

Sokoine University of Agriculture
Faculty of Agriculture
Department of Agricultural Engineering and Land Planning

B.Sc. IRRIGATION AND WATER RESOURCES ENGINEERING DEGREE PROGRAMME
(B.Sc. IRWE)

PROGRAMME AIMS

The B.Sc. Irrigation and Water Resources Engineering degree programme aims to provide:

- i) The necessary background in technology, analytical and managerial skills which will enable graduates to analyse and assess engineering systems for effective application to irrigated agriculture.
- ii) Professionalism that permits graduates to fill responsible professional positions that demand both engineering and agricultural related skills.
- iii) Knowledge and skills in the design, construction, operation, management and maintenance of irrigation and water resources systems including rain water harvesting for agricultural production.
- iv) The necessary entrepreneurial skills required for graduates to become job creators rather than job seekers.
- v) A sound base from which the graduates can embark on postgraduate studies in irrigation and water resources engineering and related professional disciplines.

To produce graduates who:

- i) Can spearhead modernization of agriculture.
- ii) Have more knowledge focussed on irrigation and water resources engineering.
- iii) Are well versed with the techniques and aspects of irrigation and water resources engineering.
- iv) Can apply multidisciplinary approaches to plan, design, and execute relevant research in irrigation and water resources engineering.
- vi) Can provide the necessary analytical and managerial skills to manage irrigation and water resources systems for sustainable development.

COURSE STRUCTURE

SEMESTER 1

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 110	Workshop Training I	0	0	120	2
AE 111	Engineering Drawing	15	0	90	2
AE 112	Engineering Statics	45	0	30	2
CIT 100	Computer Application	30	0	90	2.5
ENV 111	Introduction to Meteorology	30	0	30	1
MTH 104	General Mathematics I	45	30	0	2
Total		165	30	360	11.5
ELECTIVE COURSES					
AEA 101	Introductory Agricultural Economics	30	10	20	1.5
DS 100	Theories, Principles, and Current Issues of Development	45	30	0	2
LRM 111	Introduction to remote sensing	20	0	20	1.0
SC 100	Communication Skills I	45	30	0	2
Total		140	70	40	4.5
Total Semester 1		305	100	400	16.0

SEMESTER 2

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 110	Workshop training II	15	0	90	2
AE 114	Fundamentals of Electrical Engineering	45	0	30	2
AE 115	Engineering Dynamics	45	0	30	2
AE 222	Computer Aided Drafting	15	0	30	1
MTH 107	General Mathematics II	45	30	0	2
SC 101	Communication Skills II	45	30	0	2
Total		210	60	180	11
ELECTIVE COURSES					
AE 116	Computer Applications for Engineers	15	0	30	1
AEA 102	Introduction to Agribusiness	30	15	15	1.5
EE 105	Principles of Administration and Management	20	20	0	1
CIM 104	Social-cultural implications of ICT	30	60	0	2
MTH 106	Introductory Statistics	45	0	30	2
Total		140	95	75	7.5
Total Semester 2		350	155	255	18.5
Total Semester 1 & 2		655	255	655	34.5

SEMESTER 3

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 210	Introduction to Engineering Design	20	0	20	1
AE 211	Strength of Materials	45	0	30	2
LRM 112	Introduction to Geographic Information Systems (GIS)	20	0	20	1
BPE 211	Applied Thermodynamics	45	0	30	2
MTH 201	Biometry	45	30	0	2
Total		175	30	100	8
ELECTIVE COURSES					
AEA 202	Agricultural Marketing Management	50	20	0	2
EE 202	Extension Methods	30	60	0	2
ENV 211	Occupational Health Hazards and Safety Practices	30	0	0	1
MTH 202	Numerical Methods II	45	30	0	2
RD 202	Natural Resources Management	45	30	0	2
Total		200	140	0	9
Total Semester 3		375	170	100	17

SEMESTER 4

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 212	Surveying	30	0	60	2
AE 217	Engineering Materials Technology	30	20	40	2
AE 219	Computer Programming	30	0	60	2
CS 204	Principles of Agronomy	30	0	30	1.5
IWE 210	Fluid Mechanics	30	20	40	2
MTH 108	Numerical Methods I	45	30	0	2
Total		195	70	230	11.5
ELECTIVE COURSES					
AEA 204	Farm Management	30	20	40	2
AEA 209	Economic Survey Methods	20	0	20	1
AEA 210	Agribusiness and Entrepreneurship Development	30	30	30	2
ENV 206	Climatology	15	0	30	1
RD 210	Computer Applications in Statistical Data Analysis	30	0	30	1.5
Total		125	50	150	7.5
Total Semester 4		320	120	380	19.0
Total Semester 3 & 4		695	290	480	36.0

SEMESTER 5

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
IWRE 311	Analysis of Structures	30	30	0	1.5
IWRE 312	Water Supply	15	0	30	1
IWRE 313	Design of Drainage Systems	15	10	20	1
IWRE 314	Waste Treatment Systems Design and Management	30	0	30	1.5
IWRE 315	Applied Hydrology	30	10	20	1.5
IWRE 316	Sediment Transport	20	0	20	1
IWRE 317	Design of Irrigation Systems	30	0	30	1.5
Total		170	50	150	9.0
ELECTIVE COURSES					
IWRE 321	Rainwater Harvesting	15	0	30	1
AE 310	Instrumentation and Measurements	30	0	60	2
BPE 311	Engineering Properties of Biological Materials	30	0	60	2
FBL 303	Integrated Watershed Management	30	30	0	1.5
*RD 308	Designing Rural Development Programmes/Projects	20	20	0	1
Total		125	50	150	7.5
Total Semester 5		295	100	300	16.5

* This course is a pre-requisite of the course RD 309

SEMESTER 6

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
IWRE 300	Research Methods	45	0	30	1.5
AE 322	Electrical Power Systems and Machines	45	0	30	2
IWRE 310	Irrigation Agronomy	30	0	0	1
IWRE 318	Soil Mechanics and Foundation Engineering	45	10	20	2
IWRE 319	Soil Physics for Irrigation and Water Resources Engineers	30	20	40	2
IWRE 320	Hydrogeology	30	0	30	1.5
Total		225	30	150	10.0
ELECTIVE COURSES					
AE 326	Computer Aided Design	15	0	30	1
AE 328	Communications and Computer Networking	15	0	30	1
AEA 306	Human Resource Management	50	20	0	2
RD 309	Appraisal, Monitoring and Evaluation of Rural Development Programmes/Projects	45	30	0	2
Total		125	50	60	6
Total Semester 6		350	80	210	16.0
Total Semester 5 & 6		645	180	510	32.5

SEMESTER 7

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 413	Engineering Operations Management	30	0	0	1
AE 430	Engineering Professional Ethics and Laws	30	0	0	1
IWRE 400	Research Project I	0	10	110	2
IWRE 410	Irrigation Structures	30	20	40	2
IWRE 412	Environmental Hydraulics	30	0	30	1.5
IWRE 413	Soil and Water Conservation Engineering	30	20	40	2
Total		150	50	220	9.5
ELECTIVE COURSES					
AE 418	Sensors and Controls for Precision Agriculture	15	0	30	1
AEA 303	Agribusiness Finance and Credit Management	30	30	30	2
IWRE 418	Introduction to Soil-Water-Crop Modelling and Simulation	30	30	0	1.5
Total		75	60	60	4.5
Total semester 7		225	110	280	14.0

SEMESTER 8

COURSE ANTE	COURSE TITLE	CONTACT HOURS			CREDITS
		Lect	Sem	Prac	
CORE COURSES					
AE 425	Mathematical Planning Techniques	15	30	0	1
IWRE 400	Research Project II	0	10	50	1
IWRE 411	Design of structures	45	10	20	2
IWRE 414	Design of Detention Reservoirs and Small Dams	45	0	30	2
IWRE 415	Irrigation Water Management	20	0	20	1
IWRE 416	Construction Techniques	30	30	0	1.5
IWRE 417	Public Health in Water Resources Development	30	0	0	1
IWRE 419	Drainage and Land Reclamation	15	0	30	1
Total		200	80	150	10.5
ELECTIVE COURSES					
AE 419	Agricultural Machinery Management	30	0	30	1.5
AE 421	Occupational Safety Management	15	30		1
AEA 311	Business Laws and Ethics	40	40	0	2
ENV 306	Environmental Impact Assessment	45	0	30	2
RD 206	Cooperative and Rural development	45	0	30	2
Total		175	70	90	7
Total Semester 8		375	150	240	17.5
Total Semester 7 & 8		600	260	520	31.5

PRACTICAL TRAINING

LEVEL OF PRACTICAL TRAINING	DURATION (Weeks)	TIMING	ACTIVITIES TO BE UNDERTAKEN
PT 1	8	After the 2 nd semester	Craftsman level
PT 2	8	After the 4 th semester	Technician level
PT 3	8	After the 6 th semester	Engineer's level
PT 4	2	As a group in the last 2 weeks of the 8 th semester	Engineer's level

PRINCIPLE LEARNING OUTCOMES

A Knowledge and Understanding

On successful completion of the degree programme, students should be able to demonstrate the knowledge and understanding of:

- A1 high level of competence in engineering principles and appreciation of its current and future developments and technologies.
- A2 essential facts, concepts, theories and principles of irrigation and water resources, and its underpinning science and mathematics.
- A3 role played in society by irrigation and water resources engineers.
- A4 range of potential water sources and engineering techniques employed for quantitative analysis.
- A5 processes driving the hydrological cycle and the physico-chemical processes associated with wastewater treatment.
- A6 water resources development to climate change and.
- A7 legal requirements governing engineering activities.

Teaching strategy

Lectures are the main way of imparting knowledge and understanding (A1-A7). Seminars and small group tutorials are also used: seminars and tutorials are led by staff and/or students. Computer software packages are also used.

Learning strategy

Students are encouraged to contribute to their own learning experience by independent reading. They are provided with references to books, scientific papers and other learning materials to enhance their understanding of specific subject areas. They are also given group work exercises to encourage a collective approach and responsibility for gathering knowledge and sharing of understanding.

Assessment strategy

Students are primarily assessed by written examinations supported by a variety of different forms of coursework that include essays, projects, case studies and other exercises. Most courses include coursework, thus ensuring an element of formative as well as summative assessment. Seminar, tutorial and poster presentation exercises assess knowledge and understanding that is demonstrated verbally. The final research project report in the fourth year (which is not directly

supported by lectures or seminars) assesses students' abilities to independently acquire knowledge and understanding.

B Practical Skills

On successful completion of the degree programme, students should be able to:

- B1 design and construct irrigation and water resources engineering structures.
- B2 operate, maintain and manage irrigation and water resources engineering systems.
- B3 apply appropriate modelling and analytical methods in planning and design of irrigation and water resources engineering systems.
- B4 use appropriate software packages in the analysis, design and evaluation of irrigation and water resources engineering systems.
- B5 apply system approach to engineering problem solving.

Teaching strategy

Professional/practical skills relevant to irrigation and water resources engineering applications shall be demonstrated in specific lectures, seminars, laboratories, computing sessions, workshops, field visits, practical training, individual and group project work, and design work (B1-B5).

Learning strategy

Students shall acquire skills (B1-B5) through a 'hands-on' approach in the most applied modules, e.g. Workshop Training; Engineering Drawing, Land Survey, Computer Aided Drafting, and use of Policies and Engineering Codes of Practice.

Assessment strategy

The methods outlined in section A also test the development of practical skills (B1-B5). Case-studies and report writing and presentation are the major methods of assessment.

C Intellectual/Cognitive skills

On successful completion of the degree programme, students should be able to:

- C1 evaluate and forecast hydrological events using technical procedures
- C2 assess the performance of engineering systems and components.
- C3 assess and manage risks related to irrigation and water resources systems.
- C4 analyze and design irrigation and water resources systems considering cost and environmental issues
- C5 appraise irrigation and water resources systems considering cost and environmental issues
- C6 apply engineering principles to analyse multi-disciplinary problems in order to formulate appropriate solutions
- C7 apply management techniques which may be used to achieve engineering objectives within that context

Teaching strategy

Seminars provide the main opportunity for students to evaluate evidence and formulate objective and coherent arguments (C1-C7). Problem solving skills are developed in tandem with the range of activities described above that are designed to develop their practical skills.

Learning strategy

Students learn through problem-solving, handling data, and discussion. Students are encouraged to justify their opinions in discussions and in their final research project reports where they practice production of reasoned arguments and analysis.

Assessment strategy

The range of methods described in sections A and B also provide an opportunity to assess cognitive skills (C1-C7), e.g., in the form of seminars. The final research project report is a major vehicle for the assessment of all the cognitive skills (C1-C7).

D Key Transferable Skills

On successful completion of the degree programme, students should be able to:

- D1 effectively use information technology (IT).
- D2 effectively communicate with target audience.
- D3 work independently, through managing own learning, time management, showing initiative and adaptability.
- D4 work successfully as a member of a multidisciplinary team.
- D5 develop informed, logical, and justified opinions.

Teaching strategy

The use of computers and data analysis (D1) features throughout the duration of the degree programme. As well as contributing directly to key skills, they also contribute to the other learning outcomes A, B and C. Oral communication and presentational skills (D2) are practised, particularly in seminars and tutorials. Several modules involve teamwork (D4). All modules involve independent, student-centred work requiring completion by specific deadlines (D3 and D5)

Learning strategy

Students learn through the production of reports. Emphasis is placed on time management throughout the programme.

Assessment strategy

The strategy and methods used to assess learning outcomes A, B and C provide an integrated approach to the development of key skills D1-D5 from a broad base. The final research project report is also a major vehicle for the assessment of the key skills (D1-D5).

ATTRIBUTES OF THE GRADUATES

As a result, graduates of the B.Sc. in Irrigation and Water Resources Engineering degree programme should be able to work in one or a combination of the following areas:

- i) Large scale irrigation projects
- ii) Urban water supply authorities
- iii) Small-scale mechanised farmer managed schemes
- iv) Irrigation and water resources engineering consulting firms
- v) Rural water supply projects

- vi) Construction companies specialised in irrigation projects and development of water resources systems
- vii) Design and construction of waste water projects
- viii) Environmental management and protection
- ix) CBO's, NGO's
- x) Institutions of higher learning
- xi) Teaching and research institutions as teachers/tutors/trainers and consultants in areas related to irrigation and water resources engineering; design, monitoring and evaluation of programmes and projects
- xii) Self employment

DURATION OF THE DEGREE PROGRAMME

In accordance with the Semester guidelines and standards, the duration of the B.Sc. degree programme in Irrigation and Water Resources Engineering shall be eight Semesters for full time students and up to 16 Semesters for part time students.

ADMISSION REQUIREMENTS

In addition to the minimum admission requirements for first degree courses at SUA, applicants to the B.Sc. in Irrigation and Water Resources Engineering degree programme must:

a) 'A' level candidates (Direct Entrants)

Possess Principal level passes in Advanced Level Mathematics and Physics/Chemistry/Geography AND at least a credit pass in Physics and Chemistry/Biology/Science and Practice in Agriculture in the Ordinary Level Certificate of Secondary Education Examination or an Equivalent Examination.

The sum of the points from the principal level passes should not be less than 4.0.

b) Mature Entrants

Possess NTA 5 Certificate or equivalent qualifications with an average grade of C and at least a "C" grade in Mathematics.

Possess a Diploma in Agricultural Engineering or related field having passed with at least a credit and must have a credit pass in Mathematics in the Certificate of Secondary Education Examination.

SPECIAL EXAMINATION REGULATIONS

a) General Regulations

In addition to the general examination regulations, the following shall apply for B.Sc. in Irrigation and Water Resources Engineering degree programme:

- (i) Students' performance shall be assessed continuously throughout the course.
- (ii) The pass mark shall be **50%** for all the examinations.
- (iii) Each candidate shall be required to undertake a Special Project, whose report shall be completed and submitted for examination at least two weeks before the start of the final

Semester examinations. Special Projects shall be conducted during the last three Semesters. A candidate failing in the Special Project will not be allowed to graduate until he/she passes it.

- (iv) Each candidate shall be required to undertake Practical Training in industry (PT) during the long break at the end of the second, fourth and sixth Semesters and also, after six weeks of the eighth Semester. Each Practical Training shall be assessed and will form part of the assessment of the succeeding Semester.
- (v) Where a candidate fails in Industrial Practical Training, guidelines for PT assessment shall apply.
- (vi) A candidate who fails in a course that is assessed by continuous assessment only viz. ABE 110 shall be required to retake the failed course when it is next offered provided he/she does not fail in more than one third of the courses and his/her GPA is not less than 2.6.
- (vii) Courses that are offered by other Faculties and Institutes shall be governed by the regulations of the respective Faculty or Institute.

b) Course Work and end of Semester Assessments

- i) Course work assessment for courses which do have laboratory practicals shall be done by giving students tests, essays, practicals and assignments and the assessment shall carry 60% of the final marks. The end of Semester examination shall comprise 40% of the marks.
- ii) Course work assessment for courses which do not have laboratory practicals shall be done by giving students tests, essays, and assignments and the assessment shall carry 40% of the final marks. The end of Semester examination shall comprise 60% of the marks.
- iii) Courses that do not involve formal lectures, viz. ABE 110 shall be assessed by giving practical assignments that will comprise 100%.

c) Special Rules

- (i) A student will be expected to have a course load of at least 12 credits for each of semester.
- (ii) In order to graduate a student should have accumulated a minimum of 96 credits which will contribute 90% of the overall GPA and the remaining 10% will come from Practical Training.

d) Practical Training in Industry

The Department of Agricultural Engineering and Land Planning shall be responsible for the organization and running of the Industrial Practical Training sessions at the end of the second, fourth, and sixth Semesters during the long break and also after six weeks of the eighth Semester. The duration of each Practical Training session shall be eight weeks. The Preparation and conduct of the training shall be done as follows:

A. Preparation of Practical Training

- i) The allocation of Industrial Practical Training places to students shall be undertaken by the Department of Agricultural Engineering and Land Planning. Training at a practical training place not approved and allocated by the Department before the start of training shall not be recognized.
- ii) Lists of Practical Training places shall be made available to students not later than five weeks before the end of the respective Semesters.

- iii) The allocation of Practical Training places to students shall be completed not later than one week before the end of the respective Semesters.

B. Guidelines for Practical Training Assessment

- i) Every Industrial Practical Training shall be treated as a subject of the succeeding Semester.
- ii) Non completion of Practical Training shall lead to failure.
- iii) Practical Training reports shall be handed in for assessment before the end of the second week of the succeeding Semester and marking completed before the end of that Semester.
- iv) Candidates may be required to present themselves before the examiners for an oral examination.
- v) A candidate who fails in a part of a Practical Training because of reasons other than (ii) or (iii) shall be allowed to carry it forward and retake the Practical Training in the particular part failed. If the candidate fails again, he/she will be required to repeat the training when it is next offered before proceeding to the next one or before he/she can be allowed to graduate.
- vi) A candidate who fails in a Practical Training examination because of reasons mentioned in (ii) or (iii) shall be required to repeat the training when it is next offered before proceeding to the next one or before he/she can be allowed to graduate.
- vii) A candidate who fails after repeating a Practical Training twice shall be discontinued from studies.
- viii) Students, who do not go to places allocated to them for Practical Training without satisfactory reasons shall be deemed to have absconded from PT and shall as a result, be discontinued from their studies.

WEIGHTING OF FINAL RESULTS

- (a) All assessed courses in the first to the last Semester shall count towards the final results.
- (b) The weighting of the examinations grade shall be as follows:
 - i) The total weight shall be 1.0
 - ii) The total weight factor of the three Industrial Practical Training sessions shall be 0.1
 - iii) The total weight factor for all the subjects including the Special Project shall be 0.9. The weight of each subject contributing to this weight factor shall be proportional to the number of credits for the respective course.
- (c) The grading system shall be as follows:
 - A = 70 – 100
 - B⁺ = 65 – 69
 - B = 60 – 64
 - C = 50 – 59
 - D = 40 – 49
 - E = 0 – 39
- (d) Classification of Degrees

The final degree classification shall be as follows:

Class	Grade	GPA range
First Class	A	4.4 – 5.0
Upper Second	B+	3.5 – 4.3
Lower Second	B	2.7 – 3.4
Pass	C	2.0 -2.6

14.5 Long Term Plans

The Department is expected to grow in terms of academic and research programmes in the proposed areas of study. This will cover training at the undergraduate and postgraduate levels and clientele short courses. Out of the expected strength it is also expected to conduct consultancy activities and advisory services in a wider engineering context. In totality the Department envisages to grow to a Faculty of Campus College. Thus there will be need to source for external funding to establish more infrastructure and acquire relevant and sufficient equipment