

## COURSE OUTLINE

---

### Residential Wiring

Course Title

ET 122

Dept & Course No.

---

#### I. COURSE DESCRIPTION

This course provides the students with comprehensive and practical approach to become successful residential electricians. It covers practical wiring experience in connecting and installing various types of branch circuits and services for lighting, heating, burglar and alarms, and power for typical single-family dwelling units to multiple-family residential units. More specifically, it covers important concept like planning a job, roughing in and trim out, ground fault circuit interrupters, and maintaining/troubleshooting a residential electrical wiring system in accordance with the latest edition of National Electrical Code. It also deals with installing, commissioning, operating, troubleshooting, repairing and maintaining small stand-alone solar PV system. Appropriate CAI will be used.

II. SEMESTER CREDIT: 4

III. CONTACT HOURS PER WEEK:

<u>2</u>	<u>6</u>	<u>8</u>
Lecture	Lab	Total

IV. PREREQUISITE: ET 111 Basic Electricity

#### V. STUDENT LEARNING OUTCOME:

*Upon completion of the course, the students will be able to, with 65% accuracy to;*

1. Install electrical wiring in residential unit according to plans and specifications

#### VI. COURSE CONTENT

- A. General information for electrical installation
  1. Parts of electrical plan
  2. Electrical symbols
  3. Blue print
  4. Plans and specifications
  5. Licensing and permits
  6. National Electrical Code
- B. Diagramming
  1. Schematic diagrams
  2. Wiring diagram
  3. One line diagram
  4. Interpreting electrical diagram
  5. Drawing/Sketching electrical diagrams
- C. Installing sheathed non metallic cable
  1. Tools commonly used in installing sheathed nonmetallic cables
  2. Sheathed nonmetallic cable
  3. Roughing-in in wooden studs
  4. Roughing-in in metal studs
  5. NEC requirement in installing electrical wiring using sheathed nonmetallic cable
- D. Installing electrical wiring using PVC

2. Trim-out and Install wiring devices and lighting fixtures

conduit

1. Tools, materials and equipment used in installing PVC conduit
2. Different kind of PVC
3. Bending PVC
4. Roughing-in in concrete walls and ceiling
5. Roughing-in in wooden studs
6. Roughing-in in metal studs
7. Fishing electrical conductor inside the conduit
8. NEC requirements in installing electrical wiring using PVC conduit

E. Wiring devices

1. Switches
2. Single pole switches
3. Three-way switch
4. Four-way switch
5. Convenience outlets
6. Convenience outlets
7. Special purpose outlet
8. Lighting Fixtures

F. Incandescent lamp

1. Theory of operation
2. Different kinds of incandescent lamps
3. Incandescent lamp fixtures
4. Life expectancy of incandescent lamp
5. Advantages and disadvantages of incandescent lamps

G. Fluorescent lamp

1. Theory of operation of fluorescent lamp
2. Types of fluorescent lamps
3. Assembling fluorescent lamps
4. Advantages and disadvantages of fluorescent lamp
5. Different type of fluorescent lamp fixtures
6. Compact fluorescent lamp
7. Life expectancy of fluorescent lamp.
8. Installing fluorescent lamp fixtures.

H. NEC requirements in installing lighting fixtures

I. Fuses

1. Different types of fuse
2. Fuse boxes and safety switches
3. NEC requirements in installing fuse boxes and safety switches

J. Circuit breakers

1. Types of circuit breakers
2. Panel boards and other load centers

3. Install electrical protective devices

4. Install service entrance and lateral conductors
  - K. NEC requirement in installing panel boards and load centers
  - L. Service Entrance
    1. Size of service entrance conductor
    2. Clearance requirements
    3. Grounding and bonding
    4. Underground service
    5. Overhead
    6. NEC requirements in installing service entrance conductors
  - M. Lateral conductors
    1. Service lateral conductors
    2. NEC requirements in installing lateral conductors
5. Install signal, alarm and communication devices
  - N. Alarm and communication devices
    1. Bell, chimes and annunciator
    2. Smoke and fire alarm
    3. Burglar alarm
  - O. NEC requirements in installing alarm and communication system
6. Commission electrical installation
  - P. Electrical Testing
    1. Testing electrical installation for short and ground fault
    2. Measuring insulation resistance of old and newly installation electrical installation
    3. Troubleshooting and repair of electrical installation
7. Troubleshoot, repair and maintain residential wiring system.
  - Q. Troubleshooting technique
8. Install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system
  - R. Repairing and maintaining residential wiring system
  - S. Stand-alone PV Systems
    1. PV safety basic
    2. Solar resource and orientation
    3. System components
    4. Site survey and assessment
    5. Installation and commissioning
    6. Operations, maintenance and troubleshooting

## VII. MATERIALS AND EQUIPMENT

1. Romex wire 12/2 AWG
2. Romex wire 14/2 AWG
3. Romex wire 14/3 AWG
4. 3-way switch
5. 4-way switch
22. Scale
23. Ruler
24. Basic electrical hand tools
25. Special tools
26. Sets of blueprints

- |   |   |
|---|---|
| 6. single pole switch   | 27. Calculator                                |
| 7. photo cell   | 28. Personal Computer                         |
| 8. single outlet  | 29. Lamp control trainer                      |
| 9. duplex outlet  | 30. load center                               |
| 10. Ground-Fault Circuit Interrupter (GFCI)                               | 31. electrical lighting fixtures              |
| 11. special purpose outlet  | 32. incandescent bulb                         |
| 12. lamp holder   | 33. compact fluorescent lamp                  |
| 13. utility box   | 34. electrical tape                           |
| 14. junction boxes  | 35. metallic conduit                          |
| 15. circuit breakers  | 36. non metallic conduit                      |
| 16. solar panel   | 37. DC light                                  |
| 17. charge controller   | 38. DC fan                                    |
| 18. MC4 connector   | 39. DC circuit breaker                        |
| 19. IR thermometer  | 40. MC4 crimper                               |
| 20. Deep cycle battery  | 41. DC clamp ammeter                          |
| 21. VOCTEC Solar PV Training – Hand's-on Training Manual, Second Edition. | 42. Insulation resistance tester              |
|   | 43. USAID-ASU-VOCTEC Mobile Training Toolkit. |

**VIII. TEXT AND REFERENCES**

A. *Required Text*

Ray C. Mulin. **RESIDENTIAL WIRING 16<sup>th</sup> Ed.** Delmar Publishers Inc: A division of Thomson Learning Inc: 2008.

B. *Reference*

**National Electrical Code 2014.**

**VOCTEC Solar PV Training – Hand's-on Training Manual, Second Edition.**

**IX. METHOD OF INSTRUCTION**

- A. Lecture-discussion
- B. Demonstration
- C. Video Presentation
- D. Self-pace learning
- E. Peer teaching
- F. Laboratory Performance/Field activities

**X. METHOD OF EVALUATION**

A. Knowledge will be evaluated using the following methods:

- 1. Written test
- 2. Graded recitation/Oral presentation
- 3. Instructor's Interview

B. Skills will be evaluated using the following criteria:

- 1. Accuracy
- 2. Quality of work
- 3. Safety
- 4. Timeliness/Completion

C. Final grade are computed and weighted using the following criteria:

Class participation.....	15%
Quizzes/Short Tests.....	20%
Midterm/Final Exams.....	25%
Lab Performance/Projects.....	40%

**TOTAL** 100%

D. Transmutation of total percent to letter grade:

90-100%.....	A
80-89%.....	B
70-79%.....	C
65-69%.....	D
00-64%.....	F

## TASK LISTING

**ET 122 Residential Wiring**

**Credit:**

**2**

**2**

**96**

Course No. & Title

Lec

Lab

Total Lab Hrs

STUDENT LEARNING OUTCOMES	Allotted Hours
<p><b>1. Install electrical wiring according to plans and specifications</b></p> <p>A. Draw electrical diagrams according to client's requirements</p> <ol style="list-style-type: none"> <li>1. Draw schematic diagram</li> <li>2. Draw wiring diagram</li> <li>3. Convert schematic to wiring diagram</li> <li>4. Convert one line to wiring diagram</li> </ol> <p>B. Install electrical wiring using sheathed nonmetallic cable</p> <ol style="list-style-type: none"> <li>1. Identify tools and equipment used in installing electrical wiring using sheathed non metallic cable.</li> <li>2. Perform roughing-in activities in wood studs/metal studs.</li> <li>3. Install electrical wiring using sheathed non metallic cable using sheathed non metallic cable in line with the latest edition of National Electrical Code.</li> </ol> <p>C. Install electrical wiring using PVC conduit.</p> <ol style="list-style-type: none"> <li>1. Prepare PVC for installation</li> <li>2. Bend PVC according to installation requirements</li> <li>3. Perform roughing-in activities in wooden studs/metal studs using PVC</li> <li>4. Perform roughing-in activities in concrete walls and ceiling using PVC</li> <li>5. Install electrical wiring using PVC in line with the latest edition of National Electrical Code.</li> </ol>	24
<p><b>2. Trim-out and install wiring devices and lighting fixtures</b></p> <ol style="list-style-type: none"> <li>A. Trim-out wooden walls</li> <li>B. Install switches and outlets</li> <li>C. Replace defective wiring device.</li> <li>D. Install lighting fixtures</li> <li>E. Assemble fluorescent lamp fixtures</li> <li>F. Install lighting fixtures in line with the NEC requirements.</li> <li>G. Troubleshoot and repair lighting fixture.</li> </ol>	16
<p><b>3. Install electrical protective devices</b></p> <ol style="list-style-type: none"> <li>A. Calculate sizes of fuse/circuit breakers and panel boards</li> <li>B. Install fuse box</li> <li>C. Install panel boards and circuit breakers according to NEC requirements.</li> </ol>	4
<p><b>4. Install signal, alarm and simple communication devices</b></p> <ol style="list-style-type: none"> <li>A. Identify different cables and special tools used in installing signal, alarm and simple communication devices.</li> <li>B. Install gravity drop annunciator</li> <li>C. Install lamp annunciator</li> <li>D. Install bell, chimes, and buzzers.</li> </ol>	4
<p><b>5. Install service entrance and lateral conductors</b></p> <ol style="list-style-type: none"> <li>A. Calculate size of service entrance conductors according to plans and specification</li> <li>B. Determine size of protective equipment according to plans and specifications</li> <li>C. Identify different kinds of materials, tools and equipment in installing service entrance and lateral conductors</li> <li>D. Install service entrance and lateral conductors in line with the NEC requirements</li> </ol>	8
<p><b>6. Commission electrical installation</b></p> <ol style="list-style-type: none"> <li>A. Perform insulation resistance testing</li> <li>B. Test electrical installation for short and ground fault</li> <li>C. Measure insulation resistance of old and newly installation electrical installation</li> </ol>	4
<p><b>7. Troubleshoot, repair and maintain residential wiring system</b></p> <ol style="list-style-type: none"> <li>A. Troubleshoot and repair of electrical installation</li> </ol>	4
<p><b>8. Install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system</b></p> <ol style="list-style-type: none"> <li>A. Measure/calculate irradiance level under different conditions.</li> <li>B. Measure PV output at different tilt angle.</li> <li>C. Measure key electrical parameters of two PV modules in series and in parallel configurations.</li> </ol>	32

<ul style="list-style-type: none"> <li>D. Measure solar irradiance input and key output electrical parameters of PV module and calculate power conversion efficiency of the module.</li> <li>E. Determine the effect of temperature on voltage, current and power of PV.</li> <li>F. Determine appropriate wire size to minimize voltage drop.</li> <li>G. Assemble a complete stand alone system using MTT components.</li> <li>H. Operate a small stand alone system.</li> <li>I. Troubleshoot, repair and maintain small stand alone system.</li> </ul>	
TOTAL	96

Palau Community College  
ET 122 Residential Wiring  
Course Learning Outcomes

During the course experience, the **course learning outcomes** (CLOs) will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical ratings of 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance of each of the course learning outcomes listed below:

Rating Scale:	5	Excellent
	4	Above average
	3	Average
	2	Below Average
	1	Unacceptable

**CLO 1:** Install service entrance and lateral conductors

5	The student is able to install service entrance and lateral conductors without any supervision and instruction.
4	The student is able to install service entrance and lateral conductors with limited supervision but no instruction.
3	The student is able to install service entrance and lateral conductors with limited supervision and limited instruction.
2	The student has difficulty to install service entrance and lateral conductors and requires considerable supervision and instruction.
1	The student is unable to install service entrance and lateral conductors even with supervision and instruction.

**CLO 2:** Install electrical wiring, communication and alarm system in residential unit according to plans and specifications

5	The student is able to install electrical wiring, communication and alarm system in residential unit according to plans and specifications without any supervision and instruction.
4	The student is able to install electrical wiring, communication and alarm system in residential unit according to plans and specifications with limited supervision but no instruction.
3	The student is able to install electrical wiring, communication and alarm system in residential unit according to plans and specifications with limited supervision and limited instruction..
2	The student has difficulty to install electrical wiring, communication and alarm system in residential unit according to plans and specifications and requires considerable supervision and instruction.
1	The student is unable to install electrical wiring, communication and alarm system in residential unit according to plans and specifications even with supervision and instruction.

**CLO 3:** Perform roughing-in, trim-out and install wiring devices and lighting fixtures

5	The student is able to perform roughing-in, trim-out and install wiring devices and lighting fixtures without any supervision and instruction.
4	The student is able to perform roughing-in, trim-out and install wiring devices and lighting fixtures with limited supervision but no instruction.
3	The student is able to perform roughing-in, trim-out and install wiring devices and lighting fixtures with limited supervision and limited instruction.
2	The student has difficulty to perform roughing-in, trim-out and install wiring devices and lighting fixtures and requires considerable supervision and instruction.



1	The student is unable perform roughing-in, trim-out and install wiring devices and lighting fixtures even with supervision and instruction.
---	---

**CLO 4:** Commission, troubleshoot, repair and maintain residential electrical wiring system.

5	The student is able to commission, troubleshoot, repair and maintain residential electrical wiring system without any supervision and instruction.
4	The student is able to commission, troubleshoot, repair and maintain residential electrical wiring with limited supervision but no instruction.
3	The student is able to commission, troubleshoot, repair and maintain residential electrical wiring with limited supervision and limited instruction.
2	The student has difficulty to commission, troubleshoot, repair and maintain residential electrical wiring and requires considerable supervision and instruction.
1	The student is unable to commission, troubleshoot, repair and maintain residential electrical wiring even with supervision and instruction.

**CLO 5:** Install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system.

5	The student is able to install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system without any supervision and instruction.
4	The student is able to install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system with limited supervision but no instruction.
3	The student is able to install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system with limited supervision and limited instruction.
2	The student has difficulty to install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system and requires considerable supervision and instruction.
1	The student is unable to install, commission, operate, troubleshoot, repair and maintain small stand-alone solar PV system even with supervision and instruction.

**MARKING SHEET**  
**ET 122 Residential Wiring**  
**TROUBLESHOOTING A SINGLE FAMILY DWELLING UNIT (SKELETON HOUSE)**

Name of student: \_\_\_\_\_  
 \_\_\_\_\_

Date: \_\_\_\_\_  
 Instructor: \_\_\_\_\_

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
<b>ACCURACY</b>	<b>10 or 1</b>		<b>35%</b>
1. Troubles are identified using appropriate testing and measuring instruments	10 or 1		Average of gained points X 10 X 35%
2. Ground fault on the circuit is located and rectified according to best practices	10 or 1		
3. Short circuit is located and corrected in accordance with the best practices	10 or 1		
4. Rectified circuit is tested using appropriate testing and measuring instrument before re-energizing the circuit.	10 or 1		
<b>WORKMANSHIP (QUALITY OF WORK/APPEARANCE)</b>			<b>25%</b>
1. Wires and other defective components are removed without making any further damage to other components	10		Average of gained points times 10 times 25%
2. Defective components are replaced and re-mounted in place according to NEC	10		
3. Splices and joints are re-done according to NEC.	10		
4. Splices and joints are re-insulated according to NEC	10		
<b>SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT</b>			<b>20%</b>
1. Area is cleaned every after each session	10		Average of gained points times 10 times 20%
2. Tools and equipment properly used.	10		
3. Materials are used properly	10		
4. Safety procedure is strictly observed within the duration of work	10		
<b>TIMELINESS/COMPLETION</b>			<b>20%</b>
1. Work is submitted one or more days ahead of due date	10		Average of gained points times 10 times 20%
2. Work submitted on due date	8		
3. Work submitted a day after due date	4		
4. Work submitted more than two days after due date	0		

Assessor

MARKING GUIDE  
**ET 122 Residential Wiring**  
**TROUBLESHOOTING A SINGLE FAMILY DWELLING UNIT (SKELETON HOUSE)**

<b>CRITERIA</b>
<b>ACCURACY</b>
<ol style="list-style-type: none"> <li>1. Troubles are identified using appropriate testing and measuring instruments</li> <li>2. Ground fault on the circuit is located and rectified according to best practices</li> <li>3. Short circuit is located and corrected in accordance with the best practices</li> </ol> <ul style="list-style-type: none"> <li>• <i>If the above criteria are met, 10 points is awarded. If the criteria are not met, 1 point is awarded.</i></li> </ul>
<b>QUALITY OF WORK (WORKMANSHIP)</b>
<ol style="list-style-type: none"> <li>1. Wires and other defective components are removed without making any further damage to other components <ul style="list-style-type: none"> <li>• 2 points is for every damaged made to other components.</li> </ul> </li> <li>2. Defective components are replaced and re-mounted in place according to NEC <ul style="list-style-type: none"> <li>• 2 points is for every defective component not replaced and not re-mounted properly</li> </ul> </li> <li>3. Splices and joints are re-done according to NEC. <ul style="list-style-type: none"> <li>• 2 points is for every improperly done splices and joints</li> </ul> </li> <li>4. Splices and joints are re-insulated according to NEC <ul style="list-style-type: none"> <li>• 2 points is for every improperly insulated splice and joint</li> </ul> </li> </ol>
<b>SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT</b>
<ol style="list-style-type: none"> <li>2. Area is cleaned upon completion of the job <ul style="list-style-type: none"> <li>• 10 points is awarded to properly cleans area</li> <li>• 6 points is awarded for slightly cleaned area</li> <li>• No point is awarded if the area is unclean.</li> </ul> </li> <li>3. Tools and equipment properly used. <ul style="list-style-type: none"> <li>• 2 points deduction for every improper used of tools and/or equipment</li> </ul> </li> <li>4. Materials are used properly <ul style="list-style-type: none"> <li>• 2 points deduction for every improper used of materials</li> </ul> </li> <li>5. Safety procedure is strictly observed within the duration of work <ul style="list-style-type: none"> <li>• 2 points deduction for every violation of safety rules.</li> </ul> </li> </ol>
<b>TIMELINESS/COMPLETION</b>
<ol style="list-style-type: none"> <li>1. 10 points is awarded if work is submitted one or more days ahead of due date</li> <li>2. 8 points is awarded if work submitted on due date</li> <li>3. 4 points is awarded if work submitted a day after due date</li> <li>4. Zero for the work submitted more than two days after due date</li> </ol>