PYP EE4503 NOV/DEC 13 Megarine Tee

1a) - Voltage drop : maximum voltage drop from supply to load must not exceed 4%. Bigger cable size reduces voltage drop but increase cable costing.

- Current Carrying Capacity : the cable current carrying capacity must be higher than breaker rating to prevent damage to cable during fault.

- Fault Level : the cable must be able to withstand the thermal constraint.
$S^2k^2 \geq I_f^2 t$. #

b) Office : 1-ϕ 230V, 3-ϕ 400V CP5 Table 4B pg 117

Connected Load		DF	Current Demand	
- $(24 \times 2 \times 36 \times 1.8)/230 = 13.52A$	(item 1)	90%	12.17A	1-ϕ
- $(1 \times 20) = 20A$	(item 9)	100%	20A	
$(2 \times 20) = 40A$		50%	20A	
- $(1 \times 200)/230 = 0.87A$	(item 10)	100%	0.87A	
$(9 \times 200)/230 = 7.83A$		75%	5.87A	
			58.91A	
- $P_o = \eta \times PF \times \sqrt{3} \times V_{in} \times I_{in}$				3-ϕ
$5000 = 0.85 \times 0.87 \times \sqrt{3} \times 400 \times I_{in}$				
$\Rightarrow I_{in} = 9.76A$		100%	9.76A	

i) Max. Current Demand $= 9.76 + [58.91]/3$
$= 29.4A$ #

ii) With 20% load growth : $29.4 \times 1.2 = 35.3A$
∴ Breaker size is 40A #

c) 1/C PVC-insulated copper conductor
$L = 120m$
metal trunking (method 3)
group with 2 other similar circuit
temperature $40^\circ C$

Total connected load $= [13.52 + 20 + 40 + 0.87 + 7.83]/3 + 9.76$
$= 37.2A$

$\Rightarrow I_b = 37.2A$, $I_n = 40A$

i) $I_Z \geq I_n / [C_i \times C_a \times C_g]$

$C_i = 1$, $C_a = 0.87$, $C_g = 0.7$
C_a: ↳ CP5 Table 4C1
C_g: ↳ CP5 Table 4B1

$I_Z \geq 65.7A$
$\Rightarrow I_{tab} = 68A$, $S = 16mm^2$ # (CP5 Table 4D1A, Col. 5 pg217)

ii) $V_{drop\,max} = 2\%$ of $400V = 8V$
$V_d = I_b \times Z \times 10^{-3} \times L$ $Z = 2.4$ from CP5 Table 4D1B, Col. 6
$= 37.2 \times 2.4 \times 10^{-3} \times 120$
$= 10.7V$

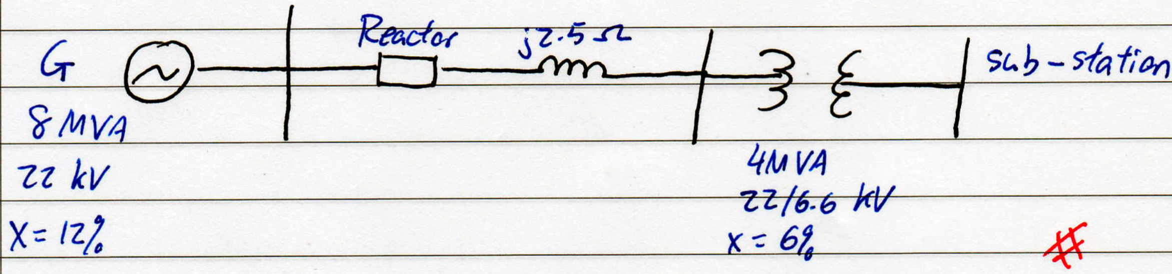
Since $V_d > V_{drop\,max}$ ∴ unable to meet the requirement.

Select the next higher S value which is $25mm^2$
Check: $Z = 1.55$ from CP5 Table 4D1B, Col. 6
$V_d = 37.2 \times 1.55 \times 10^{-3} \times 120$
$= 6.92V$

Since $V_d < V_{drop\,max}$ ∴ $S = 25mm^2$ is more suitable. #

2)

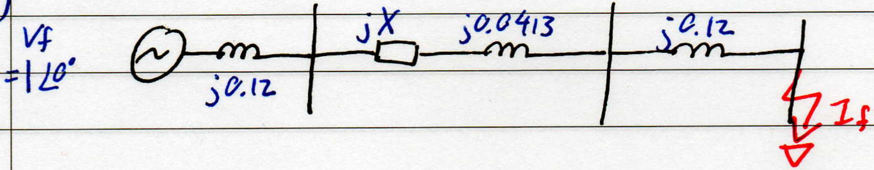
i)



ii) $I_{Gfl} = S_G / [\sqrt{3} \times V_G]$

$= 210\,A$

iii)



$S_b = 8MVA$, $V_b = 22kV$, $Z_b = 60.5\,\Omega$, $I_b = 210A$

$I_{Gfl} = 1pu$, $I_f \leq 2 I_{Gfl} = 2pu$

$Z_{cable} = j2.5/60.5 = j0.0413$

$Z_{Tx} = j0.06 \times \left(\frac{8}{4}\right) = j0.12$

$\frac{V_f}{I_f} = [j0.12 + jX + j0.0413 + j0.12] = \cancel{j2}\ j0.5$

$\therefore\ jX = j0.2187$

$X_{actual} = 13.23135\ \Omega/phase$

$\Rightarrow$ Reactor reactance $\geq 13.23135\ \Omega/phase$

3i) $Z_E = (0.05 + 0.05 + 0.1 + 0.15)$
$= 0.35\,\Omega$ #

CPS Table 17A pg 222

ii) $Z_S = Z_E + 1.38(R_1 + R_2) \times 10^{-3} \times L$
$= 0.35 + 1.38(19.51) \times 10^{-3} \times 15$
$= 0.754\,\Omega$

CPS Table 41B2, (f)

$Z_{smax} = 1.02\,\Omega$

Since $Z_S < Z_{smax}$, $\therefore$ it complies with shock protection. #
For each MCB, they have different critical fault current boundary. When fault current is higher than this boundary, trip time will be lower. Hence lower impedance than the boundary impedance will ensure tripping before 5 sec. #

iii) $I_f = V / Z_S = 305A$ #

iv) From Type 2 MCB graph, pg 194, 32A MCB
$t = 0.018\,s$
$k^2 S_{cpc}^2 \geq I_f^2 t$
$115^2 \times 1.5^2 \geq 305^2 \times 0.018$
$29756 \geq 1674$ (True)

Since $k^2 S_{cpc}^2 \geq I_f^2 t$, $\therefore$ it is suitable & meet the thermal constraints. #

When the person is touching the phase & neutral conductor, standing on an insulator. The RCD does not sense current different between phase & neutral, hence does not trip. #