SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

CERTIFICATE IV IN ELECTRICAL ENGINEERING – STAGE 4

EEE445-ELECTRICAL INSTALLATION TECHNOLOGY B

FINAL EXAMINATION PAPER – PENSTER 4 -2014

DAY/DATE: As per TT TIME: As per TT ROOM: As per TT

INSTRUCTIONS TO STUDENTS:

1. You are allowed 10 minutes extra reading time during which you are not allowed to write.

2. Begin each **SECTION** on a fresh page and use both sides of the sheet.

3. Write your candidate number at the top of each answer sheet.

4. Insert all foolscaps, graph paper, drawing paper etc in their correct sequence and secure with string.

5. For all sheets of paper on which rough / draft work has been done, cross it through and you must attach to the answer booklet.

6. Write clearly the number(s) of the question(s) attempted on top of each sheet.

7. **AS/NZS 3000:2007 WIRING RULE BOOKS ARE ALLOWED**

8. **ATTEMPT ALL QUESTIONS**

SECTION A - MULTIPLE CHOICE (20 MARKS)

In each of the following statements, one of the suggested answers is the best one. Write the identifying letter of the answer beside the question number on your answer sheet.

1. Heat dissipation in trunking is achieved through the:

    a. coolers
    b. air-con
    c. cooling fins
    d. slots or holes

2. The two common insulator types used for aerial wiring are the:

    a. shackle and pin
    b. pin and lock
    c. shackle and lock
    d. disc

3. The largest type of testing devices used by electricians are the:

    a. manual operated
    b. automatic
    c. timers
    d. visual indicators

4. The most common type of fitting designed by the manufacturers to be used in the installation of MIMS cables is the:

    a. insulating tape
    b. multimetre
    c. screwdriver
    d. cable gland

5. Underground wiring system is mostly employed in:

    a. remote areas
    b. densely populated areas
    c. less populated areas
    d. domestic dwellings

6. An under carpet wiring system is one that is installed:

   a. Beneath floors.
   b. Beneath the building
   c. Beneath modular carpet tiles
   d. Beneath the rugs

7. Apart from being double insulated the cable used for catenary support system should be:

   a. copper
   b. solid
   c. stranded
   d. aluminium

8. One of the places where under-floor trunking system is best supplied is the:

   a. under-carpet
   b. underground
   c. under supermarket counter
   d. under workshop machines

9. The best type of cable to be used in boiler or engine rooms is:

   a. TPS cable
   b. PVC cable
   c. Steel cable
   d. MIMS cable

10. Trunking is sometimes referred to as:

   a. Ducting
   b. Toughing
   c. Cable raceway
   d. All of the above

11. In a delta connected three phase system there is:

   a. excess neutral current
   b. two voltages
   c. line and phase voltages
   d. no neutral current

12. Steel piping used for wiring situation which is exposed to weather shall be:

    a. enameled
    b. sheradized
    c. galvanized
    d. all of the above

13. The most appropriate testing device used to identify an open circuit when there is no supply is the:

    a. voltmeter
    b. test lamp
    c. probes
    d. Ohmmeter

14. The phase sequence of a three phase alternator rotating in an clockwise direction is:

    a. CBA
    b. ABC
    c. BCA
    d. CAB

15. One of the safety precautions to be observed before commencing work and after isolating a circuit in a domestic installation is to:

    a. inform others
    b. repair quickly
    c. ascertain reason
    d. test and confirm

16. The characteristic of 3 phase system is:

    a. two voltages locked at 120 E apart
    b. two voltages locked at 90 E apart
    c. three voltages locked at 90 E apart
    d. three voltages locked at 120 E apart

17. A three phase 4 wire supply provides connection to:

a. three phase balance load
b. three phase unbalanced load
c. three phase and single phase load
d. all of the above

18. Open wiring has distinct disadvantage over other types of wiring because it :

a. has poor appearance
b. is open
c. is readily accessible
d. is cheaper

19. Most electrical accidents occur in domestic installation due to faulty:

a. equipment
b. extension leads
c. accessories
d. parts

20. Skirting trunking should be installed:

a. on the floor covering
b. after the floor covering is laid
c. before the floor covering is laid
d. when floor is laid

SECTION B **(40 MARKS)**

Answer the following questions by quoting the rule number and relevant content from the AS/NZS 3000:2007 wiring rule book.

1. Extra –low voltage cables and **separate** low voltage cables are to be installed in the same cable trunking system.State the **THREE** methods of ensuring segregation between the extra-low voltage cables and low voltage cables.
(4 marks)
2. An underground cable has been installed to comply with Category B requirements. State **FOUR** requirements for the mechanical protection of the cable.
(5 marks)
3. Name **THREE** place wiring systems are deemed likely to be disturbed?
(4 marks)
4. State **TWO** requirements for the rigid PVC conduit that is installed in direct sunlight.
(3 marks)
5. State **TWO** requirements for cable trunking installations.
(3 marks)
6. List **THREE** types of wiring enclosures used for the protection of cables?
(4 marks)
7. A TPS cable has been installed less than 50 mm from the underside of a roof. State **TWO** protection methods for that cable.
(3 marks)
8. How is **Mineral insulated metal sheathed** cables protected against vibration? (2 marks)
9. Outline the following aerial conductor clearances and maximum spans:

   (a) **Minimum height** for bare live conductors used as aerial conductor, over areas not used by vehicles.
   (b) **Minimum height** for insulated live conductors used as aerial conductor, from stay wires.
   (c) **Maximum span** for 6 mm2 bare-hard drawn copper aerial conductor.
   (d) **Maximum span** for 25 mm2 aerial bundled aluminium aerial conductor.
(6 marks)

10. Outline the **minimum depth of cover** for the following underground wiring systems;
    (a) Located within confines of a building, covering on surface of ground above wiring in category C system.
    (b) Located elsewhere to a building,poured concrete of 75 mm minimum thickness in category B.

(6 marks)

SECTION C **(40 MARKS)**

1. A single domestic installation is connected with the following loads:

    18 lighting points
    5 meter lighting track
    3 security lights (500 watts each)
    4 single 10Amps socket outlet
    3 double 10 Amps socket outlet
    50 Watts Exhaust fan
    1000 Watts strip heater
    4.8 KW instantaneous water heater
    3.6 KW Air Condition

    Determine the **maximum demand current** of the above installation.

(10 marks)

2. The wiring up to the end of a final sub-current in a non-domestic installation consists of copper V75 twin TPS cables in (protected by HRC fuse) with the following sizes, lengths and maximum demands as calculated in accordance with the requirements of the SAA wiring book.

Circuits	**Size**	**Length**	**Maximum Demand**
Consumer Mains	$10mm^2$	10m	60A
Sub-mains	$6mm^2$	20m	40A
Final Sub-circuit	$1.5mm^2$	12m	15A

    The circuits are single phase.
    Determine the voltage drop over the wiring run and what alternative cable sizes can be selected to restrict the total voltage drop to 5% as required and as well as the new voltage drop.

(8 marks)

3. What are the six factors that an electrical installation designer would take into consideration during the process of selecting a cable for a particular type of wiring?

(9 marks)

4. List the procedure to follow in order to isolate the power supply to an installation or circuit for maintenance work is the installation consists of computers and other important office equipment.

(8 marks)

5. The Mineral Insulated Cable is the safest choice for power and heating as well as for industrial building processes. Draw and label the basic components of a Mineral insulated cable.

(5 marks)

################ T HE E N D ################

MARKING SCHEME/SOLUTION GUIDE

COLLEGE: **COLLEGE OF ENGINEERING,SCIENCE & TECHNOLOGY**

SCHOOL: **SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING**

PROGRAMME: **CERTIFICATE IV IN ELECTRICAL ENGINEERING – C4EL4**

UNIT CODE: **EEE445**

UNIT TITLE: **ELECTRICAL INSTALLATION TECHNOLOGY B**

DATE: **As per TT**

EXAMINER: **SURENDRA LAL**

EEE445 – ELECTRICAL INSTALLATION TECHNOLOGY B

MARKING SCHEME

MULTIPLE CHOICES

1. C
2. A
3. D
4. D
5. A
6. C
7. C
8. C
9. D
10. C
11. D
12. D
13. D
14. A
15. A
16. B
17. D
18. A
19. B
20. C

(EACH CORRECT ANSWER CARRIES ONE (1) MARK.)

SECTION B **(20 MARKS)**

1. **State the THREE methods of ensuring segregation between the extra-low voltage cables and low voltage cables**

Clause 3.9.8.3

(a) The low voltage cable shall be of a type providing the equivalent of double insulation.

(b) All cables or each conductor of a multi –core cable shall be insulated for the highest voltage present.

(c) The low voltage cables shall be installed in a separate compartmentof a common cable trunking system having fixed and continuous barriers between compartments.

(4 Marks)

2 **An underground cable has been installed to comply with Category B requirements.State FOUR requirements for the mechanical protection of the cable**

Clause 3.11.4.3

a) Be placed not more than 75mm above the wiring system; and

b) Be not less than 150 mm wide; and

c) Overlap the wiring system by at least 40 mm on each side ; and

d) Consist of one or a combination of the following.

(5 Marks)

3. **Clause 3.9.5.2**

Wiring systems installed in the following locations are deemed likely to be disturbed:

a) On the surface of a walk or on the underside of a ceiling

b) In a space between the floor and the ground to which a person may gain entry

c) In a ceiling space having an access space of 0.6 high.

d) Within 2.0 m of any access to any space to which a person may gain entry

(4 Marks)

(Any three answers)

4. **State TWO requirements for the rigid PVC conduit that is installed in direct sunlight**

Clause 3.10.3.7

(a) Shall be of a type designated for such use; and

(b) Painted with a light coloured water based acrylic paint.

(3 Marks)

5. **State two requirements for cable trunking installations**

Clause 3.10.3.9

(a) Covers shall be able to be opened where practicable

(b) Covers shall be continuous when passing through walls or floors

(c) Cable trunking shall be accessible through the entire length.

(d) Should not rely on any readily removable cover for support

(e) Non-hygroscopic trunking shall be used to enclose insulated,unsheated conductor.

(3 Marks)

6. **Clause 3.10.2.1**

a) Steel conduits or other rtubing or conduit

b) Flexible metal conduit

c) Rigid and flexible non-metallic conduit

d) Corrugated non-metallic conduit

e) Cable trunking

(4 Marks)

(any three answers)

7. **A TPS cable has been installed less than 50 mm from the underside of a roof.State TWO protection methods for that cable.**

Clause 3.9.4.4

a) Provided with adequate mechanical protection to prevent damage; or

b) Provided with an earthed metallic armouring ,scree,covering or enclosure;

(3 Marks)

8. **How should Mineral insulated metal sheathed cables be protected against**

vibration?

Clause 3.9.73

Movement caused by vibration shall be provided for by the introducing a loop in the cable immediately before the termination.

(2 mark)

9. Outline the following aerial conductor clearances and maximum spans:

(a) Minimum height for bare live conductors used as aerial conductor, over areas not used by vehicles.
(b) Minimum height for insulated live conductors used as aerial conductor, from stay wires.
(c) Maximum span for 6 mm^2 bare-hard drawn copper aerial conductor.
(d) Maximum span for 25 mm^2 aerial bundled aluminium aerial conductor.

(6 marks)

10. Outline the minimum depth of cover for the following underground wiring

systems;

(a) Located within confines of a building, covering on surface of ground above wiring in category C system.
(b) Located elsewhere to a building,poured concrete of 75 mm minimum thickness in category B.

(6 marks)

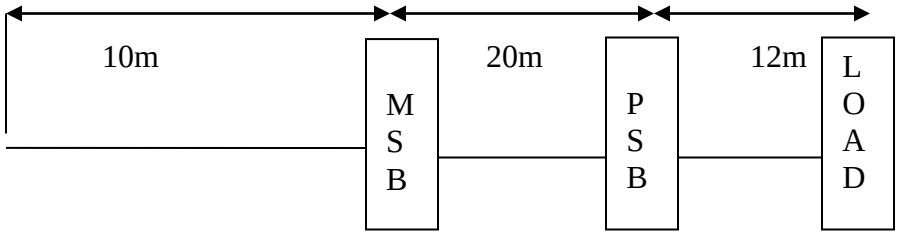
SECTION C **(60 MARKS)**

1.

LOAD	LOAD GROUP	CALCULATION	DEMAND CURRENT Amps
18 Lighting points 5 meter lighting track 50W exhaust fan	A	1 to 20 points 3A additional 2A for next 20. 18 + 10+1 = 29 points 3 + 2 = 5	5
3 security lights 500 W each	A (ii)	75% connected load 1500/240 X 0.75 = 4.7	4.7
4 single and 3 double 10 amps socket outlet 1000 Watts strip heater	B(i)	10A for 1to 20 points 4 + 6 + 1 = 11	10
4.8 KW instantaneous W/H	E	33.3% connected load 4800/240 X 0.333	6.7
3.6 KW Air Con	D	75% connected load $\frac{3600}{240}$ x 75 = 11.25	11.25
MAXIMUM DEMAND			**37.65**

(10 Marks)

2.



DEMAND 70A 40A 15A

CABLE	$10MM^2$	$6MM^2$	$1.5MM^2$
Vi =	4.5mV/AM	7.5mV/AM	26mV/AM
Vd =	$\frac{4.5 \times 10 \times 70}{1000}$	$\frac{7.5 \times 20 \times 40}{1000}$	$\frac{26 \times 12\ 15}{1000}$
=	**3.15 V**	**6V**	**4.68V**

Total Vd = 3.15 + 6 + 4.68

= **14.37V**

5% of 240V is 12V $\Longrightarrow$ Need to change the main size to 16 mm^2

Vd = $\frac{2.8 \times 10 \times 70}{1000}$

= **1.96V**

= 1.96 + 6 + 4.68

= **12.64V**

Change the Load to $2.5mm^2$

Vd = $\frac{18 \times 12 \times 15}{1000}$

= **3.24V**

Check! 1.96 + 6 + 3.24 = 10.84 – it is now within the required voltage drop.

(8 Marks)

3. (i) Type of building structure.
   - whether the building is timber, steel, aluminium or concrete and what is its function.

   (ii) Appearance of completed installation.
   - Eg wiring because of its poor appearance has limited applications.

   (iii) Ambient temperature.
   - Different cables and encloses have different operating temperature limits.

   (iv) Mechanical hazards likely to affect the wiring system.
   - Eg conditions in an engineering workshop would be different from the roof of a domestic installation.

(v) Hazards associated with the environment.

- Situations where explosive gas or vapours are present or other special situations like public theatre etc.

(vi) Cost of the system.

- Often the initial cost is of concern but in installations such as hospitals prestigious buildings and the like reliability is important.

(each correct answer carries 1.5 marks each)

4.

a) Establish the task at hand and check all test equipment.

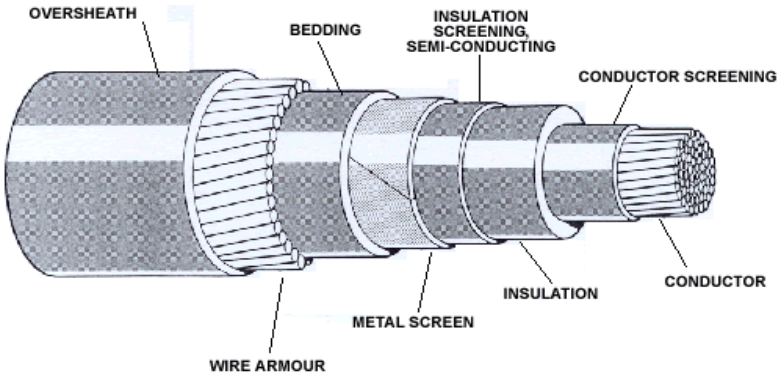
b) Verify the circuit the circuit to be worked on, know your work area properly.

c) Advice person(s) affected by the disruption before isolating the supply.

d) Locate and isolate switches, withdraw fuses and retain.

e) Test and confirm the circuit and only if the circuit is dead proceed with the job to be done.

(8 Marks)



5. **11kV CABLE CONSTRUCTION** (5 marks)

%%%%%%%%%%%% THE END %%%%%%%%%%%%