Computer Aided Drafting

Description:

This course is designed to prepare individuals with the skills and technology requested by employers using Computer Aided Drafting (CAD) design. The certificate program focuses on the development of CAD skills and problem solving strategies used for sustainability related work.

This unit will prepare you to apply for the following certification(s):

1. LEED Green Associate

   The LEED Green Associate national credential is intended for professionals who want to demonstrate green building expertise in non-technical fields of practice.

2. CAD Sustainability-Certificate for Direct Employment

   The Certificate for Direct Employment can be obtained at Pima Community College. This program has been developed for individuals interested in gaining basic to advanced computer aided drafting knowledge as applied to project sustainability.

The eligibility requirements of this course are:

- College level communication course
- College level critical thinking course

Computer Aided Drafting		
MODULE	**TOPIC**	**CREDIT HOURS**
1	Computer Aided Drafting I	4
2	Landscape Sustainability and Water Harvesting	3
3	Introduction to Revit	4
4	Design and Drafting for Sustainability	4
5	Sustainable Residential Drafting and Design	4
6	Sustainability for Building Trades	3
7	Sustainability Exam Preparation	3
	Total	**25**

Note: "Credit Hours" refers to this class being conducted at a college or community college. Each credit hour represents 16 in-class hours or one hour of class time each week for 16 weeks.

Career Options:

Work as an entry-level drafter and designer in manufacturing industries.

Academic Options:

Continue your studies by completing an associate degree in computer aided drafting.

Credits:

- ✓ Material developed by: Pima Community College
- ✓ Modified and updated by: Rebecca Bouquot, Heidi Vasiloff P.C.

This course aligns with National Recognized Certifications in Green Building Design.
For testing information go to: The U.S. Green Building Council's LEED website at *www.usgbc.org.*

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Module 1: Computer Aided Drafting I

Description:

This courses offers two-dimensional computer aided drafting (CAD) concepts and techniques. The course includes CAD methods, electronic file management, freehand sketching, visualization, dimensioning, hard designed for individuals with no computer and/or drafting experience.

Certification(s): LEED Green Associate

Prerequisite: None

Required Materials: None

Credit Hours: 4

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Describe the methods and procedures used in computer aided drafting.
2. Demonstrate the use of electronic file management.
3. Demonstrate techniques and procedures of hard copy production.
4. Demonstrate drawing and visualization techniques.
5. Discuss and incorporate industry standards into assigned drawings.
6. Demonstrate the use of scales.
7. Demonstrate the use of dimensioning.
8. Develop and present a final project.

Module 1: Computer Aided Drafting

Expected Outcome	Topic	Suggested Activities or Resources
1	Computer Aided Drafting Procedures and Methods - Utilization in today's industry - Computer and operating system - Coordinate systems - Template utilization - Draw commands - Modify commands - Dimensioning commands - Layers management - Text, dimension, and multi-leader - Annotative features	

2	Electronic File Management - Drawing File types (.DWG and .DWT) saving and preservation - File location - Back-up procedure	
3	Hard Copy Production - Paper space layout and scaling - Layer management within viewport - Hard copy print and publish	
4	Drawing Sketching and Visualization - Freehand sketching - Floor Plan - Elevations - Section views	
5	Industry Applications and Standards - Architectural - Civil	
6	Scale Reading - Architectural - Decimal Foot	
7	Dimensioning Styles - Architectural - Civil	
8	Final Project - Definition - Project-specific CAD standards - Communication skills	

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Module 2: Landscaping Sustainability and Water Harvesting

Description:

This course provides principles and strategies for sustainability in landscapes. Topics include environmental impacts, techniques in water harvesting, prevention of environmental pollution, and the protection and maintenance of natural systems.

Certification(s): LEED Green Associate
Prerequisite: None
Required Materials: None
Credit Hours: 3 Credits

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss environmental impacts of the built environment on ecosystems.
2. Describe sustainable design principles and strategies, and their implementation.
3. Discuss the impact and implications of water use in the landscape, including water harvesting.
4. Define positive and negative energy inputs and outputs that impact the landscape.
5. Demonstrate how to maximize the natural assets of a landscape.
6. Discuss new, green technologies in the field of landscape construction.
7. Describe cost-effective strategies in the development of sustainable landscapes.

Module 2: Landscaping Sustainability and Water Harvesting

Expected Outcome	Topic	Suggested Activities or Resources
1	Sustainability Concepts - Natural processes and the interconnectedness of natural systems - Implications for design and management of the evolving landscape - Issues on the environmental continuum	
2	Sustainable Design Principles and Strategies - Regional context - Minimizing site impacts - Restoring damaged sites - Natural cycles - Reuse and recycling - Sustaining the functionality of healthy environments	

3	Water - The character of water - Water resource management: demand and use - Water pollution - Soils, slopes, and earthworks - Passive water harvesting - Active water harvesting	
4	Landscape Development - Integrated site design - The manipulation and mitigation of solar influence - Growing responsibly: native vs. exotic plant species - Plant selection to reduce water usage - Plant selection for fire prevention - Plant selection for food production: energy investment and return - Cost effectiveness of sustainable landscapes	
5	Permaculture - Ethics and principles - Landscape systems and connections to human health and wellbeing	
6	Green Technology in the Landscape - Green hardscape materials and strategies - Plant hybridization for sustainability	
7	Cost Effectiveness of Sustainable Landscapes - The life-span of a landscape - Reduction of chemical usage - Maintenance requirements and cost	

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Module 3: Revit

Description:

This course offers an introduction to Building Information Modeling (BIM) for architectural applications using Revit. The course includes the develop model, build levels and views, create drawing sheets, quantify model information, and plot drawings. and design communication strategies.

Certification(s):

LEED Green Associate

Prerequisite: None

Required Materials: None

Credit Hours: 4

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Demonstrate basic skills for file management, ribbon menu and project browser navigation, and model visualization.
2. Model walls, floors, roofs, ceilings associated to reference planes.
3. Employ modify tools to model a structure.
4. Create floor plans, elevations, roof plans, reflected ceiling plans, sections, and details.
5. Employ annotation features to document model information.
6. Create schedules quantifying model information.
7. Develop a basic architectural site plan.
8. Incorporate structural components with embedded engineering information.
9. Explore design alternatives using design options, conceptual massing, and area plans.
10. Create a new family from scratch employing parametric functions.
11. Demonstrate a basic understanding of rendering techniques and design communication.
12. Create sheet and plot.

Module 3: Revit		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	File Management and Menu Navigation - File naming conventions - Ribbon Menu - Project Browser - Properties - Levels and views - File organization - Importing other project files and other 2D CAD formats - Modeling environment	
2	Basic Modeling - Walls - Floors - Roofs - Ceilings - System component types - Temporary dimensions - Reference planes - Constraints - Sketch mode	
3	Model Modification Tools - Move - Array - Copy - Mirror - Trim	
4	Views - Plans - Elevations - Sections: Building, Wall and Detail - Callouts - Drafting views - Phasing	
5	Annotation - Text - Dimensions - Keynotes - Tags	
6	Schedules - Door and Window Schedules - Room Finish Schedules	

	- Material Takeoffs - Revisions - Area Schedules	
7	Creating a Basic Architectural Site Plan - Topography and Site components	
8	Structural Components - Grids and Columns - Beams and Beam systems	
9	Schematic Design Tools - Conceptual mass, area plans and design options	
10	Component Families - Types - Instances - Modification - Templates for new families - In-place families - 3d massing - Parameters	
11	Design Communication - Materials - Rendering - Visibility graphics - Animations - Visual styles - Detail levels - Lighting	
12	Creating the Final Drawing Sheet - Sheets - Titleblocks - View coordination - Plotting	

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Module 4: Design and Drafting for Sustainability

Certification(s): LEED Green Associate

Prerequisite: None

Required Materials: None

Credit Hours: 4

Description:

This course offers Computer Aided Design and design. This course leverages Building Information Modeling (BIM) software in an Integrated Project Delivery (IPD) approach to develop site, building, thermal-resistance, ventilation, material selection, and water-conserving strategies. The course includes an introduction to Geographic Information Systems (GIS), cost estimation, energy modeling, and green building rating systems.

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss current green building concepts and standards.
2. Generate data using BIM software to assess sustainable strategies and design.
3. Discuss IPD trends and impact on the AEC industry.
4. Integrate site development strategies to minimize environmental impact.
5. Analyze basic building planning strategies for passive solar design.
6. Investigate thermal resistance strategies to increase energy-efficiency.
7. Employ ventilation strategies to reduce energy use and increase human comfort and productivity.
8. Plan material use strategies to reduce consumption of natural resources.
9. Explore water-conserving strategies to reduce potable water consumption and waste.
10. Demonstrate basic cost estimation skills to evaluate implications of green building.

Module 4: Design and Drafting for Sustainability		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Green Building Concepts and Standards - Definition of sustainability - Economic, social, and environmental implications - Green building practices - Rating systems and certifications	
2	Building Information Modeling - Parametric modeling - Database of building objects - File management - Component families - Exporting and importing different file types - Printing	
3	Integrated Project Delivery - Evolution of drawing documentation and workflow - Interdisciplinary project collaboration - Model-based information exchange - Contractual structure - Information ownership	
4	Site Development Strategies - Climate - Geographic Information Systems (GIS) - Site selection (Brownfield and Greenfield) - Encouraging alternative transportation - Reducing heat island effect - Erosion and sedimentation - Stormwater management - Reducing site disturbance	
5	Building Planning Strategies - Massing - Orientation - Maximizing outdoor space - Daylighting - Shading - Lighting	
6	Thermal Resistance Strategies - Envelope design - Insulation - Heat gain analysis	

	- Fenestration - Glazing area - Shading - Vapor barriers	
7	Ventilation Strategies - Human comfort and the Psychometric chart - Passive systems - Mechanical systems - Heating and cooling loads - Indoor Air Quality	
8	Material Selection Strategies - Reuse - Reduce - Recycle - Waste - Transportation - Renewable - Durability	
9	Water-Conserving Strategies - Plumbing systems - Fixture efficiency - Greywater - Water harvesting - Water-efficient landscaping	
10	Cost Estimation - Soft and capital costs - Life-cycle cost and long term investment considerations	

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Module 5: Sustainable Residential Drafting and Design

Description:

Certification(s): LEED Green Associate
Prerequisite: None
Required Materials: None
Credit Hours: 4

Design (CADD) for a single family residence. Final product includes site plan, floor plan, exterior elevations, foundation plan and details, building elevations, schedules, plumbing plan, mechanical plan, plumbing, and electrical plan. Project includes the integration of sustainable building strategies.

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Demonstrate CAD skills for building development.
2. Integrate residential green building strategies.
3. Develop a house design from a given program.
4. Develop a site plan.
5. Develop a floor plan.
6. Develop building elevations.
7. Develop foundation plan.
8. Develop wall and building sections.
9. Develop a roof and framing plans.
10. Develop a plumbing plan.
11. Develop a mechanical plan.
12. Develop an electrical plan.
13. Develop a complete set of working drawings and presentation.

Module 5: Sustainable Residential Drafting and Design		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Residential CAD Skills - File management - Lineweight hierarchy - Annotation style - Titleblock - Sheet and set layout - Plotting	
2	Sustainability Practices - Sustainable Sites - Water Efficiency - Energy and Atmosphere - Materials and Resources - Indoor Environmental Quality	
3	House Design - Integration of sustainable design strategies • Building orientation • Maximizing outdoor space - Program integration - Space planning - Accessibility - Building and municipal codes	
4	Site Plan - Site selection - Building location - Water harvesting - Lot and house - Setbacks and easements - Utilities - Legal description and project information - General notes	
5	Floor Plan - Floor plan drawing - Space efficiency - Dimensions - Floor plan notes	
6	Exterior Building Elevations - Building elevation design and drawings - Dimensions - Building elevation notes	

7	Foundation Plan - Sustainable approach for material origin - Foundation plan design and drawing - Dimensioning - Foundation notes - Footing details	
8	Wall and Building Sections - Green building practices • Insulation • Thermal resistance • Vapor barriers - Typical wall section - Callouts and dimensions - Building sections - Callouts and notes	
9	Roof and Framing Plans - Roof design for green practices • Insulation • Thermal resistance • Vapor barriers - Roof plan design and drawing - Framing plan design and drawing - Truss details - Beam and header callouts and notes	
10	Interior Elevations and Schedules - Interior elevation design and drawing - Sustainable materials and fixture selection - Room finish schedule - Window schedule - Door schedule	
11	Plumbing Plan - Fixture efficiency - Greywater use - Plumbing design and drafting - Plumbing symbols and abbreviations - Plumbing fixture schedule - Plumbing riser diagram	
12	Mechanical Plan - Sustainable mechanical system design and drawing • SEER rating • Sizing a system • Indoor air quality - Mechanical symbols and abbreviations - Mechanical schedule	

13	Electrical Plan - Renewable energy options - Electrical design and plan drawing - Electrical symbols and abbreviations - Electrical panel - Electrical load calculations - Service detail	
14	Working Drawing Coordination - Set development - Presentation of design and sustainable strategies	

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Module 6: Sustainability for Building Trades

Description:
This course offers fundamentals of sustainable design. Includes green building practices and implementation. Also includes green building concepts, site and building planning and development, materials, strategies, cost benefit analysis, and practical applications in the current construction business environment.

Certification(s): LEED Green Associate
Prerequisite: None
Required Materials: None
Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss current green building standards.
2. Explore strategies for employing green building design and development.
3. Examine environmental impacts of building or not building green.
4. Investigate economic impacts of building or not building green.
5. Identify and research historical perspectives of green building practices.
6. Develop a vocabulary of technical terms related to environmental projects with the impact of sustainable design.
7. Demonstrate the ability to understand the roll of the owner, contractor, civil engineer, architect, building official and the LEED Accredited Professional (AP).
8. Evaluate cost implication of green building.
9. Discuss site development, sustainable water usage onsite, and impacts and control of water runoff.
10. Explain site selection strategies.
11. Discuss building commissioning, startup, and use with identification of key players.

Module 6: Sustainability for Building Trades		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Green Building Fundamentals and Sustainability in the Building Industry - The bottom line - Economic, social, and environmental imperatives	
2	Sustainable Design and Green Building - Sustainable design practices - Reduction, reuse, and recycling of materials - Green building practices - Leadership in Energy and Environmental Design	
3	Evaluating Cost Implications of Green Building - Soft and capital costs - Life-cycle cost and long term investment considerations	
4	Site Development Considerations - Site evaluation - Site development - Brownfield development strategies - Encouraging alternative transportation - Reducing site disturbance - Reducing heat island effect - Reducing pollution of site from building and lighting - Building orientation	
5	Managing Site Water Runoff - Erosion and sedimentation - Stormwater management	
6	Improving Water Use Efficiency - Water efficient landscaping - Water efficient buildings - Recycling wastewater - Rainwater reuse	
7	Improving a Buildings Energy Efficiency - Heating and cooling systems - Passive solar heating and cooling - Maximizing energy performance	

8	Renewable Energy Sources - Wind, photovoltaic, - Solar thermal, geothermal, - Hydroelectric, biomass, and tidal systems	
9	Onsite Renewable Energy Sources - Photovoltaic - Biomass - Geothermal - Wind - Hybrid systems	
10	Improving a Building's Material Use - Reusing existing building stock - Selecting building materials - Recycled materials - Material transportation impacts - Rapidly renewable resources - Recycling construction waste	
11	Improving a Building's Indoor Environmental Quality - Ventilation systems - Methods for improving indoor air quality during construction	

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Module 7: Sustainability Exam Preparation

Description:

This course offers the study of the concepts, standards and strategies of sustainable design as applied by current rating systems. The course includes best practices for project design, construction, maintenance, and post-occupancy evaluation. Emphasis on accreditation examination preparation.

Certification(s): LEED Green Associate

Prerequisite: None

Required Materials: None

Credit Hours: 3

Expected Outcomes:

Upon successful completion of this course a student would be able to:

1. Discuss fundamental arguments and industry efforts advancing sustainable design.
2. Utilize sustainable design terminology.
3. Learn sustainability categories and their strategies.
4. Evaluate the differences and possible applications of each category strategy to a project.
5. Research a project and recognize applicable industry resources, municipal codes and guidelines.
6. Understand and access the administrative methods and procedures for the registration of a sustainable project.
7. Understand and access templates and mechanisms for the documentation of a sustainable project through its conception and conclusion.
8. Understand and factor the cost implications for project registration and construction costs.
9. Prepare for the LEED Green Associate exam.

Module 7: Sustainability Exam Preparation		
Expected Outcome	**Topic**	**Suggested Activities or Resources**
1	Fundamental Arguments and Industry Efforts - Myths about sustainability - Economic, social, and environmental imperatives - Quantifiable use of natural resources - Quantifiable data regarding waste and pollution - Best practices - Sustainability certifications - Sustainability accreditations	
2	Sustainable Industry Terminology - Concepts - Construction - Sustainability	
3	Categories and Strategies - Sustainable Sites - Water Efficiency - Energy and Atmosphere - Materials and Resources - Indoor Environmental Quality - Innovation in Design - Regional Priority	
4	Strategy Application - Project definition and evaluation - Achieving project goals	
5	Project Research - Site considerations - Use considerations - Industry resources - Municipal codes	
6	Certification Workflow - Project definition - Registration process - Prerequisites - Point systems - Preconstruction - Construction - Post construction and commissioning - Costs	
7	Project Templates and Documentation	

	- Division of responsible - Written documentation - Graphic documentation	
8	Cost Implications - Initial registration costs - Denials and appeals - Materials chain of custody - Testing and monitoring	
9	Rating System Exams - Exam requirements - Exam testing strategies - Becoming an accredited professional	

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