FNU FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

CERTIFICATE IV IN ELECTRICAL ENGINEERING-STAGE 5

EEE449 ELECTRICAL INSTALLATION TECHNOLOGY C

FINAL EXAMINATION – PENSTER 2, 2012

DATE/DAY: 12/06/2012/Tuesday **TIME**: 2.00 – 4.10pm
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 SECTION 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. ANSWER ALL QUESTIONS
9. Show all working where necessary.
10. ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE EXAM ROOM

SECTION A **(60 MARKS)**

1. State any 3 requirements for choosing the correct range of circuit breakers or fuses to protect wiring considering factors such as over-load and short circuit. (3 marks)

2. State the principle of operation of a RCD. (3 marks)

3. A three phase 240V/415V 500 KVA transformer is supplying load through mains and sub-mains. If the short circuit output (fault level) from the transformer is 10MVA and if the impedance per phase of the mains is 0.0050 Ω and the sub-main is 0.025 Ω, calculate the fault current at:
   (a) transformer
   (b) main switchboard
   (c) sub-board (9 marks)

4. How would you carry out the following tests on a new installation wiring before power is switched on?
   (a) Earth resistance test
   (b) Polarity test
   (c) Insulation resistance test (9 marks)

5. State 3 major reasons for *Earthing*. (3 marks)

6. With the help of a diagram, show the fault current path in a MEN system and accordingly explain what fault loop impedance is. (4 marks)

7. Explain the operation of thermal-magnetic trip miniature circuit breaker. (3 marks)

8. What is a voltage surge and state measures to overcome this? (2 marks)

9. Suppose you do not have access to an earth rod, what alternative method you can use to meet the earthing requirements? (2 marks)

10. Illustrate and explain the street light components and connections used in Fiji, also explain its switching. (3 marks)

11. Illustrate how supply distribution takes place in a three storey building with individual distribution boards for each level including essential components such as meters, isolators, CTs (if required), distribution boards and main switch board. (4 marks)

12. Explain radial and ring mains system of distribution? (3 marks)

(Answer the following questions with reference to the wiring rule book)

13. State some precautions and the type of wiring necessary for underwater lights in a swimming pool. (3 marks)

14. State the appropriate position to mount a call point and the sounders for a fire alarm. (2 marks)

15. State the locations in which emergency lights are desired. (2 marks)

16. Differentiate direct earthing system and multiple earthed neutral (MEN) system (2 marks)

17. List at least 5 visual inspections that are carried out by a supply authority on a new installation before power is switched on. (3 marks)

SECTION B **(40 MARKS)**

1. What does the term "current carrying capacity" of a conductor mean and state two diversity factors that affect the current carrying capacity of a conductor? (3 marks)

2. a) The following loads are connected to a three phase 240/415 volts supply in a domestic installation.
   (a) 41 lighting points
   (b) 10 x single socket outlets 10A
   (c) 1 x 3 phase 12 kW range
   (d) 1 x 3 kW air conditioning unit (single phase)
   (e) 1 x 3 phase 15 kW instantaneous water heater
   (f) 1 x 2.0 kW clothes dryer (single phase)

   Arrange the loads over the three phases so that it is balanced, hence calculate the maximum demand. (12 marks)

   b) For the above installation, the route length of consumer's mains is 20 m. Using the maximum demand from above plus allowing for an additional 200% for future loads, find the size of cables to be used for the mains if permissible voltage drop is estimated as 3%. (Reference: table attached at the back) (5 marks)

c) Given the following information, find the voltage drop incurred in the sub-mains and the final subcircuit (Reference: table attached at the back)

i)	Submains (1Ø)	Length	-	40m
		Current	-	40A
		Cable	-	(V75) 6mm^2
ii)	Final Subcircuit (1Ø)	Length	-	30m
		Current	-	15A
		Cable	-	(V75) 1.5mm^2

(6 marks)

3. Indicate the protective device rating for the following type of conductors used for specific applications: (Reference: Wiring Rule book)

   a) 6mm^2 two core and earth, flat cable installed unenclosed in air used in single phase applications.

   b) 4mm^2 - two core and earth, flat cable installed enclosed in air used in single phase applications

   (4 marks)

4. How do you provide *earthing* on a ship? (2 marks)

(Answer the following questions with reference to the wiring rule book)

5. Name TWO faults that could arise in MEN system of earthing creating dangerous situations. (2 marks)

6. Is it permissible to joint conductors within:

   a) Steel conduit

   b) PVC conduit

   c) cable trunk

   (6 marks)

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TABLE 40

THREE-PHASE VOLTAGE DROP AT 50 Hz OF SINGLE-CORE INSULATED AND SHEATHED COPPER CONDUCTORS, LAID IN TREFOIL

Conductor size	Three-phase voltage drop at 50 Hz, mV/A.m									
	Conductor temperature, °C									
	45		60		75		90		110	
mm²	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.
1	40.3	—	42.5	—	44.7	—	46.8	—	49.7	—
1.5	25.9	—	27.3	—	28.6	—	30.0	—	31.9	—
2.5	14.1	—	14.9	—	15.6	—	16.4	—	17.4	—
4	8.77	—	9.24	—	9.71	—	10.2	—	10.8	—
6	5.86	—	6.18	—	6.49	—	6.81	—	7.23	—
10	3.49	—	3.67	—	3.86	—	4.05	—	4.30	—
16	2.20	—	2.31	—	2.43	—	2.55	—	2.70	—
25	1.40	—	1.47	—	1.54	—	1.62	—	1.72	—
35	1.01	—	1.07	—	1.12	—	1.17	—	1.24	—
50	0.757	—	0.795	—	0.834	—	0.872	—	0.924	—
70	0.537	—	0.563	—	0.589	—	0.615	—	0.650	—
95	0.402	—	0.420	—	0.439	—	0.457	—	0.481	—
120	0.332	—	0.345	—	0.359	—	0.373	—	0.392	—
150	0.284	—	0.295	—	0.305	—	0.316	—	0.331	—
185	0.245	0.245	0.253	0.253	0.261	—	0.269	—	0.280	—
240	0.211	0.208	0.216	0.214	0.221	0.220	0.227	0.226	0.235	0.234
300	0.191	0.185	0.195	0.190	0.198	0.195	0.202	0.199	0.208	0.206
400	0.175	0.166	0.178	0.169	0.181	0.173	0.183	0.176	0.187	0.181
500	0.165	0.150	0.166	0.153	0.168	0.156	0.170	0.158	0.172	0.162
630	0.155	0.138	0.156	0.140	0.157	0.142	0.159	0.144	0.160	0.146

TABLE 41

THREE-PHASE VOLTAGE DROP AT 50 Hz OF SINGLE-CORE INSULATED AND SHEATHED COPPER CONDUCTORS, LAID FLAT TOUCHING OR IN A WIRING ENCLOSURE

Conductor size	Three-phase voltage drop at 50 Hz, mV/A.m									
	Conductor temperature, °C									
	45		60		75		90		110	
mm²	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.
1	40.3	—	42.5	—	44.7	—	46.8	—	49.7	—
1.5	25.9	—	27.3	—	28.6	—	30.0	—	31.9	—
2.5	14.1	—	14.9	—	15.6	—	16.4	—	17.4	—
4	8.77	—	9.24	—	9.71	—	10.2	—	10.8	—
6	5.86	—	6.18	—	6.49	—	6.81	—	7.23	—
10	3.49	—	3.68	—	3.86	—	4.05	—	4.30	—
16	2.20	—	2.32	—	2.43	—	2.55	—	2.71	—
25	1.40	—	1.47	—	1.55	—	1.62	—	1.72	—
35	1.02	—	1.07	—	1.12	—	1.18	—	1.25	—
50	0.763	—	0.801	—	0.840	—	0.878	—	0.929	—
70	0.545	—	0.571	—	0.597	—	0.623	—	0.657	—
95	0.413	—	0.431	—	0.449	—	0.467	—	0.491	—
120	0.345	—	0.358	—	0.371	—	0.385	—	0.403	—
150	0.299	0.299	0.309	—	0.319	—	0.330	—	0.344	—
185	0.262	0.261	0.270	0.269	0.277	0.277	0.285	0.285	0.296	0.296
240	0.230	0.224	0.235	0.230	0.240	0.236	0.245	0.242	0.252	0.250
300	0.212	0.201	0.215	0.206	0.219	0.211	0.222	0.215	0.227	0.222
400	0.198	0.181	0.200	0.185	0.202	0.189	0.205	0.192	0.208	0.197
500	0.188	0.166	0.190	0.169	0.191	0.172	0.193	0.174	0.195	0.178
630	0.179	0.153	0.180	0.155	0.181	0.157	0.182	0.159	0.184	0.162

TABLE 42

THREE-PHASE VOLTAGE DROP AT 50 Hz OF MULTICORE CABLES WITH CIRCULAR COPPER CONDUCTORS

Conductor size	Three-phase voltage drop at 50 Hz, mV/A.m									
	Conductor temperature, °C									
	45		60		75		90		110	
mm²	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.
1	40.3	—	42.5	—	44.7	—	46.8	—	49.7	—
1.5	25.9	—	27.3	—	28.6	—	30.0	—	31.9	—
2.5	14.1	—	14.9	—	15.6	—	16.4	—	17.4	—
4	8.77	—	9.24	—	9.71	—	10.2	—	10.8	—
6	5.86	—	6.18	—	6.49	—	6.80	—	7.22	—
10	3.49	—	3.67	—	3.86	—	4.05	—	4.29	—
16	2.19	—	2.31	—	2.43	—	2.55	—	2.70	—
25	1.39	—	1.47	—	1.54	—	1.61	—	1.71	—
35	1.01	—	1.06	—	1.11	—	1.17	—	1.24	—
50	0.751	—	0.790	—	0.829	—	0.868	—	0.920	—
70	0.530	—	0.556	—	0.583	—	0.609	—	0.645	—
95	0.394	—	0.413	—	0.431	—	0.450	—	0.475	—
120	0.323	—	0.337	—	0.351	—	0.366	—	0.385	—
150	0.274	—	0.285	—	0.296	—	0.307	—	0.322	—
185	0.234	—	0.242	—	0.251	—	0.259	—	0.271	—
240	0.198	0.198	0.204	0.204	0.210	0.210	0.216	0.216	0.224	—
300	0.178	0.175	0.182	0.180	0.186	0.185	0.190	0.189	0.196	0.196
400	0.162	0.157	0.165	0.160	0.168	0.164	0.171	0.167	0.175	0.172
500	0.152	0.143	0.154	0.146	0.156	0.148	0.158	0.151	0.160	0.155

* VOLTAGE DROP : 1 ϕ to 3 ϕ ⇒ 0.866 × 1 ϕ value
3 ϕ to 1 ϕ ⇒ 1.155 × 3 ϕ value. } Vc only.