

COURSE OUTLINE

Industrial/Commercial Wiring

Course Title

ET 211

Dept & Course No.

I. COURSE DESCRIPTION

This course covers technical knowledge and skills relevant in performing critical task and responsibilities of commercial and industrial electrician. It covers installation of electrical service, feeders and branch circuits, power and lighting; special new construction systems of commercial and industrial establishments based on the industry standards and procedures. Appropriate CAI will be used.

II. SEMESTER CREDIT: 4

III. CONTACT HOURS PER WEEK:

<u>3</u>	<u>3</u>	<u>6</u>
Lecture	Lab	Total

IV. PREREQUISITE: ET 122

V. STUDENT LEARNING OUTCOMES:

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

1. Design electrical installation requirements according the given load.

2. Install electrical wiring for commercial/industrial establishment

VI. COURSE CONTENT

- A Electrical load calculation
- 1 Lighting load
 - 2 Motor and appliance load
 - 3 Other load
 - 4 Branch circuit conductors and protective devices
 - 5 Conductor selection
 - a Size selection
 - b Correction factor
 - c Adjustment factor
 - 6 Determining number of branch circuit
 - 7 Protective device selection
- B Roughing-in activities
- 1 Different kinds of metallic conduit
 - 2 Preparing metallic conduit for installation
 - 3 Safety procedures in preparing metallic conduit for installation
 - 4 Bending metallic conduit
 - 5 Reaming and threading
 - 6 Fastening devices and supports for metallic conduits
 - 7 Identifying size of conduit for installation
 - 8 Box styles and sizing
 - 9 Special system
 - 10 Surface metal raceway
 - 11 Multioutlet assembly
 - 12 Communication system
 - 13 NEC requirements for installing metallic conduits.

- 14 Safety procedures in preparing and installing metallic conduit.
 - 15 Motor and appliance circuit
 - 16 Appliance circuit
 - 17 Basic motor circuit
 - 18 Equipment installation
 - 19 Disconnecting means
 - 20 Single motor and multiple motor circuit load
 - 21 Branch circuit conductor calculation
 - 22 Feeder conductor calculation
 - 23 Determining overcurrent and ground fault circuit protective device
 - 24 Determining overload protective device setting
3. Install service equipment and service entrance for commercial/industrial establishment.
 - C Determining feeder requirements
 - 1 OCPD selection
 - 2 Conductor type and sized selection
 - 3 Voltage drop calculation
 - 4 Raceway size determination
 - 5 Panel boards for commercial/industrial installation
 - 6 Selecting panel board
 - 7 Feeder size for panel board
 - 8 Overcurrent protection for panel board
 - 9 Preparing panel board directory
 - 10 Installing panel boards
 - 11 NEC requirements in installing panel boards
 - 12 Safety procedures in installing panel boards
 - 13 Service equipment
 - a Transformer
 - b Transformer connections
 - c Determining transformer type and size
 - d Service entrance
 - e Service entrance conductor size
 - f Grounding
 - 14 Installing service entrance and equipment
 - 15 Safety procedures in installing service entrance and equipment
 - 16 NEC requirements in installing service equipment
 4. Install intercom/telephone system for commercial buildings
 - D Different type of intercom system/telephone system
 - 1 Installing communication system
 - 2 NEC requirement in installing communication systems.
 - 3 Safety procedures in installing communication system.
 5. Determine transformer type and size for
 - E Calculating transformer size for three

commercial/industrial installation

phase and single phase loads.

- 6. Troubleshoot, repair and maintain industrial/commercial wiring system.

- F Troubleshooting technique
- G Repairing and maintaining industrial/commercial wiring system

VII. MATERIALS AND EQUIPMENT

- A. Sets of blueprints
- B. Wiring booth
- C. . Scale
- D. Romex wire 14/2
- E. Intercom system
- F. Telephone
- G. Telephone/intercom cables
- H. Bar level
- I. Basic electrical hand tools
- J. Conduit bender
- K. Pipe reamer
- L. Pipe threader
- M. Pipe cutter
- N. Hacksaw
- O. Romex wire 12/2
- P. Romex wire 14/3
- Q. Computer
- R. Wire stripper
- S. Measuring tape
- T. Standard classroom materials
- U. Calculator
- V. Metallic conduits
- W. Assorted types and sizes of electrical box

VIII. TEXT AND REFERENCES

- A. *Required Text*

Mullin, Ray and Smith Robert. **INDUSTRIAL/COMMERCIAL WIRING 13th Ed.** Delmar Publishers Inc: A division of Thomson Learning Inc; 2008.

- B. *Reference*

National Electrical Code 2008.

IX. METHOD OF INSTRUCTION

- A. Lecture-discussion
- B. Demonstration
- C. Video Presentation
- D. 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

- B. Skills will be evaluated using the following criteria:

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

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

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

15th Ed 7/11

TASK LISTING

ET 211 Industrial/Commercial Wiring

Course No. & Title

Credits:

3

Lec

1

Lab

48

Total Lab Hrs

COURSE LEARNING OUTCOMES	Allotted Hours
<p>1. Design electrical installation requirements according the given load.</p> <p>1.1. Determine minimum lighting loading for a given area.</p> <p>1.2. Determine minimum receptacle rating for a given area.</p> <p>1.3. Tabulate unbalance load</p> <p>1.4. Calculate installation requirement for cooling system.</p> <p>1.5. Calculate installation requirement for other type of electrical load.</p> <p>1.6. Determine the required number of branch circuit for a set of load.</p> <p>1.7. Calculate the correct rating for branch circuit protective device.</p> <p>1.8. Identify preferred type of wire for a branch circuit.</p> <p>1.9. Determine the required minimum size conductor for branch circuit. Perform roughing-in activities using metallic conduit in line with the given blueprints.</p> <p>1.10. Install intercom system for commercial building</p> <p>1.11. Calculate conductor size, overcurrent and ground fault protection, overload device setting for single motor load circuit.</p> <p>1.12. Calculate feeder & branch circuit conductor, overcurrent and ground fault protection, overload device setting for multiple motor load circuit.</p> <p>1.13. Install motor and appliance circuit according to given plans and diagrams.</p>	16
<p>2. Install electrical wiring for commercial/industrial establishment</p> <p>2.1. Cut and bend metallic conduit according to required length and shape.</p> <p>2.2. Ream and thread metallic conduit.</p> <p>2.3. Install metallic conduit according to NEC requirements.</p> <p>2.4. Fasten metallic conduit and electrical box using approved type of fastening devices.</p> <p>2.5. Identify box size and style according to the number of wires coming in and type of wiring devices to be installed.</p> <p>2.6. Identify size of conduit for installation.</p> <p>2.7. Install multi-outlet system</p>	14
<p>3. Install service equipment and service entrance for commercial/industrial establishment.</p> <p>3.1. Calculate the feeder loading.</p> <p>3.2. Determine minimum feeder conductor and overcurrent protective device for a given load.</p> <p>3.3. Calculate voltage drops.</p> <p>3.4. Calculate neutral conductor size.</p> <p>3.5. Install feeder conductors and overcurrent protective devices according NEC requirements.</p> <p>3.6. Identify criteria in selecting panel board.</p> <p>3.7. Place and number circuits in the panel board.</p> <p>3.8. Compute correct feeder size for panel board.</p> <p>3.9. Install panel boards</p> <p>3.10. Prepare panel board directory. Draw basic transformer connection diagrams.</p> <p>3.11. Identify type and size of transformer according to given load.</p> <p>3.12. Connect metering equipment.</p> <p>3.13. Apply ground fault requirement to an installation.</p> <p>3.14. Calculate service entrance conductor size.</p>	3

3.15. Install service equipment and service entrance according to NEC requirements.	
4. Install intercom/telephone system for commercial buildings	5
4.1. Install communication system	
4.2. Install annunciator	
4.3. Install intercom system	
5. Determine transformer type and size for commercial/industrial installation	6
5.1. Calculating transformer size for three phase and single phase loads.	
6. Troubleshoot, repair and maintain industrial/commercial wiring system.	4
	48

Palau Community College
ET 211 Industrial/Commercial 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: Design electrical installation requirements for a given load for commercial/industrial building.

5	The student is able to design electrical installation requirements for a given load for commercial/industrial building without any supervision and instruction.
4	The student is able to design electrical installation requirements for a given load for commercial/industrial building with limited supervision but no instruction.
3	The student is able to design electrical installation requirements for a given load for commercial/industrial building with limited supervision and limited instruction.
2	The student has difficulty to design electrical installation requirements for a given load for commercial/industrial building and requires considerable supervision and instruction.
1	The student is unable to design electrical installation requirements for a given load for commercial/industrial building even with supervision and instruction.

CLO 2: Install electrical wiring for commercial/industrial establishment.

5	The student is able to install electrical wiring for commercial/industrial establishment without any supervision and instruction.
4	The student is able to install electrical wiring for commercial/industrial establishment with limited supervision but no instruction.
3	The student is able to install electrical wiring for commercial/industrial establishment with limited supervision and limited instruction.
2	The student has difficulty to install electrical wiring for commercial/industrial establishment and requires considerable supervision and instruction.
1	The student is unable to apply typical approaches in troubleshooting and repairing motor control circuits even with supervision and instruction.

CLO 3: Install service equipment and service entrance for commercial/industrial establishment.

5	The student is able to install service equipment and service entrance for commercial/industrial establishment without any supervision and instruction.
4	The student is able to install service equipment and service entrance for commercial/industrial establishment with limited supervision but no instruction.
3	The student is able to install service equipment and service entrance for commercial/industrial establishment with limited supervision and limited instruction.
2	The student has difficulty to install service equipment and service entrance for commercial/industrial establishment and requires considerable supervision and instruction
1	The student is unable to install service equipment and service entrance for

	commercial/industrial establishment even with supervision and instruction.
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CLO 4: Install intercom system/telephone system for commercial buildings.

5	The student is able to install intercom system/telephone system for commercial buildings without any supervision and instruction
4	The student is able to install intercom system/telephone system for commercial buildings with limited supervision but no instruction
3	The student is able to install intercom system/telephone system for commercial buildings with limited supervision and limited instruction
2	The student has difficulty to install intercom system/telephone system for commercial buildings and requires considerable supervision and instruction
1	The student is unable to install intercom system/telephone system for commercial buildings even with supervision and instruction.

CLO 5: Determine transformer type and size for commercial/industrial installation.

5	The student is able to determine transformer type and size for commercial/industrial installation without any supervision and instruction.
4	The student is able to determine transformer type and size for commercial/industrial installation with limited supervision but no instruction.
3	The student is able to determine transformer type and size for commercial/industrial installation with limited supervision and limited instruction.
2	The student has difficulty to determine transformer type and size for commercial/industrial installation and requires considerable supervision and instruction.
1	The student is unable to determine transformer type and size for commercial/industrial installation even with supervision and instruction.

CLO 6: Troubleshoot, repair and maintain industrial/commercial wiring system.

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

MARKING SHEET

ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO1 – DESIGN ELECTRICAL REQUIREMENTS FOR A GIVEN LOAD FOR COMMERCIAL/INDUSTRIAL BUILDING.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		50%
1. Chosen size of wire for convenience outlet circuits is #12AWG	10 or 1		Average of gained points X 10 X 35%
2. Chosen size of wire for lighting outlet circuits is #14AWG	10 or 1		
3. Chosen size of wire for motor power circuit is #12AWG	10 or 1		
4. Chosen size of wire for motor control circuit is #16AWG	10 or 1		
5. Chosen size of circuit protection for lighting outlet circuit is 15A	10 or 1		
6. Chosen size of circuit protection for convenience outlet circuit is 20A	10 or 1		
7. Chosen size of main circuit protection is 50A	10 or 1		
8. Chosen size of circuit protection for motor power circuit is 20A	10 or 1		
9. Chosen size of circuit protection for motor control circuit is 10A	10 or 1		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			25%
1. Area is cleaned every after each session	10		Average of gained points X 10 X 25%
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		
TIMELINESS/COMPLETION			25%
1. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 25%
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		
TOTAL			

MARKING SHEET

ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO2 – INSTALL ELECTRICAL WIRING FOR COMMERCIAL/INDUSTRIAL ESTABLISHMENT.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		35%
1. Turning S ₃ wA1 in "UP" position will turn Lamps A ON	10 or 1		Average of gained points X 10 X 35%
2. Turning S ₄ wA in "DOWN" position will turn Lamps A OFF	10 or 1		
3. Turning S ₃ wA2 in "UP" position will turn Lamp B ON	10 or 1		
4. Turning S ₃ wA1 in "DOWN" position will turn Lamps A OFF	10 or 1		
5. Turning S ₄ wA in "UP" position will turn Lamps A ON	10 or 1		
6. Turning S ₃ wA2 in "DOWN" position will turn Lamp B OFF	10 or 1		
7. Turning S ₃ wB1 in "UP" position will turn Lamp B ON	10 or 1		
8. Turning S ₃ wB2 in "DOWN" position will turn Lamp B OFF	10 or 1		
9. Turning S ₃ wB1 in "DOWN" position will turn Lamp B ON	10 or 1		
10. Turning S ₃ wB2 in "UP" position will turn Lamp B OFF	10 or 1		
11. The voltage measured in convenience outlet 1 is 120VAC	10 or 1		
12. The voltage measured in convenience outlet 2 is 120VAC	10 or 1		
13. The size of wire used in lighting circuit is #14 AWG	10 or 1		
14. The size of wire used in power circuit is #12 AWG	10 or 1		
15. Turning OFF 15A circuit protection turns all the lamps OFF	10 or 1		
16. Turning OFF 20A circuit protection turns all the CO OFF	10 or 1		
17. Turning OFF the 100A main circuit breaker turns OFF lighting, power and motor circuit	10 or 1		
QUALITY OF WORK (WORKMANSHIP)			25%
1. Electrical components are installed according to measurements given.	10		Average of gained points X 10 X 25%
2. Electrical boxes are securely fastened on wiring boards	10		
3. Electrical boxes are aligned and leveled according to plans and specifications	10		
4. Pipes/conduits are bent in accordance with NEC standards	10		
5. Pipes/conduits are supported according to NEC standards	10		
6. Pipes/conduits entry point is secured by appropriate fittings	10		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			20%
1. Area is cleaned every after each session	10		Average of gained points X 10 X 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		
TIMELINESS/COMPLETION			20%
1. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 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		
TOTAL			

MARKING SHEET

ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO3 – INSTALL SERVICE EQUIPMENT AND SERVICE ENTRANCE FOR COMMERCIAL/INDUSTRIAL ESTABLISHMENT.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		35%
1. Chosen size of service entrance conductor is # 6AWG	10 or 1		Average of gained points X 10 X 35%
2. Turning OFF the 100A main circuit breaker turns OFF lighting, power and motor circuit	10 or 1		
3. Chosen size of rigid steel conduit pipe is 1 ¼" dia.	10 or 1		
4. Chosen size of panel board is 100 Ampere frame.	10 or 1		
5. Approved type of service weather head is installed according to NEC standard.	10 or 1		
QUALITY OF WORK (WORKMANSHIP)			25%
1. Electrical components are installed according to measurements given.	10		Average of gained points X 10 X 25%
2. Panel board is securely fastened on wall cavity.	10		
3. Panel board is aligned and leveled according to plans and specifications	10		
4. Conduits entry point is secured by appropriate fittings	10		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			20%
1. Area is cleaned every after each session	10		Average of gained points X 10 X 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		
TIMELINESS/COMPLETION			20%
1. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 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		
TOTAL			

MARKING SHEET ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO4 – INSTALL INTERCOM SYSTEM/TELEPHONE SYSTEM FOR COMMERCIAL BUILDINGS.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		35%
1. Dialing intercom #1, unit #1 rings, and when the handset is picked-up, two parties on the line able to communicate.	10 or 1		Average of gained points X 10 X 35%
2. Dialing intercom #2, unit #2 rings, and when the handset is picked-up, two parties on the line able to communicate.	10 or 1		
3. Dialing intercom #3, unit #3 rings, and when the handset is picked-up, two parties on the line able to communicate.	10 or 1		
4. Dialing intercom #4, unit #4 rings, and when the handset is picked-up, two parties on the line able to communicate.	10 or 1		
QUALITY OF WORK (WORKMANSHIP)			25%
1. Intercom unit is securely mounted on the wall cavity.	10		Average of gained points X 10 X 25%
2. Intercom cables are securely fastened to wall/ceiling cavities.	10		
3. Raceway/Conduit of approved type for intercom/telephone installation is used to protect cables according to NEC standards.	10		
4. Entry points are secured by appropriate fittings.	10		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			20%
1. Area is cleaned every after each session	10		Average of gained points X 10 X 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		
TIMELINESS/COMPLETION			20%
1. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 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		
TOTAL			

MARKING SHEET

ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO5 – DETERMINE TRANSFORMER TYPE AND SIZE FOR COMMERCIAL/INDUSTRIAL INSTALLATION.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		35%
1. Transformer capacity is calculated according the load specifications.	10 or 1		Average of gained points X 10 X 35%
2. Transformer type is identified according to the type of location where the transformer is to be installed.	10 or 1		
3. Appropriate size of overcurrent device is chosen and installed to protect the line side of the transformer.	10 or 1		
4. Appropriate size of overcurrent device is chosen and installed to protect the load side of the transformer.	10 or 1		
QUALITY OF WORK (WORKMANSHIP)			25%
1. Transformer is installed according to manufacturer's specifications.	10		Average of gained points X 10 X 25%
2. Transformer is securely mounted on the floor with approved type of concrete anchorage.	10		
3. Transformer covers and other accessories are replaced after electrical connection is made.	10		
4. Appropriate conduit pipes are used to protect conductors from physical hazards according to NEC standards.	10		
5. Conduits entry point is secured by appropriate fittings according to NEC standards.	10		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			20%
5. Area is cleaned every after each session	10		Average of gained points X 10 X 20%
6. Tools and equipment properly used.	10		
7. Materials are used properly	10		
8. Safety procedure is strictly observed within the duration of work	10		
TIMELINESS/COMPLETION			20%
5. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 20%
6. Work submitted on due date	8		
7. Work submitted a day after due date	4		
8. Work submitted more than two days after due date	0		
TOTAL			

Assessor

MARKING SHEET

ET 211 Commercial/Industrial Wiring

Name of student: _____

Date: _____

CLO6 – TROUBLESHOOT, REPAIR AND MAINTAIN INDUSTRIAL/COMMERCIAL WIRING SYSTEM.

CRITERIA	ALLOTTED POINTS	GAINED POINTS	FINAL GRADE
ACCURACY	10 or 1		35%
1. Circuit is diagnosed using appropriate technique to identify trouble	10 or 1		Average of gained points X 10 X 35%
2. All possible causes of trouble are listed and analyze to narrow down the real cause of trouble	10 or 1		
3. All troubles in the circuit is found and rectified.	10 or 1		
4. Repair and maintenance procedure is strictly followed according best practices.	10 or 1		
5. Repaired circuit is tested using appropriate electrical instrument to ensure safety and functionality before re-energizing.	10 or 1		
QUALITY OF WORK (WORKMANSHIP)			25%
1. Defective part of the circuit is removed and replaced according to best practices.	10		Average of gained points X 10 X 25%
2. Circuit's integrity is restored after repair and maintenance procedure is done according to NEC standards.	10		
3. Device cover is replaced after troubleshooting and repair is done according to NEC standards.	10		
4. All parts of the circuits are securely fastened according to NEC standards.	10		
SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT			20%
1. Area is cleaned every after each session	10		Average of gained points X 10 X 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		
TIMELINESS/COMPLETION			20%
1. Work is submitted one or more days ahead of due date	10		Average of gained points X 10 X 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		
TOTAL			

Assessor

MARKING GUIDE

ET 211 Industrial/Commercial Wiring

CRITERIA
ACCURACY
<p>CLO1 – Design electrical requirements for a given load for commercial/industrial building.</p> <p>CLO2 – Install electrical wiring for commercial/industrial establishment.</p> <p>CLO3 – Install service equipment and service entrance for commercial/industrial establishment.</p> <p>CLO4 – Install intercom system/telephone system for commercial buildings.</p> <p>CLO5 – Determine transformer type and size for commercial/industrial installation.</p> <p>CLO6 – Troubleshoot, repair and maintain industrial/commercial wiring system.</p> <ul style="list-style-type: none"> • 10 points will be awarded if the criteria on each CLO are met, 1 point if the criteria are not met.
QUALITY OF WORK (WORKMANSHIP)
<p>CLO1 – DESIGN ELECTRICAL REQUIREMENTS FOR A GIVEN LOAD FOR COMMERCIAL/INDUSTRIAL BUILDING.</p> <p><i>**The "Workmanship" criterion is not used to assess CLO1</i></p>
<p>CLO2 – INSTALL ELECTRICAL WIRING FOR COMMERCIAL/INDUSTRIAL ESTABLISHMENT.</p> <ol style="list-style-type: none"> 1. Electrical components are installed according to measurements given. Tolerance $\pm 5\%$ <ul style="list-style-type: none"> • 1 point deduction for every incorrect measurement. 2. Electrical boxes are securely fastened on wiring boards <ul style="list-style-type: none"> • 2 points deduction for every box not securely fastened. 3. Electrical boxes are aligned and leveled according to plans and specifications <ul style="list-style-type: none"> • 2 points deduction for every box not properly aligned and leveled 4. Pipes/conduits are bent in accordance with NEC standards <ul style="list-style-type: none"> • 2 points deduction for each conduit pipe with bend defects. 5. Pipes/conduits entry point is secured by appropriate fittings <ul style="list-style-type: none"> • 2 points deduction for every entry point not secured by appropriate fitting.
<p>CLO3 – INSTALL SERVICE EQUIPMENT AND SERVICE ENTRANCE FOR COMMERCIAL/INDUSTRIAL ESTABLISHMENT.</p> <ol style="list-style-type: none"> 1. Electrical components are installed according to measurements given. Tolerance $\pm 5\%$ <ul style="list-style-type: none"> • 1 point deduction for every incorrect measurement. 2. Panel board is securely fastened on wall cavity. <ul style="list-style-type: none"> • 2 points deduction if the panel board is not securely fastened on wall cavity. 3. Panel board is aligned and leveled according to plans and specifications <ul style="list-style-type: none"> • 2 points deduction if the panel board is not properly aligned and leveled 4. Conduits entry point is secured by appropriate fittings <ul style="list-style-type: none"> • 2 points deduction for every entry point not secured by appropriate fitting.
<p>CLO4 – INSTALL INTERCOM SYSTEM/TELEPHONE SYSTEM FOR COMMERCIAL BUILDINGS.</p> <ol style="list-style-type: none"> 1. Intercom unit is securely mounted on the wall cavity. <ul style="list-style-type: none"> • 2 points deduction for every intercom unit not securely mounted on the wall cavity. 2. Intercom cables are securely fastened to wall/ceiling cavities. <ul style="list-style-type: none"> • 2 points deduction for every intercom cable not securely fastened on the wall/ceiling cavity. 3. Raceway/Conduit of approved type for intercom/telephone installation is used to protect cables according to NEC standards. <ul style="list-style-type: none"> • 2 points deductions for every cable run not appropriately protected by raceway/conduit. 4. Entry points are secured by appropriate fittings. <ul style="list-style-type: none"> • 2 points deduction for every entry point not secured by appropriate fitting.
<p>CLO5 – DETERMINE TRANSFORMER TYPE AND SIZE FOR COMMERCIAL/INDUSTRIAL INSTALLATION.</p> <ol style="list-style-type: none"> 1. Transformer is installed according to manufacturer's specifications. <ul style="list-style-type: none"> • 2 points deductions for every manufacturer's specification not followed. 2. Transformer is securely mounted on the floor with approved type of concrete anchorage. <ul style="list-style-type: none"> • 2 points deductions for every missing bolts/nuts on the transformer mounting frame. • 2 points deductions for every mistightened bolts/nuts on the transformer mounting frame. 3. Transformer covers and other accessories are replaced after electrical connection is made. <ul style="list-style-type: none"> • 2 points deductions for every misreplaced accessory

4. Appropriate conduit pipes are used to protect conductors from physical hazards according to NEC standards.
 - 2 points deductions for every improperly protected conductor.
5. Conduits entry point is secured by appropriate fittings according to NEC standards.
 - 2 points deduction for every entry point not secured by appropriate fitting.

CLO6 – TROUBLESHOOT, REPAIR AND MAINTAIN INDUSTRIAL/COMMERCIAL WIRING SYSTEM.

1. Defective part of the circuit is removed and replaced according to best practices.
 - 2 points deduction for every damage inflicted to other parts of the circuit during removal of defective parts.
2. Circuit's integrity is restored after repair and maintenance procedure is done according to NEC standards.
 - 2 points deductions for every NEC standard violation.
3. Device cover is replaced after troubleshooting and repair is done according to NEC standards.
 - 2 points deductions for every device cover improperly replaced.
4. All parts of the circuits are securely fastened according to NEC standards.
 - 2 points deductions for every improperly fastened part of the circuit.

SAFETY, PROPER USED OF TOOLS, MATERIALS AND EQUIPMENT

1. Area is cleaned upon completion of the job
 - 10 points is awarded to properly cleans area
 - 6 points is awarded for slightly cleaned area
 - No point is awarded if the area is unclean.
2. Tools and equipment properly used.
 - 2 points deduction for every improper use of tools and/or equipment
3. Materials are used properly
 - 2 points deduction for every improper use of materials
4. Safety procedure is strictly observed within the duration of work
 - 2 points deduction for every violation of safety rules.

TIMELINESS/COMPLETION

1. 10 points is awarded if work is submitted one or more days ahead of due date
2. 8 points is awarded if work submitted on due date
3. 4 points is awarded if work submitted a day after due date
4. Zero for the work submitted more than two days after due date