400V$

$\therefore$ $10mm^2$ single-core PVC insulated cable can meet SS638 requirement of 4% voltage drop.

B2 b)



$Z_E = 0.65\,\Omega$

$$Z_S = Z_E + (R_1 + R_2)$$

From Table AA, $R_1 + R_2 = 10.49\ m\Omega/m$

$$\therefore Z_S = 0.65 + 1.38\left(\frac{10.49 \times 10}{1000}\right)$$

$$= 0.65 + 0.14476$$

$$= 0.795\ \Omega$$

From Table 41B2 (L),

Max earth fault loop Impedance for 40A Type B MCB = $1.15\ \Omega$

$$Z_{S\,(max)} \geq Z_{S\,(cal)}$$

$\therefore$ CPC meets both shock protection requirement.

$k^2S^2 \geq I^2t$

$(115^2)(S^2) \geq (289^2)(0.1)$

$S \geq 0.6315\ mm^2$

$I_F = \frac{230}{0.795} = 289.3$ A

For 289.3A, $t = 0.1\,s$, (40A Type B MCB)

$\therefore$ Size of $2.5mm^2$ meet thermal constraint requirement.