MARKING SCHEME/SOLUTION GUIDE

College: CEST

School/Department: SEEE

Programme: C4EL5

Unit Code/Title: **EEE449/ELECTRICAL INSTALLATION TECHNOLOGY C**

Date of Exam: ___29/07/2014___

Time: __2pm to 4.10pm___

Examiner's Name: *Sumendra Kumar*…

Signature…

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SECTION A

1.

a) Lifts
b) Escalators
c) Toilets
d) Motor generator
e) Covered car parks

(5 Marks)

2. CB's can be classed by consideration of means used to obtain the tripping action. The types of tripping element used are as follows:

a) thermal
b) magnetic
c) thermal - magnetic
d) electronic

3. In an installation, nuisance tripping of RCDs may be caused by voltages higher than normal. These high voltages are variously known as voltage surge, voltage transcients,voltage spikes. The cause of the over voltage may be caused by lightening, switching transient, build up of static charges due to atmospheric conditions.

4. Full Load Current = $\frac{KVA}{\sqrt{3}\times V}$

$$= \frac{1000\times 10^3}{\sqrt{3}\times 415}$$

= **696.43 Amps**

a) Fault current at transformer

= **696.43** x $\frac{100}{4}$

= **17,410Amps**

Now the transformer impedence

$$Z_1 = \frac{240}{I_{fault}}$$

$$= \frac{240}{17,410}$$

$$= 3.78 \times 10^{-3}$$

= **0.01378**

b) Fault current at main switchboard

$$= \frac{240}{Z_1 + Z_2}$$

$$= \frac{240}{0.01378 + 0.0030}$$

= **14,302 Amps**

c) Fault current at sub-board.

$$= \frac{240}{0.01378 + 0.0030 + 0.020}$$

= **6,525.3 Amps**

5. a) Polarity test
Disconnect the earth wire from the neutral link and test with a voltmeter or test lamp. Test lamp will light or voltmeter will give full voltage reading between active supply line and earth wire. There will no reading between neutral line and earth.

b) Insulation resistance test
Use megger to do insulation resistance test on circuit conductors. High readings in MΩ shall be obtained between all conductors. Any low reading will indicate an insulation breakdown.

c) Operation of E.L.C.B
i) Use test button. If test button is pressed,ELCB should trip.
ii) Use test lamp at the power point.ELCB shall trip if tested between active and earth.

6. Emergency switching
Clause 2.3.5.1

Examples of electrical installations where means for emergency switching are used are as follows:

a)	Machinery	g)	Electrical testing & research facilities
b)	Conveyors	h)	boiler rooms
c)	Groups of machines	i)	Large kitchens
d)	Pumping facilities	j)	Teaching labs
e)	Ventilation systems	k)	High voltage discharge lighting
f)	Certain large buildings		e.g neon signs

(Any 5 carries one mark each)

7. a) Direct earthing system

$$I = \frac{V}{R}$$

$$= \frac{240}{0.2+2+2+10}$$

$$= \frac{240}{14.2}$$

$$= 16.9 \text{ Amps}$$

b) MEN system

Resistance of the parallel path

$$R = \frac{1}{1/10+1/0.2}$$

$$= 0.196\ \Omega$$

$$I = \frac{V}{R}$$

$$= \frac{240}{0.2+2+2+0.196}$$

$$= 54.59 \text{ Amps}$$

8. Thermal Trip Circuit breakers

To achieve tripping, a bimetal strip is heated either by the load current (or a fixed proportion of the load current) passing through it. When heated, the two metals of the bimetal expand at different rates, causing the strip to bend and operate a toggle, which opens the breaker.

Magnetic trip circuit breaker

In this type of circuit breaker, the load current or a fraction of it passes through the coil of an electromagnet. The magnet attracts an iron armature and mechanically breaks the linkage holding the circuit breaker in the ON position thus tripping it.

Thermal-magnetic

This type of circuit breaker utilizes a thermal element to provide the time delay characteristic and the ambient temperature facility, while short-circuit is provided by magnetic action. When overload occurs, time delay is provided by the time to heat the bimetal element. (4 marks)

(*Explaining any of the above carries 4 marks*)

9. Reverse polarity

Reverse polarity in this system will cause the active too be directly connected to earth (to short circuit to earth) at the neutral link. High values of current will be present, and an immediate shock and fire hazard will be created.

(4 marks)

Open circuit on supply neutral

If this fault occurs in an MEN system, because of the connection between neutral and the main earth at the neutral link there will be no indication that a fault condition exists.

(4 marks)

10. Fuses are time delay rated to indicate the relationship between the current through the fuses and the time it takes for the fuse to open.
The three time delay ratings of fuses are:

a) Delay
b) Standard
c) Fast

(3 marks)

SECTION B

1.

Maximum Demand using table B2 Column 2

1)	**Red**	**White**	**Blue**
Lights	20 lights	----------	----------
G.P.O's	Nil	10 G.P.O	Nil
A/C	Nil	Nil	2.5KW A/c unit.
Range	4Kw hot plate	3.0Kw oven	
Water heater	10.8KW	10.8KW	10.8KW
Cloth dryer	2.0 KW	Nil	Nil

(3) (3)

LOADS	RED	WHITE	BLUE
Lights	3 Amps		
GPOs		10 Amps	
A/Con			$\frac{2500}{240}\times\frac{75}{100}=7.8$ To be included in LG B(i)
Range	$\frac{4000}{240}\times\frac{50}{100}=8.33$		$\frac{3000}{240}\times\frac{50}{100}=6.25$

Water heater	$\frac{10800}{240}=\frac{45}{3}=15\times\frac{1}{3}=4.95$	$\frac{10800}{240}=\frac{45}{3}=15\times\frac{1}{3}=4.95$	$\frac{10800}{240}=\frac{45}{3}=15\times\frac{1}{3}=4.95$
Cloths dryer	$\frac{2000}{240}\times\frac{50}{100}=4.16$ To be included in LG B(i)		
TOTAL	16.28	14.95	11.20

Heaviest loaded phase is Red phase = 20.44 Amps.

2. $Vd = \frac{L \times I \times Vc}{1000}$ *(1)*

Vd_1 *in consumers mains* $= \frac{7.5 \times 10 \times 50}{1000}$

= 3.75 volts *(1)*

Vd_2 *in consumers mains* $= \frac{7.5 \times 20 \times 30}{1000}$ *(1)*

= 4.5 volts *(1)*

Vd_3 *in consumers mains* $= \frac{18 \times 12 \times 15}{1000}$ *(1)*

= 3.24 volts *(1)*

Total voltage drop = 3.75+4.5+3.24

= 11.49 volts. *(1)*

a) The voltage drop does not exceed 12 V

Permitted voltage drop $= \frac{5 \times 240}{100}$ *(1)*

= 12 volts *(1)*

b) No changes are required. *(1)*

3. K9.5.1

a) General location of the substation and the consequence of fire arising from it.
b) Type of electrical protective systems installed to minimize the possibility of fire or blast occurring
c) Provision of automatic fire-extinguisher equipment
d) Quantity of insulating liquid involved

(4 marks)

4. Clause: 3.14.1

Shall be capable of maintaining an adequate supply to the electrical equipment when exposed to fire or mechanical damage.

(2 marks)

5.

a) Its characteristics may change when fuse elements are replaced
b) Low breaking capacity
c) Lacking in discrimination.

(3 marks)

6. Clause: 1.4.73
A device intended to isolate supply to protected circuits, socket outlets or elect trical equipment in the event of current flow to earth which exceeds a predetermined value. (2 marks)

7. Clause: 4.14.4
An autotransformer shall not be used to supply electrical equipment including circuit wiring,having a voltage rating of less than the highest input or output voltage of the transformer..

(2 marks)

8. Clause:2.3.2.1.1

No switch or circuit breaker shall be inserted in the neutral conductor:
a) of consumer mains
b) where the neutral conductor is used as combined protective earthing and neutral conductor for protective earthing of any portion of an electrical installation.

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(3 marks)