

# BI 0802 - INTRODUCTION TO LIGHTING RETROFITS

## Catalog Description

Formerly known as CET 802

Prerequisite: Completion of BI 801 with grade of "Pass"

Hours: 40 (20 lecture, 20 laboratory)

Description: Provides well-rounded competency-based understanding of lighting retrofit trade fundamentals through hands-on experience in commercial retrofit procedures and skills. Includes electrical safety, policies, and practices as relate to retrofit work. Students required to secure personal protective equipment as of first class session. (pass/no pass grading) (noncredit)

## Course Student Learning Outcomes

- CSLO #1: Demonstrate knowledge of electricity and wiring fundamentals as they apply to lighting retrofit work.
- CSLO #2: Display with accuracy a thorough understanding of the basic steps and procedures of a typical lighting retrofit, including all safety requirements.
- CSLO #3: Identify fixtures, devices, and components typical to lighting retrofit activity to industry standard.
- CSLO #4: Demonstrate safe ladder use when accessing ceiling and wall mounted fixtures to industry standard.

## Effective Term

Fall 2020

## Course Type

Noncredit

## Contact Hours

40

## Outside of Class Hours

14

## Total Student Learning Hours

54

## Course Objectives

Lecture Objectives:

1. Identify common work hazards in the lighting retrofit trades
2. Explain the importance of Lock-out / Tag-out during retrofits
3. List safety protocols for typical lighting retrofit activities
4. Explain the 4 major benefits of lighting retrofits:
  - (a) reduces energy use/ cost
  - (b) positive environmental impact / improved air quality
  - (c) improves light quality
  - (d) reduces maintenance cost
5. Identify the primary uses for lighting
6. Differentiate between task and area lighting
7. Differentiate between interior and exterior lighting
8. Explain how light is measured

9. Differentiate between Lumens and Foot Candles.
10. Solve various lighting equations
11. Define Luminous Efficacy
12. Define Luminaire
13. Identify the basic types of interior lighting fixtures: recessed, surface mount, suspended
14. Differentiate between the De-lamping and Re-lamping
15. Differentiate between different types of lighting technologies Halogen, incandescent, Fluorescent, LED, CFL, HID, etc. and the efficiencies of each
16. Differentiate between different sizes of fluorescent tubes: T-12, T-10, T-8, T-5
17. Determine light hue in degrees Kelvin for various fluorescent lamps
18. Describe the function and operation of a fluorescent ballast
19. Identify different fluorescent ballast: instant start; rapid start; programed start
20. List the advantages of an electronic adaptable (universal) ballast over a magnetic ballast.
21. Differentiate between shunted and non-shunted fluorescent tube sockets (tombstones)
22. Identify different ballast configurations: 1 tube up to 4 tube
23. List the steps/ procedures for a typical T-12 to T-8 fluorescent retrofit.
24. Explain the benefits of LED lighting retrofits
25. List the steps for a T-8 to LED retrofit with external driver
26. List steps for a fluorescent to LED retrofit with internal driver
27. Identify typical exterior lighting retrofits
28. Differentiate between HID, halogen, & low pressure lighting
29. Identify common symbols used in electrical blueprints
30. Use Ohms law/Watts law for lighting circuit calculations
31. Explain the importance of properly grounding light fixtures
32. Identify various grounding hardware and equipment typical to lighting installations
33. List the conductors and hardware common to lighting retrofit work to include wire gauge and type
34. Differentiate between EMT and flex conduit, and explain the uses of each in typical lighting retrofit work
35. Correctly use the wire gauge chart to determine wire size for specific lighting circuits on the plans provided
36. Correctly use ohms law to show voltage drop in a circuit
37. Define ampacity – and explain why it is important when designing lighting circuits
38. Explain the code requirements for over current protection for lighting circuits
39. Identify the various lighting control options and explain the advantages of ea., to include: occupancy sensors, dimmers; timers; time clocks; photocells and sensors; motion detectors; energy management systems (EMS)
40. Map a typical 3/way switch lighting circuit for the room on the activity sheet provided

Laboratory Objectives:

1. Use safe work practices and routines when performing wiring and retrofit activities in the lab and on the job
2. List Personal Protective Equipment (PPE) required for lighting retrofit work.
3. Follow OSHA safety rules and guidelines when using ladders during lighting retrofits
4. Effectively employ lock-out tag-out procedures when performing lighting retrofits
5. Verify that the power is off using a voltage proximity tester
6. Perform practice lighting retrofit activities in the lab following safety protocols and NEC requirements.
7. Demonstrate safe use of meters and diagnostic gear used during lighting retrofit activities

8. Accurately measure and cut the EMT conduit provided
9. Install the ½ EMT conduit as per the conduit plan (provided)
10. Using the appropriate tubing bender – accurately bend the conduit according to the plan – provided.
11. Correctly pull single, double, and multiple stands of wiring through the conduit.
12. Install to code correct switch boxes and lighting boxes
13. Identify the correct wire type and gauge for lighting circuits
14. Correctly wire/install a single pole switch lighting circuit
15. Correctly wire/ install a three way switch lighting circuit
16. Demonstrate how to wire various fluorescent ballast (1 tube, 2 tube, 3 tube, 4 tube) to the power supply and respective tube terminals (tomb stones)
17. Accurately size circuit breakers to various lighting circuits
18. Perform a LED tube retrofit with internal drivers
19. Perform a LED tube retrofit with external drivers
20. Correctly wire ultra sonic and infrared occupancy sensors
21. Accurately install independent fixture controls
22. Correctly install whole system circuit level controls
23. Accurately install fixture level lighting controls
24. Perform a variety of interior lighting retrofits – as assigned
25. Correctly install an electronic controllable F-tube ballasts
26. Retrofit select exterior lighting fixtures
27. Accurately install photo cell switches (daylight sensors) on exterior light circuits.
28. Replace a single pole switch with a manual timer switch
29. Replace a halogen wall pack with an LED unit
30. Convert a canopy light from incandescent to LED.

## General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

## Articulation Information

- Not Transferable

## Methods of Evaluation

- Objective Examinations
  - Example: Students will answer questions on retrofit procedure, steps, analysis, components, safety protocols required in the lighting retrofit projects. Points will be assigned to each question and converted to a letter grade.
- Skill Demonstrations
  - Example: Students will demonstrate the correct and safe use of various lighting diagnostic tools/equipment, and the electrical tools required during lighting retrofit projects. The grading is determined by a grading rubric.

## Repeatable

Yes

## Methods of Instruction

- Laboratory
- Lecture/Discussion

Lab:

1. Lab techniques will be presented in a "describe / show / review" methodology. Students will complete a safety test before using equipment and demonstrate an understanding of Lock-Out/Tag-Out (LOTO). Instructor will work with students until they can successfully complete the test with 100% success rate. Laboratory OBJ 1

Lecture:

1. Instructor will lecture on the importance of and rationale for lighting retrofits, electrical safety considerations, and protocols. The student will be given an opportunity to clarify any questions in an instructor-guided discussion. Lecture OBJ 1

## Typical Out of Class Assignments Reading Assignments

1. Read the handout "What is a Lighting Retrofit". Be prepared to participate in a class discussion and to answer quiz questions.
2. Read the UC Davis Lighting Efficiency Center report on LED Lighting: <http://cltc.ucdavis.edu/publication/201505-electrical-compatibility-mr16-led-replacements> and be prepared to discuss and answer questions.

## Writing, Problem Solving or Performance

1. Prepare a report on light quality in the classroom and it's affects on work efficiency, learning, and health.
2. Using the light and electrical meters provided, and following safe practices, calculate the efficacy of classroom lighting.
3. Work the lighting efficiency problems on the activity sheet provided, and be ready to share your work in class.

## Other (Term projects, research papers, portfolios, etc.)

1. Research and prepare a report on the benefits of a lighting retrofit – from T-12 to LED - for a classroom situation. Include efficiency, improved light quality, environmental benefits, and return on investment projections.
2. Maintain a class notebook organized by topic that includes lecture notes, lab notes, class handouts, and supplementary materials.

## Required Materials

- Lighting Retrofit and Relighting
  - Author: James R. Benya and Donna J. Leban
  - Publisher: John Wiley & Sons
  - Publication Date: 2011
  - Text Edition: 1st
  - Classic Textbook?: No
  - OER Link:
  - OER:
- Lighting & Controls, Transitioning to The Future
  - Author: Stan Wierczyk
  - Publisher: The Fairmont Press, Inc. Lilburn, GA
  - Publication Date: 2014
  - Text Edition: 1st
  - Classic Textbook?: No
  - OER Link:
  - OER:

**Other materials and-or supplies required of students that contribute to the cost of the course.**

Student manuals provided by the instructor.