The outline of the Master Degree curriculum in Integrated Water Management

The distribution of contact hours by semester and course

INTEGRATED WATER MANAGEMENTMSc 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	
JWM101	Soil-water-plant relationships	56	28	28	2+2T				6
JWM102	Advanced statistics	56	28	28	2+2T				6
JWM103	Principles of modelling	56	28	28	2+2T				6
JWM104	GIS	56	28	28	2+2T				6
JWM105	Principles of remote sensing	56	28	28	2+2T				6
WM201	Soil and water conservation engineering	56	28	28		2+2T			6
WM202	Water resource management	56	28	28		2+2T			6
WM203	On-farm hydraulic structure	56	28	28		2+2T			6
WM204	Hydrology	56	28	28		2+2T			6
	Elective	56	28	28		2+2T			6
Option: Irrigation and drainage									
WM301A	Irrigation and drainage(Advanced)	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: Integrated watershed and land use management									
WM301B	Integrated watershed and land use 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: Water and land information systems									
WM301C	Water and land information 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
	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:									
WME01	Agrienvironment								
WME02	Water ecology								
WME03	Surface and groundwater management								
WME04	Agrometeorology								
WME05	Project management								
WME06	Operation and maintenance of modern irrigation systems								
WME07	Irrigation project design and evaluation								
WME08	Irrigated crop production								
WME09	Water policy and law								
WM301A/E	Irrigation and drainage (Advanced)								
WM301B/E	Integrated watershed and land use management								
WM301C/E	Water and land information systems								
WME10	Environmental management								
WME11	Scientific writing and communication skills								
WME012	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	**JWM101(Integrated Water 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 Integrated Water Managementand 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	**JWM102(Integrated Water 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	**JWM103 (Integrated Water 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**	**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.**

	Week No 9-11 Week No 12 Week No 13 Week No 14	▪ Averill Law. ▪ Paul Fishwick. The complete types of models necessary to 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	**JWM104 (Integrated Water 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	**JWM105 (Integrated Water 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 spectroscopy**
	Week No 4	**Spectroscopy of water**
	Week No 5	**Spectroscopy of rocks and minerals**
	Week No 6	**Spectroscopy of soil**
	Week No 7	**Spectroscopy of vegetation**
	Week No 8	**Spectral analysis for Earth science investigations**
	Week No 9	**Integration and visualization of geoscience data**
	Week No 10	**Concepts in data and image interpretation**
	Week No 11	**Visible and infrared sensors**
	Week No 12	**Radar technology**
	Week No 13	**Remote sensing platforms**
	Week No 14	**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 and Water Conservation Engineering**
Program Name	**Integrated Water Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**WM201**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ understand cycles and the interactions between soil, water, air and living organisms. ▪ Evaluate basic soil weight-volume relationships for soil and related characterization and classification schemes . ▪ Understand the pedostructure concept and its impact to soil water medium characterization and modeling. ▪ Apply statistical methods to hydrology and evaluate the associated risks during design stages ▪ study precipitation forms, their characteristics, and measurements ▪ Evaluate the factors affecting soil water movements ▪ Estimate drainage area and predict runoff ▪ Estimate evapotranspiration and study factors affecting it ▪ Understand and apply Universal Soil Loss Equation ▪ Apply Geographic Information Systems (GIS) for water quality analysis ▪ Work in teams to design on-farm soil and water conservation systems ▪ Develop a simplified model for solute movement in the soil ▪ Work in teams to conduct a laboratory experiments to study impact of field management practices on soil and water conservation.
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Soil and water resources management** **Week No 2** — **Hydrological and ecological ecosystem cycles** **Week No 3** — **Soil – water relationships** **Week No 4** — **Topographic Surveys** **Week No 5-7** — **Runoff Prediction** **Week No 8** — **Evapotranspiration** **Week No 9-11** — **Geographic Information Systems (GIS) for water quality analysis** **Week No 12** — **Design on-farm soil and water conservation systems** **Week No 13** — **Models of solute movement in the soil** **Week No 14** — **Soil and water quality computer models**

Mode of assessment during the semester	**Control questions posed during lectures and home assignments.**
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:	▪ **Glenn Schwab, Schwab, Delmar D. Fangmeier (1995). Soil and Integrated Water ManagementSystems. Wiley, John & Sons, Incorporated** ▪ **Andy D. Ward, Stanley Trimble, Stanley Trimble, Stanley W. Trimble, M. Gordon Wolman (2003). Environmental Hydrology. CRC Press** ▪ **Joseph A. Salvato, Nelson Leonard Nemerow, Franklin J. Agardy, Nelson L. Nemerow, Franklin J. Agardy (2003). Environmental Engineering. Wiley, John & Sons, Incorporated** ▪ **William Fangmeier, William J. Elliot, Glenn O. Schwab, Elliott, Workman (2005). Soil and Water Conservation Engineering. Cengage Delmar Learning**

Course Title	**Water resource management**
Program Name	**Integrated Water Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**WM202**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**This course examines the social, political and economic dimensions of water-supply development. The course introduces students to hydrologic science but focuses on the intersection of water development and the social relations of power that mediate access to this contentious resource, including recent privatization efforts. The course introduces water as a physical and social phenomenon.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** Introduction **Week No 2** General Concepts in Hydrology **Week No 3** Global Hydrologic Cycle **Week No 4** Evapotranspiration **Week No 5** Infiltration and Runoff **Week No 6** Stream flow **Week No 7** Surface and Groundwater Water Hydrology **Week No 8** Wastewater Treatment **Week No 9** Climate Change and the Hydrologic Cycle **Week No 10** The Politics of Water Scarcity **Week No 11** The Economics of Water **Week No 12** International Water **Week No 13** Surface Water **Week No 14** Groundwater
Mode of assessment during the semester	**seminar exercises and term papers**
Type of exam	**Oral and written exam**
Compulsory practice related to the course	**not have**
Compulsory and recommended literature:	▪ **S.L. Dingman, Physical Hydrology, 2nd edition, Prentice-Hall, Inc., New Jersey, 646 pp., 2002.** ▪ **Ronald C. Griffin, Water Resource Economics: The Analysis of Scarcity, Policies, and Projects, The MIT Press 2006** ▪ **Cech Thomas V., Principles of Water Resources: History, Development, Management, and Policy (Custom Edition), John Wiley&Sons; 2005.**

Course Title	**On Farm Hydraulic Structure**
Program Name	**Integrated Water Management M.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**WM203**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	▪ **This course introduces the principles, methods of water regulation and distribution of flow through different hydraulic structures on an irrigation system.** ▪ **Understanding and using the structures and devices for measurements.**
Personnel background	**(Lecturer, practical teacher)**
Course content:	**Week No 1** – **Irrigation network operation** **Week No 2** – **Intake structures** **Week No 3** – **Intakes of small canals** **Week No 4** – **Intake structure on secondary canals** **Week No 5** – **Intake with stone mesh weir** **Week No 6** – **Flow dividing structures** **Week No 7** – **Farm turnouts** **Week No 8** – **Constant head orifice turnout** **Week No 9** – **Open flumes and Pre-cast farm turnouts** **Week No 10** – **Plastic siphon and PVC pipe turnouts** **Week No 11** – **Water level and velocity control structures** **Week No 12** – **Checks equipped with hand operated gates semi and automated checks** **Week No 13** – **General features of drops and chutes** **Week No 14** – **Structures and devices for measurements**
Mode of assessment during the semester	**Mid Term Exam + Discussion Groups + Home assignments**
Type of exam	**Oral Exam + Written Exam at the end of Semester**
Compulsory practice related to the course	**Field trip to different farms**
Compulsory and recommended literature:	▪ **USDA Soil Conservation Service – National Engineering Handbook. Irrigation.** ▪ **Nath, B. 1969. Criteria for fixing outlets and their commands of perennial irrigation Systems in Northern India.** ▪ **Humpherys, A. S. and Robinson, A. R. 1971. Field evaluation of drop-check structures for farm irrigation systems. USDA.** ▪ **Kraatz, D.B. and I.K. Mahajan. 1975. Small hydraulic structures. FAO No.26/ Vol.1** ▪ **Kraatz, D.B. and I.K. Mahajan. 1975. Small hydraulic**

	structures. FAO No.26/Vol.2 ▪ Robinson, A.R. and A.S. Humpherys 1967. Water control and measurement on the farm. Irrigation of Agric. Land. USA. ▪ 7. Skogerbroc, G.V. R.S. Bennett, and W.R. walker 1972. Installation and field us of cut-throat flumes for water measurement. Integrated Water ManagementTechnical report No. 19 , Colorado State University.

Course Title	**Hydrology**
Program Name	**Integrated Water ManagementM.Sc.**
Scheduled Semester	**First Year – Second Semester**
Course code	**WM204**
Course Type	**Compulsory**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**The purpose of the course is to:** ▪ **Explain the components of the hydrologic cycle, including precipitation, evapotransportation, infiltration, subsurface flow, and runoff.** ▪ **Analysis of hydrologic data.** ▪ **Estimate areal rainfall from point rainfall.** ▪ **Estimate flood magnitude.** ▪ **Design urban stormwater drainage systems.** ▪ **Use computer models to estimate catchment yield.** ▪ **Design the storage capacity of water supply reservoirs.** ▪ **Estimate the yield characteristics of groundwater aquifers.**
Personnel background	**Lecturer + practical teacher**
Course content:	**Week No 1** — **Introduction to Hydrology** **Week No 2-4** — **Land-Atmosphere Interactions:** ▪ **Precipitation** ▪ **Interception** ▪ **Evapotranspiration** **Week No 5** — **Principles of Fluid Dynamics** **Week No 6** — **Open Channel Hydraulics** **Week No 7** — **Channel and Reservoir Routing** **Week No 8** — **Streams and Floods** **Week No 9** — **Groundwater Hydraulics** **Week No 10** — **Groundwater Hydrology** **Week No 11** — **Water in the Unsaturated Zone** **Week No 12** — **Urban Stormwater Drainage** **Week No 13** — **Catchment Hydrology** **Week No 14** — **Catchment Yield Analysis**
Mode of assessment during the semester	**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:	▪ **Wilfried Brutsaert (2005). Hydrology: An Introduction. Cambridge University Press.** ▪ **Maidment, D R (ed) 1993, Handbook of Hydrology, McGraw Hill.** ▪ **Pilgrim, D H (ed) 2001, Australian Rainfall and Runoff - A Guide to Flood Estimation, IEAust, vol 1.**

Course Title	**Irrigation and Drainage**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester	**Secondary Year – third semester**	
Course code	**WM301A/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 student will study the basic concepts and principles of the irrigation and drainage system this course help student to study different irrigation and drainage system . Also help students to determine amount of irrigation water and the suitable time for irrigation .Drainage systems will be studied and tested in this course .**	
Personnel background	**Lecturer + practical teacher**	
Course content:	**Week No 1** **Week No 2** **Week No 3** **Week No 4** **Week No 5** **Week No 6** **Week No 7** **Week No 8** **Week No 9** **Week No 10** **Week No 11** **Week No 12** **Week No 13** **Week No 14**	**Water quality** **Amount of irrigation water** **Farm irrigation systems** **Surface irrigation** **Surface irrigation methods** **Sprinkler irrigation methods** **Factors affecting performance** **Mobile rain gun systems** **Trickle irrigation system** **Application of chemicals** **Contemporary drainage materials** **Drainage pipes and structures** **Guidelines for installation and maintenance of system.** **Maintenance of drain pipes .**
Mode of assessment during the semester	**Practical field work and term papers**	
Type of exam	**Homework + Seminars + Oral and written exam**	
Compulsory practice related to the course	**Non**	
Compulsory and recommended literature:	▪ **FAO. Crop water requirements. Gidelines for predicting crop water requirements, paper 24. FAO, Rome, 144 p.** ▪ **SHRMA R.K. and T.K. Sharma (1990). Irrigation and drainage. Vol. I, Printed at Charman Enterprises, R-69/1 Ramesh Pack, Laxmi Nagar, Delhi 110 092.** ▪ **Maw, B.W., C.F. Douglars, C.C. Dowler, J.M. Moore, M.B. Parker, and M.G.** ▪ **Arakeri, H.R., Donahue, Roy (1984). Principles of soil conservation and water management, M/s Oxford & IBH Co. New Delhi.**	

Course Title	**Integrated watershed and land use management**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester	**Secondary Year – third semester**	
Course code	**WM301B/E**	
Course Type	**Compulsory / Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	▪ **Introduction and definitions of watershed and management** ▪ **Better understanding of the topics discussed and to contribute to improved operation of sustainable watershed management in the country** ▪ **Dealing creatively with an eminent case study from the country for workable and feasible solutions.**	
Personnel background	**Lecturer + practical teacher**	
Course content:	**Week No 1**	**Introduction and definition of watershed management .**
	Week No 2	**Brief description of water movement and drainage in the Egyptian agriculture.**
	Week No 3	**Evaluation of water application, distribution, drainage, ground water, and lakes and sea**
	Week No 4	**Management of water and natural resources efficiently to sustain local economy and environment**
	Week No 5	**Conservation of water and soil against pollution from agricultural chemical, industrial wastes, etc.**
	Week No 6-7	**Point and non point sources pollution, diffusion, transfer, and fate of pollution in soil, water and air.**
	Week No 8	**Social work and group collaboration for the management and services offered for watershed development and issues involved**
	Week No 9	**Advanced topics serving Integrated Water Managementincluding GIS, remote sensing,**
	Week No 10	**database setup.**
	Week No 11-12	**Land use and trends in habilitation, including cropping patterns, rural and urban planning and effects on natural resources**
	Week No 13-14	**Stakeholder uses: Living people, recreation, employment, etc. and partnership of all components in the development programs** **Case studies of important current issues facing watershed and environment impacts in Egypt.** **The government and policy making**

	intervention in the problems
Mode of assessment during the semester	Mid Term Exam + Discussion Groups + Home assignments
Type of exam	Oral Exam + Written Exam at the end of Semester
Compulsory practice related to the course	Field trips
Compulsory and recommended literature:	▪ Brooks, K. N., P.F. Foolliott, H. M. Gregersen and J.L. Thames. 1991. Hydrology and the management of watersheds, Iowa State University Press, Ames, Iowa. ▪ Cruz, R. A., 1990. integrated land use planning and sustainable watershed management, J. Philippine Dev., 47 (xxvi, No. 1) : 27-49 ▪ FAO, 1997. Guidelines and manual on land use planning and practices in watershed management and disaster reduction. ▪ Isobel, W. Heathcote, 2007. Integrated watershed management : Principles and Practices.

Course Title	**Water and Land Information System**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester	**Secondary Year – third semester**	
Course code	**WM301C/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 purpose of the course is to:** ▪ **Help students to understand modeling such as Mathematical models, Linear and non- linear programming and Simulation models.** ▪ **Describe the purpose of Geographical information systems (GIS) and its Components.** ▪ **Present the Geographic Information Technologies.** ▪ **Define the aim of GIS.** ▪ **Describe the Spatial Reference Systems.** ▪ **Give students an appreciation of the fundamental principles of Basic data modeling such as Vector data modeling, Raster data modeling and image data.** ▪ **Discuss avantages and disadvantages of vector and raster data models.** ▪ **familiarize students with Remote sensing (RS) and digital image processing systems.** ▪ **Take the student through the applications of Remote Sensing and GIS in Water and Land Management.** ▪ **Describe the techniques of Managing Information Systems {MIS}.** ▪ **Teach students how they can use information systems technologies on Decision Support.**	
Personnel background	**Lecturer**	
Course content:	**Week No 1**	**Introduction on water and land management criteria**
	Week No 2	**Modeling and its applications in water balance monographies**
	Week No 3	**Introduction to Geographic Information System (GIS) and its applications on water and land management**
	Week No 4	**Geographical Data Modeling**
	Week No 5	**Applications of GIS**
	Week No 6	**Introduction to remote sensing (RS)**
	Week No 7	**Remote sensing systems**
	Week No 8	**Digital image processing systems**
	Week No 9	**Integration of Remote Sensing (RS) and Geographic Information System (GIS)**
	Week No 10	**Applications of Remote Sensing and GIS in Water and Land Management**

	Week No 11 Week No 12 Week No 13-14	Management Information Systems {MIS} Decision Support Systems {DSS} Expert systems in water and land management with respect to the environmental enhancement
Mode of assessment during the semester	Accomplishment of seminars, term paper, oral and final written exam.	
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:	▪ M. Chandra and S. K. Ghosh (2006) Remote Sensing and Geographic Information System. Alpha Science Intl Ltd. ▪ van Dijk and M.G. Bos (2001)GIS and Remote Sensing Techniques in Land and Water Management. Springer; 1 edition ▪ Burrough, P.A. (1986): Principle of Geograhpical Information Systems for land resources assessment. Oxford, Oxford, University Press. ▪ Characteristics of Models: TAHAN, Charles/ TIGHE, Brian/ AVERY, Nate: Forming a Global Model of the Earth System: Combining the Atmosphere/Biosphere, Hydrosphere/Biosphere, and Biodiversity models. ▪ Data and Information/Digital Information: YEUNG, Albert K. (1998): Information Organization and Data Structure. NCGIA Core Curriculum Unit 51. http://www.ncgia.ucsb.edu/giscc/units/u051/ ▪ Definitions/ Meaning of “GIS”: AEGIS, U.C. Berkeley College of Environmental Design (2000): Homepage. http://www5.ced.berkeley.edu:8005/aegis/ ▪ Geographic Information: ESRI (1998): About GIS. What can GIS do for you?. http://www.esri.com/library/gis/abtgis/gis_do.html ▪ Geographic Information Technologies: Canada Center for Remote Sensing CCRS (1998): Fundamentals of Remote Sensing. http://www.ccrs.nrcan.gc.ca/ccrs/eduref/tutorial/indexe.html ▪ JINDRICH, Jerry (1998): Spatial Concepts. http://www.meddybemps.com/9.600.html ▪ Managing Spatial Data: GARDELS, Kenn: A Comprehensive Data Model for Distributed, Heterogeneous Geographic Information. http://www.regis.berkeley.edu/gardels/geomodel_def.htm ▪ Objectives: UNESCO (1999): Introduction to Geographic Information Systems. Training Modul A. http://gea.zvne.fer.hr/module/module_a/module_a1.html ▪ Perception and Cognition: ERVIN, Stephen (1999): Digital Landscape Modeling and Visualization. http://www.gsd.harvard.edu/~servin/ascona/ ▪ U.M. Shamsi (2005). GIS Applications for Water, Wastewater, and Stormwater Systems. CRC;	

Course Title	**Agrienvironment**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME01**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**The objectives are to discover and understand the principles behind the interactions that occur in agroecosystems, and to use these principles to develop more sustainable methods for managing agroecosystems. While an agroecosystem with a well-defined boundary is convenient for study, it does not stand by itself. All types of ecosystems (agricultural, natural, urban) are linked and interact with one another, and so these interactions must be considered as well.**	
Personnel background	**Lecturer**	
Course content:	**Week No 1**	**Ecological experimentation in agriculture; basic chemical process-carbon cycle.**
	Week No 2	**Climate and adaptation of agricultural crops.**
	Week No 3	**Nitrogen in agroecosystems; fertilizer elements in the environment.**
	Week No 4	**Macro and micronutrients and their availability to crops.**
	Week No 5	**Decomposition: beneficial soil organisms.**
	Week No 6	**Plant succession and competition; weed ecology and management.**
	Week No 7	**Distribution and sampling of agricultural pests; introduction to insects.**
	Week No 8	**Population dynamics; pesticides and the environment; plant-parasitic nematodes.**
	Week No 9	**Plant disease and environment; integrated pest management.**
	Week No 10	**Host plant resistance and conservation of genetic resources.**
	Week No 11	**Cropping systems and agroecosystems in the landscape; crop rotation and cover crops.**
	Week No 12	**Intercropping; conservation tillage.**
	Week No 13	**Mulches and organic amendments.**
	Week No 14	**Human population growth; sustainable agriculture.**
Mode of assessment during the semester	**Brain storming sessions – Home assignments**	
Type of exam	**oral exam during the semester and written exam at the end of the semester.**	

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

Course Title	**Water Ecology**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME02**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**The aim of the course is to provide the theoretical, practical, and methodological fundamentals, as well as complex skills and techniques on Hydrobiology and Water Ecology.**	
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** **Week No 8** **Week No 9** **Week No 10** **Week No 11** **Week No 12** **Week No 13-14**	**Introduction** **The key concepts of hydrobiology and hydroecology.** **Abiotic factors of environment** **physical-chemical characteristics of water and their impact on the existence of the hydrobiontes.** **Biotic factors of environment.** **Anthropogenic factors of environment.** **Hydrobiology and water ecology of water basins.** **Life in natural water basins.** **Life in artificial water basins.** **Life in ground water basins.** **Life in ocean.** **Life in ocean.** **Ecological concepts of hydrosphere conservation**
Mode of assessment during the semester	**Home assignments and brain storming sessions**	
Type of exam	**Oral exam + written exam at the end of the semester**	
Compulsory practice related to the course	**Trips to marine life sites**	
Compulsory and recommended literature:	**Fred Pearce (2007). When the Rivers Run Dry: Water--The Defining Crisis of the Twenty-first Century. Beacon Press** **Anita Ganeri (2003). I Wonder Why the Sea Is Salty and Other Questions about the Oceans. Kingfisher** **Samantha Gray, Samantha Gray, Sue Thornton, Mary Ling (2001). Ocean. DK Publishing, Inc.**	

Course Title	**Surface and groundwater management**
Program Name	**Integrated Water Management M.Sc.**
Scheduled Semester	
Course code	**WME03**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**This course explain how can surface and underground water sources be developed.** **At the end of this course student should be able to:** ▪ **Water quality management** ▪ **Water and wastewater treatment** ▪ **Surface and groundwater resource assessment and development** ▪ **River engineering and management** ▪ **Environmental impact assessment** ▪ **Water distribution systems** ▪ **Management techniques**
Personnel background	**Lecturer**
Course content:	**Week No 1** — **Introduction & Historical Perspective** **Week No 2** — **water resources information systems** **Week No 3** — **The Hydrologic Cycle & Surface Water Hydrology** **Week No 4** — **Groundwater Hydrology.** **Week No 5** — **Agricultural pollution & Wastewater Treatment.** **Week No 6** — **Climate Change and the Hydrologic Cycle.** **Week No 7** — **Urbanization, Water Use and Water Quality Monitoring** **Week No 8** — **Water Pollution Wastewater Treatment.** **Week No 9** — **Human Activities and their Effects on Water Resources.** **Week No 10** — **Integrated Water ManagementLaw.** **Week No 11** — **Application to surface and GroundIntegrated Water Management** **Week No 12** — **The Politics of Water Scarcity.** **Week No 13** — **Optimisation methods in water resources management and planning** **Week No 14** — **International Water Rights - Who Owns the Water? The Future of Global Water Management.**
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:	▪ **Cech, Thomas. 2005. Principles of Water Resources: History, Development, Management, and Policy. 2nd Edition. Wiley.** ▪ **Todd, D.K., Groundwater Hydrology, 2nd ed., Wiley, New York, 1980.** ▪ **WRAY-35. 1995. The water resources of Yemen. Sana'a, General Department of Hydrology; The Netherlands, TNO Institute of Applied Geoscience.** ▪ **Stuart G. Walesh (1989)Urban Surface Water Management. Wiley-Interscience**

Course Title	**Agrometerology**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME04**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**Study the basic concept of meteorological phenomena especially which related to agriculture and climate analysis. The course also introduces the principles of environmental and human health protection and those phenomena which are considered to have an impact on the environment**	
Personnel background	**Lecturer**	
Course content:	**Week No 1** **Week No 2** **Week No 3** **Week No 4-5** **Week No 6** **Week No 6-7** **Week No 8-9** **Week No 10-11** **Week No 12-13** **Week No 14**	**Introduction agricultural meteorology and the importance of its education.** **Weather and climate.** **Measurement of (sunshine and insulation, heat, atmospheric moisture, vapor pressure, humidity).** **Evaporation & Evapotranspiration.** **Using meteorological data to estimate water consumption and irrigation requirements.** **Precipitation (fog, dew, frost, clouds).** **Air pressure, wind (pressure gradient and wind) meteorology phenomena (depression or cyclone, anti cyclone, storm,** **Climatic interceptions and its effect on crop production** **Management of climatic interceptions** **Climate change and its effect on crop production.**
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	**Trips to meteorology stations**	

Compulsory and recommended literature:	▪ **David G. G. Andrews .(2000). Introduction to Atmospheric Physics. Elsevier Science & Technology Books.** ▪ **Wieringa, J.; Lomas, J., (2001). Lecture notes for training agricultural meteorological perosnel, WMO-No. 551, 196 p** ▪ **Daniel S. Wilks. (2005). Statistical Methods in Atmospheric Sciences. 2nd edition. Elsevier Sciece & Technology Books** ▪ **John Day. (2005). The Book of Clouds . Elsevier Science & Technology Books.** ▪ **John Wallace, Peter V. Hobbs, Peter Victor Hobbs (2006). Atmospheric Science: An Introductory Survey . 2nd edition. Elsevier Science & Technology Books.**

Course Title	**Project Management**
Program Name	**Integrated Water Management M.Sc.**
Scheduled Semester	
Course code	**WME05**
Course Type	**Elective**
Credit value of the course	**6 credit hours**
Schedule of Education	**14 Weeks**
Course Coordinator	
Other staff	
Educational objectives	**On successful completion of this topic, students should have an understanding of:** ▪ **Define the aim of the project to allow creation of a planning baseline.** ▪ **Define the aim statement for the definition and stages of the project.** ▪ **Define project time requirements for creation of a planning baseline.** ▪ **Prepare project schedules as networks.** ▪ **Prepare and display cost planning, definition, monitoring and control use cost benefit analyses.** ▪ **Discuss the nature and importance of a work breakdown structure in project management.** ▪ **use techniques for project control.** ▪ **Discuss the behavioral aspects of projects in terms of project personnel and the project manager.** ▪ **Understand the role of teams and the concepts of leadership** ▪ **Use available project management software.** ▪ **Bring a small project to successful completion .**
Personnel background	**Lecturer + Practical teacher**
Course content:	**Week No 1** — **Introduction** **Week No 2** — **The project environment** **Week No 3** — **Definitions** **Week No 4** — **Planning** **Week No 5** — **Financial analysis of projects** **Week No 6-7** — **Project time** ▪ **Project time planning** ▪ **Project time definition** **Week No 8-9** — **Network** ▪ **Network scheduling techniques** ▪ **Network analysis** **Week No 10-12** — **Cost** ▪ **Cost planning** ▪ **Cost definition** ▪ **Cost monitoring and control** **Week No 13** — **Project review and completion** **Week No 14** — **Project control**

Mode of assessment during the semester	**Accomplishment of seminars, Term paper.**
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:	▪ **Roberson, J. A., J. J. Cassidy and M. H. Chaudhry (1988). Hydraulic Engineering. Houghton Mifflin Co. Boston. USA.** ▪ **Jensen, M. E. , R. D. Burman and R. G. Allen (1990). "Evapotranspiration and Irrigation Water Requirements". Amer Soc. Civil. Eng. Irrig. Drainage Div. Report No. 70.** ▪ **Associates Bernan (1997). Quality Control of Wastewater for Irrigated Crop Production. Bernan Associates** ▪ **Martin Hvidt (1998). Water, Technology and Development: Upgrading Egypt's Irrigation System. St. Martin's Press.** ▪ **Phillip Z. Kirpich (1999). Water Planning for Food Production in Developing Countries. University Press of America** ▪ **Aw Djibril, Djibril Aw, Diemer Geert, Geert Diemer (2004). Making a Large Irrigation Scheme Work. World Bank Publications**

Course Title	**Operation and maintenance of modern irrigation systems**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME06**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	**This course aims to introduce students to the Irrigation System Maintenance and Operations Learning Process. Demonstrated ability to conduct Maintenance Survey in the field. This course examines ability to develop a Maintenance and operation Plan for an irrigation water conveyance and delivery system. Also one of the important objectives of this course is to introduce students to use advanced hydraulic simulation and Integrated Water Managementmodeling software for irrigation conveyance and delivery system operations.**	
Personnel background	**Lecturer + Practical teacher**	
Course content:	**Week No 1**	**Irrigation system operation,**
	Week No 2	**Crop water requirement,**
	Week No 3	**Identification of maintenance problems in irrigation system,**
	Week No 4	**Principles of operation plan,**
	Week No 5	**Preparation of an operation plan,**
	Week No 6	**Implementation of operation plan responding to rainfall,**
	Week No 7	**Implementation of operation plan during irrigation water scarcity,**
	Week No 8	**Irrigation system efficiency and estimation of water losses,**
	Week No 9	**Operation plan, computer and its uses in reservoir operation,**
	Week No 10	**Reservoir sedimentation,**
	Week No 11	**Operation and maintenance of drip irrigation systems** ▪ **Causes and prevention of clogging** ▪ **Causes and prevention of irregular pressure in the system** ▪ **Optimisation of water use and energy consumption Performance evaluation of drip irrigation systems** ▪ **Uniformity and efficiency of drip irrigation systems.**
	Week No 12	**Design operation and maintenance of movable and semi-movable sprinkler systems**

		▪ Water distribution uniformity and efficiency ▪ Advantages and restriction of application ▪ Criteria for selection of irrigation methods considering irrigation costs, labour requirements, water consumption and energy consumption
	Week No 13	Application of chemicals
	Week No 14	Operating Irrigation Controllers
Mode of assessment during the semester	seminar exercises and term papers	
Type of exam	Homework, Term paper, Field practices, Oral and written exam	
Compulsory practice related to the course	Non	
Compulsory and recommended literature:	▪ American Society of Agricultural Engineers Monograph 1980, Design and Operation of Farm Irrigation Systems. ▪ Glenn J. Hoffman; Robert G. Evans; Marvin Eli Jensen; Derrel L. Martin; Ronald L. Elliott (7200)Design And Operation Of Farm Irrigation Systems. Amer Society of Agricultural. ISBN-13: 978-1892769640 ▪ Sidney Twichell Harding (2008). Operation And Maintenance Of Irrigation Systems. Koebel Press; ISBN-13: 978-1409769224 ▪ R. L Petruschell (1982). Models for sprinkler irrigation system design, cost, and operation. Rand Corporation, ASIN: B0006XZJSO ▪ Michael J. Boswell (1984). Micro irrigation design manual. James Hardie Irrigation, Inc.	

Course Title	**Irrigation Project Design and Evaluation**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME07**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	▪ **To learn basic principles of irrigation management. Included in these basics are fundamentals of soil-water relations** ▪ **To gain and experience on designing pumps, pipes, and channels** ▪ **To be familiar with calculating evapotranspiration and irrigation scheduling** ▪ **To learn knowledge about economics and irrigation efficiency** ▪ **To be familiar with landscape irrigation; agricultural surface, sprinkler, and drip irrigation; chemigation; and water quality.**	
Personnel background	**Lecturer + Practical teacher**	
Course content:	**Week No 1**	**Definition of irrigation, soil constituents including mineral components, soil texture, and colloidal material.**
	Week No 2	**Water in soils, mechanics of water movement in soils, components of soil water potential.**
	Week No 3	**Methods of measuring soil water content and suction including feel, gravimetric, volumetric methods, neutron probes, electric resistance meters and tensiometers.**
	Week No 4	**Water Supply and design and evaluation of irrigation structures like drop structures, weirs, gates, flumes and channels.**
	Week No 5	**Evapotranspiration**
	Week No 6	**Water Quality and Soil Salinity Management**
	Week No 7	**Irrigation Scheduling, irrigation water sources, quality and quantity.**
	Week No 8	**Measurement of irrigation water - direct, weirs, orifices, flumes, stream gauging and floats.**
	Week No 9-10	**Design and evaluation of surface irrigation systems and methods to increase its efficiency.**
	Week No 11-12	**Design and evaluation of sprinkler Irrigation System**
	Week No 13-14	**Design and evaluation of drip or Trickle Irrigation.**

Mode of assessment during the semester	**Control questions posed during lectures and self-evaluation by the MSc students**
Type of exam	**oral exam during the semester and written exam at the end of the semester.**
Compulsory practice related to the course	**Field trips and lab sessions.**
Compulsory and recommended literature:	▪ **Roberson, J. A., J. J. Cassidy and M. H. Chaudhry (1988). Hydraulic Engineering. Houghton Mifflin Co. Boston. USA.** ▪ **Jensen, M. E. , R. D. Burman and R. G. Allen (1990). "Evapotranspiration and Irrigation Water Requirements". Amer Soc. Civil. Eng. Irrig. Drainage Div. Report No. 70.** ▪ **Associates Bernan (1997). Quality Control of Wastewater for Irrigated Crop Production. Bernan Associates** ▪ **Martin Hvidt (1998). Water, Technology and Development: Upgrading Egypt's Irrigation System. St. Martin's Press.** ▪ **Phillip Z. Kirpich (1999). Water Planning for Food Production in Developing Countries. University Press of America** ▪ **Aw Djibril, Djibril Aw, Diemer Geert, Geert Diemer (2004). Making a Large Irrigation Scheme Work. World Bank Publications**

Course Title	**Irrigated crop production**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME08**	
Course Type	**Elective**	
Credit value of the course	**6 credit hours**	
Schedule of Education	**14 Weeks**	
Course Coordinator		
Other staff		
Educational objectives	▪ **Understand the basic soil-plant-water parameters related to irrigation.** ▪ **Understand how to estimate the quantity of water required by crops** ▪ **Using manual and computer methods.** ▪ **Be able to plan and design irrigation and drainage projects.** ▪ **Understand the computer applications in irrigation designs.** ▪ **Design channels and other irrigation structures required for irrigation, soil conservation, flood control and other Integrated Water Managementprojects.**	
Personnel background	**Lecturer + Practical teacher**	
Course content:	**Week No 1**	**Definition of irrigation, soil constituents including mineral components, soil texture, and colloidal material.**
	Week No 2	**Water in soils - mechanics of water movement in soils, components of soil water potential.**
	Week No 3	**Soil moisture equilibrium points like field capacity, permanent wilting point, available water and readily available water; definition of soil wetness.**
	Week No 4	**Methods of measuring soil water content and suction including feel, gravimetric, volumetric methods, neutron probes, electric resistance meters and tensiometers.**
	Week No 5	**Crop water and net irrigation water requirements.**
	Week No 6	**Evapotranspiration: definitions of evaporation, transpiration and evapotranspiration (ET), Factors affecting ET, ET concepts, determination of ET using the preferred Penman-Monteith method**
	Week No 7	**Leaching requirements.**
	Week No 8	**Irrigation efficiencies - application, water conveyance, Christiansen's coefficient, water storage and irrigation efficiencies.**
	Week No 9	**Irrigation Scheduling, irrigation water sources, quality and quantity.**
	Week No 10	**Measurement of irrigation water - direct, weirs, orifices, flumes, stream gauging and floats.**
	Week No 11	**Evaluation of surface irrigation systemsa and**

	Week No 12 Week No 13 Week No 14	methods to increase its efficiency. Sprinkler Irrigation System Drip or Trickle Irrigation. Design of irrigation structures like drop structures, weirs, gates, flumes and channels.
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:	▪ Roberson, J. A., J. J. Cassidy and M. H. Chaudhry (1988). Hydraulic Engineering. Houghton Mifflin Co. Boston. USA. ▪ Jensen, M. E. , R. D. Burman and R. G. Allen (1990). "Evapotranspiration and Irrigation Water Requirements". Amer Soc. Civil. Eng. Irrig. Drainage Div. Report No. 70. ▪ Associates Bernan (1997). Quality Control of Wastewater for Irrigated Crop Production. Bernan Associates ▪ Martin Hvidt (1998). Water, Technology and Development: Upgrading Egypt's Irrigation System. St. Martin's Press. ▪ Phillip Z. Kirpich (1999). Water Planning for Food Production in Developing Countries. University Press of America ▪ Aw Djibril, Djibril Aw, Diemer Geert, Geert Diemer (2004). Making a Large Irrigation Scheme Work. World Bank Publications	

Course Title	**Water policy and law**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME9**	
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** **Week No 2-4** **Week No 5-8** **Week No 9-12** **Week No 12-14**	**Overview** **International water law** ▪ **Procedural rules** ▪ **Institutional mechanisms** ▪ **Dispute resolution** ▪ **States rights** **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)** **The emergence of water as a human right** ▪ **Government obligations** ▪ **Implementation issues** ▪ **Potential violations** ▪ **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	**Environmental management**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME10**	
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 the course are to:** ▪ **introduce students to the major environmental concepts and issues confronting managers working in corporations, businesses, government, industries, and non-profit groups.** ▪ **provide students with strategic and operational approaches to environmental management that can be taken by business and society.** ▪ **introduce students to the concept of environmental management systems and the international environmental management system standard.**	
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** **Week No 8** **Week No 9** **Week No 10** **Week No 11** **Week No 12** **Week No 13** **Week No 14**	**Environmental Philosophy and Ethics** **Introduction to Environmental Politics and Policies** **Ecology** **Environmental Planning** **Wetland Ecology** **Riparian Ecology** **Hydrogeology** **Water Quality Assessment and Management** **Air Quality Assessment and Management** **Environmental Permitting** **Modeling and Environmental Planning** **Environmental Health and Safety Management** **Environmental Toxicology** **Management of Chemical and Hazardous Waste Materials**
Mode of assessment during the semester	**Control questions posed during lectures and home assignments.**	
Type of exam	**oral exam during the semester and written exam at the end of the semester.**	
Compulsory practice related to the course	**Field trips**	

Compulsory and recommended literature:	▪ **Jerald L. Schooner (1996). Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil. Wiley, John & Sons, Incorporated Gary F. Zimmer (2000). Biological farmer. Acres U.S.A.** ▪ **Donald F. Kettl and Michael H. Armacost (2002). Environmental Management. Brookings Institution Press** ▪ **Arthur W. Warrick, A. W. Warrick (2003). Soil Water Dynamics. Oxford University Press, USA** ▪ **P. Schjonning, S. Elmholt, B. T. Christensen (2003). Managing Soil Quality: Challenges in Modern Agriculture. CABI**

Course Title	**Scientific writing and Communication skills**	
Program Name	**Integrated Water Management M.Sc.**	
Scheduled Semester		
Course code	**WME11**	
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** **Week No 2** **Week No 3** **Week No 4** **Week No 5** **Week No 6** **Week No 7** **Week No 8** **Week No 9** **Week No 10** **Week No 11** **Week No 12** **Week No 13** **Week No 14**	**what is a scientific paper?** **how to prepare a title** **How to list authors** **Authorship** **How to list addresses** **How to prepare the abstract?** **preparing and writing acknowledgments?** **citing the literature** **how to design effective tables?** **how to prepare effective illustrations?** **the communication process** **introductory “mini-presentation” speeches** **Listening** **workplace communication** **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	**Non**
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 Water Management M.Sc.**
Scheduled Semester	
Course code	**WME12**
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** — **Research in soil and water management.** **Week No 2** — **Information Systems** **Week No 3-4** — **Literature and/or Reviews** **Week No 5-6** — **Ethical Issues** **Week No 7-8** — **Preparation of Research Plans** **Week No 9-10** — **Instrumentation and Data Acquisition** **Week No 10-11** — **Design of experiments and statistical analysis** **Week No 12-13** — **Good writing and analysis of technical papers** **Week No 13** — **Writing Research Papers and Reports** **Week No 14** — **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.**