

AEN 4108 IRRIGATION SYSTEM DESIGN AND MANAGEMENT

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MSc Hydrotechnics: Irrigation and Drainage Engineering
(Moldavia),
Fulltime Lecturer.

Course Type: CORE (B.Sc. Agric. Engineering IV)

1. COURSE

Course Credits (CU): 3 CU i.e. 45 Contact Hours per semester

Course Duration: 15 weeks (45 hours) i.e. 30 LH, 30 PH

COURSE DESCRIPTION

Irrigation principles: Evapo-transpiration, irrigation requirements and scheduling, plant-soil-water relationship, efficiencies, measurement of irrigation water and delivery rates. Land grading and field layout. Irrigation methods: border, check basin, furrow, sprinkler and drip irrigation. Design and management of irrigation systems. Gender considerations in planning, design, selection and management of irrigation systems

2. COURSE OBJECTIVES

To produce agricultural engineering graduates who:

- understand the concepts, principles and application of irrigation in enhancement of crop production
- are competent in the design, installation and management of irrigation systems

3. READING LIST

- Andreas P. S., A. S. Joop, M. A. R. Paul and V.H. Sven, 1991. **Irrigation Manual, Volume I and II**. UNDP/FAO ZIM/85/004 Project.
- Brouwer C. and M. Heibloem, 1985. **Introduction to irrigation**. Irrigation Water management Training manual no. 1. FAO.
- Brouwer C. and M. Heibloem, 1986. **Irrigation Water Needs**. Irrigation Water management Training manual no. 3. FAO.
- Brouwer C. and M. Heibloem, 1986. **Irrigation Methods**. Irrigation Water management Training manual no. 5. FAO.
- Brouwer C., J. P. Hoevenaars, B. E. Van Bosch, N. Hatcho and M. Heibloem, 1992. **Scheme Irrigation Water Needs and Supply**. Irrigation Water management Training manual no. 6. FAO.
- Brouwer C., J. P. Hoevenaars, B. E. Van Bosch and N. Hatcho, 1992. **Canals**. Irrigation Water management Training manual no. 7. FAO.
- Chin, D.A., 2000. **Water Resources Engineering**. Prentice Hall, New Jersey.
- Feddes R. A. and R.W. R. Koopmans, 1995. **Agrohydrology**. Department of Water Resources, Wageningen Agricultural University.
- Hansen V. E., O. W. Israelsen and G. E. Stringham, 1962. **Irrigation Principles and Practices**. John Wiley and sons, Inc.
- James, L.G., 1988. **Principles of Farm Irrigation System Design**. John Wiley, New York.
- Journal of Irrigation and Drainage Engineering, American Society of Civil Engineers.
- Michael, A. M., 1978. **Irrigation Theory and Practice**. Vikas Publishing House PVT, New Delhi.
- Punmia B. C. and B. B. L. Pande, 1987. **Irrigation and WaterPower Engineering**. N.C. Jain, Delhi.
- Schwab, O. G., K. R. Frevert, T. W. Edmister and K. K. Barnes, 1981. **Soil and Water Conservation Engineering**. John Wiley & Sons, New York

4. COURSE CONTENT, METHODS OF INSTRUCTION, TOOLS AND EQUIPMENT REQUIRED

Lecture	CONTENT	METHOD OF INSTRUCTION / Time allocated	TOOLS / EQUIPMENT NEEDED
LECTURE 1. Introduction to Irrigation	<ul style="list-style-type: none"> • Definition of irrigation • Brief history of irrigation practice in the world • Importance and potential of irrigation in the world and Uganda and water resource utilisation • Introduction to irrigation principles 	Interactive Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk, Maps
LECTURE 2. Soil- Plant –Water Relationships	<ul style="list-style-type: none"> • Recap of Basic Soil physical properties (texture, structure, porosity)and their relationship to soil moisture • Methods of expression of soil moisture content • Soil water retention curve and soil moisture constants 	Lecture (2hrs)	LCD Projector and Screen, BB/Chalk
LECTURE 3. Soil- Plant -Water Relationships	<ul style="list-style-type: none"> • Plant rooting depths, effective root zone, crop characteristics (stages of growth, length of growing period, etc) • Total Available Moisture(TAM),depletion factor, Readily Available Moisture (RAM) and irrigation requirement • Crop response to water stress 	Lecture (2 hrs) Field based Practical (4 hrs) on soil texture determination, Infiltrometer test	LCD Projector and Screen, BB/Chalk. Hydrometers, Chemicals, Ring Infiltrometers, Tank, Water, Transport (30 seater)
LECTURE 4 Evapotranspiration (ET)	<ul style="list-style-type: none"> • Definition, factors affecting ET process • Reference, Crop and Actual Evapotranspiration(ET) • Direct ET measurement methods • Use of equations for ET determination 	Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk
LECTURE 5 Evapotranspiration (ET)	<ul style="list-style-type: none"> • Use of computer soft wear (CropWat) for ET determination 	Lecture (2 hrs) Computer Practical for CropWat (3 hrs)	LCD Projector and Screen, BB/Chalk. Computer Lab CropWat soft wear
LECTURE 6 Irrigation Requirements.	<ul style="list-style-type: none"> • Historical rainfall data, reliable and effective rainfall • Groundwater contribution through capillary rise to the root zone • Irrigation requirements 	Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk, Probability graph paper
LECTURE 7 Irrigation	<ul style="list-style-type: none"> • Irrigation scheduling principles • Irrigation efficiencies and their effect and 	Lecture (2 hrs)	LCD Projector and

scheduling, irrigation efficiency	importance in design and management		Screen, BB/Chalk
LECTURE 8 Salinity and leaching	<ul style="list-style-type: none"> • Irrigation water quality • Salinity types, problems and their management in irrigated agriculture • Leaching concept and methods • Gender considerations in design 	Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk
LECTURE 9 Surface irrigation design and management	<ul style="list-style-type: none"> • Factors affecting Land grading (levelling) , field layout • Land levelling design methods and earthwork volumes 	Lecture (2 hrs) Field trip (3hrs)	LCD Projector and Screen, BB/Chalk Transport (30 seater)
LECTURE 10 Surface irrigation design and management	<ul style="list-style-type: none"> • Furrow, border and basin irrigation water application method design and management • Measurement of irrigation water (weirs, flumes, division boxes, siphons, etc) 	Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk
LECTURE 11 Basic pipe hydraulics and Sprinkler irrigation design and management	<ul style="list-style-type: none"> • Laminar and turbulent flow • Friction head loss in pipe flow hydraulics, the moody diagram, head loss in pipes with multiple openings • Components of sprinkler irrigation system, accessories, selection of appropriate sprinkler head 	Lecture (2 hrs) Field trip (4 hrs)	LCD Projector and Screen, BB/Chalk Transport (30 seater)
LECTURE 12 Sprinkler irrigation design and management	<ul style="list-style-type: none"> • Design of lateral, sub main and main pipe lines • Installation of sprinkler system, operation maintenance and management 	Lecture (2 hrs) Field based Practical on uniformity test (4 hrs)	Buckets, Plastic cups, Tape measure, Transport (30 seater)
LECTURE 13 Drip irrigation design and management	<ul style="list-style-type: none"> • Components of drip irrigation system, selection of appropriate drip lines • Design of lateral, manifold, sub main and pipe • Installation drip system, operation maintenance and management 	Lecture (2 hrs) Design exercise (seminar) (6 hrs)	LCD Projector and Screen, BB/Chalk Flip charts, Markers, Graphs
LECTURE 14 Pumps and power unit	<ul style="list-style-type: none"> • Classification of pumps • Centrifugal pumps, affinity laws, , NPSH, cavitation, suction lift, connection in parallel and series 	Lecture (2 hrs)	LCD Projector and Screen, BB/Chalk
LECTURE 15 Pumps and power unit	<ul style="list-style-type: none"> • Pump efficiency, water horsepower, brake horse power, • Selection of pump and power unit • Operation and maintenance 	Lecture (2 hrs) Field visit Practical on pump installation and priming (6 hrs)	Buckets, Transport (30 seater)

5. SUMMARY OF TIME NEEDED

Interactive lectures covering theory	30 hrs
Class and station-based practical	17 hrs
Field visits	07 hrs
Seminars	06 hrs

6. OVERALL COURSE EVALUATION

Continuous Assessment Test	20%
• At least 2 tests (first after lecture 8 and second after lecture 12)	
• Marked out of 20 each	
Continuous Assessment (Assignments, practical, Field work)	20%
• At least 1 assignment	
• Practical	
• Field trip by attendance	
• Marked out of 20 each	
Final examination	60%