

AGRICULTURAL WATER MANAGEMENT
Course Structure - at a glance

CODE	COURSE TITLE	CREDITS
AWM 501 *	WATER RESOURCES MANAGEMENT	2+1
AWM 502 *	SOIL-WATER-PLANT-ENVIRONMENT SYSTEMS	2+1
AWM 503 *	CROP WATER REQUIREMENTS AND IRRIGATION PLANNING	2+1
AWM 504 *	PRESSURIZED IRRIGATION SYSTEM AND DESIGN	2+1
AWM 505 *	DROUGHT CLIMATOLOGY	2+0
AWM 506 *	SOIL, WATER QUALITY AND POLLUTION	2+1
AWM 507	REMOTE SENSING AND GIS IN WATER MANAGEMENT	2+1
AWM 508	ECONOMICS OF WATER USE	2+0
AWM 509	WATERSHED MANAGEMENT	2+1
AWM 510	ENVIRONMENTAL IMPACT	2+1
AWM 511	ECONOMICAL, SOCIAL AND INSTITUTIONAL PROSPECTS AND ISSUES OF WATER RESOURCES MANAGEMENT	2+0
AWM 591	SEMINAR FOR M. SC. (AG.)	1+0
AWM 599	RESEARCH FOR M. SC.(AG.)	20

* **Compulsory for Master's programme**

Minor Departments **9**

Agronomy

Soil & Water Engineering

Soil Science

Supporting departments **5**

Statistics and Mathematics

Agricultural Economics

Plant Physiology

Non credit compulsory courses

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATION SKILLS	0+1
PGS 503 (e-course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-course)	DISASTER MANAGEMENT	1+0

Objective

To impart knowledge on water status, resources, runoff, ground water assessment for managing the water sources with simulation modeling, optimal allocation and conjunctive use.

Theory**UNIT I**

Hydrologic cycle and Hydrologic Processes.

UNIT II

India's water resources and their development.

UNIT III

Water needs for future in different sectors. Water resources data.

UNIT IV

Analysis of rainfall data, soil water balance, runoff estimation.

UNIT V

Ground water concept, porosity, permeability and transmissivity. Basic equations of ground water flow. Identification of recharge zones and boundaries. Assessment of recharge and aquifer system.

UNIT VI

Irrigation water distribution practices in India

UNIT VII

Principles of decision making in water resources, planning and management –systems analysis, identification of objectives, benefits, costs, decision variables, constraints and production functions, use of simulation optimization models and forecasting models.

UNIT VIII

Expert systems, decision support systems for planning and operation, water management projects. Conjunctive use of canal and ground water in irrigation projects. Water quality management models, case studies.

Practical

Analysis of rainfall data, Application of soil water balance by estimating all components of water balance, Estimation of runoff, Estimation of infiltration, Estimation of permeability, Formulation and application of Ground water flow model, Assessment of ground water potential, Use of simulation model for water resources planning, Use of optimization model for optimal water allocation, Use of DSS for water resources management, Use of water quality model, Use of DSS for water resources management and water quality

Suggested Readings

Arora, K.R. 1996. *Irrigation, Water power and water resources Engineering*. Standard Publishers distributors, 1705-B, Nai Sarak, Post Box No. 1066, New Delhi-6

Ritzema, H.P. (Editor-in-chief). 1994. *Drainage Principles and Applications* –ILRI Publications-16, International Institute for Land Reclamation and Improvement. P.O.Box 45, 6700 AA Wageningen, The Netherlands.

Todd D.K. John . 1959. *Ground Water hydrology*. Wiley and sons, New York.
 De Vries J.J and Hromadka. T.V. 1992. *Computer models for surface water* – MC Grow Hill, New York
 Maidment D.R. (Ed)1992. *Hand book of Hydrology*. MC Grow Hill New York
 Andrew Albert Dzurik Rowman and Littlefield .1992. *Water Resources Planning*. MC Grow Hill New York

AWM 502 SOIL WATER PLANT ENVIRONMENT SYSTEMS 2+1

Objective

To have comprehensive understanding of soil-plant-water regimes in relation to climate for planning an efficient irrigation system.

Unit- I: Soil Water Relations

Soil profile and horizon description. Soil physical properties-Texture, structure, bulk density, particle density, pore space, soil depth, soil /plough pan, Adhesion ,Cohesion, capillarity etc,. Water structure, physical properties of water. Energy concept of soil water-redox potential, solute content and its movement in soil. Soil moisture constants. Theories of water availability. Soil hydraulic properties. Soil moisture measurement.

Unit –II: Plant Water relations

Role of water in plant,. Water relationship of cell and whole plant-water and ion uptake and movement mechanism in plant systems. Concept of plant water potential and their measurement. Factors affecting plant water absorption. Plant structure and root development-effective root zone depth-moisture sensitive stages. Water stress and plant growth.

Unit – III: Evapotranspiration

Evapotranspiration (ET)-evaporation, transpiration, factors influencing ET. Measurement of actual ET. Measurement of PET-empirical methods. Weather parameters-solar radiation, air temp., air humidity, wind speed and their measurement. Soil-Water –Plant-Atmosphere Continuum (SPAC).Energy balance at crop surface. Control of ET losses. Aridity indices. Crop Co-efficient (Kc). Yield response factor(Ky).

Practical

Study of soil profile and description of soil profile horizons, Estimation of bulky density, Estimation of particle density, Determination of Field capacity by field method, Determination of permanent wilting point by field method, Determination of infiltration rate, Determination of hydraulic conductivity under saturated conditions, Determination of moisture retention characteristics of soil in laboratory by pressure plate apparatus, Determination of soil moisture content by Tensiometer, Measurement of soil moisture content by TDR/Profile probe, Measurement of plant water potential, Working of crop ET problems, Measurement of weather parameters, Study of aridity indices- case studies, Study of influence of water stress on crop yield

Suggested Readings

Panda, S.C. 1996. *Agronomy*. Agro-Bios(India), Jodhpur

- Reddy, S.R. 2007. *Irrigation Agronomy*. Kalyani publishers, New Delhi
- Michael, A.M. 1992. *Irrigation-Theory and Practice*. Vikas publishers, New Delhi
- Misra, R.D. and M.Ahmed. *Manual on Irrigation Agronomy*. Oxford and IBH publishers FAO. *Irrigation and drainage paper No. 56*
- Shankara Reddi, G.H.and T.Yellamanda Reddy 2002 *Efficient use of irrigation water*. Kalyani publishers, New Delhi
- Mukund Joshi and T.K.Prabhakar Setty. 2006. *Irrigation and water management* Kalyani publishers, New Delhi.
- Majumdar, D.K. 2002. *Irrigation Water management-Principles and practice*. PHI Pvt.Ltd, New Delhi.

AWM 503 CROP WATER REQUIREMENTS AND IRRIGATION PLANNING 2+1

Objective

To impart knowledge to students on hydraulics, design of channels, crop water requirement and irrigation planning

Unit I

Properties of fluids, fundamentals of fluid flow, steady flow, uniform flow, equation of continuity, energy equation and momentum equation. Open channel flow, Manning's equation, Chezy's equation, hydraulic jump, normal depth, laminar flow, Reynold's number, turbulent flow, Darcy's Weisbach equation, friction factor.

Unit II

Design of channels, flow in closed conduits, Measurement of irrigation water and empirical equations for water flow, weirs, notches, orifices and empirical equations.

Unit III

Land use capability and soil and land irrigability assessment. Factors affecting irrigation water requirement, estimation of seasonal and annual water, land irrigation requirement of crop (s). Estimation of progressive, seasonal and peak consumptive water use and its significance in operation of an irrigation project.

Unit IV

Irrigation scheduling to crops, and different irrigation methods. Crop response functions to irrigation. Matching of net irrigation demand to water supply characteristics through modification of irrigation technology. Cropping pattern and cropping intensity, crop planning in relation to changing scenario of water availability.

Practical

Assessment of types of flow, Design of open channels, Field visit to canal command area, Design of channels based on command area and cropping pattern, Measurement of irrigation water using weirs, Measurement of irrigation water using flumes and current meter, Design of surface irrigation methods, Design of surface irrigation methods – Surdev model, Design of surface irrigation methods - exercises, Calculation of crop water requirement – Kc curve and reference crop ET, Calculation of crop water requirement – Average, peak and seasonal water use, Calculation of Irrigation requirement of important crops and water use efficiency, Estimation of irrigation efficiencies, Study of crop response functions to irrigation, Irrigation scheduling to important crops, Irrigation scheduling to important crops

Suggested Readings

- Murthy, V.V.N. 1985. *Land and water management engineering*. Kalyani Publications, New Delhi.
- Ven T Chow. 1976. *Open channel hydraulics*. New York, McGraw-Hill
- Dilip Kumar Majumdar, 2002. *Irrigation and water management Principles and Practices*. Prentice – Hall of India Private Limited, New Delhi.
- Lenka, 2005. *Irrigation and Drainage*. Kalyani Publishers, Hyderabad.
- Sankara Reddi, G.H. and Yellamanda Reddy, T. 2002. *Efficient use of irrigation water*. Kalyani Publishers, New Delhi.
- Michael. A.M. 1992. *Irrigation Theory and practice*. Vikas Publishing house Private Limited, New Delhi.
- Sehgal, J. 1996. *Pedology – concepts and applications*. Kalyani Publications, New Delhi.

AWM 504

PRESSURIZED IRRIGATION SYSTEM AND DESIGN

2+1

Objective

To impart knowledge on importance of Sprinkler and Drip irrigation systems, design consideration of system components for efficient and economical adoption of the system.

Theory

UNIT I

An overview of Sprinkler irrigation, types of systems, components of system, design objectives, uniformity, adequacy and efficiency of application.

UNIT II

Design of different types of sprinklers, Design of pipe lines, laterals manifold, submain and mains, Design of traveler sprinkler system, layout, nose selection, gun sprinklers.

UNIT III

Trickle irrigation overview, types of system, and components of the system.

UNIT IV

Design objectives of Trickle irrigation system, uniformity, adequacy and efficiency of application.

UNIT V

Design of Trickle system, layout, emitter selection, lateral design, control head components, filtration and fertigation.

Practical

Study of components of sprinkler irrigation system, Designing of Sprinkler irrigation system for groundnut, Irrigation scheduling procedure for sprinkler irrigation of field crops, Calculating Christiansen's coefficient of uniformity with experimental data, Visit to Sprinkler irrigated cropped field, Study of components of drip irrigation system, Irrigation scheduling procedure for drip irrigation of fruit trees, Irrigation scheduling procedure for drip irrigation of row crops, Designing of drip irrigation system for sugarcane, Designing of drip irrigation system for vegetables, Designing of drip irrigation system for mango, Demonstration of fertigation practice, Evaluation of design emission uniformity, Acid treatment for drip irrigation system, Chlorination of drip irrigation system, Visit to drip irrigated mango & grape orchard

Suggested Readings

1. James, L.G. 1988. *Principles of Farm Irrigation System Design*. John Wiley & Sons Inc., New York 10158
2. Burt, C.M. and Styles, S.W. 1999. *Drip & Microirrigation for Trees, Vines and Row crops*. ITRC, California Polytechnic State University, San Luis Obispo, California
3. Burt, C.M., O'Connor, K. and Ruehr, T. 1998. *Fertigation*. ITRC, California Polytechnic State University, San Luis Obispo, California 93407
4. Benami, A. and Ofen, A. 1993. *Irrigation Engineering – Sprinkler, Trickle, Surface irrigation principles, Designs and Agricultural Practices*. Michlol, Ltd., Haifa, Israel 32000
5. Bucks, D.A., Nakayama, F.S. and Warrick, A.W. 1983. *Trickle irrigation for crop production*. Elsevier Publications, Amsterdam, Netherlands

C.No. AWM 505

DROUGHT CLIMATOLOGY

2+0

Objective

To impart the knowledge to the students on climatology of drought, impact and assessment of drought, monitoring and combating of drought

Unit I

Definitions; Causes, climatology of drought, EL Nino and La Nina, Synoptic weather systems during drought, drought indices and characteristics.

Unit II

Significant droughts in India. Impact of climate change on water resources. Agronomic practices during drought. Forest fire and drought, drought impact and assessment,

Unit III

Crop weather forecasting –modification of microclimate through heat evasion and trapping-modification of weather through solar radiation management. Case studies of successful micrometeorological applications.

Unit IV

Drought monitoring, Drought mitigation and advisory services, Drought prediction, appraisal and drought policy. Drought proofing and management .

Unit V

Modern tools including remote sensing and GIS in monitoring and combating droughts.

Suggested Readings

- Ramakrishna, Y.S., Rao, G.G.S.N., Sastry, P.S.N. and Rao, V.U.M.(Editors). 2006. *Agricultural drought: Aspects of Micro meteorology 4th SERC School – DST Sponsored Programme (25th Sep to 15th Oct, 2006)*. CRIDA, Hyderabad
- Ghadekar, S. R. *Meteorology*
- Prasada Rao, G.S.L.H.V. *Agricultural Meteorology*.
- Anji Reddy, M, 2006. *Text book of Remote sensing and geographical information system*. B.S. Publications.

- Chakraborty Sahoo, R.N. 2004. *Fundamentals of Geographic information system*. Viva books
- Chang, J.M. 1968. *Climate and Agriculture*. Aldine publications
- Lal, D.S.1998. *Climatology*. Sharda pustak bhawan
- Thompson, R.1997. *Applied climatology. Principles and practice*. Rout ledge
- Ramsastry, A.A. 1984. *Weather and weather forecasting*. Publication division, GOI, New Delhi.
- Singh, S.V., Rathore, L.S and Trivedi, M.K.N. 1999. *A guide for Agrometeorological Advisory services*. Department of science & Technology, NCMRWF, New Delhi

AWM 506

SOIL AND WATER QUALITY AND POLLUTION

2+1

Objective

To impart knowledge about different indicators of soil and water quality, their impact on soil productivity and their assessment and management. The course also provides insight in to the causes, effects and control of soil and water pollution.

Theory

UNIT I

Soil Quality- Quantitative indicators of soil quality (physical, chemical and microbiological)- minimum data set – Physical: texture, soil depth, infiltration, bulk density, water holding capacity, aggregate stability- Chemical: organic carbon, pH, EC, extractable NPK, Sodium Absorption Ratio - Microbiological: microbial biomass C and N, soil respiration, potentially mineralizable N (anaerobic incubation)- integration of indicators into soil quality index using Soil Management Assessment Framework (SMAF), a tool for quantitative soil quality evaluation method developed by USDA.

UNIT II

Water quality- guidelines and criteria for soil quality evaluation – water quality related problems in irrigated agriculture (salinity, low infiltration, specific ion toxicity and miscellaneous problems) – Salinity: build up of salinity, effect on crops, management, drainage and control by leaching, crop tolerance and cultural methods. Infiltration problems: evaluation, management, soil, water amendments, deep tillage, organic residues, irrigation management – Specific ion toxicity: Effect of Cl, Na, B, management-leaching, crop selection, cultural practices, toxicity effects due to sprinkler irrigation – Miscellaneous problems: excess nitrogen, abnormal pH, scale deposits, clogging in drip irrigation system, metal corrosion. Water quality for live stock -Waste water reuse – case studies.

UNIT III

Soil Pollution – Land application of wastes: bio-solid wastes, industrial effluents, distillery and paper mill effluents, Tannery and textile industrial effluents – Mechanism of interaction of wastes with soil – effect of sewage waste application on soil characteristics and crop responses, excessive use of fertilizers – excessive nitrates – heavy metals contaminants in fertilizers as soil pollutants, pesticides, insecticides, fungicides, herbicides – reducing pesticide levels in soils – potentially toxic elements: Cd, Pb, Hg, Ni, Cr, Se, As – reducing heavy metal pollution in soil – radio nuclides – case studies.

UNIT IV

Water pollution: Indicators of water pollution - Categories of water pollutants: organic matter, pathogens, plant nutrients, sediments, petroleum oil, radioactive materials, heat – Sources

of water pollutants: domestic waste water, infectious agents, plant nutrients, industrial water pollution, Agricultural water pollution, solid waste pollution, thermal and radioactive pollution – Effect of water pollutants on aquatic biota – state of ground water pollution in Indian cities –case studies - purification of water: drinking and sewer water – Legislation – Environment Protection Act and Water (prevention and control of pollution) Act.

UNIT IV

Management and improvement of soil and water quality - improving the crop productivity.

Practical

Collection of soil samples from different ecosystems (Forestry, Agro Forestry, Cultivated fields, Grass lands etc). Entry operations and sample preparation, Visit to pollution affected areas in the city and collection of soil and water samples. Entry operations and sample preparation, Introduction to Soil Management Assessment Framework (SMAF) – a tool for evaluation of soil quality – minimum data set for quantification of soil quality indicators, Estimation of physical soil quality indicators: bulk density, texture, Estimation of Aggregate stability, Soil moisture retention at field capacity and wilting point using pressure membrane apparatus, Infiltration studies in soils under different ecosystems, Microbial biomass carbon and nitrogen estimation, Respiration studies in soils under different ecosystems, Estimation of chemical soil and water quality indicators: Estimation of pH, EC in soil and water samples and organic carbon in soil samples, Estimation of Na, Ca and Mg of soil and water samples and computation of SAR, Estimation of extractable N of soils, Estimation of extractable P and K of soils, Estimation of carbonates, bicarbonates, chlorides (Residual Sodium Carbonate), nitrates and boron in water

Suggested Readings

- Ayers, R.S. and Westcot, D.W. 1994. *Water quality for Agriculture*, FAO Irrigation and Drainage Paper 29. Rev. 1.
- Chandra Sekhar, M. and Sankara Rao, M. 2004. *Environmental Science*. 5th Edn. The HiTech Publishers, Hyderabad.
- ISSS. 2002. *Fundamentals of Soil Science*. Indian Society of Soil Science. IARI. New Delhi.
- John W Doran and Alice J Jones. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America Special Publication No. 49, Inc. Madison, Wisconsin, USA.
- Ramesh Chandra and Satish Kumar Singh. 2009. *Fundamental and Management of Soil Quality*. Westville Publishing House, New Delhi.
- Susan S Andrew, Douglas L. Karlen and Cynthia A. Cambardella. 2004. *The Soil Management Assessment Frame work. A Quantitative Soil Quality Evaluation method*. Soil Science Society of America Journal. Vol. 68, Nov-Dec. pp 1945-1762.
- Srivastava, K.P. 2001. *An introduction to environmental study*. Kalyani Publishers, Hyderabad.
- Tandon, H.L.S. 1993. *Methods of analysis of soils, plants, waters and fertilizers*. Fertilizer Development and Consultation Organisation. New Delhi.
- U.G.C. 2005. *Text Book of Environmental studies for undergraduate courses*. University Grants Commission. Universities Press (India) Private Ltd.
- USDA. 1998. *Soil Quality Test Kit Guide*. United States Department of Agriculture, Agricultural Research Service, Natural Resources Conservation Service. Soil Quality Institute

Objective

The course provides an insight into the principles and basic concepts of Remote Sensing, Geographical Information System, techniques of satellite data processing and application of these modern tools for inventory, monitoring and management of different aspects of water management in Agriculture.

Theory**UNIT I**

Elements involved in remote sensing, Electromagnetic spectrum, Remote Sensing terminology, Energy Sources, Energy interactions with earth surface features and atmosphere, spectral properties of vegetation, soil and water bodies. Resolution, Sensors and Satellites, Visual Interpretation techniques- Basic elements.

UNIT II

GIS definition and Terminology, GIS categories, Components of GIS, fundamental Operations of GIS, A theoretical Frameworks for GIS, GIS types of data representation, Raster and Vector Data Structures, Comparisons between data Structures. Map language – spatial elements, classification of maps, map scale, map projections. Map referencing system – national and international Satellite data.

UNIT III

Digital Image Processing techniques - Image rectification and registration-Image enhancement-Image classification-Accuracy assessment, Data merging and Data integration.

UNIT IV

Crop inventory – Acreage estimation, Production forecasting and Condition assessment. Land Use/Land cover analysis. Irrigated Land assessment and inventory – Assessment of Irrigation water requirements – Irrigation Scheduling – Assessment of surface water logging. evapotranspiration estimation, Remote sensing based approaches for soil moisture assessment.

UNIT V

Flood plain zoning, Drought assessment and monitoring, Hydrological characterization of watershed, Soil erosion modeling and erosion hazard assessment.

Practical

Acquaintance with instruments used in Remote Sensing, Introduction of RS and GIS software's – Topographic sheets-Map language-Reference system, Study of boarder information of satellite images - Using image processing software (Erda imagine) - Loading of Satellite data and Pre processing geo rectification and registration of toposheets and satellite image and mosaicing, Image enhancement techniques band rationing – image merging, Use of Spectro radiometer – Spectral reflectance of crops and soils, Calculation of spectral indices, Handling of Global position system, Unsupervised classification for land use land cover mapping, Supervised classification techniques, Map preparation – legend – graticules, index, Visit to NRSA, Infrared Thermometer and its use in scheduling irrigation – calculation of various thermal indices like CWRI (Crop Water Stress Index, Visit to AP State Remote Sensing Application Centre (APSRAC) and A P Forestry Academy, Hyderabad, Watershed characterization and runoff assessment using Arc GIS

Suggested Readings

- Anji Reddy, M. 2001. *Remote Sensing and Geographical Information Systems*. Second Edition. Book Syndicate Publication, Hyderabad.
- David L Verbyla. 1995. *Satellite Remote Sensing of Natural Resources*. Lewis Publishers, New York, Imprint of CRC Press, LLC, Florida, US.
- John R Jensen, 1986. *Introductory Image Processing A remote sensing perspective* Second Edition. Printice Hall Series in Geographic Information Science, New Jersey.
- Indian Institute of Remote Sensing (IIRS), Dehradun. Lecture notes of PG Diploma in Remote Sensing applications in agriculture
- Thomas M Lilles and Ralph W Kiefer. 2001. *Remote Sensing and Image Interpretation*. Fourth Edition, John Wiley & Sons, Inc. New York. / Book Syndicate Publication, Hyderabad (Indian Edition)
- Venkataratnam, L. Ravi Sankar, T. and Sudarshana, R. 2004. *Remote Sensing applications, Soils and Crops, status, issues and prospects*. National Remote Sensing Agency, Hyderabad.

AWM 508

ECONOMICS OF WATER USE

2+0

Objective

To impart the knowledge on production functions, optimum allocation of water and economics of water.

Unit I

Crop response to irrigation water and application of production function for optimum utilization of irrigation water.

Unit II

Mathematical models of computer simulation/system analysis to water allocation and management problems.

Unit III

Linear programming, dynamic programming, multi-purpose and multi-objective water resources development, allocation and optimization of irrigation water for increasing returns.

Unit IV

Groundwater economics and conjunctive use plan of water resources.

Unit V

Water trade and water pricing.

Suggested Readings

- Alpha C. Chiang. 1984. *Fundamental methods of mathematical economics*. Mc Graco- Hill book company, New Delhi.
- Palanisami, K. Paramasicam, P. and Ranganathan, R. 2002. *Agricultural Production economics- Analytical methods and applications*. Associate publishing company, New Delhi.
- Heady O Earl and Dillon L. John. 1988. *Agricultural Production Functions*. Kalyani Publishers, New Delhi.

Shenoy, G.1989. *Linear programming – Principles and applications*. Wiley Eastern publications.
Dorfman, R. 1996. *Linear programming and economic analysis*. Mc Graw Hill.
Lomba, N.P. 2006. *Linear programming*. Tata Mc Graw Hill.
Vasertein, 2006. *Introduction to linear programming*. Pearson Education publication

AWM 509

WATERSHED MANAGEMENT

2+1

Objective

To impart the knowledge to students on concepts of watershed and integrated watershed management with community participation

Unit I

Concepts of watershed components, delineation, problem identification, deterioration and priority concepts. Land and water degradation. Land capability and land suitability classification. Hydrological processes.

Unit II

Integrated watershed management, data base generation and management, impact evaluation and assessment. Watershed resources appraisal. Community participation, role of NGO's and political will & support. Watershed management programmes in the country-overview, sustainability aspects, economic evaluation and environmental assessment.

Unit III

Concepts of soil and water conservation, Soil and water conservation measures, Soil erosion. Effective life of dams and water retention structures. Mechanics of wind erosion; types of wind erosion and soil movement; wind erosion control measures.

Unit IV

Analysis of hydrologic data including rainfall, evapotranspiration; watershed characteristics; overland flow. Methods of estimation of runoff; peak rate and time distribution of hydrograph; synthetic hydrograph; infiltration process; hydrologic evaluation of land treatment. Erosion control.

Unit V

The role of soil water conservation work, river valley projects; soil conservation department, CADA etc.

Suggested Readings

Khan, M.A. 2006. *Watershed Management for Sustainable Agriculture* Agrobios, Jodhpur
Oswal, M.C. 1999. *Watershed Management (for dryland Agriculture*, Associated Publishing Company, New Delhi.
Gunny Honore (Editor). 2002. *Principles and practices of integrated watershed management in India*. Indo-German Bilateral Project on watershed development, New Delhi.
Murthy, J.V.S. 1994. *Watershed management in India*, Wiley eastern limited, New Age international limited, Hyderabad
Druvanarayana, V.V., Sastry, G. and Patnaik, U.S. 1990. *Watershed management*. ICAR, New Delhi.
Tideman, E.M. 1996. *Watershed Management – Guidelines for Indian conditions*. Omega scientific Publishers New Delhi

Objective

To impart the knowledge to students on environmental impact of irrigation project and its assessment

Unit I

Nature of environmental impacts of water resources development, environmental impact statement for irrigation and drainage projects, protocols, procedures and regulations in India, use of Geographic Information Systems for assessment and prediction of impacts.

Unit II

Preparation of EIA reports on water resources projects, Social assessment, Risk and uncertainty and matrix methods in EIA. Agricultural non-point pollution sources. Modelling pollutant transport in runoff and sediment; modeling pollutant loadings to ground water. Case studies on EIA of irrigation and drainage projects.

Unit III

Definition, Objectives, activities and basic aspects of diagnostic analysis of irrigation projects. Study and measurement of performance parameters. Interaction of productivity and water use efficiency under different fertility levels. Efficient utilization of irrigation water. Operational management of irrigation and drainage net works. Participatory irrigation water management.

Unit IV

Fundamentals of conceptual framework for performance evaluation of irrigation projects. Evaluation of irrigation projects in relation to basic objectives. Equitable water distribution. Socioeconomic, political and organizational implications in the management of irrigation systems.

Unit V

Pricing of irrigation water. Case studies.

Suggested Readings

- Joshi, L.K. and Rakesh Hooja (Editor). 2000. *Participatory Irrigation Management –Paradigm for the 21st Century*. Pawat Publications, New Delhi.
- Bos, M.G., Burton, M.A. and Molden, D.J. 2005. *Irrigation and Drainage performance Assessment-Practical Guidelines*. CABI publishing, UK and USA.
- Hosetti, B.B. 1998 *Environmental impact assessment and Management*. Daya Publishing house New Delhi.
- Trivedy, R.K. 2004. *Hand book of Environment Laws, Acts, Guidelines, Compliances and standards*. B.S. Publications. Hyderabad
- Shansi, U.M. 2000. *GIS applications for water, waste water and storm water systems*, Taylor & Grancis, Newyork
- Purohit, S.S. and Agrawal K.A. 2004. *Environmental Pollution causes, effects and control*. Agrobios (India), Jodhpur
- Richard Helmer and Ivanildo Hespanbol (Editor) 1997 *Water Pollution Control A guide to the use of water quality management principles*. E & FNSPON, An imprint of Thomas Professional New york, Madras
- Kulkarni, V.S., Kaul, S.N. and Trivedy, R.K. 2002. *A Hand book of Environment Impact Assessment*. Scientific Publishers (India), Jodhpur

**AWM 511 ECONOMICAL, SOCIAL AND INSTITUTIONAL PROSPECTS AND 2 + 0
ISSUES OF WATER RESOURCES MANAGEMENT**

Objective

To impart the knowledge to students on economical, social and institutional issues of water resources management

Unit I

Principles of economics and their application in water resources management. Economic dimensions of irrigation systems appraisal – economic appraisal of irrigation programmes and water harvesting technologies, project feasibility criteria, assessment of costs and benefits and internal rate of return. Water resources pricing: theory and practice.

Unit II

Policy approaches for efficient on-farm water utilization – equity and efficiency in water distribution. Irrigation management alternatives and productivity impact.

Unit III

Institutional framework in canal command and watershed areas. Organizations, their roles and functions. Water users associations and participatory irrigation management; Case studies.

Unit IV

Elements of theory of sampling. Data generation and socio-economic methodological framework for irrigation water management studies.

Unit V

Water laws, water rights and managing conflicts. Inter-state water disputes. Banking and financing mechanisms in water resources management.

Suggested Readings

- Gittinger, J. P. 1982. *Economic analysis of Agricultural projects*. The Johns Hopkins Univ. Press.
- Bansil, P.C. 2004. *Water Management in India*. Concept Publishing company, New Delhi
- Little I.M.D. and Mirlees J.A. 1974. *Project Appraisal and planning for developing countries*. Oxford & IBH publications.
- Kothari, C. R. 2004. *Research Methodolgy-Methods and Techniques*. Wishwa Prakashan, Chennai
- Venkata Subramanian, V.1999. *Introduction to Research Methodology in Agricultural and Biological sciences*. SAGE publications

List of Journals

- Journal of water management
Indian Journal of Agronomy
Indian Journal of Agricultural Sciences
Agricultural water management
Irrigation and drainage
Irrigation Science
Annals of Arid zone

Agronomy Journal
Field crops Research
Ground water
Hydrology Journal
Indian Journal of water Management
International Journal of water Resources development
Irrigation and Drainage systems
Journal of Agricultural Engineering
Journal of Agricultural water Management
Journal of agriculture and forest Meteorology
Journal of Agro meteorology
Journal of Hydrology
Journal of Indian Water Resources Society
Journal of Irrigation and Power
Journal of Irrigation and Drainage Engineering
Journal of Soil and Water Conservation
Water Research
Water International
Water Policy
Water Resources Management
Water Resources Journal
Water Resources Bulletin
Water Resources Research
Water Science and Technology
Water and Energy International
Water, Air and soil Pollution
Advances in Agronomy
Advances in water Resources
Soil science society of American Journal
Soil Science and plant nutrition
Environment pollution
Journal of Indian Society of Soil Science
Soil Science
Plant and soil
Indian society of Coastal Agricultural Research

Journal of Environment Biology

www.indianjournals.com

www.springerlink.com/journals

www.sciencedirect.com

www.scijournals.com

www.elsevier.com

Suggested Broad topics for Master's Research

Water Resources Assessment and use efficiency through remote sensing and GIS

Water management strategies in different crops and cropping systems

Modeling soil water relationships

Validation of existing models for crop water requirement

Water quality and pollution remedial measures

Assessment and water management strategies for different irrigation projects

Studies on drought indices

Assessment of Ground Water use and management

Micro irrigation and fertigation

Rain water conservation and management

Approaches for estimation of evapotranspiration

Use of poor quality water for irrigation

Climate change and water management

Management strategies under deficit water situations

Studies on Water saving technologies