Senior High School

DepED
DEPARTMENT OF EDUCATION

Lesson Exemplar in Electrical Installation and Maintenance(EIM)

Quarter 1

LE
6

Lesson Exemplar for Electrical Installation and Maintenance
Quarter 1: Unit 1

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Learning Area	Electrical Installation and Maintenance	**Grade Level**	11
Semester	1	**Quarter**	1
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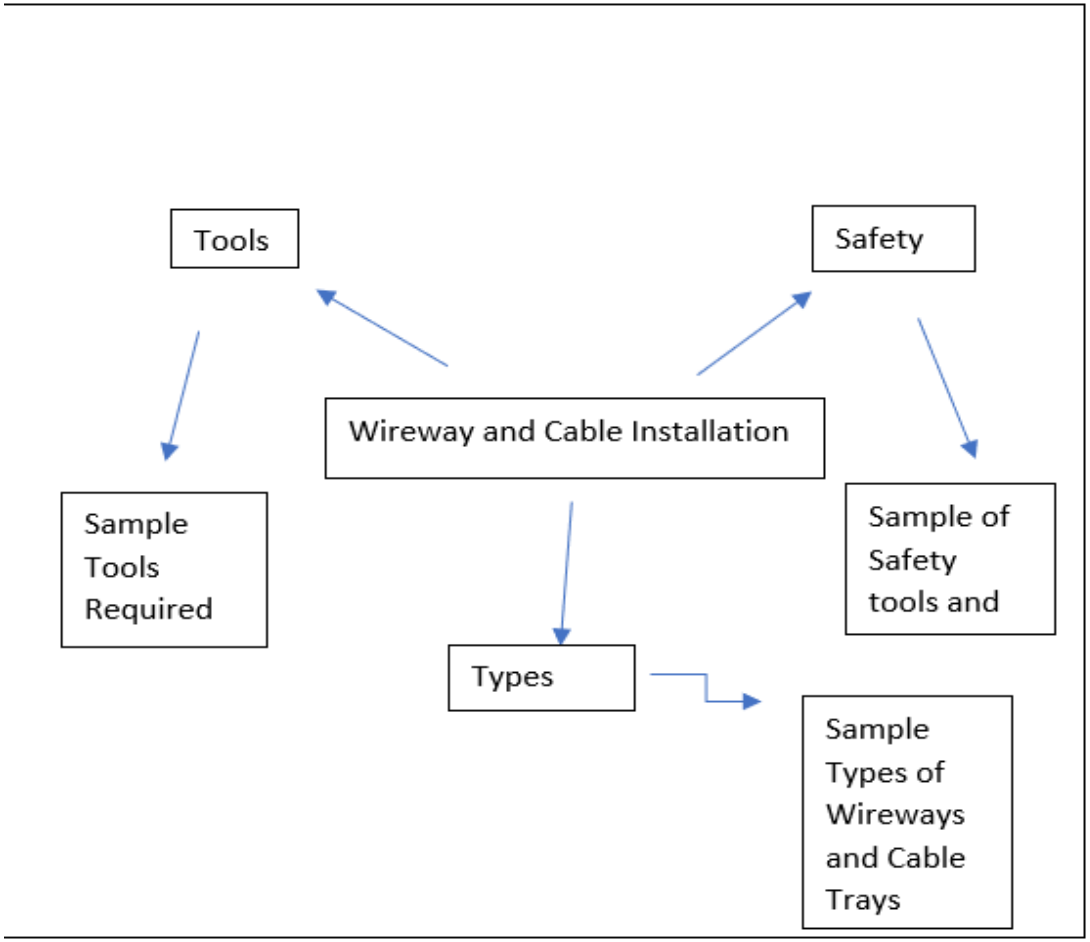
I. OBJECTIVES *(Identifying the Goals)*	
Content Standard	**Content Standard:** The learners demonstrate an understanding of roughing-in activities for residential/building wiring systems.
Performance Standard	**Performance Standard:** The learners perform roughing-in activities for residential/building in accordance with the PEC standard.
Learning Competencies	**Perform Procedures for Installing Electrical Non-Metallic and Metallic Conduits (Cable trays, terminal cabinets, and distribution panels) (Week 3)**
II. REFERENCES and MATERIALS	• ***Pita N. (2015). Electrical Installation and Maintenance. Phoenix Publishing House.*** • **Gonzales, R. M., & del Rosario, R. C. (2018). *Electrical Installation and Maintenance NC II (TVL K to 12).* Rex Book Store.** • **Perez, E. L., & Tan, F. C. (2017). *Electrical installation and maintenance: Learning module.* Department of Education – Learning Resources Management and Development System.** • **Department of Education. (2016). *K to 12 Basic Education Curriculum: Electrical Installation and Maintenance Learning Module* (Grade 11 and 12). Bureau of Learning Resources.** • ***TESDA Training Regulation EIM NC 2, s. 2015*** • **Training Materials** **1. Metallic conduits/non-metallic conduit** 1.1 Rigid Steel Conduits (RSC) 1.2 Intermediate Metallic Conduit (IMC) 1.3 Electrical Metallic Tubing (EMT) 1.4 Polyvinyl Chloride Pipe (PVC) 1.5 Non-metallic flexible conduit (NMFC) **2. Fittings** 2.1 Conduits and Reducers 2.2 Lock nut and bushing 2.3 Entrance cap

	2.4 Nipple 2.5 Elbow 2.6 PVC/Metal fittings and Connectors **3. Accessories** 3.1 Electrical Boxes • Utility Box • Junction Box • Pull box/Splice box 3.2 Conduit supports (e.g. hangers) 3.3 Conduit Strap 3.4 Connectors (straight and angled) **4. Tools and equipment** Including but not limited to: 4.1 Spirit level, hack saw, pipe cutter, plumb bob, pipe reamer, pipe threader, pipe bender, bolt cutter, electric drill, heat gun, measuring tape 4.2 Electrical power tools - Power drills - Portable grinder
III. CONTENT	Non-Metallic and Metallic Conduit Installation Procedures • **Cable trays, terminal cabinets, and distribution panels**
IV. OBJECTIVES *(Setting Clear Objectives and Analyzing the Tasks)*	*By the end of 1 week, learners must be able to:* 1. Identify the tools and materials to be used for wireways and cable trays installation. 2. Perform the procedure of wireways and cable trays installation. 3. Observe safety precautions. 4. Document work completion report.

IV. PROCEDURES	**ANNOTATION**
A. Activating Prior Knowledge	**Day 1** **1. Concept Making:** Start with a discussion about experiences at home or in the community. 1.1. Let the Students create a Mind Map around Cable Tray Systems and Wireway Installations. 1.2. Let the students include branches like types, uses, safety, tools, and standards.	Concept mapping is important in TechVoc discussions because it helps students visually organize and connect complex technical concepts, making it easier to understand how various tools, systems, and procedures relate to each other. By mapping out ideas, learners move beyond rote memorization and

The following is the Sample Students' Output



develop critical thinking skills essential for real-world problem-solving. It also supports the integration of theory and hands-on practice, promotes active learning through collaboration, and aids both students and teachers in identifying knowledge gaps and reinforcing learning. Overall, concept mapping enhances comprehension, retention, and application of technical knowledge in vocational education.

The teacher will group the students into 5 groups and let them choose their leader and secretary. Then, he/she will distribute the following materials to the students;

1. Manila Paper
2. Colored Car tolina (varied colors)
3. Pentel pen
4. compass

The teacher will instruct the students to establish the following;

1. ***CENTER CONCEPT***:
   - the teacher will instruct to write "WIREWAY AND CABLE TRAY INSTALLATION" center of the manila paper
- ***2. BRANCHING TOPICS:***

		- the teacher will instruct the students to write the concept in their minds if they can hear the WIREWAY AND CABLE TRAY INSTALLATION" on the aspects of the following; ○ **Types** (e.g., solid-bottom, ladder, trough, etc.) ○ **Components** (e.g., elbows, tees, covers, fasteners) ○ **Tools Required** (e.g., drill, level, measuring tape) ○ **Installation Steps** (e.g., layout, mounting, securing, testing) ○ **Safety Considerations** (e.g., PPE, working at heights, electrical isolation) ○ **Code Requirements** (e.g., NEC, local regulations) **3. Sub-branches:** Let the students list or draw specific examples.

	2. Video Observation with Pre-Questions **Strategy:** 1. Show a short video clip of cable tray or wireway installation. 2. Before playing it, ask students to predict what tools, materials and steps they will see. **Goal:** Triggers recall and sets a purpose for viewing.	**4. Connections:** Let the students use arrows or lines to show relationships. Videos engage students more effectively than text alone and help bridge the gap between theory and hands-on practice, particularly in technical-vocational subjects such as Electrical Installation. Using video clips in discussing wireways and cable raceways is important because they visually demonstrate real-life applications, installation techniques, and safety practices, making abstract concepts easier to understand. The teacher will present a video clip showing cable tray and wire way installation. Suggested video links below **A. Video Title:** **HOW TO INSTALL CABLE TRAY EIM NCII** https://www.youtube.com/watch?v=wfgOkimENXM B. Video Title: Wireway System https://www.youtube.com/shorts/mNBIJqYMrzg

		The teacher will solicit input from the class to help the students understand the relevance and purpose of the activities conducted in relation to the real-world work environment.
B. Instituting New Knowledge	**Day 2** **1. Presenting Examples (Rough-in Process)** A video clip will be presented to the students showing rough-in process of wire ways and cable trays installation. (suggested video clip links below) https://www.youtube.com/shorts/BsMh-_P9I9A https://www.youtube.com/watch?v=StQyExEw2fc&t=85s	The teacher will present the video to the class and stressing the strong points while asking also the students on their different opinions on how to do rough-in activities systematically.

A. Tools:

Tools	Description
Measuring Tape	For accurate measurement of tray runs and conduit lengths.
Screwdrivers (Flat & Phillips)	For fastening/unfastening screws on fittings and accessories.
Cordless Drill/Driver	For drilling holes and fastening anchors or screws.
Hole Saw / Knockout Punch Set	To make holes in junction boxes or panel boards.
Conduit Bender	For bending electrical conduits to fit design paths.
Fish Tape / Cable Puller	Used to route wires through conduits or trays.
Level (Spirit Level / Laser Level)	Ensures trays and conduits are installed straight and level
Pliers (Linesman, Needle Nose, Cutting)	For gripping, cutting, and manipulating wires.
Hammer	For driving nails or positioning mounting hardware.
Hacksaw / Power Saw	For cutting cable trays and conduits to length.
Personal Protective Equipment (PPE)	Includes gloves, safety glasses, helmet, etc.

B. Materials:

Materials	Description
Electrical Conduits (PVC, EMT, IMC, RMC)	Protects and routes electrical wiring.
Cable Trays (Ladder, Perforated, Solid Bottom)	Supports insulated electrical cables used for power distribution.
Wireways / Raceways	Enclosed pathways for protecting conductors.
Support Brackets / Hangers / Trapeze Supports	Used to suspend and secure cable trays.

Focusing tools and materials is essential when teaching wireways and cable raceways because it helps students understand the proper equipment needed for safe and efficient installation. Knowing the correct tools and materials ensures accuracy, promotes safety, and prepares learners for real-world tasks, making them more confident and competent in performing electrical work.

The teacher will discuss also the different tools and materials to be used in Wireways and cable Trays Installation. The teacher will use artistic powerpoint presentation or canva to capture the interest of the students.

Junction Boxes / Pull Boxes	Points for wire pulling, splicing, or branching circuits.	After the discussion of the tools and materials the teacher will ask pivotal questions to scaffold the next concept on the steps and procedures in wireways and cable raceways.
Conduit Fittings (Elbows, Couplings, Connectors)	Joins and changes direction of conduits.	
Expansion Joints	Allows for thermal expansion and movement in trays or conduits.	
Cable Clamps / Ties / Straps	Secures cables inside trays or conduits.	
Anchors and Screws / Bolts	For fastening trays and supports to walls or ceilings.	
Grounding Materials (Ground Wire, Lugs, Straps)	Ensures system is safely grounded.	
Warning Labels / Markings	For identification and safety compliance.	

2. Procedure in wireways and cable trays installation

1. Planning

1.1 Review electrical plans and blueprints.

1.2Mark locations for outlets, switches, lights, and junction boxes on studs or walls.

1.3. Confirm compliance with code requirements (NEC or local code).

1.4. Coordinate with other trades (HVAC, plumbing) to avoid conflicts.

Note: Key Considerations:

a. Spacing of receptacles (typically every 12 feet in living areas).
b. Location of special circuits (e.g., kitchen appliances, HVAC).

	2. Installing Electrical Boxes 2.1. Mount outlet, switch, and fixture boxes to studs using nails or box brackets. 2.2. Set correct box **depth and height** (e.g., 12-18 inches for outlets, 48 inches for switches). 2.3. Use **metal or plastic boxes** depending on application. Key Considerations: a. Ensure boxes are **secure and level**. b. Use **fan-rated boxes** for ceiling fans. 3. Drilling Holes and Running Cable 3.1. Drill holes through studs (typically centered and 1 ¼" from edge to prevent nail damage). 3.2. Pull conduit wiring through holes to each box 3.3. Leave at least **6–8 inches of wire** extending from each box for connections. Key Considerations: a. Use **drill stops** to avoid damaging other systems. b. Use **cable staples** to secure wiring, following spacing rules. **4. Wire Identification and Labeling** 4.1. Use color-coded wires (black for hot, white for neutral, green or bare for ground). 4.2. Label wires with tape or marker for circuit identification.	

	43. Group wires going to the panel and label destination (e.g., "kitchen lights"). **5. Grounding** 5.1. Ground all metal boxes and devices. 5.2. Connect bare copper or green wire to **grounding screws** in boxes. 5.3. Bond all grounds together using wire nuts or grounding clips. **6. Making Pigtails and Wire Terminations** 6.1. Strip wires using wire strippers. 6.2. Create **pigtails** (short lengths of wire 15.0 cm) for device connections using wire nuts. 6.3. Ensure all connections are **tight and secure**. **7. Routing to the Panel** 7.1. Route cables to the main **breaker panel or subpanel**. 7.2. Leave enough slack for **future connection to breakers**. 7.3. Do not connect to breakers until final trim-out. **8. Safety and Inspection** 8.1. Use **protective nail plates** over studs where wires run close to edges.	

	8.2. Perform a **self-inspection**: box fill, wire supports, grounding, labeling. 8.3. Schedule and pass **rough-in electrical inspection** before drywall. **Purpose:** Visualizes the step-by-step process. **3. Discussing the Concept (Problem-Based Learning)** **Strategy:** Give a practical scenario or problem to solve. **Scenario:** You are part of an electrical team assigned to install the cable tray system in a new industrial manufacturing facility. The plant has several production areas where control cables and power cables need to be routed overhead. Your task is to determine the **total number of cable tray sections** required for the project. Project details: The facility has **4 production zones**. Each zone requires the following cable tray runs: • **Zone A**: 28 meters • **Zone B**: 15 meters • **Zone C**: 40 meters • **Zone D**: 22 meters Each **standard cable tray section** is **3 meters long**. Add **10% extra** for wastage and future modifications.	The teacher will discuss and demonstrate the following thru socialized classroom discussion method of teaching with demonstration method of teaching with different actual wireways and cable raceways installation using the electrical wiring mock-up board. This activity will enhance the capability of the students. The teacher will present the problem thru a power point presentation.

	The project requires **only straight tray runs** (no bends or tees for this problem). Task to the students: 1. **Calculate the total length** of cable tray needed for all zones. 2. **Determine how many 3-meter sections** are required. 3. Add **10% extra** to the total number of trays for contingency. 4. Round up to the nearest whole number (you can't order half a tray). 3. **Developing Mastery (Team-Based Wiring Relay)** The teacher will prepare ahead of time the wiring boards for the 5 groups to perform. 1. Divide the class into 5 groups 2. Each member completes one stage of installation: mounting wireway, pulling wire, terminating ends, labeling. Rules: • Points awarded for speed, accuracy, and neatness. • Penalties for code violations.	Expected Answer: Solution Steps: 1. Total cable tray length = 28+15+40+22=105 meters 2. Number of 3-meter tray sections = 105/3=35 sections 3. Add 10% extra: 35×10%=3.5 4. Round up: **Final number of trays needed = 39** **Answer: 39 cable tray sections**

C. Demonstrating Knowledge and Skills	**Day 3** **I. Practical Application** **Activity:** • In the same group of students (5 groups) • Provide them with materials: wireway sections, elbows, couplings, cable trays, fasteners, and tools. • Assign tasks such as: 1. Assembling a wireway run between two points. 2. Installing a ladder-type cable tray across two walls or a ceiling frame. 3. Mounting supports at correct intervals (based on code). **Note:** • Evaluate the accuracy of measurements, support spacing, level alignment, and secure fittings. **Accomplishment of Completion Checklist** (Pls refer to the attached Checklist **ANNEX A**)	The teacher will assign the tools and materials to the five groups, using the same student grouping for the practical application exercise. Additionally, following the various safety procedures will be given top importance.

V. ASSESSMENTS *(Assessing Learnings)*	**Day 4 (Assessment, Feedbacking and Submission of Completion Reports)** **Summative Assessment** **Lesson Title**: **Wire ways and Cable Trays Installation** **Instructions:** Choose the correct answer for each question. Each question is worth **1 point**. Total: **10 points** **Name**: _____ **Grade/Section**: _____ **Date**: _____ **MCQ** **Diredtion** 1. What is the main function of a cable tray system? A. To ground all equipment B. To reduce voltage drop C. To support insulated electrical cables used for power distribution D. To route control panels 2. Which of the following is a type of wireway? A. Basket tray B. Conduit box C. Ladder-type tray D. Surface metal raceway

	3. According to the NEC, what is the maximum fill capacity of a wireway cross-section with conductors? A. 25% B. 40% C. 60% D. 100% 4. What material is commonly used for cable trays in corrosive environments? A. PVC-coated steel B. Copper C. Lead D. Plain carbon steel 5. What component is typically used to connect sections of ladder-type cable trays? A. U-bolts B. Couplers C. Tray clamps D. Splice plates 6. What is the standard support spacing for horizontal cable tray runs? A. Every 2 feet B. Every 4 feet C. Every 5 feet D. Every 10 feet

	7. Which of the following is a safety requirement when installing cable trays near electrical panels? A. No trays allowed within 2 meters B. Tray must be grounded and bonded C. Tray must be painted yellow D. Only non-metallic trays are permitted 8. Which of the following is not a cable tray type? A. Ladder B. Channel C. Trough D. Raceway 9. When installing wireways vertically, supports must be provided at intervals not exceeding: A. 3 feet B. 4 feet C. 6 feet D. 10 feet 10. What is the best practice before pulling cable into a wireway or tray system? A. Apply voltage to test load B. Ground the tray before installing cables C. Check route for sharp edges, obstructions, and fill D. Paint the tray or wireway

	Answer Key 1. C 2. D 3. B 4. A 5. D 6. C 7. B 8. D 9. C 10. C
VI. REFLECTION *(Feedback and Continuous Improvement)*	Reflection Questions for Students 1. **What new knowledge or skills did you gain from learning about electrical plans and roughing-in procedures?** *(Encourages learners to recall and internalize key takeaways.)* 2. **What part of the lesson did you find most challenging, and how did you overcome it?** *(Promotes self-awareness and learning from struggle.)* 3. **How can you apply what you learned in real-life situations at home or in future work as an electrician?** *(Helps learners connect theory to practical, real-world use.)*

	Reflection Questions for Teachers 1. What aspects of the lesson went well, and why? 2. What areas need improvement, and how can I adjust for next time? 3. What changes will I make in the next delivery of this lesson?

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Annex A.

Completion Checklist: Rough-in Process

Metallic Electrical Conduits and Cable Trays on Mock-up Wiring Boards

No.	Task Description	✔ Done	Remarks
A.Preparation			
A.1	Wiring layout diagram is reviewed and followed		
A.2	All tools and PPE (gloves, safety glasses, etc.) are prepared		
A.3	Materials (EMT/RMC, cable trays, boxes, clamps) are checked for quality		
A.4	Mock-up board is clean and securely mounted for work		
B. Metallic Conduit Installation (e.g., EMT)			
B.5	Correct size and type of metallic conduit used		
B.6	Conduits are measured and cut accurately		
B.7	Bends made using a conduit bender (no flattening or deformation)		
B.8	Edges deburred; no sharp edges left		
B.9	Threading (if RMC) is clean and correctly sized		
B.10	Conduits are aligned and secured using clamps/supports at proper intervals		
B.11	Locknuts, bushings, and couplings properly installed		
B.12	Junction boxes mounted flush and positioned according to plan		
C. Cable Tray Installation (If applicable)			
C.13	Tray mounted level and secured on mock-up board		
C.14	Proper type and size of tray used (ladder/trough type)		
C.15	No sharp edges or burrs on tray cuts or joints		
C.16	All tray covers or accessories are properly installed (if used)		
D. Quality and Safety Compliance			

D.17	Conduits and trays do not obstruct other system paths on mock-up		
D.18	Workmanship is neat, professional, and complies with PEC standards		
D.19	Area cleaned; tools returned properly		
D. 20	Final inspection completed by teacher		

Teacher Remarks:

Assessed by: _____

Date: _____

ANNEX 2

ANSWER KEY TO THE LEARNING ACTIVITY SHEET (LESSON 6)

Situational	Question #	Key Answer/Expected Response
1	Q1	Measure clearance, mark conduit line below tray, ensure no overlaps or conflicts
	Q2	Conduit bender
	Q3	Every 3 meters max (per PEC)
	Q4	To prevent heat buildup, ensure accessibility, avoid physical damage
2	Q1	Reject the damaged/dented conduit
	Q2	Use a reamer or file to remove burrs
	Q3	To protect wires from sharp edges, especially during pulling
	Q4	Gloves, goggles, safety shoes
3	Q1	A 90-degree bend (or "up-bend")
	Q2	Use anchors and brackets spaced according to tray specs and PEC
	Q3	Possible overheating, poor accessibility, or violation of standards
	Q4	Use measuring tape, check reference marks, consult diagram