**Irrigation Repair and Theory**

**Description:**

Irrigation repair and theory examines producer and landscaper options for supplementing rainfall outdoors as well as for providing water to containerized plants. Proper soil or media moisture greatly enhances crop quality and productivity; it is essential for profitability, water conservation and maintaining environment quality. The certificates of this module explore troubleshooting, repair, construction, and design in both production and landscape environments. Students will be familiarized with on- and off-grid components as well as high- and low-pressure systems. Hands-on activities will include assembly and repair of various types of systems and materials, timer programing, and design calculations. This course aligns with Program Learning Outcome #s 1,2, & 4

**Methods of Instruction:**

The course will be taught using multiple instructional methods. These methods will include lecture, audio-visual presentations, group discussion and hands-on exercises. Typically, following the lecture presentation, students will receive additional articles from source literature that either illustrates current research into the topic or explores related, relevant or higher concepts.

**Successful Completion:**

A student must attend all sessions, demonstrate hands-on proficiency of skills presented, and complete any additional self-study assignments to receive a certificate.

**Odds-n-Ends:**

All class sessions may involve “hands-on” projects. Safety glasses or other personal protective equipment may be needed for some classes and will be provided. The student is expected to dress appropriately for each class including durable footwear or heavy-duty boots. Long pants and work shirts that cannot be caught on any machine are recommended. Rain gear is highly recommended. Long hair should be secured so as not to hang freely. All jewelry should be removed.

Smoking is not permitted during class – students who need to smoke will be allowed to do so away from other students and away from entrances – we do not have a designated smoking area.

Cell phone use and texting during class is prohibited. Turn them to vibrate or off.

Hawaii Community College’s Student Conduct Regulations, Sexual Harassment and Attendance policies will be enforced in this class.

Every student is expected to be familiar with and abide by the Hawaii Community College Student Conduct Code. The Student Conduct Code states: "impermissible behavior...includes that which directly or indirectly interferes with or disrupts the process of teaching, learning, research, and administration." Refer to the college catalog for more information.

**Academic Accommodations:**

Hawaii Community College is committed to provide equal access to the campus, course information and activities for students who have disabilities.

If you have a documented disability and / or related access need, please contact a counselor for the Ha`awi Kokua Program (**934-2725).**  The office is located on the Manono Campus - Building 388, Room 106.

If you are a student who needs to have an accommodation, please discuss your needs with the disabilities office and make your request in a timely manner.

Hawaii Community College also has generalist counselors available if you have any issues which may have a negative impact on your ability to successfully complete this course, and other courses you are taking.

Call **934-2720** if you have a need to see a generalist counselor.

**Learning Outcome Objectives:**

On successful completion a learner will be able to:

1. Understand plant water requirements.
2. Manage soil/media moisture to optimize plant growth.
3. Repair or assemble basic irrigation components and materials.

**Session 1 (hrs 0-4 + self study)**

*Attention Grabber:*

Plant available water:

<http://www.youtube.com/watch?v=zOL6-JXYVQo>

Water movement in soil:

<http://www.youtube.com/watch?v=vmo0FRAVgkM>

*Direct Instruction:*

Terms and concepts relevant to understanding plant soil water relationships.

1. Soil and media
	1. Particle size
	2. Density
	3. Bulk density
	4. Porosity- micro and macro pores
	5. Moisture holding capacity
2. Characteristics of water- adhesion, cohesion, and capillary movement/rise
3. Water in the field
	1. Saturation
	2. Gravitational water
	3. Field capacity
	4. Plant available water vs. moisture holding capacity
	5. Permanent wilting point
	6. Hygroscopic water

See:

Soil water dynamics <http://www.nature.com/scitable/knowledge/library/soil-water-dynamics-59718900>

Understanding irrigation management factors. *Colorado State University Extension Publication, MG Garden Notes #263.* Retrieved from <http://www.ext.colostate.edu/mg/Gardennotes/263.pdf>

Ingels, Jack. 2009. *Landscaping Principles and Practices* (7th Edition)*.* Del Mar, New York

Plaster, Edward J. 2009. *Soil Science and Management* (5th Edition). Delmar.

Additional materials are in soil water relations folder.

*Activities:*

 Determine bulk density total porosity, airspace and moisture holding capacity of various soil or media samples.

*Additional Independent Study:*

Read and or view supplemental material not covered in class.

 UCTV Irrigation and Water Management:

 <http://www.uctv.tv/shows/Irrigation-and-Water-Management-8356>

**Session 2 (hrs 4-8 + self study)**

*Attention Grabber:*

John Deere Water supertif:

<http://www.deere.com/media/player/player_en_us.html?src=s/flash/deerecompany/water/supertifmovie_h.mp4&lowsrc=s/flash/deerecompany/water/supertifmovie_m.mp4&autostart=true>

*Cementing PVC:*

*http://www.youtube.com/watch?v=Zirp8vqApQc*

 Copper sweating:

 <http://www.youtube.com/watch?v=Rv-ivJbls68>

<http://www.planitdiy.com/how-to/plumbing/how-to-sweat-copper-pipes-fittings/>

Irrigation system components narrated presentation, IFAS, University of Florida:

<http://abe.ufl.edu/faculty/mdukes/articulate-presentations.shtml>

*Direct Instruction:*

PVC irrigation materials

1. Pipes
	1. Schedules and wall thickness
	2. Sizes
	3. Temperature limitations
	4. CPVC
2. Fittings overview and terms
3. Gluing demonstration.

Copper sweating and “sharkbite” slip fittings

1. Cutting copper pipe and tubing
2. Preparing/cleaning the pipe and fitting
3. Role of flux
4. Heating
5. Solder
6. Slip fitting alternatives
7. Fire considerations reminder

See:

 Copper and pvc folders in resources

*Activities:*

Hands on practice gluing pvc pipes and fittings

 Hands on practice sweating copper pipes and fittings

 “Tour” of various irrigation systems and their components

*Additional Independent Study:*

Study additional materials

**Learning Outcome Objectives:**

On successful completion a learner will be able to:

1. Program and schedule irrigation to meet weekly water requirements
2. Design and construct a circulating hydroponic system
3. Design and assemble irrigation systems according to hydraulic principles and plant requirements
4. Monitor soil/media pH, EC, and moisture content

**Session 3 (hrs 8-12 + self study)**

*Attention Grabber:*

Video on irrigation controller programing, IFAS, University of Florida http://abe.ufl.edu/faculty/mdukes/video-presentations.shtml

*Introduction:*

 Discussion: How do we know when to water and for how long?

*Direct Instruction:*

 Meeting watering needs

1. General ranges of precipitation desirable for various plant types
2. Evapotranspiration
3. Determining precipitation rate of a system
4. Calculating total run time
5. Developing the schedule
6. Deep less frequent irrigation vs. daily watering
7. Wetting patterns and soil type- considerations for drip and microsprinkler irrigation
8. Special considerations for irrigating containerized plants- frequent micro watering strategy
9. Time of day to water

Irrigation controller programing demonstration

Irrigation solenoid valve parts and servicing demonstration

 Trouble shooting and minor repairs of sprinklers, emitters, and risers

Role of electricity in irrigation systems

1. AC vs. DC systems
2. Trouble shooting shorts with continuity test
3. Testing the solenoid

See:

Ingels, Jack. 2009. *Landscaping Principles and Practices* (7th Edition)*.* Del Mar, New York.

McCready, M.S., M.D. Dukes and K. Migliaccio, (2009). Basic repairs and maintenance for home landscape irrigation systems. *IFAS, University of Florida, AE451.* Retrieved from <http://edis.ifas.ufl.edu/pdffiles/AE/AE45100.pdf>

Irrigation tutorial <http://www.irrigationtutorials.com/faq/repair-valve.htm>

Also Rainbird Irrigation Manual and Hunter or Digg controller instructions in resources folder.

*Activities:*

Practice calculations for precipitation rates and weekly irrigation run times

 Hands-on controller programming of various models

 Multimeter- checking continuity of the wiring

 Clean/service a solenoid irrigation valve and its diaphragm.

**Session 4 (hrs 12-16 + self study)**

*Direct Instruction:*

Hydraulic principles and terms

1. Head
2. Pressure
3. Static pressure and dynamic or working pressure
4. Flow
5. Velocity
6. Friction
7. System output
8. System uniformity

Pipes- sizing and charts

 Sprinkler head spacing considerations

 Types of sprinkler heads

Pressure regulation and compensating sprinklers/emitters

Irrigation zones

See:

Ingels, Jack. 2009. *Landscaping Principles and Practices* (7th Edition)*.* Del Mar, New York.

Rainbird Landscape Irrigation Design Manual <http://www.rainbird.com/documents/turf/IrrigationDesignManual.pdf>

Hunter Irrigation Design Manual <http://www.hunterindustries.com/sites/default/files/DG_ResidentialSprinklerSystemDesignHandbook_dom.pdf>

*Activities:*

Practice various design element calculations

*Additional Independent Study:*

Read additional materials or watch presentations from <http://abe.ufl.edu/faculty/mdukes/articulate-presentations.shtml>

 Study and complete questions in the Rainbird Design Manual.

 Develop an irrigation design.

**Session 5 (hrs 16-20 + self study)**

*Direct Instruction:*

Flexible poly tubing- a myriad of quick simple uses.

Drip/micro irrigation system characteristics and components.

Step by step example of sprinkler and drip irrigation design

1. Available pressure
2. GPM available- meter capacity
3. Area to be irrigated
4. Sprinkler selection- spacing and location
5. Main line placement and orientation
6. Lateral placements
7. Sizing Pipes
8. Locating valves/zones and controller
9. Calculating system pressure loss and uniformity

Special drip/low pressure system considerations

1. Wetting patterns and soil type
2. Slopes
3. Looped systems

Common nursery irrigation techniques

1. Risers and overhead sprinklers
2. Drip and spotspitters
3. Sub irrigation
4. Additional considerations for epiphytes and other specialty crops
5. Time of day to irrigate

 See:

Ingels, Jack. 2009. *Landscaping Principles and Practices* (7th Edition)*.* Del Mar, New York.

Rainbird Landscape Irrigation Design Manual <http://www.rainbird.com/documents/turf/IrrigationDesignManual.pdf>

Rainbird Low-volume Irrigation Design Manual http://www.hunterindustries.com/sites/default/files/dg\_plddesignguide\_dom.pdf

Hunter Irrigation Design Manual <http://www.hunterindustries.com/sites/default/files/DG_ResidentialSprinklerSystemDesignHandbook_dom.pdf>

Hunter Drip Design Guide <http://www.hunterindustries.com/sites/default/files/dg_plddesignguide_dom.pdf>

*Activities:*

Assembly of a simple polytubing system with spaghetti tubing and spotspitter or drip emitters.

Install various sprinklers, sprayers and emitters; compare precipitation rates and droplet size.

Design an irrigation system and develop a material list.

*Additional Independent Study:*

Read and/or view supplemental material not covered in class.

**Session 6 (hrs 20-24 + self study)**

*Attention Grabber:*

Hydroponic Virtual Field Day, IFAS, University of Florida <http://vfd.ifas.ufl.edu/suwanneevalley/hydroponicgreenhouse/index.shtml>

*Introduction:*

Discussion of historical examples of hydroponics

*Direct Instruction:*

Basics of circulating hydroponic or aquaponic systems

1. Pumps
2. Closed vs. drain to waste systems
3. Media
4. Raft culture
5. Film techniques
6. Dutch buckets
7. Bell siphons for ebb and flow aquaponics
8. Importance/role of media in aquaponic systems
9. Vertical, tower and wall production systems
10. Fertilizers

Constant liquid feed- fertigation

1. Injectors
	1. Function
	2. Proportion selection
	3. Multiple injectors series vs. parallel plumbing
2. Fertilizers- understanding the label
3. Testing fertilizer strength
4. Fertilizer compatibility concerns

Media monitoring methods for advanced containerized production

1. Saturated media extract vs. pour through methods
2. Importance of monitoring and record keeping

Specialized controllers with looping programs for propagation mist benches and other uses.

See:

Ingels, Jack. 2009. *Landscaping Principles and Practices* (7th Edition)*.* Del Mar, New York

Camberato, D., Lopez, R., & Mickelbart, M. (n.d.). Commercial greenhouse and nursery production: ph and electrical conductivity measurements in soilless substrates. *Purdue University, Department of Horticulture and Landscape Architecture, Purdue Extension*, HO-237-W. Retrieved from

<http://www.extension.purdue.edu/extmedia/ho/ho-237-w.pdf>

England, K., Camberato, D., & Lopez, R. (n.d.). Commercial greenhouse and nursery production: water-soluble and controlled-release fertilization. *Purdue University, Department of Horticulture and Landscape Architecture, Purdue Extension*, HO-251-W. Retrieved from

<http://www.extension.purdue.edu/extmedia/HO/HO-251-W.pdf>

University of Florida, Irrigation Research <http://abe.ufl.edu/mdukes/index.shtml>

Dosatron <http://www.dosatronusa.com/markets-served/horticulture.aspx>

Peter’s soluble fertilizers <http://everris.us.com/plant-nutrition/water-soluble-fertilizers>

*Activities:*

Program a controller with looping function for propagation misting

 Set up a simple circulating hydroponic system

 Calculate stock tank fertilizer rates for fertigation systems

 Test EC and pH of a growing media

*Additional Independent Study:*

Read additional materials

 Construct a circulating hydroponic or aquaponic system

 Design an irrigation system

This workforce solution was funded by a grant awarded by the U. S. Department of Labor’s Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U. S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.