SOKOINE UNIVERSITY OF AGRICULTURE

FACULTY OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL ENGINEERING AND LAND PLANNING

MSc. In Agricultural Engineering

Core Courses

All students enrolled in M.Sc. (Agric. Eng.) programme must take AEE 626, RE 600, AE 600, AE 601, AE 617, AE 619 and must complete a minimum of 12 credit hours.

Course and Content

AE 600 INSTRUMENTATION AND MEASUREMENT IN AGRICULTURE ENGINEERING (30 LECT., 30 PRACT. HRS)

Introduction to instrumentation in agricultural engineering. 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. Components of an instrumentation and control system. Compartment 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 deign including measurement of temperature of fluids, solids, surface, measurements of fluid flow, strain, vibration, noise speed, displacement, light, and heat flux, moisture content.

Bernoulli's equation and momentum formula; flow in pipes and channels, flow and pressure measurements. Dimensional analysis and similitude studies.

AE 601 INTRODUCTION TO PROGRAMMING IN FORTRAN
(30 Lect., 30 Pract. Hrs)

Fundamental computer concepts: the Micro-computer revolution. Computer and programme. Computer organization. Input/output devices. Terminals. The ORTRAN language; high-level languages. Fortran line, compilers and interpreters. Algorithms. Integer and real arithmetic. Variables, expressions, and the assignment statement; Rules of precedence. Library functions. Input and output: format, free input, format statements and specifications. Decision and control: program flow. GO TO and IF statements. The STOP statement. Loops: The O statement. Do LOOPS. Nested loops, Valid and Invalid loop structures; Subscripted Variables; Arrays. The DIMENSION statement, Arrays and Loops. Permissible subscript forms. Matrices, Input/output of arrays. The implied DO loop. Subprograms: Functions and subroutines; passing arrays as arguments to sub-programs. Declarations: Implicit and explicit typing. COMMON

and EQUIVALENCE STATEMENTS. The DATA initialization statement. Character manipulation. Character STORAGE. Files: Sequential and direct files. Reading and writing sequential files. Binary files. Reading and writing direct files.

AE 602 PHOTOGRAMMETRY AIRPHOTO INTERPRETATION AND REMOTE SENSING (45 Lect., 60 Pract. Hrs)

Geometry of vertical, titled and oblique aerial photography; rectification by stereoscopic plotting instruments.

Imacery systems including LANDSAT, SLAR, SPOT and MSS data; digital image processing and enhancement; optical evaluatin of data; planning a quantitative remote sensing study; techniques for classification accuracy assessment; area frame sampling; ground survey and data collectin techniques; geological, geomorphological, vegetation, soils and climatic evaluation using remotely sensed and ground data Priciples of GIS for land resources assessment.

AE 603 LAND RESOURCE PLANNING (30 Lect., 6D Pract. Hrs)

Methods of soil surveys; soil classification; surveys; terrain analysis; data collection, and quality assessment; land capability and suitability collection and quality assessment; land capability and suitability classification; land use plan formulation and evaluation.

AE 606 THERMODYNAMICS (15 Lect., 30 Pract. Hrs)

Fundamental concepts, the thermodynamic system, firs and second laws of thermodynamics, properties of liquid, vapours, and gases. The steady flow – equation, flow equation, low measurement. Gas cycles with particular reference to refrigeration, coefficient of performance, refrigerator construction, installation and fault diagnosis. Heat transfer by conduction, convection and radiation.

AE 607 IRRIGATION DESIGN (60 Lect., 60 Pract. Hrs)

Introduction: Irrigation as an input to agricultural development, irrigation need classification, moisture stress in plants, soil water management at allowed deficit.

Crop water requirements: evapotranspiration, irrigation requirement, Irrigation scheduling.

Project identification and planning: planning, data for planning, types of irrigation development.

Irrigation system: factors influencing choice of irrigation, systems capacity, systems efficiency.

Surface irrigation design; soil wetting and intake properties, infiltration, redistribution, types of surface irrigation, on-farm water distribution, streamsize, irrigation time, command, field intakes; surface irrigation design project.

Overhead irrigation design: irrigation methods, conventional pipe and riser systems, mobile, systems overhead operating principles, patterns, overhead irrigation design procedures.

Irrigation structures: canal classification, canal alignment, seepage, lining of canal, canal design, erodible channels, nonerodible nonsilting channels, water level and water control structures, checks canal escapes, outlets, drops, chutes bridges, culverts.
Trickle irrigation: components and design of trickle system, emitter characteristics.
Land grading land forming needs, grading principles, equipment and working procedure, best fit plane.

AE 608 DRAINAGE AND LAND RECLAMATION (30Lect., 30Pract. Hrs)
Benefits of drainage. Drainage methods; surface and surface 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: analyzing rainfall data, evapotransiration, 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 soils management.

AE 609 PROPERTIES OF CROP MATERIALS (15 Lect., 15 Pract. Hrs)
Physical-mechanical prpperties: size, shape volume, density and rheology; viscoelasticity, viscoplasticity, viscometry, aero-dynamics, friction and conesion; optical and electrical properties, concepts and measurement techniques and application.
Influence of maturity, harvesting technique and transport on the structure and properties of harvest crops. Rheology of slurries and pumping of non-Newtonian materials and homogeneous and heterogeneous suspensions.

AE 610 CROP DRYING (30 Lect., 15 Pract. Hrs)
Fundamentals of drying: equilibrium moisture contents, moisture movement within solids, heat and moisture transfer between air and stock, safe drying temperature, falling and constant rate drying techniques and methods; thin layer drying, deep layer drying, drying of deep beds using M cEwen and O'Callaaghan, and Hukili's methods, sun drying and solar drying. Bins and storage driers, batch driers, continuous driers. Energy sources, fuel and firing, heat exchangers; resistance of crop material to air flow. Control of drying process, drying of fruits and vegetables, traditional blanching method. Design studies and exercises on drying techniques and methods appropriate in tropical conditions.

AE 611 CROP PROCESSING (30 Lect., 15 Pract. Hrs)
Cleaning and grading: theories of separation and selected seed cleaning machines. Milling of grain: theories of communication and fracture mechanics, characteristics of mining machines. Separation techniques of solid-liquid regimes, filtration and extraction, sedimentation and centrifuging. Mixing theory and determination of degree of mixing. Mixing machine characteristics applied on fluids powders and pastes. Process modeling of mixers by dimensional analysis. Thermal processes, freezing,

thawing of foods, distillation, evaporation, freeze drying, plant layout and services. Flow diagrams. Properties of milk and milk products: sterilization pasteurization, homogenization, butter making. Ice cream freezing ghee and cheese making sanitation and plant design.

AE 612 STORAGE AND MATERIAL HANDLING & FARM STRUCTURES DESIGN (45 lect., 15 Pract. Hrs)

Materials handling (systems) Elements:

Belt and chain drives. Coupling, clutches and brakes, ball and roller bearing, tooth wheel drives, design methodology. Handling systems: conveyors; hoisting equipment; winches, cranes, elevators – methods and selection; size and capacity selection and matching. Storage: bulk on-floor bins, warehouse and godowns; traditional storage structures and their improvement. Protection of crops from attack by pests, micro-organisms, rodents control factors and methods. Storage: criteria, structural consideration, environment, cooling methods, humidity control. Refrigerated storage and transport. Cost estimation. Structural design of farm buildings and storage structures. Construction details and techniques. Baths, dips and spray races, farm fences and roads. Introduction to construction related to storage systems, bins frames, thrust panels, access roads, services and dust extraction. Design of storage buildings and structures: underground, tower soils, godowns and warehouses. Analysis of forces using Janen's theory, Rankine's theory, Liquid pressure theory, examples and calculations,. Cone angle, bursting stresses, bridging. Contracts and quantity surveying. Design studies and exercises drawn from agricultural building and structures.

AE 613 AGRICULTURAL MACHINERY OPERATINOS AND MANAGEMENT (45 Lect., 30 Pract. Hrs)

Machinery – Technical Studies:

Technical evaluation, functions in crop production processes, analysis of components critical to machine work output and quality. Machine power requirements and compatibility with power sources. Analysis of machine systems for following operations: crop establishment: application of fertilizer and manures and pesticides: harvesting of grass, grain roots, vegetables and fruits: materials handling. Performance of specific machine mechanisms.

Agricultural Economic Studies:

Overview on mechanization management. Work day probabilities. Labour and machinery combinations. Machinery costs: fixed, variable, timeliness costs, records. Multif-farm machinery use; tractor hire, constractors, syndicates. Infrastructural and other requirements for successful mechanization of agricultural and other requirements for successful mechanization of agricultural and other requirement's for successful of mechanization of agricultural and other requirement's for successful mechanization of agriculture. Farm workshop and operation including staff establishment and organization. Financing machinery acquisition. Machine selection and replacement techniques; budgeting; costing techniques, break-even analysis, investment appraisal,

discounted cash flows. Government mechanization policy. Programmes and strategy formulation.

Operational Research Studies:
Application of operational research techniques to agricultural operations management. Computer based methods: linear programming and simulation; work systems design; queueing theory; inventory control; networks; transport models. Machinery maintenance, replacement and selection models.

AE 614 DESIGN AND MANUFACTURIGN OF AGRICULTURAL MACHINERY
(30 Lect., 30 Pract. Hrs)

Machine tool operation, forgoing, press work, casting, heat treatment, welding, sheet metal work, fabrication, iigs and fixtures. Design of machine components and sample assemblies. General solution of design problems. Standardization, surface quality tolerances and fits. Detachable and permanent joints, springs. Design consideration and rules. Pipe and pipe fittings, Shafts. Influence of manufacturing methods and production quantities and design. Joining of metals and components, transfer of quantities and design. Joining of metals and component, transfer of components, transfer of load between components. Couplings and clutches, belt and chain drives, brakes, ball and roller bearings, tooth wheel drives. Design methodology – outlines. Conveyors for materials handling. Manufacturing systems. Manufacturing services and controls.

AE 615 SOIL AND TRACTOR – IMPLEMENT
MECHANICS (30 Lect., 30 Pract. Hrs)

Mechanical properties of agricultural soils and granula'r materials, the effect of cementation, compaction and moisture, soil-metal interaction in soil and moisture conservation and in root-bed preparation. Implement design. And use tractor engine and performance of off-road power units, tractor implements matching. Tractor implement dynamics, weight transfer and instability, implement hitching and control.

AE 616 AGRICULTURAL EXTERNSINO AND FARMING SYSTEMS (30 Lect. Hrs)

Introduction: Definitions of agricultural extension and farming systems. The components of the farm – household system: the farm resources, the i household, off – farm components. The environments of farm-household systems: the natural cultural, economic and policy environments. Farming systems research (FSR0 concepts and procedures, e.g. diagnosis, on-farm research, etc; farmer participation in FSR. Introducing change into a fanning system: factors influencing the impact of outside intervention; the process of adoption and diffusion of Innovations. The role of agricultural extension in promotion 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 FSR in solving land and water management programs (a multidisciplinary approach).

AE 617 PROJECT PLANNING (15 LECT., 30 PRACT. HRS)

Inter-relationships between projects, progrmmes and plans. Project cycle: identification, appraisal, preparation, implementation, monitoring and evaluation. Identifying and valuing of benefits and costs, tyes of prices for project appraisal including market prices and accounting prices; social economic and financial analysis of projects.

Declaration procedures with special emphasis on agricultural rural projects and structures; technological spilovers and externalities of agricultural projects; measures of project worth with special emphasis on payback period, benefit costs ratio, net projects. Mathematical planning techniques in land and water management projects.

AE 618 HYDROLOGY AND AGROMETEOROLOGY (30 Lect. 30 Pract. Hrs)

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

AE 619 SOILD-PLANT – WATER RELATIONS (20Lect., 30Pract., Hrs)

Discussion of the solid liquid and gaseous phases of the soil and their interactions. The state of water in soils. Movement of water in soils. Absorption of water by plant roots. Factors affecting water absorption. Soil air and aeration. Soil temperature and heat flow. Environmental aspects of plant-water relationships. The energy balance. The water balance. Determination of evapotranspiration. Soil compaction and consolidation. Water stress end plant growth.

AE 620 AGRICULTURAL WATER MANAGEMENT (30 Lect., hrs)

Irrigation management techniques: when to Irrigate, how much to apply, climatic factors, soil factors, production functions, moisture sensitive growth stages, management strategies. Maximizing and optimizing 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 presets, operation and maintenance, water management and water users, Irrigation manpower planning. Environmental impacts of irrigation projects: View points or 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.

AEE- 600 RESEARCH PLANNING AND MANAGEMENT (30 Lect., hrs)

The role and character or research, history, Philosophy, and organization of scientific ideas. The interdependence of ‘pure’ and ‘applied’ science. Logic of scientific inquiry;

testing of hypotheses. Project in applied research. Types of agricultural research determination of priorities, the identification of researchable problems. Formulation of a research proposals 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 research report. Evaluation of research performance.

AEA 500 STATISTICS (60 Lect. Hrs, (60 Pract. Hrs)

Review of basic statistical concepts and coefficients. Measurements relating to simple, stratified, and cluster random samples. Review of analysis of variance. Interpretation of factorial analysis with statistically significant interaction terms. Package computer programs for transformation of variables, multiple regression, analysis of variance and covariance. Faculty of Agriculture interpretation of computer print-out.

THESIS

To relate to the candidate's area of specialization.

APPENDIX I

REVISED MSC. (AGRIC. ENG.) PROQRAME

A. **Regulations and Guidelines for the Degree**

The current regulations and guidelines for Masters Degree at Sokoine university of Agriculture win apply.

B. **The programme and purpose**:

The MSc. (Agric. Eng.) programme in department of Agricultural Engineering and Land Planning 1 designed to t am students for professional positions in the public agencies, parastatals, private organizations, teaching and research institutions.

The programme shall consist of course work and research. Opportunity for specialization is provided 1n the following areas:
(i) Land Use Planning, (ii) Irrigation, (iii) Machinery and Mechanization, (iv) Post Harvest Technology, and Farm Structures. Areas of specialization will be determined by elective courses and research topic.