Western Technical College

10614148 Building Systems

Course Outcome Summary

Course Information

Description	This course familiarizes advanced architectural students with basic design procedures, system characteristics and flexibilities of mechanical and electrical systems in construction. A working-level knowledge of the principles and practices related to building electrical, plumbing, HVAC, fire protection, and telecommunications systems will be presented. Students will make connections through practical exercises and real world design problems.
Career Cluster	Architecture and Construction
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	72

Pre/Corequisites

Prerequisite	10614132 Architectural Drafting - Commercial
Prerequisite	10614134 Structural Drafting - Commercial
Prerequisite	10804107 College Mathematics
Pre/Corequisite	10614136 Architectural Bldg Info Mgmt

Textbooks

Design Integration Using Autodesk Revit 2022. Copyright 2021. Stine, Daniel John. Publisher: Schroff Development Corporation. **ISBN-13**: 978-1-63057-451-2. Required.

Success Abilities

1. Cultivate Passion: Increase Self-Awareness

2. Live Responsibly: Embrace Sustainability

Program Outcomes

1. Develop construction documents
2. Evaluate building materials
3. Develop building designs
4. Integrate building systems

Course Competencies

1. Summarize plumbing system fundamentals.

Criteria

You will know you are successful when

1.1. you prepare a report identifying the important characteristics of a specific community water supply system.
1.2. you present findings of important characteristics of a specific community water supply system.
1.3. you compare and contrast the features of various water efficient plumbing fixtures.
1.4. you solve basic plumbing system design problems.
1.5. you match valve photos to valve types.
1.6. you list LEED compliant features of plumbing systems.

Learning Objectives

1.a. Describe the basic components of modern plumbing systems.
1.b. Differentiate between potable and non-potable water.
1.c. Identify sources of water supply for a community.
1.d. Compare community water supply systems to private water supply systems.
1.e. Discuss well construction and protection methods.
1.f. Identify common materials used for pipes and tubing.
1.g. Describe the function of five common types of plumbing fixtures.
1.h. Explain the use of various types of valves used in plumbing systems.
1.i. Describe the differences between the three types of code-compliance inspections.
1.j. Review LEED criteria for plumbing systems.

2. Evaluate water supply system design requirements.

Criteria

You will know you are successful when

2.1. you solve basic water supply system design problems.
2.2. you calculate water supply system fixture units.
2.3. you sketch a basic water supply system.
2.4. you compare and contrast water heater features.

Learning Objectives

2.a. Describe the six main parts of a building water supply system.
2.b. Discuss the importance of maintaining proper water pressure.
2.c. Discuss the effects of water velocity on a building water supply system.
2.d. Outline factors that affect pipe durability.
2.e. Explain the use of fixture units in water supply system design.
2.f. Define terms related to water supply system design.
2.g. Compare various methods of regulating water temperatures in building water supply systems.
2.h. Define terms related to pumps used in water supply systems.
2.i. Compare two types of water softening methods.
2.j. Determine requirements for various aspects of water supply system design.

3. Evaluate sanitary drainage system design requirements.

Criteria

You will know you are successful when

3.1. you solve basic sanitary drainage system design problems.
3.2. you calculate sanitary drainage system fixture units.
3.3. you sketch a basic sanitary drainage system.
3.4. you calculate roof drainage requirements.

Learning Objectives

3.a. Describe features of traps in sanitary drainage systems.
3.b. Explain requirements for vents in sanitary drainage systems.
3.c. Explain the use of drainage fixture units in sanitary drainage system design.
3.d. Describe methods of installing sanitary drainage system components.
3.e. Determine requirements for various aspects of sanitary drainage system design.

4. Develop various plumbing drawings.

Criteria

You will know you are successful when

4.1. you draw a water supply system diagram using Revit MEP software.
4.2. you draw a sanitary drainage system diagram using Revit MEP software.
4.3. your drawings contain symbols legends.
4.4. your drawings contain plumbing lines for given design.
4.5. your drawings contain symbols for given design.
4.6. your drawings contain abbreviations for given design.
4.7. your drawings contain lineweights that emphasize plumbing information.
4.8. your drawings contain building information that matches given design.
4.9. your drawings contain lineweights that de-emphasize building information.

Learning Objectives

4.a. Cite basic components of plumbing plans.
4.b. Identify symbols used in preparing plumbing plans.
4.c. List attributes typically included in plumbing fixture schedules.
4.d. Differentiate between single-line and detailed isometric drawing.
4.e. Describe how various CAD applications can be used to draft plumbing plans.

5. Summarize thermal and environmental concepts related to buildings.

Criteria

You will know you are successful when

5.1. you graph various room environmental conditions on a psychrometric chart.
5.2. you identify variables that can be modified to obtain acceptable comfort levels using a psychrometric chart.
5.3. you solve basic thermal related design problems.
5.4. you list LEED compliant requirements of thermal and environmental systems.
5.5. you sketch water intrusion solutions.

Learning Objectives

5.a. Differentiate between heat and temperature.
5.b. Describe the three modes of heat transfer.
5.c. Summarize aspects of psychometrics.
5.d. Discuss factors that influence body heat and thermal comfort.
5.e. Correlate indoor air contaminants to indoor air quality.
5.f. Discuss the importance of ventilation in buildings.
5.g. Describe the three basic categories of moisture problems in buildings.
5.h. Summarize methods used to minimize moisture problems in buildings.
5.i. Describe the relationship of solar positioning and sustainability.

6. Compute heating load for buildings.

Criteria

You will know you are successful when

6.1. you compare and contrast heat loss through various building materials.
6.2. you identify thermal characteristics of air films and air spaces.
6.3. you identify outside heating design temperature for a specific geographical location
6.4. you suggest insulation levels for a building element.
6.5. you compare and contrast different insulation materials.
6.6. you solve heating load related design problems.
6.7. you calculate heat loss through various building envelope elements.
6.8. you calculate total building heat loss using hand calculations.
6.9. you calculate temperature differential for a specific geographical location.
6.10. you show total building heat loss using Revit MEP.

Learning Objectives

6.a. Differentiate between natural convection and forced convection.
6.b. Define terms related to radiation heat transfer.
6.c. Describe how various types of surfaces affect radiant heat transfer.
6.d. Identify factors that contribute to heat loss in a building.
6.e. Summarize the relationships between R, C, k, and U values.
6.f. Describe common methods of controlling various types of heat loss in buildings.
6.g. Differentiate between building heat loss and heating load.
6.h. Determine outside design temperature.
6.i. Explain how thermal insulation restricts the flow of heat.

7. Compute cooling load for buildings.

Criteria

You will know you are successful when

7.1. you identify outside cooling design temperature for a specific geographical location.
7.2. you identify solar heat gain factors of various building materials.
7.3. you compare and contrast parameters of different glazing materials.
7.4. you suggest glazing options for a building type.
7.5. you compare and contrast different solar shading techniques.
7.6. you suggest solar shading options for a window configuration.
7.7. you solve heating load related design problems:
7.8. you calculate solar heat gain through various building envelope elements.
7.9. you calculate temperature differential for a specific geographical location.
7.10. you show total building cooling load using Revit MEP.

Learning Objectives

7.a. Describe the factors that must be considered to determine heat gain in buildings.
7.b. Differentiate between sensible and latent heat.
7.c. Explain effects of over sizing cooling equipment.
7.d. Determine geographical design conditions affecting cooling load computations.
7.e. Explain how building design factors relate to heat gain.
7.f. Explain how building occupancy relates to heat gain.
7.g. Compare infiltration calculations for heat gain to infiltration calculations for heat loss.

8. Analyze HVAC systems in buildings.

Criteria

You will know you are successful when

8.1. you participate in a tour of a building that utilizes various heating, ventilating and air conditioning systems.
8.2. you prepare a report of building tour observations.
8.3. you identify various heating systems.
8.4. you identify various ventilation systems.
8.5. you compare and contrast passive solar systems with active solar systems.

Learning Objectives

8.a. Describe various building solar systems.
8.b. Differentiate between boilers and furnaces.

8.c. Describe rooftop units.
8.d. Compare features of various types of cooling systems.
8.e. Describe types of ventilation equipment.

8.f. Compare humidification to dehumidification.
8.g. Describe various air distribution components.
8.h. Describe various hydronic distribution components.
8.i. Summarize LEED requirements for building energy management.
8.j. Compare features of residential HVAC systems to features of commercial HVAC systems.

9. Develop HVAC drawings.

Criteria

You will know you are successful when

9.1. you draw an HVAC system diagram using Revit MEP software.
9.2. your drawings contain a furnace sized for given design.
9.3. your drawings contain ducts sized for given design.
9.4. your drawings contain supply registers sized for given design.
9.5. your drawings contain return grills sized for given design.
9.6. your drawings contain lineweights that emphasize HVAC information.
9.7. your drawings contain building information that matches given design.
9.8. your drawings contain lineweights that de-emphasize building information.

Learning Objectives

9.a. Cite basic components of HVAC plans.
9.b. Identify symbols used in preparing HVAC plans.
9.c. Compare residential HVAC plans to commercial HVAC plans.
9.d. List attributes typically included in various HVAC schedules.
9.e. Differentiate between single-line and double-line HVAC plans.
9.f. Describe how various CAD applications can be used to draft HVAC plans.

10. Outline electrical theory, materials, and systems for buildings.

Criteria

You will know you are successful when

10.1. you calculate current drop or voltage drop using appropriate variables.
10.2. you trace electricity path from generator to electrical device.
10.3. you identify electrical costs for specific geographic locations.
10.4. you sketch steps to convert DC power to AC power.

Learning Objectives

10.a. Describe various electrical generation systems.
10.b. Differentiate between conductors, insulators and semiconductors.
10.c. Define various units of electricity.
10.d. Outline basic circuit fundamentals.
10.e. Differentiate between direct current and alternating current.
10.f. Describe various building electrical components.
10.g. Discuss importance of occupant protection from electrocution.
10.h. Describe basic electrical theory.
10.i. Outline strategies for protecting electrical equipment.

11. Summarize building electrical design principles.

Criteria

You will know you are successful when

11.1. you identify applicable electrical codes.
11.2. you identify common electrical devices used in buildings.
11.3. you analyze an electrical bill for a given building.
11.4. you calculate demand load for a building type.
11.5. you select electrical panel board.
11.6. you determine electric service entrance size.

Learning Objectives

11.a. Discuss importance of following electrical codes.
11.b. Identify basic electrical service specification requirements.
11.c. Compare residential electrical systems to commercial electrical systems.
11.d. Outline conductor enclosure requirements.
11.e. Specify occupant protection requirements.
11.f. Apply basic electrical system design guidelines.

12. Evaluate lighting design requirements.

Criteria

You will know you are successful when

12.1. you measure artificial lighting footcandle levels in various rooms within a building.
12.2. you compare room lighting levels to IESNA recommended levels.
12.3. you suggest lighting solutions for a specific type of room task.
12.4. you measure daylighting footcandle levels of various spaces inside and outside a building.
12.5. you create a daylighting study model for a room or building.
12.6. you construct a light fixture.
12.7. you create a candlepower distribution curve for a light fixture.
12.8. you compare and contrast various lamps used in lighting fixtures.

Learning Objectives

12.a. Discuss importance of following lighting standards and codes.
12.b. Define terms related to behavior of light.
12.c. Discuss characteristics of artificial lighting.
12.d. Identify types of artificial light sources.
12.e. Categorize forms of architectural lighting.
12.f. Compare various lighting installations.
12.g. Apply basic lighting design guidelines.
12.h. Compare features of various lighting system controls.
12.i. Summarize basic day lighting principles.
12.j. Solve basic lighting design problems.

13. Develop various electrical drawings.

Criteria

You will know you are successful when

13.1. you draw an electrical system diagram using Revit MEP software.
13.2. your drawings contain a symbols legend.
13.3. your drawings contain a panel schedule.
13.4. your drawings contain code compliant device symbols for given design.
13.5. your drawings contain lineweights that emphasize electrical information.
13.6. your drawings contain building information that matches given design.
13.7. your drawings contain lineweights that de-emphasize building information.

Learning Objectives

13.a. Cite basic components of electrical plans.
13.b. Identify symbols used in preparing electrical plans.
13.c. Compare residential electrical plans to commercial electrical plans.
13.d. List attributes typically included in various electrical schedules.
13.e. Differentiate between lighting plans and power plans.
13.f. Describe how various CAD applications can be used to draft electrical plans.

14. Analyze life safety systems in buildings.

Criteria

You will know you are successful when

14.1. you analyze an existing building or room noting locations of life safety systems.
14.2. you draw a life safety system diagram using Revit MEP software.
14.3. you research testing reports for various building materials and present to class.

14.4. you list appropriate strategies to achieve building security for a designated building type.

Learning Objectives

14.a. Discuss importance of incorporating life safety systems in buildings.
14.b. Explore various aspects of fire.
14.c. Describe performance of various materials in a fire.
14.d. Compare building construction types.
14.e. Differentiate between passive fire protection methods and active fire protection methods.
14.f. Identify components of fire detection and alarm systems.
14.g. Outline strategies used to achieve building security.

15. Analyze telecommunication systems in buildings.

Criteria

You will know you are successful when

15.1. you compare and contrast various network topologies.
15.2. you analyze an existing building or room noting locations of telecommunication systems.
15.3. you draw a telecommunication system diagram using Revit MEP software.
15.4. you research future telecommunication trends/directions.

Learning Objectives

15.a. Summarize fundamentals of telecommunication systems.
15.b. Diagram various network topologies used.
15.c. Compare properties of various transmission media.
15.d. Outline strategies used to connect telecommunication devices.
15.e. Describe main subsystems of a commercial structured cabling system.
15.f. Outline design requirements for subsystems of a structured cabling system.
15.g. Describe main components of an advanced home wiring system.