Institute of Water and Flood Management (IWFM)
BUET, Dhaka

Approved Postgraduate Course Content

M.Sc. (WRD) / Ph.D.:

WFM 6000: Thesis (Credit Hour: variable; cumulative 18 max. for M.Sc., 45 max. for Ph.D.)

WFM 6002: Special Studies (Credit Hour: 3)

WFM 6101: Alluvial River Processes (Credit Hour: 3)

Fundamentals of open channel flow; Alluvial geomorphology; Stream form and classification; Regimes of flow; Sediment transport; Degradation, aggradation and scour; Bank erosion; River training; Dredging; Morphological characteristics of GangesBrahmaputra-Meghna Delta.

WFM 6102: Advanced Watershed Hydrology (Credit Hour: 3)

Conceptual models of hydrologic processes in watershed; Uncertainty in hydrologic analysis; Flow routing; Watershed simulation; Hydrologic forecasting; Contaminant transport; Hydrologic effects of land use change; Impact of climate change.

WFM 6103: Hydrologic Information System (Credit Hour: 3)

Introduction to hydrologic information system; Importance and advancement of hydrologic science; Hydrologic data: source, classification, acquisition; Hydrologic metadata; Hydrologic Information database; Analysis and visualization of data; Sharing and retrieval of hydrologic information through Web and other sources; Application of hydrologic information system for water resources management.

WFM 6104: Water, Gender and Society (Credit Hour: 3)

Water and civilization; Socio-cultural structures and values; Water and development; Water, culture and religion; national and international water rights regime; water and governance; water and equity; Concept of gender; Theories about gender relations; feminism and development; Gender in water related policies; Gender issues in water and water induced disaster management; Gender assessment tools; Gender mainstreaming in water management.

WFM 6105: Water and Ecosystem (Credit Hour: 3)

Definition of ecosystem; Freshwater ecosystems – river, wetlands, floodplains; Coastal ecosystems - mangrove, inter-tidal, estuarine; Ecosystem functions and services; Ecosystem valuation; Ecosystem and IWRM; Eco-hydrology and eco-hydraulics -

concepts, principles and application; Assessment6 of environmental flow; Eco-friendly water structures; Ecosystem approach to water management.

WFM 6201: Hazards and Risk Analysis (Credit Hour: 3)

Natural hazards: climate, riverine and coastal; Man made hazards; Presentation of hazards data; Hazards assessment; Expected damage; Risk analysis; Risk reduction measure: structural and non-structural; Operation and maintenance of mitigation facilities; Reliability analysis; Risk-based zoning; Forecasting and warning; Hazard management planning; Case studies.

WFM 6202: Remote Sensing and GIS in Water Management (Credit Hour: 3)

Introduction to remote sensing; Principles of remote sensing; Remote sensing systems; Digital image processing; Concepts of GIS; Spatial data: sources, acquisition and entry; Database; Vector and raster data; Data analysis; GIS output; Integration of remote sensing and GIS; Application of remote sensing and GIS in water resources modeling and management.

WFM 6203: Environmental Economics (Credit Hour: 3)

Scope and objectives of environmental economics; Validation of environmental resources; Cost effectiveness analysis; The concept of market mechanism and efficiency; Failure of market mechanism: public bads (pollution) and externalities; Correcting market failure through property rights; Controlling pollution through incentives, price mechanism and government intervention; Economic development and environment: national and international perspectives.

WFM 6204: Hydrologic Statistics (Credit Hour: 3)

Characteristics of hydrologic data; Probability and statistics; Probabilistic analysis; Multiple regression and correlation; Regional analysis; Analysis of hydrologic time series; Stochastic models; Sequential generation of hydrologic information; Statistical decisions.

WFM 6205: Hydrologic Design for Water Use (Credit Hour: 3)

Issues in hydrologic design; Assessment of water demand; Uncertainty in hydrologic estimates and water demand; Storage and drought related statistics; Selection of design event; Estimation of reservoir capacity: water supply, runoff detention; Design for hydropower; Estimation of in-stream requirements: navigation, river morphology, salinity control, ecology.

WFM 6206: Groundwater Resource Assessment (Credit Hour: 3)

Flow in subsurface environment; Surface and subsurface exploration of groundwater; Hydraulics of pumping and recharging wells; Evaluation of aquifer properties; Groundwater pollution and saline water intrusion; Impacts of groundwater withdrawal; Modeling of aquifer systems.

WFM 6207: Water Resources System Analysis (Credit Hour: 3)

Characteristics of water resources systems; Concept of systems analysis; Systems techniques: linear, nonlinear, dynamic and multi-objective programming; Analytical and computational frameworks for decision making; Applications in water resources management.

WFM 6208: Choice of Water Management Technology (Credit Hour: 3)

Role of technology in water management; Technology imperatives: society, culture and indigenous knowledge; Technology management: assessment, appropriateness, transfer, forecasting, risk, innovation & diffusion; Development strategies; Choice of technology for water resources management: flow control, irrigation, water supply, pumps, flood management, drainage, river training, hydropower, navigation, dredging, land reclamation, wetland conservation; Case studies.

WFM 6209: Interdisciplinary Field Research Methodology in Water Management (Credit Hour: 3)

Research and research methods in water management: inter-disciplinarity, multidisciplinarity and cross-disciplinarity in research; Tools and techniques: socio-economic, hydrological, physico-chemical and agro-ecological investigations; Stakeholder analysis: stakeholder perceptions, stakeholder diagramming; Integrated research concept development: Situation-Problem-Question-Response, conceptual and methodological framework, research questions; Research ethics; Research execution in the field.

WFM 6301: Agricultural Water Management (Credit Hour: 3)

Soil-plant-water relations; Water requirement of crops; Cropping pattern; Irrigation of lowland rice and upland crops; Irrigation management: methods, conveyance, measurement and control, efficiency and sustainability; Droughts and alleviation strategies; Crop drainage: requirements, drainage coefficient, design considerations; Fertilizers and their management; Chemical pollution.

WFM 6302: Water Development Project Planning (Credit Hour: 3)

Use of water: conjunctive and non-conjunctive; Types of projects; Structural and nonstructural components of projects; Project life cycle; Optimization techniques; Feasibility study; Risk and reliability; Project appraisal; Project management; Operation, maintenance and monitoring.

WFM 6303: Integrated Water Resources Management (Credit Hour: 3)

IWRM concepts and principles; Planning fundamentals and processes; Multi-criteria analysis; Functions of water resources system; Water management and sustainable development; National development and water policy; Basin-wide management and

water sharing; Multiple users, water rights and conflicts; Sectoral demands and resource allocation; Water use efficiency and productivity; Management of water demand and use; Institutional aspects and people's participation.

WFM 6304: River and Floodplain Management (Credit Hour: 3)

Resources, functions and ecology of river-floodplain system; Flood flow and low flow analysis; Flood damage mitigation: structural and non-structural measures; Waterways; Instream flow requirement; River pollution; River and floodplain restoration; Land and water use conflicts.

WFM 6305: Coastal Zone Management (Credit Hour: 3)

Definition and delineation of the coastal zone; Coastal zone management: concepts, issues, prospects; Coastal, estuarine and delta processes; Coastal hazards: storm surge, sea level rise, tsunami; Linkages among coastal systems; Coastal ecosystem and environment; Socio-economic, political and institutional considerations; Coastal infrastructure: erosion protection, embankment, polder, cyclone shelter, cross-dam, port and waterway; Coastal population and livelihood; Marine and coastal resources; Coastal zone policy and strategy; Case studies on Integrated Coastal Zone Management.

WFM 6306: Urban Water Management (Credit Hour: 3)

Hydrologic cycle in urban environment; Demographic and socio-economic features; Urban water systems in different landscapes; Basic concepts in overland, pipe and channel flows; Data requirement for water management; Water demand, supply and access; Management of stormwater and wastewater; Water quality and ecology of urban water bodies; Flood risk management; Institutional aspects; Master plan for urban water management.

WFM 6307: Water Control Structures (Credit Hour: 3)

Various types of hydraulic structures; Water lifting devices; Planning of water control structures: irrigation, drainage, flood management, navigation, river training; Operation and maintenance; Failures; Remedial measures.

WFM 6308: Risk Management (Credit Hour: 3)

Risk factor in water resources; Economic, social and environmental costs of risk; Spatial and temporal shifting of risk; Risk decision principles; Risk assessment methods; Risk mitigation measures: hazard reduction, vulnerability reduction, zoning, standards, regulations and economic incentives; Risk cost in decision making: selection of capacity of hydraulic structures, allocation of shelters; Residual risk and preparedness measures; Disaster response; Institutional aspects of risk management.

WFM 6309: Water Quality Management (Credit Hour: 3)

Physical, biological and chemical properties of water; Source and characteristics of pollutants; Fate and transport of pollutants in aquatic systems- lakes, rivers, estuaries, aquifers; Impact of pollutants on aquatic systems; Management of point and non-point sources of pollution; Economic and regulatory instruments of water quality management; Pollution abatement and treatment methods; Water quality monitoring.

WFM 6310: Water Disaster Management (Credit Hour: 3)

Definition of disaster; Types of water related disasters; Disaster-development linkages; Disaster management framework – Prevention, Preparedness, Response and Recovery; Tools and techniques; Structural and non-structural measures; Indigenous coping mechanisms; Organizational initiatives; Community participation and mobilization.

WFM 6311: Climate Change Risk Management (Credit Hour: 3)

The global climate system: global heat and water balance, atmospheric circulation, ocean circulation, coupled ocean and atmospheric processes; Climate variability and climate change; Assessment of climate change risks; Forecasts and scenarios development; Impact of climate change on water related hazards; Economic, social and environmental implications; Mitigation measures and adaptation techniques, Mainstreaming climate change risk management.

Institute of Water and Flood Management (IWFM)
BUET, Dhaka

Approved Postgraduate Course Content

M.Sc. (CMRM) / Ph.D.:

WFM 6102: Advanced Watershed Hydrology (Credit Hour: 3)

Conceptual models of hydrologic processes in watershed; Uncertainty in hydrologic analysis; Flow routing; Watershed simulation; Hydrologic forecasting; Contaminant transport; Hydrologic effects of land use change; Impact of climate change.

WFM 6201: Hazards and Risk Analysis (Credit Hour: 3)

Natural hazards: climate, riverine and coastal; Man made hazards; Presentation of hazards data; Hazards assessment; Expected damage; Risk analysis; Risk reduction measure: structural and non-structural; Operation and maintenance of mitigation facilities; Reliability analysis; Risk-based zoning; Forecasting and warning; Hazard management planning; Case studies.

WFM 6305: Coastal Zone Management (Credit Hour: 3)

Definition and delineation of the coastal zone; Coastal zone management: concepts, issues, prospects; Coastal, estuarine and delta processes; Coastal hazards: storm surge, sea level rise, tsunami; Linkages among coastal systems; Coastal ecosystem and environment; Socio-economic, political and institutional considerations; Coastal infrastructure: erosion protection, embankment, polder, cyclone shelter, cross-dam, port and waterway; Coastal population and livelihood; Marine and coastal resources; Coastal zone policy and strategy; Case studies on Integrated Coastal Zone Management

WFM 6311: Climate Change Risk Management (Credit Hour: 3)

The global climate system: global heat and water balance, atmospheric circulation, ocean circulation, coupled ocean and atmospheric processes; Climate variability and climate change; Assessment of climate change risks; Forecasts and scenarios development; Impact of climate change on water related hazards; Economic, social and environmental implications; Mitigation measures and adaptation techniques, Mainstreaming climate change risk management.

CMRM 6000: Thesis (Credit Hour: variable; cumulative 18 max. for M.Sc., 45 max. for Ph.D.)

CMRM 6201: Climate and Earth Systems Modeling (Credit Hour: 3)

Components of climate Model- atmosphere, ocean, sea ice, ice sheet, glaciers, land surface, aerosols; General Circulation Model; Earth System Model- global carbon cycle, dynamic vegetation, atmospheric chemistry, ocean bio-geo-chemistry, and continental ice

sheets; Climate Forcing, Climate Responses, and Physical Feedbacks; Scenarios: Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs); Reconstruction of Past Climates- Paleoclimate; Climate Predictions and Projections; Numerical Methods for Climate Modeling; Model Ensembles; Regional Climate Modeling; Statistical Downscaling; Model Evaluation- Testing, Verification, and Validation; Uncertainty and Model Biases; Data Assimilation and Parameterization

CMRM 6202: Numerical Modeling in Water and Sediment Transport (Credit Hour: 3)

Modeling Concept; Modeling Water-Related Problems; Equations and Theory for Computational Hydraulics and Fluid Mechanics; Systems of Transport Equations; Methods for Solving Algebraic Equations and Their Systems; Conservation Laws; Discretization in space: finite differences, finite elements, finite volume, structured grid, unstructured grid, grid generation; Effects of Space Discretization on Wave Propagation; Numerical Solution of the Time Integration Methods: explicit methods, implicit methods, semi-implicit methods, ADI methods, fractional step methods; Effect of Time Discretization on Wave Propagation; Properties of Numerical Methods; Numerical Treatment of Boundary Conditions; Applications.

CMRM 6203: Integrated Modeling (Credit Hour: 3)

Conceptual framework of integrated modeling; Modeling concept of complex natural and human systems; Coupled bio-physical models; System dynamics model for management of natural resources and human processes; Bayesian network to represent heterogeneous and dynamic social systems; Agent based model for non-linear, heterogeneous, and dynamic socio-ecological systems; Metamodeling; Coupled human and natural systems model for dynamic livelihood risks; Case studies with model applications.

CMRM 6204: Application of Remote Sensing in climate change (Credit Hour: 3)

Methods of Remote Sensing in Geosciences, Earth Observation Systems, Interferometry, Satellite capabilities for Air Quality observations, Remote Sensing of Particulate Matter, Monitoring of Crops and their Biophysical Characteristics, Monitoring of Extreme Dry and Wet Periods; Groundwater Monitoring, Monitoring of Coastal and Estuarine Water Quality and Ecosystem Using Remote Sensing and In Situ Data, Climate Change Monitoring Using Remote Sensing and Modeled Data, Earth observations in monitoring, tracking, and implementing Sustainable Development Goals (SDGs) and New Urban Agenda.

CMRM 6205: Climate Data Processing, Analysis, and Management (Credit Hour: 3)

Data formats: ASCII Text, Binary, NetCDF, GRIB, HDF; Data processing and visualization using open source tools: R and Python; Dealing with missing values; Data transformation, Interpolation, and Regridding; Statistical Downscaling; Bias correction; Pattern recognization and machine learning; Climate Data Management System; Basic climate statistics: central tendency, variance, and skewness; Data homogeneity and stationarity; Analysis of trend, variability, seasonality, and extremes; Correlation and regression;

Hypothesis testing; Probability density functions; Extreme value analysis; Principal component analysis; Uncertainty in climate data.

CMRM 6206: Vulnerability Assessment (Credit Hour: 3)

Concept of vulnerability; Drivers of vulnerability; Evolution of vulnerability framework; Physical vulnerability; Socio-ecological vulnerability; Socio-economic vulnerability; Capital-based vulnerability; Vulnerability for multiple impacts; Integrating different vulnerability domains; Vulnerability index; Spatial and temporal variability of vulnerability; Scale effect of vulnerability; Indicator selection for vulnerability assessment; Vulnerability assessment methods; Vulnerability assessment in adaptation planning.

Institute of Water and Flood Management (IWFM)
BUET, Dhaka

Approved Postgraduate Course Content

M.Sc. Engg. (HE) and M. Engg. (HE) / Ph.D.:

HE 6000: Thesis [18.0 Credit Hours for M.Sc. Engg. (HE) and 45.0 Credit Hours for Ph.D.]

HE 6000: Project [6.0 Credit Hours for M. Engg. (HE)]

HE 6101: Humanitarian Challenges and Climate Adaptation in Water Engineering (3.0 credit hours)

Understanding climate variability and change; Hydrologic extremes under climate change considering Non-stationarity and Uncertainty; Assessment of the impact of global warming on water resources at a regional and local scale; Climate change vulnerability and developing adaptation strategy; Adaptive design and adaptive risk management; Climate-resilient hydraulic infrastructures design and their interconnections with ecosystems and societal systems; Nature-Based Solutions using ecosystem services; Green Infrastructures; Sustainable Development; Managing Water Resources in the most climate-sensitive environments.

HE 6102: Disaster Risk Reduction and Community Resilience (3.0 credit hours)

Disaster risk reduction strategies for a resilient community; Reducing disaster risk using nature-based solutions; Ecosystem-based disaster risk reduction; Engineering solutions in disaster risk reduction; Community action and disaster; Sustainable community-based disaster risk reduction; Building disaster-resilient communities; Ecosystem-based strategies for community resilience; Path toward societal resilience; Integrating resilience and sustainability; Engineering resilience for ecology and community; Implementation of tools for disaster risk reduction; Case studies of community-based disaster risk reduction approaches.

HE 6103: Water, Agriculture and Food Security (3.0 credit hours)

Nature-based solutions for agriculture; Agriculture coping with floods, droughts and safe agriculture modes; Indigenous knowledge in agriculture; Food processing, storage and security; Conflicts, war, disasters and humanitarian food systems; Low-cost technology for food production; Modern vertical farming; Regenerative agriculture; Community participation in agriculture water management; Community agriculture - concepts, models, and impacts; Smallholder irrigation and food security.

HE 6201: Humanitarian Engineering: Ethics, Theory and Practices (3.0 credit hours)

Concepts and history of humanitarianism and humanitarian action; Evolution of humanitarian engineering; Humanitarian engineering ethics criteria; Human needs and human rights; Humanitarian crises; Humanitarian policies and conventions; Humanitarianism and sustainable development; Practice/Case study: working as a Humanitarian Engineer.

HE 6202: Humanitarian Response to Disasters (3.0 credit hours)

Disaster-induced emergencies; Principles and practicalities of humanitarian response; Understanding humanitarian foundations, coordination mechanisms and emerging issues and trends; Information management and emergency needs assessment; Coordination structures and response processes; Technical sectors (Emergency shelter; water, sanitation and hygiene in emergencies; protection programming; education in emergencies; health programming; logistics and telecommunications); Requirements for an effective humanitarian response; International humanitarian relief system; Legal framework for humanitarian assistance; Case studies of humanitarian response; Fieldwork in emergency preparedness and response, recovery and reconstruction.

HE 6203: Public Health Engineering (3.0 credit hours)

WASH concept and definitions; Global state of WASH; WASH and SDG-6; Water technologies in rural and urban settings; Water emergencies and emergency water supply; Sanitation technologies in rural and urban settings; WASH in schools, health care and public-place facilities; Waste management and waste to resource options and innovations; Hygiene practices in achieving WASH goals; Raising social awareness on hygiene; Hygiene during a pandemic; WASH and gender; Access to vulnerable, hard to reach and left out communities; WASH during natural disasters and humanitarian emergencies; WASH and public health; Policy guidelines; WASH and roles of NGOs in Bangladesh.

HE 6204: Ecosystem Services and Sustainable Community Development (3.0 credit hours)

Linkages of ecosystem services (ES), Sustainable livelihood and human well-being; Constraints and dynamics in the realization of well-being from ecosystem services; Social drivers and trade-offs between social-ecological systems and community development; Integrated approach providing scientific and policy-relevant insights; Mainstreaming ecosystem services into decision-making process; Case studies on ecosystem services for sustainable community development.

HE 6205: Urban Water Disaster Engineering (3.0 credit hours)

Urban water cycle and urban catchment hydrology; Interaction of climatic, Hydrologic process, and urban component; Rainfall-runoff analysis in urban areas; Urban planning and stormwater systems; Urban flood and waterlogging; Design of collection system; Stormwater modeling; River floods and coastal inundation management; Urban water infrastructure maintenance and management; Early warnings, disaster informatics and

climate services; Risk assessment tools and techniques; Emerging technologies in disaster mitigation; Disaster mapping and land-use zoning; Environmental impacts of urbanization and adaptation; Climate-resilient water infrastructure design; Disaster risk insurance; Disaster risk reduction and natural hazard prevention.

HE 6206: Coastal Disaster Mitigation Engineering (3.0 credit hours)

Coastal disasters; Natural versus human-induced coastal disasters; Cyclones and storm surge; Structural and non-structural measures for storm surge mitigation; Storm surge disaster in urban and rural context; Soft mitigation measures: case studies; Global tsunami source zones, tsunami generation, deep ocean detection, warning, propagation, mitigation, awareness, threats to Bangladesh coast; Coastal flooding, tidal flooding, polders and their impacts; Coastal erosion and sedimentation, countermeasures, land reclamation and their impacts; Coastal infrastructures during extreme events; Lessons from evacuation behavior during disasters; Designing climate-resilient coastal structures.

HE 6301: Community Based Engineering in Water Management (3.0 credit hours)

Bandaling for erosion protection - Causes of river erosion, types of erosion, erosion prediction; Indigenous knowledge, design principles, availability of local materials, maintenance; Homestead raising for flood protection - Prediction of flood level, determination of historic flood level, Community risk assessment, design principles of homestead raising, materials, and maintenance; Earthen cross dam for irrigation water storage - Crop water requirements; Design of earthen cross dam, community knowledge in site selection, availability of soil, dismantling of cross-dam and rebuilding.

HE 6302: Water Rights and Transboundary Water Management (3.0 credit hours)

Water science and systems in transboundary context: bio-physical system; hydro-social system; governance system; Water resources management Issues; Water resources development Issues; Riparian water management policies; Transboundary water rights; Determinants of conflicts and cooperation; Conflicts and cooperation: global experiences; Conflicts and cooperation: regional experiences; Development and codification of International Water Law; Emerging water-sharing principles and frameworks; Water and beyond water: equitable allocation and benefit-sharing; Hydro-politics and water diplomacy: synergistic approaches and negotiation techniques.

HE 6303: Pollution and Protection of Water Resources (3.0 credit hours)

Pollution sources and types for water resources: natural and anthropogenic; non-persistent/persistent; multi-cascade effects of pollutants on water resources, agriculture, and ecosystem services; riparian welfare dynamics and pollution loading: the development dilemma; technical solutions to pollution abatement institutional/ regulatory challenges for pollution abatement; economic or management solutions for pollution abatement; monitoring changes and intervention successes through tools-models and indicators; engineering human response for protection of water resources: Case studies.

HE 6304: Harmonizing Disaster Management and Environmental Conservation (3.0 credit hours)

Catchment vegetation and flooding – Rainfall interception; Wetlands and floodplains – Natural flood storage, design and management; Coastal forests and cyclones – wave attenuation, storm surge attenuation, wind protection, planning considerations; Ecosystem restoration – tools and techniques; Social and economic considerations.

HE 6305: Hydraulic Engineering for Infrastructure Development and Management (3.0 credit hours)

Observing the Earth from an open channel hydraulics perspective, River basins as a public environment and social infrastructure, Flow-sediment transport, Sediment management technologies, Rainfall-runoff prediction and hydrologic design considering sediment transport, Recent numerical simulation development and related state-of-the-art technologies, Design/planning of hydraulic structure based on the integrated management of river-and-coastal morpho-dynamics with infrastructure improvement.

HE 6306: Integrated Natural Resources Management in Watersheds (3.0 credit hours)

Natural resource management systems: general principles, interactions between hydrologic processes and land-surface conditions, management of physical settings and processes, human activities on water and watersheds, preventative and restorative strategies; Management via regulatory policies; Ecological restoration: ecosystem response to disturbance, use of ecological knowledge, socioeconomic information for effective restoration projects; Sustainable scenarios in natural resources management: key elements for sustainable social-ecological systems, sustainable scenarios for the future management.

WFM 6104: Water, Gender and Society (3.0 Credit Hours)

Water and civilization; Socio-cultural structures and values; Water and development; Water, culture and religion; National and international water rights regime; Water and governance; Water and equity; Concept of gender; Theories about gender relations; Feminism and development; Gender in water related policies; Gender issues in water and water induced disaster management; Gender assessment tools; Gender mainstreaming in water management.