The outline of the Master Degree curriculum in Integrated Soil Management

The distribution of contact hours by semester and course

Integrated Soil Management MSc PROGRAMME Mansoura University (MU), Egypt									
Course Code	Courses	Contact Hours			Semester, contact hours per week				Credit
		Total	Lec.	Pr.	I.		II		
					1.	2.	3.	4.	
					14	14	14	14	
JSS101	Soil-water-plant relationships	56	28	28	2+2T				6
JSS102	Advanced statistics	56	28	28	2+2T				6
JSS103	Principles of modelling	56	28	28	2+2T				6
JSS104	GIS	56	28	28	2+2T				6
JSS105	Principles of remote sensing	56	28	28	2+2T				6
SS201	Soil physics	56	28	28		2+2T			6
SS202	Soil chemistry	56	28	28		2+2T			6
SS203	Soil biology	56	28	28		2+2T			6
SS204	Soil survey, classification and land evaluation	56	28	28		2+2T			6
	Elective	56	28	28		2+2T			6
Option : Soil fertility and modern fertilisation advice systems									
SS301A	Soil fertility and modern fertilisation advice systems	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
Option : Soil and water quality management									
SS301B	Soil and water quality management	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
Option : Soil remediation and land reclamation									
SS301C	Soil remediation and land reclamation	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Elective	56	28	28			2+2T		6
	Thesis preparation and consultation	56	28	28				2+2	30

	Courses	Contact Hours			Semester, contact hours per week				Credit
		Total	Lec.	Pr.	I.		II		
					1.	2.	3.	4.	
					14	14	14	14	
Elective courses:									
SSE01	Low input soil cultivation systems								
SSE02	Models for soil management								
SSE03	Soil protection								
SSE04	Instrumentation and pollution control								
SSE05	Soil quality monitoring								
SSE06	Economics of environment and resource management								
SSE07	Models for water management								
SSE08	Application of GIS in water and land management								
SSE09	Advanced remote sensing								
SS301A/E	Soil fertility and modern fertilisation advice systems								
SS301B/E	Soil and water quality management								
SS301C/E	Soil remediation and land reclamation								
SSE10	Water policy and law								
SSE11	Scientific writing and communication skills								
SSE12	Research methodology								
	Total contact hours:	896	448	448					
	Total credits:				30	30	30	30	120

Abbreviations:
cr.:credit, ex.:exam, lec.:lecture, pr.:practical , T: assessed by final exam, P: assessed by semester performance

Course Title	**Soil – Water – Plant Relationships**
Program Name	**Joint Integrated Water Management M.Sc. and Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year - Joint First Semester**
Course code	**JSS101 (Integrated Soil Management M.Sc)**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **To understand the role of water in crop plant growth.** ▪ **To become familiar with moisture relations in soils and relate them to crop production.** ▪ **To understand the movement of water in soil systems.** ▪ **To become aware of plant water requirements and methods to measure and control soil moisture.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** **Soil-plant-atmosphere continuum, and explain the functions of water.** **Week No 2-3** **Transport of water through the soil-plant-atmosphere continuum in relation to differences in water potential.** **Week No 4-5** **Principal processes and functions of photosynthesis and respiration, and the responses of plants to water and aeration stress.** **Week No 6** **Effects of soil structure and texture on the water holding capacity of soils.** **Week No 7** **Measuring soil water content and soil water potential and relate one to the other through the soil water release characteristic.** **Week No 8** **Analyze and interpret data on soil water content and movement in saturated and unsaturated conditions.** **Week No 9** **Water stress and its management.** **Week No 10** **Nutrients availability and transport in soil matrix.** **Week No 11** **Nutrients uptake mechanisms as affected by soil conditions** **Week No 12** **Water quality monitoring.** **Week No 13** **Soil Drainage** **Week No 14** **Wetland water management and water table control**
Mode of assessment during the semester	**Home assignments – Reports**
Type of exam	**Oral exam + written exam at the end of the semester**

Compulsory practice related to the course	**Field trips**
Compulsory and recommended literature:	▪ **E. G. Gregorich, Gregorich, M. R. Carter (1997). Soil Quality for Crop Production and Ecosystem Health. Elsevier Science & Technology Books** ▪ **Marschner, H. (1995). Mineral Nutrition of Higher Plants. Academic Press, London.** ▪ **Winter, E.J. (1998). Water, Soil and the plant. ISBN: 0-333-12948-2** ▪ **P. Schjonning, S. Elmholt, B. T. Christensen (2003). Managing Soil Quality: Challenges in Modern Agriculture. CABI**

Course Title	**Advanced Statistics**
Program Name	**Joint Integrated Water Management M.Sc. and Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year - Joint First Semester**
Course code	**JSS102 (Integrated Soil Management M.Sc.)**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**The course introduces students to various experimental designs and the rationale behind these designs. The student will study the basic concepts and principles of the general linear model. This course help student to evaluate research questions and results. Also help them to generate "exciting" hypotheses and test theories. In addition to make the following processes; set up data to be ready for analysis, analyze the data and reach appropriate conclusions, test hypotheses and theories using a model-comparison approach And present results in a final style.**
Personnel background	**Lecturer & practical teacher**
Course content:	**Week No 1** — **Introduction** ▪ **The general linear model** ▪ **Descriptive statistics** **Week No 2** — **Descriptive statistics.** ▪ **Variance** ▪ **Z-Scores.** ▪ **Covariance.** ▪ **Correlation** **Week No 3** — **Significance testing.** **Week No 4** — **hypothesis testing** **Week No 5** — **Simple regression** **Week No 6** — **Types of research.** **Week No 7** — **Reliability.** **Week No 8** — **Validity** **Week No 9** — **Introduction to ANOVA** **Week No 10** — **Multiple comparison tests** **Week No 11** — **Factorial designs** **Week No 12** — **Multiple regression** **Week No 13** — **Regression and ANOVA/probability** **Week No 14** — **Random effects models**
Mode of assessment during the semester	**Exercises and term papers**
Type of exam	**Homework - Seminars - Oral and written exam**
Compulsory practice related to the course	**Non**

Compulsory and recommended literature:	▪ **Deborah A. Boehm-Davis (2003). Advanced Statistics and Research Methods for Psychology. 2055 David King Hall** ▪ **Behrens, J. T. (1997). Principles and procedures of exploratory data analysis. *Psychological Methods, 2,* 131-160.** ▪ **Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied *multiple regression/correlation analysis for the behavioral sciences*. 3rd Edition. Lawrence Erlbaum Associates. ISBN 0-8058-2223-2.**

Course Title	**Principles of modeling**	
Program Name	**Joint Integrated Water Management M.Sc. and Integrated Soil Management M.Sc.**	
Scheduled Semester	**First Year - Joint First Semester**	
Course code	**JSS103 (Integrated Soil Management M.Sc.)**	
Course Type	**Compulsory**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	▪ **This course concerns the Principles of Modeling identifies the essential concepts that must be taught to students to create models.** ▪ **The purpose of the course is to:** ▪ **To give students an appreciation of the fundamental principles of modeling** ▪ **To describe the purpose of modeling and simulation.** ▪ **Introduce the basic terms, concepts, techniques, and applications of modeling.** ▪ **Present the basic principles derived by key thinkers over a lifetime of experience.** ▪ **Introduces many types of models such as the Conceptual, Dynamic, Logical, Decision, and Control models.** ▪ **Teach students a practical process for creating models** ▪ **Take the student through the entire modeling process from problem statement to the specification of data to drive the model.** ▪ **Teach students instruction on building software implementations of conceptual models.**	
Personnel background	**Lecturer**	
Course content:	**Week No 1** **Week No 2-3** **Week No 4-5** **Week No 6-8** **Week No 9-11**	**Importance of modeling** **Principles of Modeling** ▪ **Basic terms and concepts** ▪ **Techniques** ▪ **Applications of modeling.** **Philosophy of Modeling** ▪ **The means of create a model.** ▪ **Objective of model and advantages are realized.** ▪ **Difference between the Science and the Art of modeling.** **The basic principles derived by key thinkers over a lifetime of experience** ▪ **Alan Pritsker.** ▪ **Grady Booch.** ▪ **Ivar Jacobsen.** ▪ **Averill Law.** ▪ **Paul Fishwick.** **The complete types of models necessary to**

	Week No 12 Week No 13 Week No 14	capture the behavior of a system ▪ Conceptual models. ▪ Dynamic models ▪ Logical models. ▪ Decision models. ▪ Control models. Creating simulation models via practical process. The entire modeling process . Software development (The Programming).
Mode of assessment during the semester	case study and accomplishment of seminars	
Type of exam	Reports, problem solving, oral exam during the semester and written exam at the end of the semester.	
Compulsory practice related to the course	Non	
Compulsory and recommended literature:	▪ Ernest O. Doebelin , "System Dynamics: Modeling, Analysis, Simulation, Design", Marcel Dekker, Inc., 1998. ▪ Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd. ▪ Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: UML 2 Toolkit, WILEY-Dreamtech India Pvt. Ltd.	

Course Title	**GIS**
Program Name	**Joint Integrated Water Management M.Sc. and Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year – Joint First Semester**
Course code	**JSS104 (Integrated Soil Management M.Sc.)**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **Gain a basic, practical understanding of GIS concepts, technical issues, and applications.** ▪ **Learn where GIS fits in the world of Information Systems and maps, how it is unique and why it is important.** ▪ **Understand the technical language of GIS.** ▪ **Understand how GIS is used as one tool of spatial analysis, especially with reference to the Social Sciences** ▪ **Gain practical experience using ArcInfo, a powerful and popular desktop GIS package.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Introduction and Overview of Geographic Information Systems** **Week No 2-4** — **GIS and Maps, Map Projections and Coordinate Systems** **Week No 5-6** — **Spatial Data Models and using ArcInfo** **Week No 7-9** — **Data Sources, Data Input and Data Quality** **Week No 10-11** — **Spatial Analysis** **Week No 12-14** — **Making Maps**
Mode of assessment during the semester	**Projects + Home assignments**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Non**
Compulsory and recommended literature:	▪ **Michael Worboys and Matt Duckham (2004). GIS, A Computing Perspective (2nd edition). Boca Raton, CRC Press.** ▪ **Yann Arthus-Bertrand, Lester Russell Brown, Herve Le Bras, Jean-Robert Pitte (2005). "Earth from Above". HNA Books** ▪ **Markus Neteler, Helena Mitasova (2007). Open Source GIS: A Grass GIS Approach. Springer-Verlag New York, LLC** ▪ **Wilpen L. Gorr, Kristen S. Kurland (2007). GIS Tutorial : Workbook for ArcView 9. ESRI Press**

Course Title	**Principles of remote sensing**
Program Name	**Joint Integrated Water Management M.Sc. and Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year - Joint First Semester**
Course code	**JSS105(Integrated Soil Management M.Sc.)**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **Understanding of spectral signatures to be demonstrated with samples throughout the electromagnetic spectrum.** ▪ **Interpretation of unknown reflectance spectra in relation to features in spectra of minerals, water, vegetation and atmospheric targets.** ▪ **Understanding of principles of remote sensing techniques by outlining a sensor design according to spectral responses of Earth's surfaces and the atmosphere.** ▪ **Defining the advantages and needs for orbit selection according to acquired ground resolution, spectral characteristics and temporal changes.** ▪ **Demonstration of capability to interpret remote sensing data in order to:** ▪ **Understand the processing and enhancement of satellite images for identifying geological structures and vegetation coverage,** ▪ **Recognize coastal morphology from space,** ▪ **Recognize global changes and environmental monitoring with data from special sensors.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **The electromagnetic spectrum and atmospheric considerations** **Week No 2** — **Imaging spectrometry** **Week No 3** — **Spectral characteristics and principles of** **Week No 4** — **spectroscopy** **Week No 5** — **Spectroscopy of water** **Week No 6** — **Spectroscopy of rocks and minerals** **Week No 7** — **Spectroscopy of soil** **Week No 8** — **Spectroscopy of vegetation** **Week No 9** — **Spectral analysis for Earth science investigations** **Week No 10** — **Integration and visualization of geoscience data** **Week No 11** — **Concepts in data and image interpretation** **Week No 12** — **Visible and infrared sensors** **Week No 13** — **Radar technology** **Week No 14** — **Remote sensing platforms** **Applications**

Mode of assessment during the semester	**Projects + Home assignments**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Non**
Compulsory and recommended literature:	▪ **Ravi P. Gupta, R. P. Gupta (2003). Remote Sensing Geology. Springer-Verlag New York, LLC** ▪ **Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman (2007). Remote Sensing and Image Interpretation. Wiley, John & Sons, Incorporated** ▪ **Wilpen L. Gorr, Kristen S. Kurland (2007). GIS Tutorial : Workbook for ArcView 9. ESRI Press**

Course Title	**Soil Physics**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**SS201**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **To develop student competence in judging the effect of physical soil properties on crop growth and soil water movement in a given situation using readily available information.** ▪ **Study of the physical properties of soil with emphasis on water retention and flow and on ion movement in unsaturated soils.** ▪ **Learn about soil dynamics; stress, strain and strength.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** – **Soil physical properties.** **Week No 2-3** – **Soil-water potential: concepts and measurement.** **Week No 4** – **Saturated water flow.** **Week No 5** – **Water flow in unsaturated soils.** **Week No 6** – **Field soil water regime.** **Week No 7-8** – **Transport in soil.** **Week No 9-10** – **Gas Flow.** **Week No 11-12** – **Soil Temperature.** **Week No 13-14** – **Spatial Variability of Soil Physical Properties.**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students – Home Assignments.**
Type of exam	**Oral exam + written exam at the end of the semester.**
Compulsory practice related to the course	**Lab sessions**
Compulsory and recommended literature:	▪ **T. J. Marshall, Calvin W. Rose, and J. W. Holmes. (1996). Soil Physics. Cambridge University Press.** ▪ **W. W. Warrick, A. W. Warrick (2002). Soil Physics Companion. CRC Press.** ▪ **Rattan Lal, Manoj Shukla, Arun Shukla *and* Manoj K. Shukla (2004). Principles of Soil Physics (Books in Soils, Plants, and the Environment Series. CRC Press.**

Course Title	**Soil Chemistry**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**SS202**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ To understand of soil chemical processes such as weathering, adsorption, precipitation, complex formation, and ion exchange. ▪ To understand fundamental of soil chemical processes such as sorption/desorption, ion exchange, precipitation, dissolution, oxidation-reduction, polymerization, and hydrolysis. ▪ To familiarize students with aspects of soil colloids and their equilibrium and kinetic reactions with nutrients, metals, and organic chemicals. ▪ To familiarize students with soil salinity and alkalinity.
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Soil solid phase.** **Week No 2** — **Raw materials and weathering processes.** **Week No 3** — **Chemistry of soil minerals.** **Week No 4** — **Chemistry of organic colloids.** **Week No 5** — **The Soil Solution Phase.** **Week No 6** — **The Soil/Solution Interface (double layer theory).** **Week No 7** — **Surface exchange reactions.** **Week No 8** — **Soil reaction (pH).** **Week No 9-10** — **Soil pH management.** **Week No 11-12** — **Chemistry of soil nutrients** **Week No 13-14** — **Chemical processes of soil pollutants**
Mode of assessment during the semester	**Home assignments and self evaluation exam.**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Lab sessions**
Compulsory and recommended literature:	▪ Kim H. Tan. (1993). "Principles of Soil Chemistry" (second Edition). Madison Avenue, New Yourk. ▪ Malcolm S. Cresser, Ken Killham, Anthony Edwards (1993). Soil Chemistry and its Applications. Cambridge University Press ▪ Hinrich L. Bohn, George A. O'Connor, Brian L. McNeal. (2001). Soil Chemistry. Wiley, John & Sons, Incorporated ▪ Alfred R. Conklin (2005). Introduction to Soil Chemistry: Analysis and Instrumentation. ISBN: 0-471-46056-7.

Course Title	**Soil Biology**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**SS203**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **Recognize and describe the major groups, functions, and interactions of soil organisms.** ▪ **Explain the interrelationships between plants and soil organisms in energy and nutrient transfer.** ▪ **Describe nutrient transformations in microbial food webs found in soils, sediments, rhizospheres, and waste treatment systems, including constructed wetlands and composts.** ▪ **Describe effects of various disturbance factors on the soil habitat and its organisms.** ▪ **Write more effectively about scientific topics by the end of the class.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Soil as a habitat for organisms;** **Week No 2** — **Overview of soil organisms and their functions.** **Week No 3** — **Organic matter as a base of soil food web, and its decomposition.** **Week No 4** — **Soil bacteria and fungi.** **Week No 5** — **Growth of microorganisms.** **Week No 6** — **Protozoans.** **Week No 7** — **Annelids and vermicompost.** **Week No 8** — **Nematodes** **Week No 9** — **Mites and collembola.** **Week No 10** — **Mycorrhizae.** **Week No 11** — **Biological activity in the rhizosphere.** **Week No 12** — **Ecological interactions and biological controls.** **Week No 13** — **Nitrogen fixation and Legume symbioses.** **Week No 14** — **C:N ratios and nitrogen transformation in soil.**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Field trips**

Compulsory and recommended literature:	▪ **James B. Nardi (2007). Life in the Soil: A Guide for Naturalists and Gardeners. University of Chicago Press.** ▪ **Richard D. Bardgett (2005). Biology of Soil: A Community and Ecosystem Approach. Oxford University Press, USA** ▪ **Alvin Silverstein, Virginia Silverstein, Charles Ed. Silverstein (2000). Life in a Bucket of Soil. Dover Publications**

Course Title	**Soil Survey, Classification and Land Evaluation**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**SS204**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **To develop student competence in judging the effect of physical soil properties on crop growth and soil water movement in a given situation using readily available information.** ▪ **Study of the physical properties of soil with emphasis on water retention and flow and on ion movement in unsaturated soils.** ▪ **Learn about soil dynamics; stress, strain and strength.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** – **Soil survey concept** **Week No 2** – **Soil features - examination and description** **Week No 3** – **Soil features - composition and characterization** **Week No 4** – **Role of remote sensing and Geographic information system (GIS) on soil survey, classification and land use evaluation.** **Week No 5** – **Soil Mapping** **Week No 6** – **Classification of soils, U.S. Soil taxonomy** **Week No 7** – **Gelisols and Histosols** **Week No 8** – **Andisols and Spodosols** **Week No 9** – **Oxisols and Vertisols** **Week No 10** – **Aridisols** **Week No 11** – **Ultisols and Mollisols** **Week No 12** – **Alfisols, Entisols and Inceptisols** **Week No 13-14** – **Factors controlling land use**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Lab sessions**
Compulsory and recommended literature:	▪ **Robert F. F. Keefer (2000). "Handbook of Soils for Landscape Architects". Oxford University Press** ▪ **U. S. Department of Agriculture (2002). "Soil Survey Manual". University Press of the Pacific** ▪ **Soil Survey Staff. (2003). "Keys to Soil Taxonomy". USDA, NRCS**

Course Title	**Soil Fertility and Modern Fertilization Advice System**	
Program Name	**Integrated Soil Management M.Sc.**	
Scheduled Semester	**Second Year – third semester**	
Course code	**SS301A/E**	
Course Type	**Compulsory / Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**The course objectives include** ▪ **A background in the essential plant nutrients that includes their behavior in soil and water.** ▪ **2-An emphasis on what soil, climate, and water quality properties influence nutrient availability and plant health.** ▪ **A background in plant nutrient deficiency symptoms.** ▪ **4-A background in prescriptive fertilizer or amendment recommendations to increase nutrientn availability.** ▪ **5-An emphasis on quantitative and chemical factors that control and measure soil and plant nutrient content, and soil nutrient availability.** ▪ **6-A basic understanding of the environmental implications of fertility management and operations.** ▪ **7- Understand the best management practices for applying nutrients as fertilizers or manure to maximize profitability and minimize environmental risk.**	
Personnel background	**Lecturer + practical teacher**	
Course content:	**Week No 1-2**	**Cycles and transformation process of nutrients** **- Carbon cycle** **- Nitrogen cycle** **- Phosphorus cycle**
	Week No 3-4	**Factors affecting soil fertility and productivity**
	Week No 5	**Effects of farm practices on soil fertility** **Effect of adding organic matter, regulating soil pH, regulating salinity and reducing damage from excess water.**
	Week No 6	**Soil fertility evaluation system** **Nutrient deficiency symptoms of plants, plant analyses, soil testing, biological tests.**
	Week No 7	**Nutrient requirements of main crops**
	Week No 8	**Modern fertilization advice systems advice**
	Week No 9	**Fertilization under stress condition**
	Week No 10	**Fundamentals of fertilizers application: Crop characteristics, soil characteristics, fertilizer characteristics, nutrients and water quality, prices of nutrient unit**
	Week No 11	**Recycling of nutrients through animal manures and other organic materials**
	Week No 12	**Economics of fertilizer use**
	Week No 13	**Input of nutrients on the environment**
	Week No 14	**Nutrient legislation**

Mode of assessment during the semester	**Home assignments and self evaluation exam.**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Lab sessions + field visits**
Compulsory and recommended literature:	▪ **Mengel, K. and E.A. Kirkby. (1987). Principles of Plant Nutrition, 4th ed. International Potash Institute, Worblaufen-Bern, Switzerland.** ▪ **Havlin, J.L., J.D. Beaton, Tisdale, S.L., and W.L. Nelson. (1999). "Soil Fertility and Fertilizers, 6th ed" Prentice Hall, Upper Saddle River, NJ.** ▪ **Marschner, Horst. (1995). Mineral Nutrition of Higher Plants, 2nd ed. Academic Press Inc. San Diego, CA** ▪ **Westerman, R.L. (ed.) (1990). Soil Testing and Plant Analysis, 3rd. ed. Integrated Soil ManagementSociety of America, Inc., Madison, WI** ▪ **Havlin, Samuel L. Tisdale, Werner L. Nelson, S. Tisdale, J. Beaton (2004). "Soil Fertility and Fertilizers: An Introduction to Nutrient Management". Prentice Hall**

Course Title	**Soil and Water Quality Management**	
Program Name	**Integrated Soil Management M.Sc.**	
Scheduled Semester	**Second Year – third semester**	
Course code	**SS301B/E**	
Course Type	**Compulsory / Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	▪ **Understand basic principles of soil and water quality** ▪ **Learn to assess and evaluate soil quality related to agricultural production and environmental quality.** ▪ **Apply problem solving skills to a wide range of soil, water, and plant problems in agriculture.** ▪ **Learn and understand how to manage soil quality in shadow of sustainable agricultural systems.** ▪ **Understand important environmental concepts and principles.** ▪ **Build a foundation of chemical principles for understanding the behavior of chemical constituents in soil and water systems.** ▪ **Gain experience in applying these principles to manage soil and water quality parameters** ▪ **Study the relationships between land use and the behavior of water in the soil and the landscape**	
Personnel background	**Lecturer + practical teacher**	
Course content:	**Week No 1**	**Definition of Soil Quality, Inherent Soil Quality**
	Week No 2	**Water quality parameters**
	Week No 3	**Dynamics of soil quality as a measure of sustainable management.**
	Week No 4-5	**Soil quality indicators:** ▪ **Soil physical and chemical indicators** ▪ **Soil microbiological indicators** ▪ **Soil morphology indicators**
	Week No 6	**Water Quality parameters** ▪ **Water quality analysis** ▪ **Waste water management**
	Week No 7-9	**Soil and water quality assessment** ▪ **Minimum data sets needed to evaluate soil quality managements.** ▪ **Qualitative and quantitative assessments of soil and water quality** ▪ **Principles of soil mapping** ▪ **Soil and water quality management components**
	Week No 10	**Monitoring of soil and water quality management** **Use of satellite data and Geographic Information Systems (GIS).**
	Week No 11	**Practices needed to enhance soil quality under different soil and water quality situations.**
	WeekNo12-13	

	Week No 14	▪ Soil tillage ▪ Soil drainage Development of soil and water quality test kit for monitoring sustainability of soil quality management practices.
Mode of assessment during the semester	Home assignments, self evaluation exam and brain storming sessions	
Type of exam	Oral exam + written exam at the end of the semester	
Compulsory practice related to the course	Lab sessions + field visits	
Compulsory and recommended literature:	▪ Goudie, Andrew Goudie (1991). Techniques for Desert Reclamation. Wiley, John & Sons, Incorporated ▪ National Research Council Staff (1993). Soil and Water Quality: An Agenda for Agriculture. National Academies Press ▪ J. W. Doran, A. J. Jones, Alice J. Jones, John Walsh Doran, Integrated Soil ManagementSoc. (1996). Methods for Assessing Soil Quality. ASA-CSSA-SSSA ▪ E. G. Gregorich, Gregorich, M. R. Carter (1997). Soil Quality for Crop Production and Ecosystem Health. Elsevier Science & Technology Books ▪ Donald L. Sparks (2002). Environmental Soil Chemistry. Elsevier Science & Technology Books ▪ Mattheus F.A. Goosen, Walid H. Shayya (1999). Water Management, Purification and Conservation in Arid Climates, Vol. 1. CRC Press ▪ P. Schjonning, S. Elmholt, B. T. Christensen (2003). Managing Soil Quality: Challenges in Modern Agriculture. CABI ▪ Valentina Lazarova, Akica Bahri, Akica Bahri (2004). Water Reuse for Irrigation: Agriculture, Landscapes, and Turf Grass. CRC Press ▪ Adolf Ebel , Teimuraz Davitashvili (2007). Air, Water and Soil Quality Modelling for Risk and Impact Assessment. Springer-Verlag New York, LLC	

Course Title	Soil Remediation and Land Reclamation	
Program Name	Integrated Soil Management M.Sc.	
Scheduled Semester	Second Year – third semester	
Course code	SS301C/E	
Course Type	Compulsory /Elective	
Credit value of the course	6 credit hours	
Schedule of Education	14 Weeks	
Course Coordinator		
Other staff		
Educational objectives	▪ To study the diagnosis of salt affected soils, calcareous, sandy and contaminated soils and the activities concerning to development and improving their productivity. ▪ To understand the role of soil amendments for land reclamation in different soils. ▪ To be aware with irrigation water effects on crop production and soil quality ▪ To understand how to evaluate the quality of irrigation water and its management. ▪ To be aware with different soil contamination sources ▪ To understand basics of different soil remediation types such as physico-chemical remediation and phytoremediation .	
Personnel background	Lecturer + practical teacher	
Course content:	Week No 1 Week No 2-3	Reclamation and remediation definition Salt affected soil (saline – Alkaline) • Saline Soil ▪ Diagnoses of saline soil ▪ Sources of salts in soil ▪ Salinization process ▪ How to avoid the accumulation of salts ▪ Reclamation of saline soil ▪ Leaching requirement • Alkaline Soil ▪ Diagnoses of alkaline soil ▪ Alkalinization processes ▪ How to avoid the alkalinization ▪ Reclamation of alkaline soil ▪ Gypsum requirement
	Week No 4	Calcareous Soil ▪ Problems of calcareous soil ▪ Reclamation of calcareous soil
	Week No 5	Sandy Soil ▪ Problems of sandy soil ▪ Reclamation of sandy soil
	Week No 6	Irrigation water quality ▪ Salinity hazard ▪ Sodium hazard ▪ pH ▪ Alkalinity

		▪ Specific ions ▪ Heavy metals ▪ Microbial contaminants
	Week No 7	Soil Erosion
	Week No 8-9	Pollution: definition Characterization and identification of contaminated sites Introduction to global pollution Sources of soil pollution ▪ Fertilizers as a source of pollution ▪ Pesticides ▪ Municipal wastes ▪ Atmospheric pollution
	Week No 10	Soil processes affected soil pollutants ▪ Soil pH and Redox conditions ▪ Adsorption and desorption ▪ Mobility and transport
	Week No 11	Technologies of soil remediation Terminology and definitions Physico-Chemical separation ▪ Isolation ▪ Capping ▪ Subsurface barriers ▪ Immobilization
	Week No 12-13	Solidification/Stabilization Virtification Extraction Soil washing Electrokinetic treatment
	Week No 14	Phytoremediation ▪ Rhizophiltration ▪ Phytotransformation ▪ Plant-Assisted bioremediation
Mode of assessment during the semester	Home assignments and self evaluation exam.	
Type of exam	Oral exam + written exam at the end of the semester	
Compulsory practice related to the course	Lab sessions + field visits	

Compulsory and recommended literature:	▪ **Goudie, Andrew Goudie (1991). Techniques for Desert Reclamation. Wiley, John & Sons, Incorporated** ▪ **Hillel Rubin , N. Narkis, J. Carberry, Judith B. Carberry, Nava Narkis (1998). Soil and Aquifer Pollution: Non-Aqueous Phase Liquids - Contamination and Reclamation. Springer-Verlag New York, LLC** ▪ **R.M. M. Harrison, Royal Society of Chemistry, R. E. Hester, R. E. Hester (2001). Assessment and Reclamation of Contaminated Land, Vol. 16. Royal Society of Chemistry** ▪ **Donald L. Sparks (2002). Environmental Soil Chemistry. Elsevier Science & Technology Books** ▪ **C. Paul Nathanail, R. Paul Bardos (2004). Reclamation of Contaminated Land. Wiley, John & Sons, Incorporated**

Course Title	**Low Input Soil Cultivation System**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE01**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **Learn and understand the modern strategies of soil quality on shadow of sustainable agricultural system.** ▪ **Design on-farm nutrient management systems that are economically and environmentally sustainable** ▪ **Learn how to increase the quantity and the quality of the produced crops in a friendly way with the environment.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** **Vegetative cover crops** **Week No 2** **Mulching techniques** **Week No 3** **Composting techniques** **Week No 4** **Using earthworm to enhance soil fertility and productivity** **Week No 5** **No-till planting** **Week No 6** **Ridge-till planting** **Week No 7** **Contour planting** **Week No 8** **Grass strips** **Week No 9** **Crop rotations** **Week No 10** **Strip cropping** **Week No 11** **Perennial crops** **Week No 12** **Terraces** **Week No 13** **Agroforestry** **Week No 14** **Costs and benefits of conservation**
Mode of assessment during the semester	**Control questions posed during lectures and carrying out projects.**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Field trips + lab. sessions**
Compulsory and recommended literature:	▪ **Reganold, J. P., J. D. Glover, P.K. Andrews, H. R. Hinnan, (2001). Sustainability of three apple production systems. Nature 410:926-930.** ▪ **Pacini, C., A. Wossink, G. Giesen, C. Vazzana, R. Huirne, (2003). Evaluation of sustainability of organic, integrated and conventional farming systems: a farm and field-scale analysis. Agriculture, Ecosystems and Environment 95:273-288.** ▪ **Magdoff, F.R. and R.R. Weil. 2004. Soil organic matter in sustainable agriculture. CRC Press, Boca Raton, FL. 416 pp.**

	▪ **Pimentel, D. P. Hepperly, J. Hanson, D. Douds, R. Seidel, (2005). Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. BioScience 55(7):573-582.** ▪ **C. J. Baker, K. E. Saxton, W. R. Ritchie (2006). No-Tillage Seeding in Conservation Agriculture. CAB International**

Course Title	**Models of Soil Management**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE02**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **Explain the physical and chemical properties of soils suitable for crop production.** ▪ **Use soil testing methods to assess soils characteristics suitable for crop productioN.** ▪ **Describe appropriate techniques for sustainable soil management for crop production.** ▪ **Explain the methods used in managing earthworks in a way which is sensitive to soil condition.** ▪ **Identify and propose solutions for a number of problems that may occur with soils for crop production.** ▪ **Describe the relationship between soil characteristics and plant health.** ▪ **Describe appropriate techniques for soil management in crop production**
Personnel background	**Lecturer**
Course content:	**Week No 1** — **Plant growth and factors affecting it** **Week No 2** — **The root and its environment** **Week No 3-4** — **Soil tillage** **Week No 5-7** — **Soil erosion** **Week No 8** — **Management of soil reaction (pH)** **Week No 9** — **Soil organic matter management** **Week No 10** — **Macronutrients in soil, its transformations and management.** **Week No 11** — **Mmicronutrients and toxic elements in soil, its transformations and management.** **Week No 12** — **Soil aeration management** **Week No 13** — **Organic wastes and fertilizers** **Week No 14** — **Economics of fertilization soil fertility management**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Non**

Compulsory and recommended literature:	▪ **J. Dvorak, L. Novk (1994). Soil Conservation and Silviculture. Elsevier Science & Technology Books** ▪ **Horst H. Gerke, U. Hornung, Y. Kelanemer (1999). Optimal Control of Soil Venting: Mathematical Modeling and Applications. Birkhauser Verlag** ▪ **D. K. Benbi *and* R. Nieder *(*2003*).* Handbook of Processes and Modeling in the Soil-Plant System. CRC Press** ▪ **Michael A. Fullen, John A. Catt (2004). Soil Management: Problems and Solutions. A Hodder Arnold Publication**

Course Title	**Soil Protection**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE03**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **The main objective of this course is to understand the factors affecting soil quality, and how to manage these factors to protect soil productivity.** ▪ **Understand the factors which cause soil or nutrients loss and decrease the soil productivity.** ▪ **Learn and understand the modern strategies of soil protection on shadow of sustainable agricultural system.**
Personnel background	**Lecturer + Practical teacher**
Course content:	**Week No 1** — **Soil properties description** ▪ **Soil physical properties** ▪ **Soil chemical properties** ▪ **Soil biological properties** **Week No 2** — **Soil quality parameters** **Week No 3** — **Soil tillage management** **Week No 4** — **Soil organic matter management** **Week No 5** — **Soil compaction management** **Week No 6** — **Soil salinity and alkalinity management** **Week No 7** — **Soil nutrients availability management** **Week No 8** — **Soil erosion concept and the philosophy of its facing.** **Week No 9** — **Wind erosion** **Week No 10** — **Wind erosion prediction and management** **Week No 11** — **Water erosion** **Week No 12** — **Water erosion prediction and management** **Week No 13** — **Plant water stress and its management** **Week No 14** — **Soil contamination and its management**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Field trips and lab sessions**

Compulsory and recommended literature:	▪ **Plaster, E. G. (1992). Integrated Soil Managementand Management. Delmer Publishers Inc.** ▪ **E. G. Gregorich, Gregorich, M. R. Carter (1997). Soil Quality for Crop Production and Ecosystem Health. Elsevier Science & Technology Books** ▪ **P. Schjonning, S. Elmholt, B. T. Christensen (2003). Managing Soil Quality: Challenges in Modern Agriculture. CABI**

Course Title	**Instrumentation and Pollution Control**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE04**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**The course will develop an understanding of methods that limit the spread of pollutants in the human and natural environment. The integrated approach consists of embedding pollution control technology into long-term ecological, material, and energy policies and into the current knowledge of decomposition, transformation and dispersion of potentially toxic substances.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1-3** Ecological and Technological Concepts **Week No 4-5** Industrial Ecology. **Week No 5-6** Inorganic Contaminants. **Week No 7** Organic Contaminants. **Week No 8-9** Air Pollution Control. Weeks **Week No 10** Wastewater. **Week No 11-12** Potable Water. **Week No 13** Soil pollution. **Week No 14** Wastes recycling.
Mode of assessment during the semester	**Control questions posed during lectures and brain storming sessions.**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Lab sessions**
Compulsory and recommended literature:	▪ **Maria Csuros. (1997). Environmental Sampling and Analysis. CRC Press** ▪ **H. Rubin , N. Narkis, J. Carberry, Judith B. Carberry and Nava Narkis . *(1998).* Soil and Aquifer Pollution : Non-Aqueous Phase Liquids - Contamination and Reclamation. Springer-Verlag New York, LLC** ▪ **Gaetano Joseph Celenza, Joseph G. Celenza *(*1999*).* Industrial Waste Treatment Process Engineering: Pretreatment and Pollution Prevention, Vol. 1. CRC Press** ▪ **Jean-Louis Riviere (2000). Ecological Risk Evaluation of Polluted Soils. Taylor & Francis, Inc.** ▪ **H. Dennison Parker, G. D. Pitt *(*2008*).* Pollution Control Instrumentation for Oil and Effluents. Springer-Verlag New York, LLC.**

Course Title	**Soil Quality Monitoring**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE05**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health. In this course, state-of-the-art studies on soil quality and the principles, assessment and management of soil quality are examined with respect to biological production, plant and animal health, food security, and environmental quality. After studying this course, the students should be able to understand basic principles of soil quality and learn to assess and evaluate soil quality related to agricultural production and environmental quality.**
Personnel background	**Lecturer + Practical teacher**
Course content:	**Week No 1** — **What is soil quality?** **Week No 2** — **Why do we need soil quality concept?** **Week No 3** — **Soil Components and Basic Soil Quality Properties** **Week No 4** — **Soil Quality Indicators** **Week No 5** — **Soil Quality Assessment** **Week No 6** — **Measurements of Soil Quality Indicators** **Week No 7** — **Soil Quality Management for Plant Production: Part I. Soil quality factors** **Week No 8** — **Soil Quality Management for Plant Production: Part II. Processes and management** **Week No 9** — **Management of Soil Quality for the Environment: Water Quality** **Week No 10** — **Soil quality monitoring and management for Air Quality** **Week No 11** — **Soil quality monitoring and management for Plant Health** **Week No 12** — **Soil quality monitoring and management for Animal Health** **Week No 13-14** — **Soil quality monitoring and management for Food Security**
Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**Oral exam + written exam at the end of the semester**

Compulsory practice related to the course	**Field trips + Lab sessions**
Compulsory and recommended literature:	▪ **Arshad, MA; Martin, S (2002). Identifying critical limits for soil quality indicators in agro-ecosystems. AGR ECOSYST ENVIRON, 88 (2): 153-160 Sp. Iss. SI FEB.** ▪ **He, Z. L., X. E. Yang, V. C. Baligar, and D. V. Calvert. (2003). "Microbiological and biochemical indexing systems for assessing acid soil quality". ADV. AGRON, 78: 89-138.** ▪ **Schjonning, P., S. Elmholt, and B. T. Christensen (Ed). (2004). Managing Soil Quality: challenges in Modern Agriculture. CABI Publishing, Cambridge, MA.**

Course Title	**Economics of Environment and Resources Management**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE06**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**To develop a strong understanding of the fundamental principles of environmental and resource economics.** **To expose you to the breadth of the field.** **To help develop the ability to read and synthesize papers in applied economics.** **To foster creative and independent thinking about problems in the area of environmental and resource economics.**
Personnel background	**Lecturer**
Course content:	**Week No 1-3** — **Economics of production, costs, and agricultural supply** **Week No 4** — **Agriculture and Agribusiness** **Week No 5-6** — **Environmental resources economics** **Week No 7-8** — **Environmental resources Marketing** **Week No 9-10** — **Farm Management** **Week No 11** — **Agricultural Policy** **Week No 12** — **Sociology and Rural sociology** **Week No 13** — **Agricultural Cooperation** **Week No 14** — **Economics of agricultural resources and environment**
Mode of assessment during the semester	**Control questions posed during lectures and brain storming sessions**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**None**
Compulsory and recommended literature:	▪ **Gerald A. Carlson, David Zilberman, John A. Miranowski, David Zilberman, John Miranowski (1993). Agricultural and Environmental Resource Economics. Oxford University Press** ▪ **Wesley D. Seitz, Harold G. Halcrow, Gerald Nelson, Gerald C. Nelson, Gerald Nelson (2001). Economics of Resources, Agriculture, and Food (Agricultural Economics Series) McGraw-Hill Higher Education** ▪ **Bekele A. Shiferaw, S. M. Swinton (2005). Natural Resources Management in Agriculture: Methods for Assessing Economic and Environmental Impacts. CAB International.** ▪ **W. Douglass Shaw (2005). Water Resource Economics and Policy: An Introduction. Edward Elgar Publishing, Incorporated**

Course Title	**Models for Water Management**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE07**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ Evaluate the wide range of water management modeling software to help students to identify, select, and acquire the optimal software program for their particular modeling needs. ▪ Covers general-purpose software packages that deal with water management models. ▪ Considers packages that focus on specific models for water distribution systems; ground water; stream hydraulics; river and water quality.
Personnel background	**Lecturer**
Course content:	**Week No 1** Introduction **Week No 2** Role of models in water management **Week No 3** Computer modeling **Week No 4** Modeling systems **Week No 5** Expert systems **Week No 6** General purpose software **Week No 7** Model development **Week No 8** Water management models **Week No 9** Water distribution system models **Week No 10** Ground water models **Week No 11** Water runoff models **Week No 12** Stream hydraulics models **Week No 13** River and river system operation models **Week No 14** Water Quality Models
Mode of assessment during the semester	**accomplishment of seminar**
Type of exam	**oral exam during the semester and written exam at the end of the semester.**
Compulsory practice related to the course	**Non**
Compulsory and recommended literature:	▪ M. C. M. Van Loosdrecht (1999); Application of Models in Water Management. Pergamon Press Inc; 1 edition; 282 pages ▪ Ralph A. Wurbs (1995); Water Management Models: A Guide to Software. Prentice Hall PTR. ▪ Asit K. Biswas (1981); Models for Water Quality Management (McGraw-Hill series in water resources and environmental engineering); Mcgraw-Hill (Tx) ▪ Bay-Delta Modeling Forum (2000); Protocols for Water and Environmental Modeling. Ad hoc Modeling Protocols Committee

Course Title	**Application of GIS in Water and Land management**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE08**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**To provide a basic, practical understanding of GIS concepts, technical issues, and applications applied to soil and water science using ArcGIS geographic information system.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Introduction to GPS, remote sensing, and GIS applications to precision agriculture and watershed modeling.** **Week No 2-3** — **Precision Agriculture.** **Week No 4-5** — **GPS Application to precision farming.** **Week No 6** — **Soil maps, soil sampling, photos and images** **Week No 7-8** — **Soil, water, vegetation reflectances, assessing crop nutrient sufficiency** **Week No 9-10** — **Soil quality and productivity mapping.** **Week No 11** — **Mapping of soil OM.** **Week No 12** — **Mapping of soil clay concentration** **Week No 13** — **GIS data manipulation, Analysis, and modeling** **Week No 14** — **Analysis operations and data scaling**
Mode of assessment during the semester	**Projects and home assignments**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Non**
Compulsory and recommended literature:	▪ **P. Soares , D. Reed (2003). Modelling Forest Systems. CAB International** ▪ **Michael Worboys and Matt Duckham (2004). GIS, A Computing Perspective (2nd edition). Boca Raton, CRC Press.** ▪ **Yann Arthus-Bertrand, Lester Russell Brown, Herve Le Bras, Jean-Robert Pitte (2005). "Earth from Above". HNA Books** ▪ **Markus Neteler, Helena Mitasova (2007). Open Source GIS: A Grass GIS Approach. Springer-Verlag New York, LLC** ▪ **Wilpen L. Gorr, Kristen S. Kurland (2007). GIS Tutorial : Workbook for ArcView 9. ESRI Press**

Course Title	**Advanced remote sensing**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE09**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**To understand how different objects on the Earth's surface reflect and absorb electromagnetic energy (with special reference to the desert environment).** **To learn how to analyze satellite imagery and extract relevant information about Earth surface properties.** **To introduce students to the concept of digital imagery and a variety of remote sensing applications.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Image interpretation** **Week No 2** — **Image Processing** **Week No 3** — **Image Classification** **Week No 4** — **Improving visualizations (Image Fusion)** **Week No 5** — **Remote Sensing of Vegetation** **Week No 6** — **Spectroscopy of soil** **Week No 7** — **Remote Sensing of Water** **Week No 8** — **Remote Sensing of Geomorphology** **Week No 9** — **Remote Sensing of Geomorphology** **Week No 10** — **Remote Sensing of Urban** **Week No 11** — **Digital Elevation Models and satellite imagery** **Week No 12** — **Radar technology** **Week No 13-14** — **Project**
Mode of assessment during the semester	**Projects + Home Assignments**
Type of exam	**Oral exam + written exam at the end of the semester**
Compulsory practice related to the course	**Non**
Compulsory and recommended literature:	▪ **Lillesand, T., and Kiefer, R. (2000). Remote Sensing and Image Interpretation, 4th edition, Wiley, New York.** ▪ **Ravi P. Gupta, R. P. Gupta (2003). Remote Sensing Geology. Springer-Verlag New York, LLC** ▪ **Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman (2007). Remote Sensing and Image Interpretation. Wiley, John & Sons, Incorporated** ▪ **Wilpen L. Gorr, Kristen S. Kurland (2007). GIS Tutorial : Workbook for ArcView 9. ESRI Press**

Course Title	**Water policy and law**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE10**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**The objectives of this course are:** ▪ **To explain the main legal principles of International water law.** ▪ **To familiarize students with the main Basic principles of law governing water use management.** ▪ **To explain the emergence of water as a human right.**
Personnel background	**Lecturer**
Course content:	**Week No 1** **Overview** **Week No 2-4** **International water law** ▪ **Procedural rules** ▪ **Institutional mechanisms** ▪ **Dispute resolution** ▪ **States rights** **Week No 5-8** **Basic principles of law governing water use management** ▪ **History and development** ▪ **Ownership and allocation** ▪ **Existing systems of water use regulation** ▪ **The protection of interests (e.g. Environment)** **Week No 9-11** **The emergence of water as a human right** ▪ **Government obligations** ▪ **Implementation issues** ▪ **Potential violations** **Week No 12-14** **Water quality management** ▪ **National water quality management strategy** ▪ **State policy**
Mode of assessment during the semester	**Term paper and oral exam.**
Type of exam	**oral exam during the semester and written exam at the end of the semester**
Compulsory practice related to the course	**Non**

Compulsory and recommended literature:	▪ **Tarlock, A. Dan, David H. Getches and James N. Corbridge (2002). Water Resource Management: A Casebook in Law and Public Policy (University Casebook Series). Foundation Press.** ▪ **Salman; M. A. Salman and Siobhan McInerney-Lankford. (2004). Human Right to Water: Legal and Policy Dimensions (Law, Justice, and Development) (Law, Justice, and Development). World Bank Publications.** ▪ **charles j. Meyers and a. Dan tarlock (1983). Supplement to water resource management: a coursebook in law and public policy, second edition. supplement (university casebook series). The Foundation Press.**

Course Title	**Scientific writing and Communication skills**
Program Name	**Integrated Soil Management M.Sc.**
Scheduled Semester	
Course code	**SSE11**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ To be familiar with the importance of and the responsibility for scientific reporting. ▪ To be familiar with the publication and peer-review process. ▪ To practice and show improvement in written communication including organization, clarity, paper citation, abstract presentation, and development of tables and figures. ▪ Use communication and analytical skills to evaluate and edit written materials developed by class members, other professionals, or those already published. ▪ Develop and write a research proposal or research article. ▪ Learning about basic communication theories and explore different types of communication, such as interpersonal, small group, and public communication. ▪ Have opportunities to develop and apply communication skills by completing exercises and assessments, participating in group interactions, and delivering presentations.
Personnel background	**Lecturer**
Course content:	**Week No 1** what is a scientific paper? **Week No 2** how to prepare a title **Week No 3** How to list authors **Week No 4** Authorship **Week No 5** How to list addresses **Week No 6** How to prepare the abstract? **Week No 7** preparing and writing acknowledgments? **Week No 8** citing the literature **Week No 9** how to design effective tables? **Week No 10** how to prepare effective illustrations? **Week No 11** the communication process **Week No 12** introductory “mini-presentation” speeches Listening **Week No 13** workplace communication **Week No 14** online communication
Mode of assessment during the semester	**Control questions posed during lectures and brain storming sessions.**
Type of exam	**Oral exam + written exam at the end of the semester**

Compulsory practice related to the course	**Home assignments**
Compulsory and recommended literature:	▪ **Larry Barker, Deborah Gaut (2001). Communication. Allyn & Bacon, Inc.** ▪ **Robert A. Day, Barbara Gastel (2006). How to Write and Publish a Scientific Paper. Greenwood Publishing Group, Incorporated** ▪ **Steve Graham, Charles A. MacArthur, Jill Fitzgerald, Jill Fitzgerald, Charles A. MacArthur (2007). Best Practices in Writing Instruction (Solving Problems In Teaching Of Literacy Series). Guilford Publications, Inc.** ▪ **John C. Gordon (2007). Planning Research: A Concise Guide for the Environmental and Natural Resource Sciences. Yale University Press**

Course Title	**Research methodology**	
Program Name	**Integrated Soil Management M.Sc.**	
Scheduled Semester		
Course code	**SSE12**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**At the end of the course student should be able to:** ▪ **Use information systems effectively.** ▪ **Understand the research cycle.** ▪ **Explain definition and typologies.** ▪ **Understand the methodological aspects and possible applications of survey research.** ▪ **Choose and apply an appropriate experimental design to a particular research problem;** ▪ **Learn how to find information and research articles on a particular research topic.** ▪ **Review the literature on their chosen subjects and develop a proposal for a research project.** ▪ **Survey management, data preparation and analysis** ▪ **Know types and use of data analysis methodologies** ▪ **Understand the principles of good writing, and be able to analyze and edit technical papers written by others.** ▪ **Develop their thesis research proposal during the course.**	
Personnel background	**Lecturer**	
Course content:	**Week No 1** **Week No 2** **Week No 3** **Week No 4** **Week No 5** **Week No 6** **Week No 7-11** **Week No 12** **Week No 13** **Week No 14**	**Research in soil and water management.** **Information Systems** **Literature and/or Reviews** **Ethical Issues** **Preparation of Research Plans** **Instrumentation and Data Acquisition** **Design of experiments and statistical analysis** **Good writing and analysis of technical papers** **Writing Research Papers and Reports** **Development of Research Proposals**
Mode of assessment during the semester	**accomplishment of seminars, Term paper**	
Type of exam	**problem solving, oral exam during the semester and written exam at the end of the semester.**	
Compulsory practice related to the course	**Non**	

Compulsory and recommended literature:	▪ **Ranjit Kumar (2005). Research Methodology: A Step-by-Step Guide for Beginners; Second Edition. Sage Publications Ltd.** ▪ **Leedy, P. D 1997, Practical Research: Planning and Design, 6th edition, MacMillan Publishing Co.** ▪ **Geoffrey R. Marczyk, David DeMatteo, David Festinger. (2005). Essentials of Research Design and Methodology. Wiley.** ▪ **Day, R. A 1995, How to Write and Publish a Scientific Paper, 4th edition, Cambridge University Press.** ▪ **Montgomary, D. C 2001, Design and Analysis of Experiments, Wiley & Sons.** ▪ **Coley, S. M. & Scheinberg, C. A 2000, Proposal Writing, 2nd edition, Newbury Sage Publications.**