ESYS 021: RESIDENTIAL ENERGY MODELING

Originator
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Justification / Rationale
Add Distance Ed Modality

Effective Term
Fall 2020

Credit Status
Credit - Degree Applicable

Subject
ESYS - Energy Systems Technology

Course Number
021

Full Course Title
Residential Energy Modeling

Short Title
BLDG ENERGY MODELING

Discipline

Disciplines List
Environmental Technologies (Environmental hazardous material technology, hazardous material abatement, environmentally conscious manufacturing, waste water pretreatment, air pollution control technology, integrated waste management, water treatment, sewage treatment)

Modality
Face-to-Face
100% Online
Hybrid

Catalog Description
This course is for students interested in a career in the building energy consulting industry. Energy consultants select the energy systems, documents, and verify energy code is being met. Energy consultants work in a team environment, coordinating directly with architects, engineers, subcontractors, and the building owners to oversee, and examine multiple pathways to achieve the energy goals set by the owners. The student will model the building with alternative wall systems, roofs, window, and energy systems to meet the owner?s energy goals. The student will receive comprehensive training in energy analysis software programs that may be used to document compliance with CA Building Energy Efficiency Standards (Title 24, Part 6), ASHRAE 90.1 Standards, HERS energy rating systems as well as residential and nonresidential Green Building rating systems, such as GreenPoint Rated and LEED.

Schedule Description
This course is for students interested in a career in the building energy consulting industry. An energy consultant selects the energy systems, documents, and verifies energy code is being met.
Prerequisite: BIT 024
Advisory: ACR 075, ARCH 011, ESYS 004, & ESYS 005

Lecture Units
2

Lecture Semester Hours
36

Lab Units
1

Lab Semester Hours
54

In-class Hours
90

Out-of-class Hours
72

Total Course Units
3

Total Semester Hours
162

Prerequisite Course(s)
BIT 024
Advisory: ACR 075, ARCH 011, ESYS 004, & ESYS 005

Required Text and Other Instructional Materials
Resource Type
Web/Other

Description
•[California] Building Energy Efficiency Standards for Residential and Nonresidential Buildings (latest version) http://energy.ca.gov/2012publications/CEC-400-2012-004/CEC-400-2012-004-CMF-REV2.pdf

Resource Type
Web/Other

Description
•[California] Residential Compliance Manual (latest version) http://energy.ca.gov/2013publications/CEC-400-2013-001/CEC-400-2013-001-CMF-REV2.pdf

Resource Type
Web/Other

Description
•[California] Reference Appendices: Joint Appendices, Residential Appendices, Nonresidential Appendices (latest version) http://energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Class Size Maximum
27

Entrance Skills
Use the appropriate ACCA Manual to determine the load factors and use the standard estimate form.

Requisite Course Objectives
ACR 075-Use the appropriate ACCA Manual to determine the load factors and use the standard estimate form

Entrance Skills
Survey a residential building to gather information for a heating and cooling load calculation.

Requisite Course Objectives

ACR 075-Survey a residential building to gather information for a heating and cooling load calculation.

Entrance Skills

Demonstrate the ability to draw appropriate solutions of assigned construction details.

Requisite Course Objectives

ARCH 011-Demonstrate the ability to draw appropriate solutions of assigned construction details.

Entrance Skills

Demonstrate an understanding of a complete set of working drawings.

Requisite Course Objectives

ARCH 011-Demonstrate an understanding of a complete set of working drawings.

Entrance Skills

Apply California energy codes in construction, regulation and design.

Requisite Course Objectives

BIT 024-Apply the codes in construction, regulation, and design

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Entrance Skills

Determine needed compliance documents for various project scenarios.

Requisite Course Objectives

BIT 024-Determine needed compliance documents for various project scenarios.

Entrance Skills

Provide pertinent information for completion, submission and registration of compliance documents.

Requisite Course Objectives

BIT 024-Provide pertinent information for completion, submission, and registration of compliance documents.

Entrance Skills

Apply basic operations to solve application problems.

Requisite Course Objectives

ESYS 004-Apply the basic operations to solve application problems.

Entrance Skills

Comprehend the concept of a fraction as part of a whole.

Requisite Course Objectives

ESYS 004-Comprehend the concept of a fraction as a part of a whole.

Entrance Skills

Apply methods of conversion between percentages, decimals and fractions,.

Requisite Course Objectives

ESYS 004-Apply methods of conversion between percentages, decimals, and fractions.

Entrance Skills

Define energy and name of its source.

Requisite Course Objectives

ESYS 005-Define energy and name of its source.

Entrance Skills

Explain the importance of the sustainable design of buildings.

Requisite Course Objectives

ESYS 005-Describe construction flaws and air leakage.
ESYS 005-Describe the different types of thermal insulation.

Course Content

1. Introduction to Energy Modeling
   a. General history of the California Energy Commission (CEC)
   b. Navigating the CEC Website
   c. Energy Code Cycles
   d. California's Long Term Energy Efficiency Plan
   e. Zero Net Energy Building Goals
   f. History of Energy Modeling for Compliance
   g. Meet the Energy Consultant
   h. End Users / Participants: Architects, Designers, Contractors, Building Dept. Staff, Plan Check Staff, Engineers, HERS Raters, Support Staff, Attorneys, Property Managers, Building Owners, Program Administrators
   i. Entry Level Skills for an Energy Consultant - Residential & Light Commercial
   j. Advanced Skills for an Energy Consultant - High-Rise, Multi-Family, Heavy Commercial, Process / Manufacturing, Refrigerated Warehouses, Institutional, OSHPD
   k. Industry Trade Organization for Energy Consultants - CABEC, Certified Energy Analyst (CEA)
   l. Intro to Special Programs: CTCAC, CDLAC, CUAC, NSHP, MASH, SASH, EUCA, CAHP, CMFNH, Build It Green, LEED
   m. Navigation Skills for Study and Energy Efficiency Research
2. Fundamentals of Compliance Software
   a. CEC Approved Compliance Software - CBECC, EnergyPro, IES VE, RightEnergy T24, Simergy
   b. 2D vs. 3D modeling
   c. Alternative Calculation Method (ACM) Manuals - Residential and Non-Residential
   d. User's Manuals and Software Support
   e. Special Features and Modeling Assumptions
   f. Heat Transfer
   g. Time Dependent Valuation (TDV)
   h. Basic Requirements of all programs
   i. Collecting Input Data
   j. Modeling the Building
   k. Generating Reports
3. Basic EnergyPro
   a. Tutorial of EnergyPro Features & Functions / Learning the Program / Defaults
   b. Calculations
   c. Reports
   d. Lab Assignment: Build a skeleton model without respect to data
4. Take-Offs - Data Collection & Mark-Up
   a. Identifying Plan Set Sheets and Locating Pertinent Data
   b. Project Data
   c. Climate Zone / Weather File
   d. Construction Types - Opaque Surfaces, Fenestration, DHW, HVAC
   e. The Building Tree

    f. Lab Assignment: Demonstrate Blueprint/Plan Set Reading Skills and Mark-Up
       Input specified data into project file

5. Take-Offs - Walls
    a. Identifying the envelope and thermal barriers
    b. Identifying zones
    c. Determining Conditioned Floor Area (CFA)
    d. Roof and Floors
    e. Building an Excel Wall Schedule
    f. Lab Assignment: Take-off Wall Dimensions and Build a Wall-Schedule
       Input the Walls into the model

6. Take-Offs - Fenestration - Windows/Skylights/Exterior Doors
    a. Identifying fenestration for energy modeling
    b. Determining Window Values - NFRC, Defaults, COG
    c. Window Sizing and Call-Outs
    d. Overhangs and sidefins
    e. Building an Excel Window Schedule
    f. Lab Assignment: Take-Off Fenestration and Build a Window Schedule
         Input the windows into the model

7. DHW / HVAC / Mechanical
    a. Identify Mechanical Components
    b. Mechanical Input Instructions
    c. Lab Assignment: Input DHW / HVAC / Mechanical into the model

8. HERS Modeling & Renewables
    a. Types of HERS Measures
    b. HERS Triggers
    c. Compliance Effect of HERS Measures
    d. Solar PV and Renewables
    e. HERS Provider Registration Process
    f. Lab Assignment: Run multiple "what-if" calculations; Input into Model

9. Prescriptive Practice
    a. Prescriptive Compliance and the Standard Reference Model
    b. Lab Assignment: Input/compare Prescriptive Exercises

10. Compliance
    a. Analyzing the report, understanding and locating input errors
    b. Making Recommendations
    c. Lab Assignment: Compliance Problem Solving Exercises

11. Commercial Lighting - Indoor
    a. Mandatory Lighting / Controls / Demand Response
    b. Daylighting / Skylit / Sidelit
    c. Complete Building, Area Category, and Tailored Category Methods
    d. Lighting Power Density (LPD)
    e. Compliance Forms
    f. Lab Assignment: Calculate LPDs; Input Basic Lighting Model

12. Commercial Outdoor Lighting
    a. Mandatory Lighting / Controls / Zones
    b. Lighting Compliance Triggers
    c. Parking Lots / Hardscape / Landscape
    d. Lab Assignment: Identify and Calculate Lighting Requirements for Compliance

13. Report Analysis

a. Reading / Analyzing the Report
b. Forms and Form Generation

Lab Content

1. Use EnergyPro, Energy Plus, and department of energy compliance software to model building's energy compliance
   a. Tutorial of EnergyPro Features & Functions / Learning the Program / Defaults
   b. Calculations
   c. Reports
   d. Lab Assignment: Build a skeleton model without respect to data
2. Take-Offs - Data Collection & Mark-Up
   a. Identifying Plan Set Sheets and Locating Pertinent Data
   b. Project Data
   c. Climate Zone / Weather File
   d. Construction Types - Opaque Surfaces, Fenestration, DHW, HVAC
   e. The Building Tree
   f. Lab Assignment: Demonstrate Blueprint/Plan Set Reading Skills and Mark-Up
3. Produce professional energy reports using sketching and excel software.

Course Objectives

	Objectives
Objective 1	Review the technics and methods necessary to show compliance with the California Energy Standards.
Objective 2	Describe the energy modeling features of a building, including their characteristics and function.
Objective 3	Study the heat transfer characteristics of building construction assemblies and how they perform, both individually and as an integrated part of a whole building system.
Objective 4	Collect and analyze building and energy efficiency data from plan set take-offs or on-site field inspections.
Objective 5	Determine if the proposed building construction, design, and installation meet mandatory code requirements.
Objective 6	Review and apply compliance software approved by the California Energy Commission (CEC).
Objective 7	Demonstrate the energy modeling skills needed to create a computer generated certified energy analysis report.
Objective 8	Make sound recommendations for energy efficient and cost-effective building design.
Objective 9	Review needed compliance documents for various project scenarios and provide needed information for completion, submission, and registration.

Student Learning Outcomes

	Upon satisfactory completion of this course, students will be able to:
Outcome 1	Examine the heat transfer characteristics of building construction assemblies and how they perform, both individually and as an integrated part of a whole building system.
Outcome 2	Explain the two common building design methods, prescriptive and performance, to comply with California energy code.
Outcome 3	Student will model building with alternative energy systems to meet energy goals.

Methods of Instruction

Method	Please provide a description or examples of how each instructional method will be used in this course.
Demonstration, Repetition/Practice	Demonstrate the energy modeling skills needed to create a computer generated certified energy analysis report.
Collaborative/Team	Work in teams to collect and analyze building and energy efficiency data from plan set take-offs or on-site field inspections.
Activity	Collect and analyze building and energy efficiency data from plan set take-offs or on-site field inspections.
Participation	Class evaluation of blue prints and plans.
Lecture	Presentation of Energy and Compliance topics in context with representative construction examples.

Laboratory	Develop blue print/plan reading skills.
Discussion	Class discussion of plan check energy audits and rating results.

Methods of Evaluation

Method	Please provide a description or examples of how each evaluation method will be used in this course.	Type of Assignment
Laboratory projects	Evaluate plans and write energy audits.	In Class Only
Self-paced testing	Out of class readings and energy problem evaluations.	Out of Class Only
Student participation/contribution	Demonstrate the energy modeling skills needed to create a computer generated certified energy analysis report.	In and Out of Class
Mid-term and final evaluations	Comprehensive exam covering content of course. Exam may be project completed out-of-class or multiple choice in-class exercise.	In and Out of Class
Tests/Quizzes/Examinations	Quizzes completed out-of-class with in-class discussion of correct answers.	In and Out of Class
Group activity participation/observation	Work in teams to collect and analyze building and energy efficiency data from plan set take-offs or on-site field inspections.	In and Out of Class
Presentations/student demonstration observations	Present and discussion building and energy efficiency data from plan set take-offs or on-site field inspections.	In Class Only
Computational/problem-solving evaluations	Computational evaluation of heat transfer and energy efficiency.	Out of Class Only

Assignments

Other In-class Assignments

1. Collect and analyze building and energy efficiency data from plan set take-offs or on-site field inspections
2. Determine if the proposed building construction, design, and installation meet mandatory code requirements
3. Reading assigned chapters.
4. Class discussion.
5. Group interaction and presentation.
6. Evaluate industry.
7. Make sound recommendations for energy-efficient and cost-effective building design

Other Out-of-class Assignments

1. Read assigned text.
2. Industry journal entry.
3. Assigned worksheets.
4. Evaluate energy bill.
5. Evaluate energy rebates and incentives.
6. Prepare for in-class discussions on specific energy topics.
7. Case studies.

Grade Methods
Letter Grade Only

Distance Education Checklist

Include the percentage of online and on-campus instruction you anticipate.

Online %
75

On-campus %

25

What will you be doing in the face-to-face sections of your course that necessitates a hybrid delivery vs a fully online delivery?

The lab Instructor will provide technical support for students learning the variables involved in energy modeling software. The hybrid section will be used to have on one contact hours with students who may be struggling applying the technics or for students who need to have access to our lab laptop that been geared up with a software license.

Lab Courses

How will the lab component of your course be differentiated from the lecture component of the course?

In lab, students apply the concepts learned in the lecture portion of the course to complete modelling and plan take off assignments.

From the COR list, what activities are specified as lab, and how will those be monitored by the instructor?

All activities are monitored by the written reports and modelling software results submitted by students.
Students use EnergyPro, Energy Plus, and department of energy compliance software to complete assignments to model a sample building's energy compliance.
Students produce professional energy reports using sketching and excel software.
Students will download blue prints and plan sets, apply the concepts learned in the lecture, and return evaluations.

How will you assess the online delivery of lab activities?

Students will submit the results from the use of modelling software.
Students will submit written evaluations of plan checks.

Instructional Materials and Resources

If used, explain how specific materials and resources outside the LMS will be used to enhance student learning.

Software from the Department of Energy will be used for modelling energy usage in a building.

Effective Student/Faculty Contact

Which of the following methods of regular, timely, and effective student/faculty contact will be used in this course?

Within Course Management System:

Timely feedback and return of student work as specified in the syllabus
Discussion forums with substantive instructor participation
Regular virtual office hours
Online quizzes and examinations
Video or audio feedback
Weekly announcements

External to Course Management System:

Direct e-mail
Posted audio/video (including YouTube, 3cmediasolutions, etc.)

Briefly discuss how the selected strategies above will be used to maintain Regular Effective Contact in the course.

Timely feedback and return of student work with comments as specified in the syllabus.
Discussion forums with substantive instructor participation.
Online quizzes and examinations with correct answers provided as study tools.
Weekly announcement.

Other Information

Provide any other relevant information that will help the Curriculum Committee assess the viability of offering this course in an online or hybrid modality.

Energy audit materials and modelling software are all available online and students will be required to use these online materials regularly when working in the field. Learning online is very appropriate and will provide additional career readiness.

MIS Course Data

CIP Code

15.0503 - Energy Management and Systems Technology/Technician.

TOP Code
094610 - Energy Systems Technology

SAM Code
C - Clearly Occupational

Basic Skills Status
Not Basic Skills

Prior College Level
Not applicable

Cooperative Work Experience
Not a Coop Course

Course Classification Status
Credit Course

Approved Special Class
Not special class

Noncredit Category
Not Applicable, Credit Course

Funding Agency Category
Not Applicable

Program Status
Program Applicable

Transfer Status
Not transferable

Allow Audit
Yes

Repeatability
No

Materials Fee
No

Additional Fees?
No

Approvals

Curriculum Committee Approval Date
12/03/2019

Academic Senate Approval Date
12/12/2019

Board of Trustees Approval Date
1/17/2020

Course Control Number
CCC000587604

Programs referencing this course
Building Energy Consultant Certificate of Achievement (http://catalog.collegeofthedesert.eduundefined?key=137/)
Building Energy Systems Professionals (BESP) AS Degree (http://catalog.collegeofthedesert.eduundefined?key=202/)

Air Conditioning Refrigeration AS Degree (http://catalog.collegeofthedesert.eduundefined?key=51/)