



**COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY
(CEST)**

**SCHOOL OF ELECTRICAL & ELECTRONICS
ENGINEERING**

**CERTIFICATE IV IN ELECTRICAL ENGINEERING
(TRIMESTER MODE) - STAGE 2**

EEE395 - ELECTRICAL INSTALLATION TECHNOLOGY A

FINAL EXAMINATION – TRIMESTER 2, 2014

**DATE/DAY: TIME: ROOM: AS PER
TIMETABLE**

INSTRUCTIONS TO STUDENTS

1. You are allowed **10 minutes** extra **reading time** during which you are **NOT** to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and **ATTACH** these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use of programmable calculator(s) is prohibited.
8. Use of **ASNZS Wiring Rule Book** is permitted.
9. Attempt **ALL** questions in all Sections

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

1. Which three factors determine the **location** of switchboards? **(3 marks)**
2. What is the recommended **voltage drop** between the point of supply and at any point in a low voltage electrical installation? **(3 marks)**
3. What is the maximum permissible operating temperature of a V75 thermoplastic cable? **(3 marks)**
4. List the nominal size of copper earthing conductor recommended to be used with the following active conductors:
 - a) Copper 6 mm²
 - b) Copper 10 mm² **(4 marks)**
5. Define the following electrical terms:
 - a) Hazardous area
 - b) Residual current device **(3 marks)**
6. What is the minimum separation of telecommunications lines to low voltage electrical service? **(3 marks)**
7. What is the minimum aerial conductor clearance of 2 core insulated hard-drawn cables over:
 - a) areas used by vehicles
 - b) over other roofs and structures **(3 marks)**
8. What is maximum span permitted for 25mm² aerial bundled cables (aluminium conductor)? **(3 marks)**
9. Explain the category A type of Underground wiring system and sketch the dimensions for an installation outside the building? **(4 marks)**
10. What should be the minimum cross-sectional area of insulated conductors to be used for:
 - a) socket-outlets
 - b) relay control circuits **(4 marks)**
11. What should be the default minimum clearance above the incandescent lamp which is recessed in the ceiling? **(3 marks)**
12. What is the maximum number of 2.5mm² PVC V90 two-core and Earth cables to be installed in a 25mm medium duty rigid UPVC conduit. **(4 marks)**

SECTION B**(30 MARKS)**

1. a) Determine the maximum demand of a single phase domestic electrical installation supplied at single-phase with the following loads:

41	lighting points
4	300 W floodlights
8 m	lighting track
6	10 A single socket outlets
5	10 A double socket outlets
1	50W exhaust fan
2	15A socket outlet
1	3.6 kW Air Condition
1	5 kW Range
1	4.8 kW instantaneous W/Heater

(10 marks)

- b) Suppose the domestic installation above is 100m away from the nearest FEA post, what would be the **voltage drop incurred** if you are using 10 mm² 2 core insulated hard drawn cable which has a three phase V_C value of 4.02 mV/Am? **(5 marks)**

2. Illustrate with a diagram the generation and stepping up of voltages at Wailoa and Nadarivatu Power Stations in Viti-Levu, further showing how it is transmitted to the western and central division and finally showing how it is specifically distributed for consumer usage.

(7 marks)

3. Explain the earthing system used in Fiji, also with the aid of a diagram, show the fault current path or the fault loop in a MEN system clearly labeling all the components. **(5 marks)**

4. Provide 3 precautions that need to be taken to prevent electric shock.

(3 marks)

SECTION C**(30 MARKS)**

1. Give 3 advantages of single phase power over 3-phase power in electrical applications. **(3 marks)**
2. Explain the operating principle of a RCD. **(3 marks)**
3. How does a thermal-magnetic circuit breaker operate? **(3 marks)**
4. Explain the term Renewable Energy and also list some sources of Renewable Energy that are used in Fiji. **(3 marks)**
5. Draw the schematic diagram of a hydro power plant. **(3 marks)**
6. Draw clearly a diagram showing two posts representing the following terms:
 - a) minimum clearance
 - b) maximum sag
 - c) maximum span
 - d) depth in ground **(6 marks)**
7. State the safe circuit isolation procedure where maintenance has to be carried out for a company that is located in a multiple complex that engages a number of staff working based at distinct floors. Mention very clearly the tag-in lock out and tag out lock-in procedure. **(5 marks)**
8. A three-phase, star connected alternator supplies a delta connected induction motor at a line voltage of 600V. The current in each line is 40A. Find:
 - a) The phase voltage of the alternator
 - b) The current in each phase of the motor **(4 marks)**

THE END



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EEE395 ELECTRICAL INSTALLATION TECHNOLOGY A

MARKING SCHEME

SECTION A**(40 MARKS)**

All references in this section is to the new rule book ASNZS 3000:2007 edition. Refer to the following clauses for detailed answers. Please do not just give marks for correct clauses but answers together in their own words get full marks.

1. Clause 2.9.2.1 page no.103 **(3 marks)**
2. Clause 3.6.2 page no.128 – 5% of the supply voltage **(3 marks)**
3. Table 3.2 page no.123 - 75°C **(3 marks)**
4. Table 5.1 page 213
a) 2.5mm² b) 4mm² **(4 marks)**
5. a) Clause 1.4.11 page 23
b) Clause 1.4.80 page 35 **(3 marks)**
6. 100mm Table 3.7 page 164 **(3 marks)**
7. a) 4.6 m Table 3.8 page 167
b) 2.0m Table 3.8 page 167 **(3 marks)**
8. 60m Table 3.9 page 168 **(3 marks)**
9. Figure 3.10 / Figure 3.11 page 160 **(4 marks)**
10. a) 2.5mm² Table 3.3 page 125
b) 0.5mm² Table 3.3 page 125 **(4 marks)**
11. 50mm Figure 4.7 page 186 **(3 marks)**
12. 1 Table C10 page 380 **(4 marks)**

SECTION B**(30 MARKS)**

1.a)

LOAD	LOAD GROUP	CALCULATIONS	DEMAND CURRENT (Amps)
41 Lighting Points 8 meter lighting track 1 50W exhaust fan	A(i)	41 + 16 + 1 = 58 points 58 points ≤ 60 allows 3 + 2 + 2 = 7	7
4 x 300W Floodlight	A(ii)	$\frac{4 \times 300}{240} = \frac{1200}{240} \times 0.75 = 3.75$	3.75
6 single 10A socket outlet 5 double 10A socket outlet	B(i)	6 + 10 = 16 points	10
15A socket outlet	B(ii)	15A outlet = 10 A	10
3.6 KW Air Condition	D	$\frac{3600}{240} \times 0.75 = 11.25$	11.25
5KW Range	C	$\frac{5000}{240} \times 0.5 = 10.41$	10.41
4.8 KW instantaneous water heater	E	$\frac{4800}{240} \times 33.3\% = 6.66$	6.67
TOTAL DEMAND			59.08 Amps

(10 Marks)

b) $V_C = (1000V_d)/(LI)$

$$V_d = \frac{V_C \times L \times I}{1000}$$

$$= \frac{4.64 \times 100 \times 59.08}{1000}$$

$$= \underline{27.41V}$$

Convert 3-phase V_C to single phase $V_C = 1.155 \times 3\text{-phase value} = 1.155 \times 4.02 = 4.64 \text{ mV/Am}$

(5 Marks)

2.

3. Fiji uses the Multiple Earthed Neutral (MEN) Earthing system. It is a current operated system and there is a connection between Neutral and Earth link, therefore current circulates in a loop as in the diagram below:

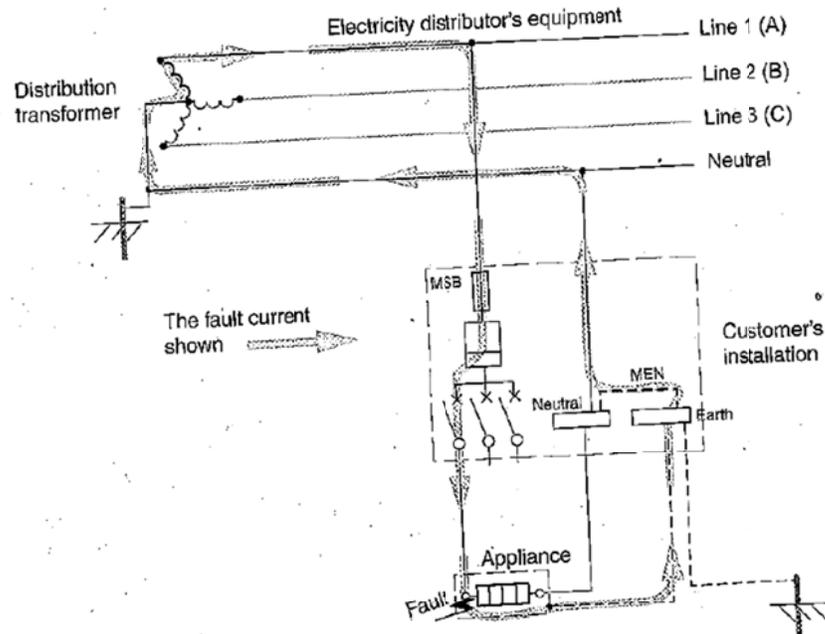


Fig. 12.5 The path taken by an earth fault current known as the fault loop

(5 marks)

4. – use of personnel protective equipment (PPEs) like safety rubber shoes, low voltage gloves, ear muffs, safety belts, safety glasses where applicable
- do not wear ornaments: wrist bands / necklaces that can conduct electricity
 - take extreme care when working at heights
 - Treat every wire as a live wire
 - do not walk with both hands while working on live circuits
 - do not be over sure of one's skills
 - Always test and confirm
 - Respect electricity

(Any 3 from above is worth 1 mark each)

(3 marks)

1. - As the number of phases increases, the output increases, thus 3-phase produces more output compared to single phase
 - Power delivered or taken from 3-phase is a more constant value. It also gives smooth start to a 3-phase motor whereas a single-phase starts with some vibration
 - Two voltages are available with 3-phase star connection thus a selection could be made whereas single-phase has only one voltage
 - A 3-phase machine can be smaller than a single phase one for the same output.
 - In a distribution system, the total quantity of material needed for three conductors is less than that required for the equivalent single phase system.

(Any 3 from above is worth 1 mark each)

(3 marks)

2.

14.3 Operating principle

The RCD uses a toroidal transformer, similar to a current transformer, to detect leakage current. The secondary winding is known as the 'sensing winding' or 'fault detection winding'. It is connected to a trip relay, which, when activated by an earth leakage current, operates main contacts to switch off the circuit. The active and neutral conductors supplying the circuit to be protected are installed so that they pass through the toroidal core (see Fig. 14.3). A toroidal transformer is one where the winding uses a circle as an axis.

(3 marks)

3. It is a combination of bi-metallic strip and an electromagnet. The bi-metallic strips expands and bends to cut-off when there is high temperatures whereas an electromagnet energizes when there's a fault current flowing.

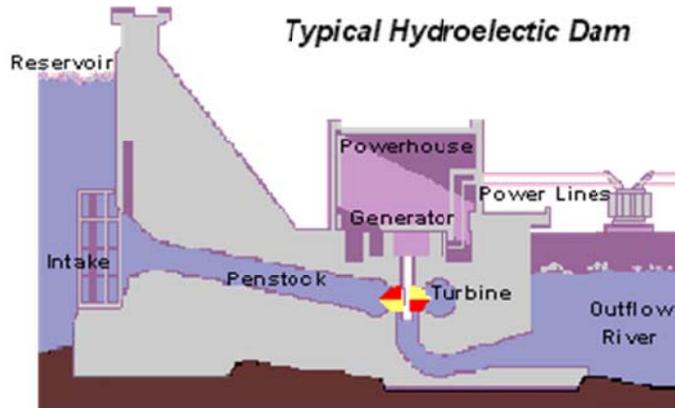
(3 marks)

4. Renewable energy is energy which can be obtained from natural resources that can be constantly replenished. Renewable energy technologies include technologies that use—or enable the use of—one or more renewable energy sources. Types of renewable energy technologies include: bioenergy, geothermal energy, hydropower, ocean energy, solar energy and wind energy

In Fiji, Hydro Power Plants exists at Wailoa (80MW) and Nadarivati Power Stations (43MW), we also have a wind farm in Butoni (10MW). Furthermore, there are some stand-alone PV

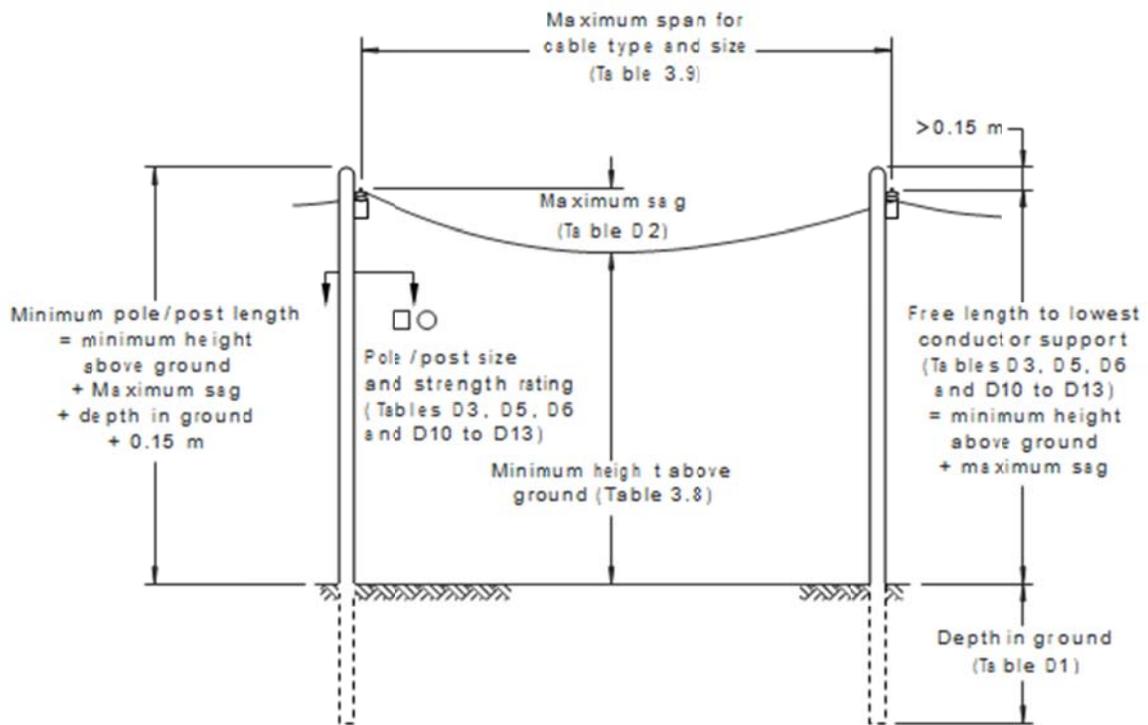
systems mostly in remote areas and outer islands. There is a 48Kw Grid connected PV system in USP. (3 marks)

5.



(3 marks)

6.



(6 mark)

7.

Reference Electrical Wiring Practice (New Edition)

(5 marks)

8.

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