Program Detailed Structure

M.Sc. Program

(F) Irrigation and Hydraulic Engineering
M.Sc. in Construction and Building Engineering
(F) Irrigation and Hydraulic Engineering

## Program Structure

### CORE COURSES:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB 760</td>
<td>Advanced Hydraulics</td>
<td>3</td>
</tr>
<tr>
<td>CB 761</td>
<td>Applied Hydraulics</td>
<td>3</td>
</tr>
<tr>
<td>CB 762</td>
<td>Design of Hydraulic Structures</td>
<td>3</td>
</tr>
</tbody>
</table>

**Subtotal**: 3 Courses * 3 Credit Hours **9**

### ELECTIVE COURSES: GROUP (1)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>CB 763</td>
<td>Surface and Subsurface Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CB 764</td>
<td>River Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 765</td>
<td>Sediment Transport</td>
<td>3</td>
</tr>
<tr>
<td>CB 766</td>
<td>Theory and Operation of Hydraulic Models</td>
<td>3</td>
</tr>
<tr>
<td>CB 767</td>
<td>Advanced Numerical Methods in Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>CB 768</td>
<td>Water Resources Systems</td>
<td>3</td>
</tr>
<tr>
<td>CB 769</td>
<td>Structures for Integrated Water Resources Management</td>
<td>3</td>
</tr>
<tr>
<td>CB 760-I</td>
<td>Soil-Water-Plant Relationship</td>
<td>3</td>
</tr>
<tr>
<td>CB 761-I</td>
<td>Irrigation and Drainage System</td>
<td>3</td>
</tr>
<tr>
<td>CB 762-I</td>
<td>Design of Hydropower Stations and Pumping Stations</td>
<td>3</td>
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</table>

**Subtotal**: 4 Courses * 3 Credit Hours **12**

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continued/…
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CB 720</td>
<td>Water Quality Management and waste Water Treatment</td>
<td>3</td>
</tr>
<tr>
<td>CB 723</td>
<td>Environmental impact Assessment of Civil Engineering Projects</td>
<td>3</td>
</tr>
<tr>
<td>CB 717</td>
<td>Project Planning and Control</td>
<td>3</td>
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<tr>
<td>CB 731</td>
<td>Advanced Geotechnical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 740-S</td>
<td>Finite Element Method</td>
<td>3</td>
</tr>
<tr>
<td>CB 752-T</td>
<td>Advanced Construction Surveying</td>
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<td><strong>Subtotal</strong></td>
<td>1 Course * 3 Credit Hours</td>
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**Research Thesis:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CB 701</td>
<td>Master's Research Thesis (Part 1)</td>
<td>6</td>
</tr>
<tr>
<td>CB 702</td>
<td>Master's Research Thesis (Part 2)</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>2 Parts * 6 Credit Hours</td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

**Total** 36
Courses
Course Code: CB 760
Course Title: Advanced Hydraulics
Credit Hours: 3

Course Description
Dimensional analysis and similitude, Fluid Hydrodynamic, Real fluid, resistance to fluid motion, Steady and unsteady flow, flow in closed conduits, wave mechanics, Application of unsteady flow in pipes.

Course Objectives
To enable the students to understand flow motion and solve advanced hydraulics problems.

Course Topics
- Dimensional analysis and similitude
- Fluid Hydrodynamic
- Real fluid and resistance to fluid motion
- Steady and unsteady flow and flow in closed conduits
- Wave mechanics
- Application of unsteady flow in pipes.

References
- Chadwick, Andrew and Morfett, John; “Hydraulics in Civil and Environmental Engineering”; Paperback: U.K.
- Davis, CV. and Sorensen (EDS); “Handbook of Applied Hydraulics”; 1978; McGraw-Hill Co; N.Y.
Course Detailed Structure  
Construction and Building Engineering  
(F) Irrigation and Hydraulic Engineering

Course Code : CB 761  
Course Title : Applied Hydraulics  
Credit Hours : 3

Course Description  
Flow in open channels, uniform flow, non-uniform flow, bed shear stress, Hydraulic structures; (Weirs, Gates, Flumes, Spillways, Culverts, Stilling basins), scour around bridge piers, sediment in front of dams.

Course Objectives  
To enable the students to hydraulically analyze different hydraulic structures, understand scour phenomena around bridge piers, and understand sedimentation phenomena upstream dams.

Course Topics

- Flow in open channels,
- Uniform flow and non-uniform flow
- Bed shear stress
- Hydraulic structures; (Weirs, Gates, Flumes, Spillways, Culverts, Stilling basins)
- Scour around bridge piers
- Sediment in front of dams

References

- Chadwick, Andrew and Morfett, John, “Hydraulics in Civil and Environmental Engineering” Paperback, U.K.
- Davis, C.V. and Sorensen (EDS); “Handbook of applied hydraulics” 1978; McGraw-Hill Co; N.Y.
Course Code : CB 762
Course Title : Design of Hydraulic Structures
Credit Hours : 3

Course Description

Course Objectives
To enable the student to define the internal forces in all elements of different hydraulic structures and design all elements of different hydraulic structures.

Course Topics
- Culverts and siphons
- Weirs
- Stilling Basin
- Regulators
- Gates and automatic gates
- Reservoirs, Dams, and Spillways

References
- American Society of Civil Engineers; “Hydraulic Designs of Spillways”; 1995; (Technical Engineering and Design Guides as Adapted from the U. S. Army Corps of Engineers Ser.; No. 12).
- Roberson, J.A; Cassidy, J.J.; and Chaudhry, M.H.; “Hydraulic Engineering”, Houghton Mifflin Co. Ven, Te Chow; Open Channel Hydraulics
Course Detailed Structure

Course Code: CB 763
Course Title: Surface and Subsurface Hydrology
Credit Hours: 3

Course Description
The hydrologic cycle, Application of the hydrologic budget, precipitation, average precipitation, Evaporation, Transpiration, Evapotranspiration, Rainfall water losses, Stream flow, Stream flow estimation, Morphological and hydrological studies of water sheds or basins, Introduction to ground water, Types of aquifers, One dimensional flow equation, Initial and boundary conditions, Ground water flow net, Analytical solution, Simplified solution for flow equations, Pumping tests, Evaluation of ground water resources, and Ground water pollution.

Course Objectives
To enable the student to understand different elements of hydrology, Establish rainfall-runoff relationship, and understand channel routing methods.

Course Topics
- The hydrologic cycle,
- Application of the hydrologic budget
- Evaporation, transpiration, and evapotranspiration
- Stream flow and stream flow estimation,
- Morphological and hydrological studies of water sheds or basins
- Introduction to ground water
- One dimensional flow equation
- Analytical solution and simplified solution for flow equations
- Pumping tests
- Evaluation of ground water resources.

References
Course Code : CB 764
Course Title : River Engineering
Credit Hours : 3

Course Description
River morphology, local scour, introduction to sediment transport theory, River training, River bank protection, River navigation enhancement, Field data collection and analysis.

Course Objectives
To enable the student to deal with river morphological problems, analyze local scour, align and plan river navigation, and collect river field data

Course Topics
- River morphology
- local scour
- Introduction to sediment transport theory
- River training and river bank protection
- River navigation enhancement
- Field data collection and analysis.

References
- Carling, P. A.; “Advances in Fluvial Dynamics and Stratigraphy”; 1996; Wiley-Liss Inc., U. S.
Course Detailed Structure

Course Code: CB 765
Course Title: Sediment Transport
Credit Hours: 3

Course Description

Course Objectives
To enable the student to understand sediment transport phenomena,, define initial and boundary conditions, understand different types of sediment loads, and apply different type of sediment transport functions.

Course Topics
- Sediment properties and initiation of sediment motion
- Bed load, Suspended load, and Total load
- Coastal sediment transport and coastal currents
- Shoreline changes
- Erosion and deposition in river basin
- Sediment budget and models
- Einstein Bed-Load function
- Transport of sediment mixtures

References
Course Code : CB 766
Course Title : Theory and Operation of Hydraulic Models
Credit Hours : 3

Course Description
Theoretical base for hydraulic models developed from governing equations, Theory of dimensional analysis, Practical aspects of construction and operation of Froude and Reynolds models, Modeling of hydraulic machinery, Rivers, Tidal flows, Heated discharge, Modern instrumentation and data handling techniques.

Course Objectives
To enable the student to understand the concept of hydraulic models, develop hydraulically based model.

Course Topics
- Theoretical base for hydraulic models
- Theory of dimensional analysis
- Practical aspects of construction and operation of Froude and Reynolds models
- Modeling of hydraulic machinery
- Rivers and Tidal flows
- Heated discharge
- Modern instrumentation and data handling techniques

References
- Chadwick, Andrew and Morfett, John; “Hydraulic in civil and environmental engineering”; Paperback; U.K.
Course Code : CB 767
Course Title : Advanced Numerical Methods in Transport Phenomena
Credit Hours : 3

Course Description
General review of numerical methods and finite element method, One dimensional unsteady flow, Quasi two dimensional unsteady flow, Unsteady dispersion in rivers, Water and sediment routing in rivers, Model calibration, Model verification.

Course Objectives
To enable the student to develop advanced models for water surface profile calculation and/or river sediment calculation, calibrate and verify the developed model with suitable data, apply the developed model for future prediction of river status.

Course Topics
- General review of numerical methods and finite element method
- One dimensional unsteady flow
- Quasi two dimensional unsteady flow
- Unsteady dispersion in rivers
- Water and sediment routing in rivers
- Model calibration
- Model verification

References
- Chadwick, Andrew and Morfett, John; “Hydraulic in civil and environmental engineering”; Paperback; U.K.
Course Code : CB 768  
Course Title : Water Resources Systems  
Credit Hours : 3

Course Description
Introduction, Surface and subsurface water hydrology, Surface and subsurface water resources management, Problems related to water resources utilization, optimal conjunction use of water resources, Linear Programming, Dynamic programming, Determinates, Practical applications.

Course Objectives
To enable the students to define and manage available water resources, solve problems related to water resources utilization, and apply linear and dynamic programming for water resources management.

Course Topics
- Surface and subsurface water hydrology
- Surface and subsurface water resources management
- Problems related to water resources utilization
- Optimal conjunction use of water resources
- Linear programming
- Dynamic programming
- Practical applications

References
Course Code : CB 769
Course Title : Structures for Integrated Water Resources Management
Credit Hours : 3

Course Description
Application of hydrology, hydraulics, principles of project formulation, and system analysis, in the selection of integrated water resources systems. Water resources management systems include water supply components for urban and agricultural usage, structures for flood and storm water management and drainage or reuse of wastewater. Discussion of technical papers and computer models related to case studies on sustainable development of surface and groundwater, system selection, construction and operation, maintenance and other topics.

Course Objectives
To prepare graduate students and industry professionals with the fundamental concepts and techniques to identify integrated hydraulic structures required for a water resources management system realizing today's associated environmental, climate, economic and water demands considerations in the region including coastal zones.

Course Topics
- Management in the Water Industry: review of basic engineering and economic planning concepts.
- Water and the Environment: use of information technology for sustainable development of water resources (Hydroinformatics)
- Hydrology Frequency Analysis
- Modeling Watershed Hydrology: surface water, ground water, and water quality
- Water Management in Estuaries and Coastal Zone
- Water Resources System Analysis
- Hydraulic Structures Management Systems and Infra-Structure
- Case studies of Water Resources Management in Arid, Semi-Arid Regions and Coastal Zone

References
Course Detailed Structure

Course Code: CB 760-I
Course Title: Soil-Water-Plant Relationship
Credit Hours: 3

Course Description
Physical properties of soil, Soil water Properties, Water movement in unsaturated soil, Transpiration and actual evaporation estimation, Models of plant growth, Crop and yield models, Irrigation water scheduling, Laboratory and field measurements.

Course Objectives
To enable the student to define the relationship between soil, water, and plant, estimating irrigation water, scheduling irrigation water and perform field and laboratory measurements to ensure best scheduling.

Course Topics
- Physical properties of soil
- Soil Water Properties
- Water movement in unsaturated soil
- Transpiration and actual evaporation estimation
- Models of plant growth
- Irrigation water scheduling
- Laboratory and field measurements.

References
Course Detailed Structure

Course Code : CB 761-I
Course Title : Irrigation and Drainage System
Credit Hours : 3

Course Description
Types and characteristics of irrigation systems, System design fundamentals, Sprinkler and trickle irrigation systems, optimum design of pressurized systems, Automation and control, Importance of land drainage, drainage requirements, Field investigation and laboratory measurements, basic theories and design fundamentals, Methods of construction and maintenance.

Course Objectives
To enable the student to understand different types of irrigation systems, design sprinkler and trickle irrigation systems, design of drainage systems, and methods for constructing and maintaining irrigation and drainage systems.

Course Topics
- Types and characteristics of irrigation systems
- System design fundamentals
- Optimum design of pressurized systems
- Automation and control
- Importance of land drainage, drainage requirements
- Field investigation and laboratory measurements
- Basic theories and design fundamentals
- Methods of construction and maintenance

References
- Melby, Pete; “Simplified Irrigation Design Professional Designer and Installer Version”; 1997; Wiley, John and Sons, Incorporated.
Course Detailed Structure  
Construction and Building Engineering  
(F) Irrigation and Hydraulic Engineering

Course Code : CB 762-I  
Course Title : Design of Hydropower Stations and Pumping Stations  
Credit Hours : 3

Course Description  
Types of power stations, Types of turbines, Design of power stations, Pumping stations, Components of pumping stations, Types of pumps, Design and efficiency, Different loads resulting from pumping stations, Design of pipeline.

Course Objectives  
To enable the student to design power stations, design pumping stations, and design pumping station pipelines.

Course Topics  
- Types of power stations  
- Types of turbines  
- Design of power stations  
- Pumping stations and types of pumps  
- Design and efficiency  
- Different loads resulting from pumping stations  
- Design of pipeline

References  
- Parker Hannifin Corporation Staff; “Hydraulic Pumps and Controls”; 1995; Parker Hannifin Corporation.  
- Krivchenko, G. I.; Hydraulic Machines: Turbines and Pumps”; 1993; Lewis Publishers, U. S.