




Bangladesh Open University

 SARD SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT কৃষি ও পল্লী উন্নয়ন স্কুল	School of Agriculture and Rural Development (SARD)
	Master of Science (MS) in Irrigation and Water Management

Curriculum layout for the degree of Master of Science (MS) in Irrigation and Water Management

- Requirement for registration:** Bachelor of Science in Agricultural/Civil/Water Resources Engineering or related disciplines from any recognized University
- Duration:** One and a half ($1\frac{1}{2}$) years (Registration valid for three consecutive years)
- Semester:** Three Semesters (Valid up to consecutive six semesters), two semesters in a year each of six (6) months:
- No. of courses = 12
- No. of credits = 40
- Total Marks = 2000

Distribution of courses, credits and marks

MS in Irrigation and Water Management shall be offered with 40 credits in 3 semesters each of six months duration. The courses worth 24 credits of which 12 credits shall be offered during the first semester and the other 12 credits during the 2nd semester respectively for the students. Another 16 credits shall be reserved for the research (thesis and thesis defense). The students have to start their research work for thesis (equivalent to 6 courses) under the guidance and supervision of his/her Research Supervisors after the completion of one semester and the same shall be carried through to the last semester when it will be evaluated. After the evaluation of thesis the students have to face thesis defense (equivalent to 2 courses). The distribution of courses, credits and marks are shown below:

Course Type		No. of Courses	Credits	Marks
Course (compulsory)		12	24	1200
Research	a) Thesis	equivalent to 6 courses	12	600
	b) Thesis defense	equivalent to 2 courses	4	200
Total			40	2000

N.B. 1 course = 2 credits = 100 marks; Thesis = 12 credits = 600 marks, Thesis defense (4 credits) = 200 marks: Each course will carry 80 marks for theoretical examination and 10 marks for one course assignment and 10 marks for class attendance.


Course layout for MS in Irrigation and Water Management

1st Semester

Sl.	Course Title	Course Code	Credit Hours	Marks
1.	Surface Water Hydrology	MSIWM 1201	2	100
2.	Irrigation System Design and Evaluation	MSIWM 1202	2	100
3.	Groundwater Development and Management	MSIWM 1203	2	100
4.	Soil-water-plant atmosphere Continuum	MSIWM 1204	2	100
5.	Water pollution and Environment	MSIWM 1205	2	100
6.	Integrated Water Resources Management	MSIWM 1206	2	100
Total 6 Courses			12	600



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2nd Semester

Sl.	Course Title	Course Code	Credit Hours	Marks
1.	Irrigation System Planning and Management	MSIWM 2201	2	100
2.	Drainage Engineering	MSIWM 2202	2	100
3.	River Engineering and Flood Management	MSIWM 2203	2	100
4.	Watershed Management	MSIWM 2204	2	100
5.	Hydraulic Structures	MSIWM 2205	2	100
6.	Remote Sensing and GIS in Water Resources	MSIWM 2206	2	100
Total 6 Courses			12	600

3rd Semester

Title	Credit	Mark
a. Thesis (equivalent to 6 courses)	12	600
b. Thesis defense (equivalent to 2 courses)	4	200
Thesis + Thesis defense	16	800
Grand Total	(12×2)+16 = 40 (Forty)	2000

Syllabus for MS in Irrigation and Water Management

Course Title: Surface Water Hydrology

Credit Hrs: 2

Course Code: MSIWM 1201

Unit


Title

Lesson

1	Hydrology and Its Development	Define hydrology, hydrologic cycle, broadest and narrower sense of hydrology, scale of hydrology, physical process of hydrology, hydrologic models, classification of deterministic models
2	Hydrograph Analysis and Relationship Between Unit Hydrograph and Catchment	Excess rainfall, interception, infiltration, ϕ index, instantaneous unit hydrograph, derivation of UH, determination of IUH, Nash model, general hydrologic system model (linear system in continuous time, response function of linear system), impulse response function
3	Hydrologic and Hydraulic Routing	Distinguish between channel routing and reservoir routing, lumped and distributed system routing, Saint-Venant equation with assumption, Kinematic wave velocity, kinematic wave model for rainfall runoff process, linear reservoir routing an impulse input and constant inflow, , general and modified Muskingum routing equation
4	Hydrology of Agricultural Land	Define river basin, characteristics of river basin, physical description of the basin (drainage area, stream order, drainage density, area-elevation distribution), climatic factors, topographic factor
6	Catchment Modeling	Consideration in catchment modeling, model accuracy, consistency of model performance, parameter sensitivity studies, simple and elaborate models, isolation of model parts in optimization, optimization using appropriate output function, tests of residuals, progressive modifications, mode of fitting, mode of operation
7	Time Series Analysis:	Define time series, stochastic process, stochastic models, stationary and non-stationary



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Forecasting and Updating Techniques models, mean and variance of stationary process, auto-covariance and autocorrelation coefficients, auto-covariance and autocorrelation functions, estimation of auto-covariance and autocorrelation functions, general linear process, autoregressive process

Recommended Text Books

1. Hydrology in Practice – Elizabeth M. Shaw. 2nd edition, Van Nostrand Reinhold (International) Co. Ltd., London, 1988.
2. Time Series Analysis: Forecasting and Control – G.E.P Box, G.M. Jenkins and G.C. Reinsel. 3rd edition, Prentice Hall, Englewood Cliffs, NJ, USA, 1994.

Supplementary Text Books

3. Introduction to Hydrology – Warrant Viessman, Jr., John W. Knapp, G.L. Lewis and T.E.
4. Harbaugh. Harper and Row Publishers Inc., 1977.
5. Hydrology for Engineers – R.K Linsley, M. A. Kohler and J.H. Paullus. McGraw-Hill Book Company, New York, 1975.
6. Journal of Hydrology – Elsevier Science Publishers, Amsterdam, The Netherlands.
7. Hydrological Sciences Journal – Blackwell Scientific Publications, Oxford, U.K.
8. Journal of Hydrology and Earth Systems Sciences – European Geophysical Union.
9. Bangladesh Journal of Water Resource Research – Bangladesh University Engineering and Technology, Dhaka, Bangladesh.

Course Title: Irrigation System Design and Evaluation

Credit Hrs: 2

Course Code: MSIWM 1202

Unit	Title	Lesson
1	Design Fundamentals of Irrigation Systems	Define farm irrigation, functions, types of farm irrigation systems, water application methods
2	Surface Irrigation	Surface irrigation methods, delivery systems for surface irrigated farms (level basin, border irrigation, furrow irrigation), designing farm irrigation systems
3	Sprinkler Irrigation	Types of sprinkler systems, sprinkler systems components, sprinkler systems design
4	Drip Irrigation	Benefits of drip irrigation, drip irrigation methods, major advantages of drip irrigation system, problems associates with drip irrigation system, drip system components, control of drip system clogging, fertilizer injection, drip system design
5	Evaluation of Irrigation System	Evaluation of basin, furrow, border strip, sprinkler, buried pipe, and drip irrigation
6	Performance Evaluation	Evaluation of irrigation project performance

Recommended Text Books


1. Principles of Farm Irrigation System Design – Larry G. James. John Wiley & Sons, 1993.
2. Farm Irrigation System Evaluation: A Guide for Management – J. L. Merriam and J. Keller. Department of Agricultural and Irrigation Engineering, Utah State University, 1978. American Society of Agronomy, 1967.
3. Irrigation System Design Handbook – D.D. Davis. Rain Bird Sprinkler Manufacturing Corporation, California, USA, 1976.
4. Irrigation of Agricultural Lands – R. M. Hagan, H.R. Haise and T.W. Edminster (eds.).

Supplementary Text Books

5. Irrigation Engineering and Hydraulic Structures – S.K. Garg. Khanna Publishers, New Delhi, India, 1998.
6. Irrigation Engineering and Hydraulic Structures – S.R. Shahasrabudhe. Katson Publishing House, Ludhiana, India.
7. Irrigation Water Management – Training Manual – M. Kay and Hatcho, FAO Land and Water Division, Rome, 1992.
8. Journal of Agricultural Water Management, Elsevier Science Publishers, Amsterdam, The Netherlands.
9. Irrigation Science, Springer-Verlag, USA.



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Course Title: Groundwater Development and Management

Credit Hrs: 2

Course Code: MSIWM 1203

Unit	Title	Lesson
1	Occurrence and Movement of Groundwater	Occurrence of groundwater, origin of groundwater, groundwater and hydrologic cycle, vertical distribution of groundwater, types of geologic formation and aquifers, water table and piezometric surface
2	Evaluation of Aquifer Properties and Characterization	Porosity, void ratio, specific yield, specific retention, storage coefficient, hydraulic conductivity, transmissibility, intrinsic permeability
3	Well Hydraulics for Steady and Unsteady Radial Flow Conditions	Steady radial flow into well, unsteady radial flow into well
4	Testing Water Wells for Analyzing Drawdown and Yield	Well flow near aquifer boundaries-image wells, Barrier and recharge boundaries-image wells, aquifer bounded by a research boundary, methods of images, methods of images for particular cases
5	Well Interference and Safe Spacing of Wells	Multiple well systems, partial penetration of the well, Spacing of tubewells, specific capacity and safe yield, well efficiency
6	Groundwater Quality: Physical, chemical and biological quality parameters	Importance of groundwater quality, physical, chemical and biological groundwater quality parameters
7	Saline Water Intrusion	Concept of saline water intrusion, slope of interference, shape of interference, dispersion, seawater intrusion methods, oceanic island aquifers
8	Groundwater Recharge and Safe Yield Assessment	Physical methods: saturated zone, water-budget methods
9	Groundwater Modeling Techniques	Porous media models, electric analog models, digital computer models
10	Groundwater Management	System wise and basin wise management concepts, conjunctive use of surface water and groundwater, groundwater management issues in Bangladesh

Recommended Text Books


1. Groundwater – H.M. Raghunath. 2nd edition, New Age International (P) Limited, Publishers, New Delhi, India, 1987.
2. Groundwater Assessment Development and Management – K.R. Karanth. 3rd edition, Tata, McGraw-Hill Publishing Company Limited, New Delhi, India, 1994.
3. Concepts and Models in Groundwater Hydrology – P.A. Domenico. McGraw-Hill Book Company, New York, USA, 1972.

Supplementary Text Books

4. Groundwater Resource Evaluation – W.C. Walton. McGraw-Hill Book Company, New York, USA, 1970.
5. Groundwater – R. A. Freeze and J. A. Cherry. Prentice-Hall Inc., New Jersey, USA, 1979.
6. Groundwater Hydrology - D.K. Todd. 2nd edition, John Wiley & Sons. New York, USA, 1980.
7. Groundwater Hydrology – H. Bouwer. McGraw-Hill Book Company, New York, USA, 1978.
8. Seepage and Groundwater Flow – K.R. Rushton and S.C. Redshaw. Wiley, Chichester, UK, 1979.
9. Groundwater – H. M. Raghunath. 2nd edition, New Age International (P) Limited, Publishers, New Delhi, India, 1987.
10. Groundwater Management – American Society of Civil Engineering (ASCE), Manual No. 40, 1972.
11. Groundwater – American Water Works Association (USA).
12. Journal of Irrigation and Drainage Division, American Society of Civil Engineering (ASCE).



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Course Title: Soil-Water-Plant Atmosphere Continuum

Credit Hrs: 2

Course Code: MSIWM 1204

Unit

Title

Lesson

1	Soil Physical and Chemical Properties	Soil physics, soil fertility, soil as a disperse three phase system, soil particle, pore space, density of solids, volume and mass relationship of soil constituents, dry bulk density, total/wet bulk density, dry specific volume, porosity, void ratio, soil wetness, air filled porosity, soil texture, soil structure, particle size analysis, soil profile, specific surface of a soil, behavior of clay, exchangeable cations, diffuse double layer, heat of wetting, swelling, hysteresis
2	Soil Water Characteristic Function: Retention and availability	Energy state of soil water, relation of water by soil matrix, soil moisture characteristic curve, soil water retention function, general characteristics of water retention curves and important parameters, water capacity function, soil water hysteresis, model fitting, soil as a store of water for plant, kinds of soil water, soil moisture tension, soil water constants
3	Methods of Soil-Water Measurement	Destructive methods- gravimetric/thermo gravimetric method, Non-destructive methods- TDR, capacitance probe, Direct methods- gravimetric method, neutron moderation, Indirect methods- tensiometer, gypsum block, Electrical methods- TDR, capacitance probe
4	Soil-Water Movement: Steady and unsteady state flow	Flux, flow velocity, tortuosity, hydraulic conductivity, permeability and fluidity, relationship of hydraulic conductivity and permeability to pore geometry, principle of water movement in soils, Poiseuille's equation, Darcy's law, limitation of Darcy's law, flow through saturated soils, flow through unsaturated soils, diffusivity, movement of water under temperature gradient
5	Plant-Water Physiology	Soil-plant-atmosphere continuum, plant water content, rate of transpiration, energy relations, pressure relations, metabolism and water relations
6	Root Pressure Theories and Crop-Water Uptake Functions	Structure and function of roots, flow of water to plant roots, water requirements of plant, water relation of plant cell and tissues
7	Stomatal Response and Physical Models	Osmotic adjustment, stomatal response to moisture stress
8	Crop Response to Water	Water potential, evapotranspiration, environmental factors affecting evapotranspiration, plant factor affecting evapotranspiration, potential evapotranspiration
9	Stress Tolerance and Critical Stress Periods of Crops	Moisture stress, physiological aspects of water stress, practical aspect of water stress, water stress effects on yield

Recommended Text Books


1. Plant and Soil Water Relationship: A Modern Synthesis – Paul J. Kramer. McGraw-Hill Book Company, 1975.
2. Water and Plant Life: Problems and Modern Approaches – O.L. Lange, L. Kappen and E.D. Schulze. Berlin, Springer-Verlag, New York, 1976.

Supplementary Text Books

3. Plant-Water Relationship – R.O. Slatyer. Academic Press, London, New York, 1967.
4. Water, Soil and the Plant – E.J. Winter. The Macmillan Press Ltd. London, 1978.
5. Irrigation: Theory and Practice – A.M. Michael. Bikash Publishing House (Pvt.) Ltd., New Delhi, India, 1987.
6. Transactions of the American Society of Agricultural Engineers (ASAE).
7. Journal of Agricultural Engineering Research, The British Society for Research in Agricultural Engineering.
8. Agricultural Meteorology, Elsevier Science Publishers, Amsterdam, The Netherlands.
9. Agronomy Journal, American Society of Agronomy, USA.



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10. Soil Science, The Williams and Wilkins Company, Baltimore, Maryland, U.S.A.
11. Plant Physiology, American Society of Plant Physiologists.

Course Title: Water Pollution and Environment

Credit Hrs: 2

Course Code: MSIWM 1205

Unit	Title	Lesson
1	Introduction to Hydrologic Cycle and Role of Water in the Environment	Water cycle, water in atmosphere, surface water and groundwater relation, effects of global warming on water cycle, water and environment, surface water management, changes in land and water use, effects of flood, effects of drought, need water for the environment, role of water for the environment
2	Sources of Water Pollution and Attenuation Techniques of Pollution	Water pollution, types of water pollution, sources of water pollution, causes of water pollution, effects of water pollution, how to prevent water pollution
3	Environmental Problems Due to Water Resources Development and Use	Problems of agriculture due to water resources development and use, top environmental issues (climate change, deforestation, over population, waste management) should make worry
4	Future Trends in Water Development and Management	Key trends in water development and management, key threats and challenges to develop water resource management
5	Water Quality and Environment Pollution	Pollution and how it affects water, global crisis of water pollution, environmental water quality, types of chemical contaminants, impacts of chemical contaminants on water, steps to minimize chemical contamination on water, biological contaminants, impacts of water quality on health
6	Environmental Impacts of Water Resources Projects	Impacts caused by dam and reservoir, Impacts caused by channelization projects, Impacts caused for dredging projects
7	Measurement of Environmental Variables	Temperature, rainfall, wind speed and wind direction, light intensity, evapotranspiration, drought index, solar radiation
8	Environmental Rules and Regulations	Environmental law in BD, sectoral laws, Environmental Conservation Act 1995, Environmental Conservation Rules 1997, Environmental Court Act 2010, Clean Water Act 1972, Safe Drinking Water Act 1974
9	Environmental Impact Assessment (EIA)	Define EIA, importance of EIA, Objectives of EIA, Advantages of EIA, Current EIA procedures in BD, key relevant terms in water quality management
10	Environmental Management for Irrigation and Drainage Projects	Need for environmental assessment, major impacts of irrigation and drainage projects, major problems of irrigation and drainage projects

Recommended Text Books


1. Environmental Water and Soil Analysis – P. R. Trivedi and Gurdeep Raj. Akashdeep Publishing House, New Delhi, 1992.
2. Environmental Impact Assessment – W. Larry Canter. 2nd edition, McGraw Hill Series in Water Resources and Environmental Engineering, 1995.

Supplementary Text Books

3. Environmental Impact Assessment of Irrigation and Drainage Projects – T.C. Dougherty and A. W. Hall. 53 FAO Irrigation and Drainage Paper, Food and Agriculture Organization of the United Nations, HR Wallingford, United Kingdom, 1995.
4. Environmental Management – Bala Krishnamoorthy. Prentice Hall of India Pvt. Ltd., 2005.
5. Manual for Environmental Impact Assessment – Ministry of Water Resources, Government of the Peoples Republic of Bangladesh, 1997.



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6. Water and the Environment, Water Resources and Development Service, Land and Water Development Division, Food and Agriculture Organization of the United Nations, Rome, Italy, 1990.
7. Advances in Environmental Research, Elsevier Science Publishers, Amsterdam, The Netherlands.

Course Title: Integrated Water Resources Management (IWRM)

Credit Hrs: 2

Course Code: MSIWM 1206

Unit	Title	Lesson
1	Fundamentals of Integrated Water Resources Management (IWRM)	Definition and concepts of IWRM, IWRM from a basin perspective, Communication & Learning: Gender perspective
2	Principles of IWRM	Water policy mechanisms, water act, by-laws and management plans
3	Strategies of IWRM	Availability, use and scarcity of water resources, resilience and adaptive capacity, social vulnerability and disaster management, conflicting issues and their management
4	Challenges in IWRM	Water and climate change, water and food security, water and energy nexus
5	Environmental issues in IWRM	Water pollution, health and sanitation, water and wetland ecosystem
6	Water Governance	Institutional setting and governance, water right and equity, multi-sectoral water demand allocation principles, integration of sectors/stakeholders
7	IWRM Tools and stakeholder analysis	Different tools and techniques, participatory planning, visioning, problem analysis, setting objectives and strategies, final planning

Recommended Text Books

1. Global Water Partnership, 2000. Integrated Water Resources Management. Technical Advisory Committee (TAC) Background Paper No. 4, GWP Secretariat, Stockholm, Sweden.
2. Das Gupta, A. et al, 2005. Water Sector of Bangladesh in the context of Integrated Water Resources Management: A Review. J. Water Resources Development, Vol. 21, No. 2, London.
3. Hooper, B. P., 2005. Integrated River Basin Governance: Learning from international experience, International Water Association, London, U.K.

Supplementary Text Books

4. Global Water Partnership & International Network of Basin Organizations, 2009. A Handbook of Integrated Water Resources Management in Basins. Elanders, Sweden. Web site- www.gwpforum.org.
5. Jonch – Clausen, T., 2004. IWRM and Water Efficiency Plans by 2005. GWP TAC Background Paper – 10. Stockholm, Sweden.
6. Global Water Partnership, 2014. Integrated Water Resources Management in Central Asia: The Challenges of Managing Large Transboundary Rivers. GWP Technical Focus Paper. Web site – www.gwp.org.

Course Title: Irrigation System Planning and Management

Credit Hrs: 2

Course Code: MSIWM 2201

Unit	Title
1	Benefits and Problems of Irrigation System Management
2	Planning a farm for irrigation, data requirement: climate, crop, soil, water source, energy and capital
3	Water Source Evaluation: Minimum expected source supply and source supply volume
4	Types of Water Supply: Diversion and pumping
5	Irrigation Requirement: Design daily and seasonal requirements
6	Irrigation System Design Capacity (irrigation requirement at farm level and at source level)
7	Water Conveyance
8	Irrigation System Costs and Reimbursement Criteria



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- 9 Operation and Maintenance of Irrigation Projects
- 10 Choosing a New Irrigation System

Recommended Text Books

1. Principles of Farm Irrigation System Design – Larry G. James. John Wiley & Sons, 1993.
2. Irrigation of Agricultural Lands – R. M. Hagan, H.R. Haise and T.W. Edminster (eds.). American Society of Agronomy, 1967.

Supplementary Text Books

3. Irrigation Engineering and Hydraulic Structures – S.K. Garg. Khanna Publishers, New Delhi, India, 1998.
4. Irrigation Engineering and Hydraulic Structures – S.R. Shahasrabudhe. Katson Publishing House, Ludhiana, India.
5. Irrigation Water Management – Training Manual – M. Kay and Hatcho, FAO Land and Water Division, Rome, 1992.
6. Journal of Agricultural Water Management, Elsevier Science Publishers, Amsterdam, The Netherlands. Irrigation Science, Springer-Verlag, USA.

Course Title: Drainage Engineering

Credit Hrs: 2

Course Code: MSIWM 2202

Unit	Title
1	Drainage and Crop Productions
2	Drainage Problems in Bangladesh
3	Drainage System
4	Theory, Design and Physics of Land Drainage
5	Drainage Investigation Methods
6	Saturated and Unsaturated Flow Theories and Their Applications
7	Drainage for Salinity Control and Land Reclamation
8	Drain Tube Materials and Installation
9	Design and Installation of Drain Envelop Materials

Recommended Text Books


1. Land Drainage: Planning and Design of Agricultural Drainage Systems – K. Lambert Smedema and W. David Rycroft. BT Batsford Ltd., London, 1983.
2. Drainage Engineering – James N. Luthin. Wiley Eastern Private Limited, 1966.

Supplementary Text Books

3. Drainage of Agricultural Lands – edited by James N. Luthin. Agronomy Vol. 7, American Society of Agronomy, USA, 1957.
4. Drainage of Agriculture – edited by Jan Van Schilfgaarde. Agronomy No. 17, American Society of Agronomy, USA, 1974.
5. Manual of Surface Drainage Engineering. – B. Z. Kinori. Vol I & II, Elsevier Scientific Publishing Company, NY. 1984.
6. Journal of Irrigation and Drainage Division - American Society of Civil Engineers (ASCE).
7. Irrigation and Drainage Papers – Food and Agriculture Organization of the United Nations.
8. Irrigation and Drainage Systems – An International Journal, Kluwer Academic Publishers.
9. Transactions of the American Society of Agricultural Engineering (ASAE).



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Course Title: River Engineering and Flood Management

Credit Hrs: 2

Course Code: MSIWM 2203

Unit	Title	Lesson
1	Rivers Morphology and Flow	Classification, morphological processes of alluvial rivers, river flow equations
2	River Equilibrium	Regime theory, river bends and meandering
3	River Engineering	Navigation, dredging and bridge scour
4	Sediment Transport	Bed loads and suspended loads, sediment control measures
5	Modeling Techniques	Application of numerical methods and computer models in river hydraulics
6	Flood and Its Estimation	Floods in Bangladesh, Estimation of design flood
7	Flood Control	Flood protection techniques, flood forecasting and warning, economics of flood control projects
8	Flood Management	Flood-plain management, flood management in Bangladesh

Recommended Text Books

1. Mechanics of Sediment Transport and Alluvial Stream Problems – R.J. Garde and K.H. Ranga Raju, Wiley Eastern Ltd. New Delhi, India.
2. Flood Control and Drainage Engineering – S.N. Ghosh. A. A. Balkema. Rotterdam, 1986.
3. River Engineering and Flood Protection – B. Z. Kinori and J. Mekorach. Elsevier Publishing Company, Amsterdam, 1984.
4. River Mechanics – Pierre Y. Julien. Cambridge University Press, 2002.

Supplementary Text Books

5. Hydraulics of Sediment Transport – W.H. Graf, McGraw Hill Book Company, New York.
6. Computational River Dynamics – Weiming Wu. Taylor & Francis, 2007.
7. Water Resources Engineering –R.K. Linsley and J.B. Franzini. MacGraw Hill-Book Company, New York, 1975.
8. Hydrology: Principles, Analysis and Design – H. M. Raghunath. Wiley Eastern Limited, 1985.
9. Irrigation Engineering and Hydraulic Structures – Santosh Kumar Garg. Khanna Publishing, New Delhi, India, 1998.
10. Handbook of Applied Hydraulics – C.V. Davis and T.E. Sorensen (eds.). McGraw-Hill Book Company, 1959.
11. Engineering Hydrology – K. Subramanya. Tata McGraw - Hill Publishing Company Limited, New Delhi, 1994.
12. Land and Water Management Engineering – V.V.N. Murty. Kalyani Publishers, New Delhi, Ludhiana, 1996.

Course Title: Watershed Management


Credit Hrs: 2

Course Code: MSIWM 2204

Unit	Title	Lesson
1	Introduction to Watershed Management	Concepts, principles and objectives of watershed management, importance of watershed management in Bangladesh
2	Hydrologic Cycle	Basic processes, forests in hydrologic cycle
3	Soil Erosion	Types, causes and agents of soil erosion, estimating soil erosion, effects of land use and land capability on watersheds
4	Soil Conservation Measures	Silvicultural operations, shifting cultivation
5	Forest in Watershed	Forest in watershed management, impacts of forests on the hydrological aspects, forestry practices affecting water quantity, quality and water balance
6	Planning for Watershed Management	Necessity, procedure, data requirements, economic analysis, preparation of watershed work plan



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7	Integrated and Participatory Watershed Management	Classification, organization and institutional coordination, strategy and conceptual framework, participatory processes
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Recommended Text Books

1. Watershed Management – L. R. Khan. Field Document No. 44, UNDP/FAO-BGD/85/011, Inst. of Forestry, Chittagoan University, Bangladesh, 1991.
2. Land Use and Water Resources – H. C. Pereira. Cambridge Univ. Press, U.K., 1973.
3. Principles of Forest Hydrology – J. D. Hewlett. The University of Georgia Press, Athens, 1982.

Supplementary Text Books

4. Advances in Agroforestry – L. K. Jha. APH Publishing Corporation, New Delhi. India, 1995.
5. Watershed Management in Asia and the Pacific: Needs and Opportunities for Action. AS/85/017, Tech. Report, Food and Agriculture Organization of the United Nations, Rome, 1986.
6. Soil Conservation for Developing Countries. Soils Bull. No. 30, Food and Agriculture Organization of the United Nations, Rome, 1976.
7. Soil Conservation Needs in Bangladesh – D. Lazell. Food and Agriculture Organization of the United Nations, Rome, 1982.

Course Title: Hydraulic Structures

Credit Hrs: 2

Course Code: MSIWM 2205

Unit	Title	Lesson
1	Introduction to Hydraulic Structures	Types, properties and uses of hydraulic structures, importance of hydraulic design
2	Earth Dam and Rock Fill Dam	seepage control, stability and safety measures of earth dam and rock fill dam, Designing of earth dam and rock fill dam
3	Canal Head Works, Weir and Barrage	Design of canal head works, Design of weir and barrage
4	Control Structures	Design fall, regulators, canal escape, spillways, gate and lifting devices
5	Retaining Wall and Abutments	Design of retaining wall and abutments

Recommended Text Books

1. Theory and Design of Irrigation Structures – R. S. Varshney, S.C. Gupta and R. L. Gupta. 4th edition, Nem Chand & Sons, Roorkee, U.P. India, 1979.
2. Design of Low-head Hydraulic Structures. Water Resources Series No. 45, United Nations, 1973.

Supplementary Text Books

3. Irrigation Engineering and Hydraulic Structures – S.K. Garg. Khanna Publishers, Delhi, India, 1998.
4. Design of Small Dams. A Water Resources Technical Publication, 2nd edition, US Department of the Interior, Bureau of Reclamation, 1973.
5. Soil and Water Conservation Engineering – D. D. Fangmeier, W. J. Elliot, S. R. Workman, R. L. Huffman, G. O. Schwab. 5th edition, John Wiley & Sons. Inc., New York, 2006.
6. Water Resources Engineering – R.K. Linsley and J.B. Franzini. 2nd edition. McGraw-Hill Book Company, New York, 1972.
7. Canals and Related Structure. Design Standards No. 3 U.S. Department of the Interior Bureau of Reclamation, Denver, Colorado, 1967.
8. Handbook of Applied Hydraulics – V. C. Davis, and K. Sorenson. 3rd edition, McGraw-Hill Book Company, New York, 1969.
9. Transaction of the American Society of Civil Engineers (ASCE).
10. Journal of Hydraulics Division, American Society of Civil Engineers (ASCE).



Bangladesh Open University



School of Agriculture and Rural Development (SARD)

Master of Science (MS) in Irrigation and Water Management

Course Title: Remote Sensing and GIS in Water Resources

Credit Hrs: 2

Course Code: MSIWM 2206

Unit	Title
1	Major Features of Remote Sensing and GIS
2	Importance and Areas of Application of Remote Sensing and GIS
3	Application of GIS in Water Resources
4	Digital Mapping of Water Resources Information
5	Spatial Coordinate Systems
6	Terrain Analysis Using Digital Elevation Models
7	River and Watershed Networks
8	Soil and Land Use Mapping
9	Flood Hydrology Modeling and Floodplain Mapping
10	Terrain Analysis for Hydrologic Modeling
11	Integration of Time Series and Geospatial Data

Recommended Text Books

1. GIS for Water Resource and Watershed Management – John G. Lyon. CRC, 2002.
2. Arc Hydro: GIS for Water Resources – David R. Maidment. ESRI Press, 2002.

Supplementary Text Books

3. Modeling Our World – M. Zeiler. ESR Press, 1999.
4. Groundwater Modeling Using Geographical Information Systems – George F. Pinder. 1st edition, John Wiley & Sons. Inc., 2002.

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