SOKOINE UNIVERSITY OF AGRICUTURE

DEPARTMENT OF AGRICULTURAL ENGINEERING AND LAND PLANNING

M.Sc. Irrigation Engineering and Management

Course structure

Semester 1

Code	Course title	Credits	L	S	P
Core courses					
IE 603	Surface Irrigation Systems	1	15	-	30
IE 604	Pressurised Irrigation Systems	1	15	-	30
AE 608	Drainage and Land Reclamation	1.5	30	-	30
IE 601	Crop Water Requirements	1	15	-	30
IE 602	Hydrology	1	15	-	30
Total Core		5.5	90	0	150
Elective Courses					
AE 601	Introduction to Computer Programming	1.5	30	-	30
AE 600	Instrumentation and Measurement in Agricultural Engineering	1.5	30	-	30
AE 605	Soil and Water Conservation	1.5	30	-	30
IE 608	Ground Water Resources Development	2	30	-	60
Total electives		6.5	120	0	150
Total Semester		12.0	210	0	300

Semester II

Code	Course title	Credits	L	S	P
Core courses					
EE 600	Research Planning and Management	1	30	-	-
AE 617	Project Planning and Management	1	15	-	30
AE 619	Soil-Plant-Water Relations	1	20	-	20
AE 620	Agricultural Water Management	1	30	-	-
IE 600	Statistics for Technology	1	15	-	30
IE 605	Business Studies	1	15	30	-
Total Core		6	125	30	80
Elective Courses					
AE 616	Agricultural Education and Farming Systems	1	30	-	-
IE 607	Hydraulic Structures	1	15	-	30
IE 606	Operations Research	1	15	-	30
Total electives		3	60	0	60
Total Semester		9	185	30	140

Semester III – IV

Code	Course title	Credits	L	S	P
AE 610	Dissertation	Throughout the entire period			

Course contents

EE 600 Research Planning and Management 1 credit

Aim:

To give an overview of various research methods and to prepare the students for their field research and dissertation work.

Content:

The role and character of research; History, philosophy, and organization of scientific ideas. The interdependence of pure and applied science. Logic of scientific inquiry, testing of hypothesis. Project design in applied research. Types of agricultural research, determination of priorities, the identification of researchable problems. Formulation of a research proposal. Characteristics of empirical research, the analysis of the resource base. Data quality control. Presenting empirical data graphically and statistically. Interpreting research results. The organization and writing of a research report. Evaluation of research performance.

AE 600 Instrumentation and Measurement in Agricultural Engineering 1.5 credits

Aim:

Familiarization with instrumentation currently employed for engineering measurements and process control.

Content:

Introduction to instrumentation. Review of basic field and flux phenomena and relationship: hydraulic; pneumatic; electrical; optical. Review of d.c. and a.c. circuit principles. Introduction to transducers. Factors affecting selection of instruments. Units and standards. Calibration. Static and dynamic performance of instruments.

Components of an instrumentation and control system. Compatibility of components. Interpretation of manufacturers' specifications. Signal processing, data recording and presentation. Modes of automatic control: two step; floating; proportional; proportional plus integral. Special instruments encountered in field engineering. Environmental control and machine design including measurement of temperature of fluids and solids; surface measurements of fluid flow, strain, vibration, noise, speed, displacement, light and heat flux, moisture content.

AE 601 Introduction to Computer Programming 1.5 credits

Aim:

To provide insight into the design and construction of algorithms and programmes.

Content:

Computer concepts: general description of computers; hardware versus software. Algorithms: design and construction. High level languages e.g., PASCAL, QBASIC, C, etc. Programming techniques:

treatment of sequences of data; searching in tables; sorting; etc. Software packages - examples and application: computer aided design; electronic circuit analyses.

AE 605 Soil and Water Conservation 1.5 credits

Aim:

To provide insight into the mechanics of land degradation and ways of combating it.

Content:

Agents of land degradation. Mechanics of water and wind erosion. Types, causes and effects of land degradation. Rainfall erosivity and soil erodibility. Estimation and control of erosion. Erosion control by mechanical and agronomic means. Control and alternative use of gullies. Experimental techniques for evaluation of erosion incidence under different management systems. Soil erosion hazard mapping. Water conservation practices. Catchment approach to conservation. Decision support systems for watershed management. Environmental policies and their adaptation. Environmental impact assessment.

IE 603 Surface Irrigation Systems 1 credit

Aim:

To provide insight into the design, construction and operation of gravity irrigation systems.

Content:

Introduction: types and required design variables. Hydraulics of surface irrigation: basic concepts of surface irrigation; flow equations; surface irrigation models. Design and operation of gravity or surface systems: basic considerations; contour ditch irrigation; basin irrigation; border irrigation; contour level irrigation; furrow and corrugation irrigation; wild flooding; reuse systems. Farm water distribution Systems: unlined and lined ditches; low pressure pipe systems; operation and maintenance.

AE 608 Drainage and Land Reclamation 1.5 credits

Aim:

To introduce the theory and design of surface and subsurface drainage of irrigated land including reclamation of salinized land.

Content:

Benefits of drainage. Drainage methods: surface subsurface systems. Design and layout of surface drainage systems. Design and layout of subsurface drainage systems. Drain spacing design theories based on steady and non-steady state conditions. Drainage survey and investigations: analysis of rainfall data; evapotranspiration; soil moisture. Drainage structures. Drainage materials: perforated pipes; tiles; filters; envelopes.

Management of saline and alkali soils: nature of the salt problems; criteria and methods of diagnosis; salinity control - salt balance, leaching requirements, irrigation methods, drainage, soil management.

AE 616 Agricultural Extension and Farming Systems 1 credit

Aim:

To give an overview of the concept of farming systems research and the role of agricultural extension in promoting change in a farming system.

Content:

Introduction: definitions of agricultural extension and farming systems. The components of the farm-. household system: the farm resources; the household; off-farm components. The environments of farm-household systems: the natural cultural, economic, and policy environments. Farming systems research (FSR) concepts and procedures, e.g. diagnosis, on-farm research, etc; farmer participation in FSR. Introducing change into a farming system: factors influencing the impact of outside intervention; the process of adoption and diffusion of innovations. The role of agricultural extension in promoting change in a farming system; different extension systems, organisational set-ups and their effect on agricultural technology transfer. Agricultural extension methods - individual, group and mass methods. Programme planning and evaluation. Managing and supervising extension personnel. The role of FRS in solving land and water management problems (a multidisciplinary approach).

AE 617 Project Planning and Management 1 credit

Aim:

To provide information on the state of the art of project management.

Content:

Interrelationships between projects, programmes and plans. The project cycle: identification; preparation; appraisal; implementation; evaluation. The Integrated Project Planning and Management Cycle (emphasizing the participatory approach). Project analysis: financial; economic; social analysis. Selection criteria: payback period; benefit cost ratio; net present value; internal rate of return. Project financing; project activation. Getting started. Community participation in projects. Project sustainability. Case studies of large, small, private and public, agro-based projects.

AE 619 Soil – Plant – Water Relations 1 credit

Aim:

To provide insight into the soil - plant - atmosphere continuum in relation to irrigated land.

Content:

Soil properties: soil texture; soil structure; bulk density; pore space; soil water constants; soil temperature and heat flow. Soil-water relation: the Soil as a reservoir; calculation of soil water; methods of determining soil water content; infiltration or intake rate. Soil water potential: definitions; units; potentials in an equilibrium system; soil moisture characteristic curve; measurement of soil-moisture potential; matric potential and irrigation management. Water flow in soil: flow equation; hydraulic conductivity; steady state water flow; transient state water flow; numerical solution of the water flow equation. Uptake of Soil water by plants: soil water availability to plants; factors affecting

water absorption. Water balance and energy balance in the field: water balance of the root zone; radiation exchange in the field.

AE 620 Agricultural Water Management 1 credit

Aim:

To familiarize with management techniques particularly related to small-scale irrigation.

Content:

Irrigation management techniques: when to irrigate; how much to apply; climatic factors; soil factors; production functions; moisture sensitive growth stages; management strategies including rain water harvesting; maximizing and optimising yield. Organizational management for irrigation: structures of organization; personnel recruitment and selection; management techniques; case studies of irrigation projects. Irrigation management: large and small scale projects; operation and maintenance; water management and water users; irrigation manpower planning. Environmental impacts of irrigation projects: viewpoints on environmental impacts; environmental evaluation; guidelines for minimizing adverse effects - public health, soil-water problems, water quality, policy issues. Project performance evaluation. Canal management. Case studies.

IE 604 Pressurized Irrigation Systems 1 credit

Aim:

To introduce planning and design procedures for sprinkler and localized irrigation systems.

Content:

Introduction: sprinkler system components; general, technical and economic features of set-move, solid-set and continuous-move systems; criteria for system selection. Hydraulics of sprinklers: water distribution to the soil under a static single sprinkler, a moving sprinkler and moving multiple sprinklers; sprinkler selection. Sprinkler design: field layout; sprinkler spacing; operating pressure; sizing laterals, mains and pumping plant. Trickle irrigation: trickle irrigation methods; components and equipment; system layout; emission devices; lateral lines; submain lines; mainlines. Hydraulics of trickle irrigation systems: hydraulics of emitters and trickle irrigation lines; emitter flow variation and uniformity of trickle systems. Crop water requirements under trickle irrigation: influence of ground cover; water distribution to plants; net irrigation amount; irrigation interval. The design of trickle irrigation Systems: emitter selection; lateral line design; submain design; mainline design. Trickle irrigation installation and maintenance: fittings and connection procedures; maintenance, filtration and flushing; fertilizing through trickle Systems and weed control.

IE 607 Hydraulic Structures 1 credit

Aim:

To provide theoretical and practical understanding of design procedures for structures used in water supply systems for irrigated agriculture.

Content:

Review of basic concepts of fluid flow: continuity equation; motion equation; Bernoulli theorem; energy principle; flow resistance; Moody diagram. Discharge measurement structures: types, design and characteristics of discharge measurement structures. Water level control structures: checks; movable controlled checks; automated checks. Conveyance structures: structures with subcritical flow - culverts, flumes, aqueducts, inverted siphons; structures with supercritical flow - drops, chutes. General features and hydraulic design of division structures, offtakes and diversion structures. Miscellaneous structures: silt control devices; stilling basins; protective structures; auxiliary structures.

IE 601 Crop Water Requirements 1 credit

Aim:

To provide guidance in determining crop water requirements and their application to planning, design, and operation of irrigation projects.

Content:

Definitions. Theoretical methods of estimating ET: aerodynamic, energy-balance, and combination methods. Empirical methods of estimating ET: Penman, Temperature, radiation, evaporation and humidity methods. Direct measurement of the water requirement: lysimeters and field water balance. Estimation of crop-water requirements: reference crop evapotranspiration; crop coefficients; factors affecting ETcrop. Estimation of irrigation requirements: net irrigation requirements; leaching requirements; irrigation efficiency. Field and project supply schedules. Application of computer models for scheduling purposes.

IE 608 Groundwater Resources Development 2 credits

Aim:
To give an analysis of the occurrence, exploration and exploitation of groundwater resources for agricultural purposes.

Content:

Groundwater survey: geophysical methods; surface methods; well logging. Hydrologic balance: ground water and hydrologic cycle; saturated zone; unsaturated zone (aeration zone or verdose zone). Types of aquifers: physical properties of aquifers, porosity, effective porosity, specific retention, storage coefficient, hydraulic conductivity, transmissivity. Laboratory methods for the determination of hydraulic conductivity. Darcy’s law. Dupuit Forcheimer assumptions. Flow in aquifers: homogenous and non-homogenous aquifers; isotropic and anisotropic aquifers; volume elasticity of aquifers; steady and non-steady flow; Laplace and Poisson's equations. Hydraulic head gradient and equipotential lines. Flow nets. Well flow systems: analysis of flow systems; well losses; partially penetrating wells; pumping test; step draw down test, recovery test; Land subsidence. Sea water intrusion.

Water well technology: well drilling methods; well development techniques; water quality control; organization of a drilling campaign.

IE 606 Operations Research 1 credit

Aim:

To equip students with mathematical/quantitative planning techniques including model formulation and model-building skills for solving real-life problems.

Content:

Linear programming: the simplex algorithm; use of LP computer packages; solving LPs with spreadsheets; algorithm for solving transportation and assignment problems. Network Analysis: definitions; CPM and PERT; resource allocation. Dynamic programming: notation; algorithm; use of DP in solving network, inventory, resource allocation and replacement problems. Systems analysis and computer application in irrigation management.

IE 605 Business Studies 1 credit

Aim:

To impart entrepreneurial skills and an understanding of contractual agreements.

Content:

An overview of the micro and macro foundation of business studies. Forms of business enterprises. The economic policy of business enterprises. Production and cost analysis. The profit motive for decision making. Approaches to conceiving and managing business enterprises. Motivation for entrepreneurial innovation. Market structures and strategies for competition in the international markets with a focus on agro-business in Africa. Elements of Corporate Planning and Strategic Management in the context of business environment in Tanzania type economies.

Contract Laws and procedures: definitions: requirements for valid contract; contractual organisation; types of contracts. Contract documents. Tendering: methods of tendering; evaluation of tender; bidding; claims; disputes and arbitration.

IE 600 Statistics for Technology 1 credit

Aim:

To become better acquainted with the increasing number of applications of statistics in engineering and the applied sciences.

Content:

The concept of probability. Distributions and their characteristic properties: discrete and continuous distributions. Estimation: point and interval estimates; properties of the expected value; the sampling distribution of x; the sampling distribution of s^2; some properties of estimators; general methods of point estimation; interval estimation.

Hypothesis testing: theory; tests on a sample mean; comparing two sample means; the t-test applied to paired comparisons; the χ^2 goodness-of-fit test; the F-test; distribution-free or non-parametric tests; power and other considerations.

Regression and correlations: linear regression; multiple and curvilinear regression; the correlation coefficient; estimating the regression lines; the bivariate normal distribution; interpretation of the correlation coefficient.

Applications: planning the experiment; the design and analysis of comparative experiments; the design and analysis of factorial experiments; quality control.

IE 602 Hydrology 1 credit

Aim:

To give an overview of the interaction between climatological factors and land resources.

Content:

The atmosphere: thermal aspects; pressure; moisture; precipitation; rainfall patterns - intensity and duration. Evapotranspiration. The hydrological cycle; runoff; hydrograph analysis; infiltration; stream flow measurement; flood estimation; reservoir regulation; routing; storage; yield. Instrumentation for hydrology. Sediment transport. Groundwater occurrence and movement; well hydraulics. Statistical and probability analysis of hydrological data: frequency analysis of variance and covariance. Water law; water policy. Use of prediction models.

APPENDIX I: Regulations and guidelines for M.Sc. (Irrigation Engineering and Management)

I.1 Minimum entry requirements

I.1.1 The Irrigation Engineering and Management degree programme is open to applicants with a background in agricultural engineering, civil (water resources), environmental engineering or hydrology. Minimum entry requirements are the same as for the other M.Sc. degree programmes which require a candidate to either hold an honours degree of Sokoine University of Agriculture or a qualification from an approved institution of higher learning deemed to be equivalent to an honours degree of Sokoine University of Agriculture.

I.1.2 Candidates who hold unclassified degrees should have a credit or a distinction in the subject of intended master's degree.

I.1.3 Candidates with pass degrees will also be considered for admission if:

I.1.3.1 Their undergraduate performance in the proposed subject of study was a B average or above, and

I.1.3.2 They have satisfied the relevant Faculty/Institute that they have exhibited academic potential through extensive field work, subsequent research experience and/or additional training.

I.2 Registration

I.2.1 Candidates shall be registered for the Master's degree by coursework followed by research leading to a dissertation. No student shall be registered prior to payment of fees or without submission of a commitment from a Sponsor.

I.2.2 Each candidate, shall be assigned a supervisor(s) appointed by Department/Institute at the beginning of coursework. The supervisor(s) will guide the candidate in formulating and undertaking research and shall ensure that the candidate submits a progress report once every six months to the Chairman of Senate Postgraduate Studies Committee (SPGSC) via the relevant Faculty/Institute Boards.

I.2.3 Time for reporting:- Deadline for registration shall be on the Friday of the fourth week of the first semester of the academic year.

I.2.4 Duration of registration period:-

I.2.4.1 Shall be 24 months and 36 months for full time and part time students respectively. For full time students, the first 10 months will be for coursework and development of research proposal and 2 months for preparation and soliciting funds from sponsors. The other 12 months will be used for carrying out research (9 months), submission and examination of dissertation (3 months).

In case of part time students, the first 24 months will be used for coursework, development of research proposal and securing research funds. The rest of the 12 months will be used for carrying out research (9 months), submission and examination of dissertation (3 months).

I.2.4.2 Candidates who fail to complete their dissertations within the specified period may apply for extension to Senate through their relevant Faculties/Institutes. The maximum duration of the registration period (including extensions) for full time students shall not exceed 3 years and 4 years for part time students.

I.2.4.3 Failure of a candidate to complete the Master's study programme within the specified periods shall mean his/her discontinuation from study, unless applications for extensions have been approved by Senate.

I.3 Coursework Evaluation

I.3.1 Candidates registered for the coursework and dissertation programme shall do coursework examinations following assessment procedures approved by the relevant Faculties/Institutes.

I.3.2 The coursework portion shall consist of a minimum of 12 credit hours of postgraduate courses including the core courses specified by each Department and/or Faculty/Institute. The courses may be taken at SUA or at any other approved institution. Candidates whose first degree is considered deficient or different from the one being pursued may be required to take undergraduate courses in addition to the minimum postgraduate requirements. [One credit hour = 30 hours of theory or 60 practical hours].

I.3.3 Before a candidate is allowed to proceed with the dissertation research phase of the Master's programme, the candidates must successfully complete the coursework part with a mean overall grade of 'B' or above (i.e. GPA of at least 3.0) in all core courses and 'C' or better in all the elective/optional courses designated for the respective degree programmes.

I.3.4 For part time students, candidates can be allowed to accumulate coursework results up to two years before embarking on research and dissertation phase in the third year.

I.3.5 The pass mark for core courses shall be a 'B' grade average and 'C' grade average for electives. Candidates whose average pass is below the above, in not more than two required courses, shall be required to do supplementary examination in the subject failed if the GPA is. at least 3.0 or above. The maximum grade for supplementary examination shall be B for core courses and C for elective courses.

I.3.6 Candidates whose overall grade point average (GPA) is below a 'B' (i.e. GPA below 3.0) and courses failed are more than two shall be discontinued from studies.

I.3.7 Candidates failing supplementary examinations shall be discontinued from studies.

I.3.8 Examination grading system will be the same in all Faculties/Institutes and students' raw marks will be taken into account when calculating GPA. The grading system and equations for computing GPA shall be as indicated below:

Grade	Range of Marks	Equation	Grade Point	Description
A	75 – 100%	Y = 0.024x + 2.6	4.4 - 5.0	Excellent
B^+	70 – 74%	Y = 0.08x x – 1.6	4.0 - 4.39	Very Good
B	60 – 69%	Y = 0.1x – 3	3.0 - 3.99	Good
C	50 – 59%	Y = 0.1x – 3	2.0 - 2.99	Satisfactory
D	40 – 49%	Y = 0.1x – 3	1.0 - 1.9l9	Marginal Fail
E	0 – 39%	Y = 0.025x	0 - 0.99	Absolute Fail

Where Y = Grade point; x = Raw marks.

The total Weighted Grade Points (Grade points multiplied by the credit hours of the examined subject) of all subjects will be divided by the total credit hours to determine the GPA. As a matter of principle, the final GPA shall be truncated down to one decimal place.

I.3.9 Before commencing research for dissertation, a candidate shall submit for final approval by the Department/Institute a concise proposal of the research. Before being approved, each candidate shall present his/her research proposal in a seminar to be attended by both staff and students in the Department/Institute. Where departments are small, two or more departments can organise these seminars jointly. Faculty/Institute Boards shall be informed for noting. The Department/Institute at its discretion may decline to approve the proposal or recommend revision if:

I.3.9.1 In its opinion it is unsuitable in contents.

I.3.9.2 The conditions under which the candidate proposes to work are unsatisfactory

I.3.9.3 The budget is unrealistic or prohibitive and time to undertake research will be longer than allowed.

1.3.10 There shall be no external examiners for postgraduate coursework.

I.3.11 All cases of alleged examination irregularities shall be referred to the Senate Postgraduate Studies Committee. The Committee shall have powers of summoning students and members of staff as it deems necessary. The Committee shall submit a report of its findings and recommendations to Senate for approval, prior to any action. Any candidate who shall be shown to have cheated in any part of the examination shall be discontinued from studies.

I.3.12 A candidate discontinued cannot apply for admission for the same course before 3 years have elapsed.

I.3.13 All coursework results for Master's degree programmes have to be approved by Senate before candidates are allowed to proceed with the dissertations/research phase. Coursework results shall have to be accompanied by a statement that candidate's research proposal has been approved by Department/Institute.

I.4 Submission of Dissertations

I.4.1 Candidates who qualify to continue with the research phase after the coursework part shall be required to submit, in partial fulfilment of the Master's degree requirements, a dissertation before the expiry of the registration period.

I.4.2 Three months before submitting a dissertation a candidate shall through his supervisor and Faculty/Institute, give notice in writing to the Chairman, Postgraduate Studies Committee of Senate, showing his/her intention to submit the dissertation. Examination arrangements proposed by the together with CV of the external examiner(s) shall accompany the notice.

I.4.3 Every dissertation submitted for the degree must be accompanied by a declaration by the candidate to the satisfaction of Senate, stating that it is the candidate's own original work and that it has neither been submitted nor being concurrently submitted in any other institution. The dissertation must be submitted in four copies.

I.4.4 The dissertation shall contain a statement of copy right by the author as follows: "No part of this dissertation may be reproduced, stored in any retrieval system, or transmitted in any form or by any means without prior written permission of the author or Sokoine University of Agriculture in that behalf".

I.4.5 A dissertation submitted for the Master's degree must be satisfactory as regards the format and literary presentation. Every candidate during preparation of dissertation/thesis, shall be required to follow the guidelines approved by the University Senate. These have been published under the title, "Guidelines for Preparing Dissertations, Theses and other Publications". Copies of this document are available in the Directorate of Research and Postgraduate Studies. It must also contain an abstract of not more than 300 words. The abstract shall indicate the problem investigated, the procedures followed, the general results obtained and the major conclusions reached.

I.5 Examination of Dissertation and Degree Award

I.5.1 Every dissertation submitted shall be examined by at least two specialists approved by relevant faculty/Institute Board and by Senate. At least one of the examiners must be external

to the University. The other one must be the supervisor(s) of the candidate or a competent member of Sokoine University of Agriculture.

I.5.2 The internal examiners shall be required to submit their reports about the dissertation within a maximum period of one month and external examiners a maximum of two months from the date of receipt. If the reports are not received within two months for internal examiners and three months for external examiners,, new examiners shall be appointed. Mailing time and other constraints will however be taken into consideration before appointing new examiners.

I.5.3 Each examiner shall be required to summarize his report about the dissertation with definite recommendation for one of the following actions:-

I.5.3.1 The degree be awarded subject to typographical corrections and/or minor revisions.

I.5.3.2 The degree be not awarded but the candidate be allowed to revise and resubmit his/her dissertation for re-examination.

I.5.3.3 The dissertation be rejected outright.

I.5.4 A dissertation recommended for re-writing must be re-submitted within 6 months.

I.5.5 Where the examiners are not in agreement in the overall recommendations, Senate's Postgraduate Studies Committee shall examine the case and recommend one of the following actions:-

I.5.5.1 The recommendation of the External Examiner be adopted after Senate Postgraduate Studies Committee is satisfied.

I.5.5.2 An additional independent examiner be appointed.

I.5.5.3 The relevant Faculty/Institute be requested to establish a panel from amongst the experts available to examine the candidate orally.

I.5.6 Candidate will be required to submit four corrected hard bound copies of the dissertation within two months after approval of results by Senate Postgraduate Studies Committee. Upon submission, an error free certificate will be issued to the Chairman of SPGSC by the supervisor or Head of Department/Director of Institute (in the absence of the supervisor).

I.5.7 The final decision on the award of the Master's degree shall be made by Senate on recommendation of Senate Postgraduate Studies Committee.

I.5.8 Work rejected by examiners after re-submission shall not be accepted for re-examination at Sokoine University of Agriculture.

I.5.9 A dissertation recommended by examiners for re-writing and re-examination after one re-submission and re-examination will be rejected.

I.5.10 Unless there are genuine reasons, failure of a candidate to resubmit a corrected dissertation accompanied by an error-free certificate within two months after being allowed to incorporate corrections shall mean discontinuation from studies.

I.5.11 Candidates are free to appeal to Senate against any decisions regarding awards of higher degrees.