



**Dams and Water Resources Engineering  
Department**



**High Diploma Syllabus (Water Resources)  
Dams and Water Resources Engineering Department  
First Semester 2018-2019**

	Code	subject	Hours		Units
			Theo.	Appl.	
1	DWE600	Wells and Pumps	2	1	2
2	DWE601	Optimization	2	1	2
3	DWE602	Modern irrigation techniques	2	1	2
4	DWE605	Special problem*	2		2
5	DWE606	Open channel hydraulics	2	1	2
6	DWE609	Simulation models in water resources engineering	2	1	2
		Total	12	5	12

**High Diploma Syllabus (Water Resources)  
Dams and Water Resources Engineering Department  
Second semester 2018-2019**

	Code	subject	Hours		Units
			Theo.	Appl.	
1	DWE603	Statistical application in water resources	2	1	2
2	DWE604	River mechanics	2	1	2
3	DWE607	Soil water management	2	1	2
4	DWE608	Water resources systems management	2	1	2
5	DWE610	Numerical analysis	2	1	2
6	DWE605	Special problem*	2		2
		Total	12	5	12

\* Special problem is an annual course with 4 units throughout two semesters.

**High Diploma Syllabus (Water Resources)**  
**Dams and Water Resources Engineering Department**

**DWE600: Wells and Pumps (1) (2,-,1)**

Introduction to groundwater, groundwater movement and holding water layers, hydraulics of wells (steady state), unsteady state groundwater flow, estimation of aquifer parameters.

Types of pumps, Centrifugal pumps, types of centrifugal pumps, hydraulic characteristic of centrifugal pumps, pumps efficiency, pumps curve, displacement pumps, rotary pumps, Pumps on series and parallel, water hammer. Introduction to water wells Groundwater investigation

Well development, protection and maintenance

**DWE601: Optimization (1) (2,-,1)**

Linear programming, sensitivity analysis, Integer programming, Introduction to the dynamic programming

**DWE602: Modern irrigation techniques (1) (2,-,1)**

Sprinkler irrigation, Sprinkler irrigation system, center-pivot system, linear-move system, traveler sprinkler system, trickle irrigation. Subsurface drip irrigation.

**DWE603: Statistical applications in water resources (2) (2,-,1)**

Basic concepts, Discrete statistical distribution, Continuous statistical distribution, Confidence limits and hypothesis tests, Correlation and regression, Variance analysis, Homogeneity test, Time series. Homogeneity test.

**DWE604: River Mechanics (2)(2,-,1)**

Introduction, types of rivers, bed forms, hydraulics of river flow, flow resistance, river regulation and protection, sediment transport effects and properties, types of sediments, sediment transport equations. Morphodynamic evolution of river bed profile and channel geometry due to disturbing in flow and sediment regimes.

Numerical modeling approach for river mechanic. River restoration strategies.

Morphodynamic evolution of river bed profile and channel geometry due to disturbing in flow and sediment regimes. Numerical modeling approach for river mechanic. River restoration strategies.

**DWE605: Special problems (2,-,-)**

Studies on selected topics within the field of irrigation and water resources engineering.

**DWE606: Hydraulics of open channels (1) (2,-,1)**

Introduction, Open channel flow classification, Velocity distribution, Energy coefficient, Momentum coefficient, Pressure distribution (Parallel and curvilinear flow in horizontal and sloping channels), Uniform flow equations-Compound channel cross section, Specific energy, Critical flow-Computation n of critical depth by design curves, trial and error procedure, Varied flow computations, Applications of gradually varied flow, Hydraulic jump locating-Design of open channels-General

design considerations-Design methods of unlined channels, Maximum permissible velocity method, Tractive force method, Design methods of rigid boundary channels, Experience curve method, Best hydraulic section-Minimum lining cost method-Design of riprap channels-Alluvial channels.

Minimum lining cost method-Design of riprap channels-Alluvial channels.

#### **DWE607: Soil water management (2) (2,-,1)**

Soil moisture, Water potential, Soil- plant- climate relationship, Soil heat, Soil air. Evaporation from bare soil. Energy balance in the field.

#### **DWE608: Water resources system management (2)(2,-,1)**

Introduction, Available alternatives' evaluation methods, Cost–benefit analysis, planning and analysis of water resources projects, Application of dynamic programming, Application of stochastic dynamic programming.

.١ Concept of System and Systems Analysis

Definition of a System, Types of System, Systems Approach, Systems Analysis

.٢ Systems Techniques in Water Resources

Simulation of reservoir operation, Combination of Simulation and Optimization

.٣ Reservoir Sizing

4. Hydropower Generation

#### **DWE(609):Simulation models in water resources engineering (1) (2,-,1)**

- Hydrologic engineering Centre
- River Analysis System (HEC- RAS).
- Hydrologic engineering center- Hydrologic Modeling System (HEC- HMS),
- Watershed Modelling System (WMS)

#### **DWE(610): Numerical Analysis(2) (2,-,1)**

- Numerical solution of differential equations by Milen"s and Adam"s
- Solution of systems of nonlinear equations by Newton –Raphson Method.
- Indeterminate weight and coefficients method.
- Numerical solution of D.E. by finite difference method.
- Solution of simultaneous equations by Crout's and Jacobi's method
- Diagonalization and powers of matrix
- Partitioning of matrices
- Rotation of matrix
- Cayley –Hamilton Theorem
- Complex matrices

**MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC  
RESEARCH  
UNIVERSITY OF MOSUL  
COLLEGE OF ENGINEERING**

**Dams and Water Resources Engineering Department  
2018-2019  
M.Sc. Irrigation  
M.Sc. Hydrology  
M.Sc. Hydraulic**

**Syllabus of Master of Science Courses**  
**Dams and Water Resources Engineering Department**  
**College of Engineering \Dams and Water Resources Dept. \ M.Sc.\**  
**Irrigation**

code	Subject	First Course			Second Course			Units
		Theo.	Exp.	App.	Theo.	Exp.	App.	
DWE700	Mathematics	2	2					3
DWE701	Optimization	2	2					3
DWE702	Research Methods	2						
DWE703	English Language				2			٢
DWE704	Artificial Intelligence				2	2		3
DWE705	Pumps and wells				2	3		3
DWE707	Management of Farm Irrigation Water	2	2					3
DWE708	Advanced irrigation	2	2					3
DWE709	Advanced irrigation				2	2		3
DWE710	Advanced Drainage				2	2		3
Total		8	8	0	10	8	0	26
Sum of week hrs.		16			18			

**Syllabus of Master of Science Courses**  
**Dams and Water Resources Engineering Department**  
**College of Engineering \Dams and Water Resources Dept. \**  
**M.Sc.\Hydrology**

code	Subject	First Course			Second Course			Units
		Theo.	Exp.	App.	Theo.	Exp.	App.	
DWE700	Mathematics	2	2					3
DWE701	Optimization	2	2					3
DWE702	Research Methods	2						
DWE703	English Language				٢			2
DWE704	Artificial Intelligence				2	2		3
DWE706	Open Channels Hydraulics				2	2		3
DWE714	Surface Hydrology	2	2					3
DWE715	Applied statistical hydrology	2	2					3
DWE716	Groundwater Hydrology				2	2		3
DWE717	Water Resources System Management				2	2		3
Total		8	8	0	10	8	0	26
Sum of week hrs.		16			18			

**Syllabus of Master of Science Courses**  
**Dams and Water Resources Engineering Department**  
**College of Engineering \Dams and Water Resources Dept. \ M.Sc.\**  
**Hydraulic**

code	Subject	First Course			Second Course			Units
		Theo	Exp.	App.	Theo.	Exp.	App.	
DWE700	Mathematics	2	2					3
DWE701	Optimization	2	2					3
DWE702	Research Methods	2						
DWE704	Artificial Intelligence				2	2		3
DWE705	Pumps and wells				2	2		3
DWE703	English Language (2)				٢			٢
DWE711	Intermediate fluid mechanics	2	2					3
DWE712	Dimensional Analysis and Similitude	2	2					3
DWE706	Open Channels Hydraulics				2	2		3
DWE713	Sediment Transport				2	2		3
Total		8	8	0	10	8	0	26
Sum of week hrs.		16			18			

**DWE 700 : Mathematics(1) / Common ( 2,2,0)**

Linear and Non-Linear Differential Equations with Variable Coefficients.

Total Differential Equations

Partial Differential Equations

Fourier Series.

Solution of differential equations by using matrices

Solution of differential equations by using Laplace Transform

Linear algebra

**DWE 701 : Optimization (1)/ Common ( 2,2,0)**

Introduction.

Linear programming, duality theory, sensitivity analysis.

Integer programming.

Dynamic programming.

Nonlinear programming.

Bar chart design using LP

Game theory for conflict analyses using LP

**DWE 702 : Research Methods / Common ( 0,2,0)**

1. Overview of Research Methods

- Types of Research
- Research Objectives
- Research Designs
- Data Collection Methods
- Sample Sizes
- Data Analysis

2. Research Proposal

- Literature Review
- Thesis Research Scope
- Importance of Thesis Research Proposals
- General Structure of Thesis Proposal
- Preparation of a Thesis Research Proposal

3. Selected Features of Scientific Research

- Purpose
- Durability
- Reliability
- Repeatability
- Accuracy and confidence

4. Thesis Writing and Oral Presentation

- Thesis overview
- Thesis structure
- Good oral presentation under pressure
- Preparation for progress report, journals writing and seminars

5. Engineering Research Ethics

- The research members right
- Plagiarism
- Protocol publication



- Intellectual Properties
- Patents
- Commercial values.

### **DWE 703 : English Language / Common ( 2,0,0)**

Introduction  
The sentence  
Qualities of good sentence  
Types of sentence  
Paragraph  
Qualities of good paragraph  
Punctuation and mechanics  
Writing composition 1  
Writing composition 1  
Comprehension  
Revision 1  
  
Revision 2

### **DWE 704: Artificial Intelligence(1) / Common ( 2,2,0)**

- Genetic Algorithms (5 weeks)
- Similarity between GA's and Nature Driven Adaptation Processes
- Basic Genetic Algorithm (Working Principles)
- GAs Terminology
- Encoding, Initial population
- Selection
- Roulette wheel, tournament selection
- Basic operators of Gas: crossover and mutation
- Fundamental theorem of Gas and schema theorem
- Niche and speciation
- Crowding and sharing functions
- GA's based method to solve optimization problem.
- Application
- Fuzzy Logic ( 5 weeks)
- Fuzziness: An introduction
- Fuzzy membership functions
- Membership function operations
- Optimization in fuzzy environments
- Fuzzy sets for water allocation
- Fuzzy sets for reservoir storage and release targets
- Fuzzy logic method as applied to optimization problems.
- Artificial Neural Networks (5 weeks)
- The approach
- Ann structure and topology
- Learn process
- Supervised feed forward ann and back – propagation
- Unsupervised ann
- Modelling by neural networks

- Applications
- As a substitute to any of the above topics:  
Geographical Information System (GIS) (5 weeks)
- History, Definition
- GIS components
- Data models: raster, vector, points, lines, polygons
- Data base structure, attributes
- Sources of GIS data
- Arc View program
- Applications

### **DWE 705 : Hydraulic Machines / Common ( 2,2,0)**

- Definition A hydraulic pump, Kinematic and Positive Displacement pumps.
- Pump Selection
- Centrifugal Pumps
- Performances and Characteristic of the Centrifugal Pumps
- Reciprocating Pumps
- Main Components and indicator diagram
- Elements of Hydroelectric Power Plants
- The Main Working Principles of The Turbine
- Pelton Turbine
- Kaplan Turbine, Francis Turbine
- The Safety Standards
- Hydraulic Accumulator

### **DWE 706 : Open Channels Hydraulics(2) / Hydraulic (2,2,0)**

- Type of open channels.  
Types of flow in open channels.
- Characteristics of open channels.
- Velocity and pressure distribution.
- Uniform flow, Equations of flow, applications.  
Specific Energy, critical depth, applications.
- Momentum, types of hydraulic jump.  
Gradually varied flow, general equation.
- Water surface longitudinal profiles.  
Solution of the general equation of varied flow.
- Computer program for water surface equation.  
HEC program and its applications.

### **DWE 707 : Management of Farm Irrigation Water(1) / Irrigation ( 2,2,0)**

- Crop water requirements.
- Methods of estimating reference crop evapotranspiration.
- Crop factor  $K_C$ .
- Water stress factor  $K_s$ .
- Field Irrigation Scheduling

- Farm irrigation water supply systems.
- Irrigation water use efficiency (water productivity) and ways for improvement.
- Management of deficit irrigation.
- Supplemental irrigation.
- Modernization and improvement of farm irrigation systems.

#### **DWE 708 : Advanced irrigation (I)/ Irrigation (2,2,0)**

- Planning and design methodology of irrigation systems.
- Mechanized irrigation systems, center pivot irrigation system, linear move system.
- Traveling sprinkler, Drip/ Trickle irrigation systems.
- Installation.
- Operation and maintenance of irrigation systems.

#### **DWE 709 Advanced irrigation (II)/ Irrigation ( 2,2,0)**

- water distribution under irrigation system.
- productivity economics and irrigation uniformity.
- supplemental irrigation.
- deficit irrigation.
- runoff recovery systems.
- pulse (surge) irrigation.
- evaluation and improvement of irrigation systems.

#### **DWE 710: Advanced Drainage (2)/ Irrigation ( 2,2,0)**

- Introduction, Field methods of determining hydraulic conductivity of soils, seepage analysis.
- Boundary conditions, Methods of obtaining flow nets, Basis of electrical analogue and the resistance network.
- Drainage criteria for irrigated areas.
- Discharge rate and water table.
- Unsteady state computations.
- Computation for peak irrigation period.
- Computation based on the dynamic equilibrium concept

#### **DWE 711: Intermediate fluid mechanics (1) /Hydraulic (2,2,0)**

- Description and classification of fluid motions.
- Basic equations of control volume of a fluid for: acceleration, rotation in one and three dimensional flow, conservation of mass, momentum and energy using vector notation.
- Dynamics of incompressible inviscid flow.
- Euler's and Bernoulli's equations for two dimensional flow.
- Basic concepts of the boundary layer theory.
- The flow around immersed bodies (ax symmetric and three dimensional), forces on immersed bodies.
- Flow measurement.

- Water Hammer and Piping Stresses
- Vortex Motions

### **DWE 712: Dimensional Analysis and Similitude (1)/Hydraulic (2,2,0)**

- Introduction
- Dimensions
- Dimensional homogeneity
- Dimensional analysis
- Buckingham  $\pi$  theorem
- Types of similarity
- Laws of similarity
- Similarity and modeling
- Types of models
- Distorted models
- Applications: Hydraulic structures models and rivers models

### **DWE 713 : Sediment Transport(2) / Hydraulic ( 2,2,0)**

- Introduction.
- Properties of sediment.
- Forms of bed roughness.
- Resistance to flow in loose boundary channels.
- Beginning of sediment motion and stability analysis.
- Riprap design with safety factor.
- Design of stable channels.
- The motion of bed material, bed load equations, suspended load estimation, and total load determination.
- Sediment transport in closed pipes.
- Measurement of sediment discharge.
- Introduction of river mechanics (types of rivers).
- Reservoir Sedimentation

### **DWE 714 : Surface Hydrology(1) / Hydrology ( 2,2,0)**

- Interpretation of basic hydrologic information
- Evapotranspiration (consumptive use )
- Rainfall disposition, snowfall
- Infiltration
- Rainfall – runoff relation
- Runoff process
- Overland flow hydrograph, stream flow hydrograph
- Hydrologic models
- Statistics in hydrology

### **DWE 715 : Applied statistical hydrology(1) / Hydrology ( 2,2,0)**

- Basic concepts.
- Discrete probability distribution.

- Continuous probability distribution.
- Confidence limits and hypothesis testing.
- Regression and correlation.
- Analysis of variance.
- Reliability and quality of data
- Time series.
- Stochastic hydrological models.
- Reliability and quality of data

### **DWE 716 : Groundwater Hydrology(2) / Hydrology ( 2,2,0)**

- Occurrence, distribution, and movement of groundwater
- Infiltration and flow net
- Continuity and momentum equations
- Well analysis, steady and unsteady flow equations
- Groundwater investigation
- Well digging
- Safe yield, quality of ground water, and basin wide ground water development
- Model studies and numerical analysis of groundwater

### **DWE 717 : Water Resources System Management(2) / Hydrology ( 2,2,0)**

- An Overview
- Methods for Evaluating Alternatives
- Benefit-Cost Analysis
- Project Planning and Analysis
- Application of Deterministic Dynamic Programming
- Application of Stochastic Dynamic Programming
- Multi Objective Analysis and Performance Criteria
- River Basin Simulation.
- Flood Management