

**Four Semester
Master of Engineering Course
in
Water Resources and Hydraulic Engineering**

OFFERED BY: School of Water Resources Engineering,
Faculty of Engineering and Technology,
Jadavpur University

APPROVED BY: All India Council for Technical Education (AICTE)

	Credit Points	Periods / Week		Marks	
		L	P	Exam.	Sessional
First Semester					
Three papers from Departmental Basket	3 × 3	3 × 3	-	3 × 100	-
Three papers from Interdisciplinary Basket	3 × 3	3 × 3	-	3 × 100	-
Laboratory I	3	-	4	-	100
Seminar I		-	3	-	-
Total		18	7	600	100
Second Semester					
Three papers from Departmental Basket	3 × 3	3 × 3	-	3 × 100	-
One paper from Interdisciplinary Basket	3	3	-	100	-
Term Paper Leading to Thesis	3	-	3	-	100
Laboratory II	3	-	3	-	100
Seminar II	3	-	3	-	100
Total		12	6	400	300
Third and Fourth Semester					
Thesis/Project/Dissertation	12	-	-	-	300
Viva Voice	0	-	-	-	100
Total		-	-	-	400
Grand Total					1800

1st SEMESTER:

Departmental Basket of SWRE

No.	Name of the Subject	Course No.	To be offered by
Paper 1	Aquatic Ecology and Environment	PG/DB/SWRE/01	School of Water Resources Engineering
Paper 2	Irrigation and Agronomy or, Geophysical Fluid Dynamics	PG/DB/SWRE/02 PG/DB/SWRE/03	School of Water Resources Engineering
Paper 3	Hydraulic Structure and Hydel Power Engineering or, Hydraulics and Sediment Transport	PG/DB/SWRE/04 PG/DB/SWRE/05	School of Water Resources Engineering

Interdisciplinary Basket of SWRE

No.	Name of the Subject	Course No.	To be offered by
Paper 4	Principle of Water Resources Engineering	PG/Int-B/SWRE/06	School of Water Resources Engineering
Paper 5	Water Works Engineering	PG/Int-B/SWRE/07	School of Water Resources Engineering
Paper 6	Free Surface Flow	PG/Int-B/SWRE/08	School of Water Resources Engineering

N.B. : Other subjects belonging to the interdisciplinary basket are also being offered by the other Departments/Schools of Jadavpur University

 **Laboratory – I : Water and Wastewater Analysis Laboratory and Hydrology Laboratory**

 **Seminar - I**

2nd SEMESTER:

Departmental Basket of SWRE

No.	Name of the Subject	Course No.	To be offered by
Paper 7	Advanced Hydrology or, Computational Hydro Dynamics	PG/DB/SWRE/09 PG/DB/SWRE/10	School of Water Resources Engineering
Paper8	Ground Water Dynamics or, River Hydraulics and Engineering	PG/DB/SWRE/11 PG/DB/SWRE/12	School of Water Resources Engineering
Paper 9	Design of Water Resources System	PG/DB/SWRE/13	School of Water Resources Engineering

Interdisciplinary Basket of SWRE

No.	Name of the Subject	Course No.	To be offered by
Paper 10	Water Resources Management or, Economics and Legal Aspects of Water Resources	PG/IntB/SWRE/14 PG/IntB/SWRE/15	School of Water Resources Engineering

N.B. : Other subjects belonging to the interdisciplinary basket are also being offered by the other Departments/Schools of Jadavpur University

✚ **Laboratory – II : Application Software Laboratory and Fluvial Hydraulics Laboratory**

✚ **Term paper leading to Thesis**

✚ **Seminar - II**

3rd and 4th SEMESTER:

✚ **Thesis and Vivavoce**

SYLLABI

for

THE MASTER OF ENGINEERING IN WATER RESOURCES and HYDRAULIC ENGINEERING

Departmental Basket

PG/DB/SWRE/01 Aquatic Ecology and Environment

Greenhouse effect, Climate change, Global energy balance, Carbon cycle, Oxygen cycle, nitrogen, sulphur, phosphorous and other nutrients, Lakes and reservoirs, Dissolved oxygen balance and model, Water pollution and aquatic eco-system, Water and wastewater analysis, Municipal solid waste disposal techniques-leachate generation model, Extreme events, Environmental impact assessment (EIA), Environmental audit, etc.

Books :

1. Introduction to Environmental Engineering and Science : Gilbert M. Masters, Prentice Hall of India
2. Environmental Engineering : Noward S. Peavy and Donald R. Rowe, McGraw Hill Book Company
3. Chemistry for Environmental Engineering and Science: C. N. Sawyer, P. L. Mccarty and G. F. Parkin, Tata McGraw-Hill Publishing Co. Ltd
4. Freshwater Ecology (Concepts and Environmental Applications): Walter K. Dodds, Academic Press
5. Water and Wastewater Technology : Mark J. Hammer, Prentice-Hall of India

PG/DB/SWRE/02 Irrigation and Agronomy

Irrigation techniques and quality of irrigation water, Water requirement of crops, Soil moisture irrigation relationship, Water resources utilization and irrigation development, Investigation and preparation of irrigation projects, Methods of irrigation and water rates, Water use management, Measurement of water, Water logging and land reclamation, Causes and control of water logging, Improvement of irrigation efficiencies, Benefit cost ratios, Canal irrigation system, Design of irrigation channels, Lining of irrigation lands including definition and types, Economics of lining, Surface and sub-surface drainage, Estimation of crop water requirement, Estimation of irrigation water requirement, Scheduling irrigation, etc.

Agronomy and agro-ecosystem, Soil and its composition, Crop productivity, Climate and zoning, Soil fertility and fertilizer, Plant-water relation, Soil and water conservation, etc.

Books :

1. Irrigation Water Management (Principles and Practice): Dilip Kumar Majumdar, Prentice Hall of India
2. Irrigation Engineering and Hydraulic Structure : Santosh Kumar Garg, Khanna Publication
3. Irrigation Engineering : R. K. Sharma and T. K. Sharma, S. Chand and Company
4. Irrigation Theory and Practice : A.M. Michael, Vikas Publishing House
5. Irrigation Engineering: Asawa, New Age International (P) Ltd.
6. Soil and Water Conservation Engineering : Glen Schwabelliot and Glen Schwab, Wiley
7. Soil Engineering in Theory and Practice : A. Singh, CBS Publishers

PG/DB/SWRE/03 Geophysical Fluid Dynamics

Introduction to atmosphere, Structure of the atmosphere, Radiational and thermal regime of the atmosphere, Rotating coordinate frames, Equation of motion in rotating coordinate frames, Coriolis acceleration, The Rossby number, Flow in stratified field, Vorticity, Circulation, Kelvin's theorem, Vorticity equation, Potential vorticity, Thermal wind, The Taylor – Proudman theorem, Geostrophic motion, Viscous motion – turbulent stress, Atmospheric boundary layer, Ekman layer, Inviscid shallow water waves, Mechanism of wind generated waves, Cyclone and Cyclone generated wave, Oceanic circulation, Mechanism of air-sea interaction and its modeling, etc.

Books :

1. Geophysical Fluid Dynamics : R.S. Long
2. The Theory of Rotating Fluids : Harvey Philip Greenspan, Cambridge University Press
3. Natural Aerodynamics : P.S. Scorer, Pergamon Press, London
4. Geophysical Fluid Dynamics: Joseph Pedlosky, Springer
5. Introduction to Geophysical Fluid Dynamics: Benoit Cushman-Roisin, Prentice Hall

PG/DB/SWRE/04 Hydraulic Structure and Hydel Power Engineering

Theories of seepage, Wave theory, Dams and barrages, Design of weirs and barrages, Dams in general – types and selection, Designing of reservoir capacity with capacity-elevation and area-elevation curves of a reservoir site, Design and construction of gravity dams, Water conveying channels and structures, Penstocks, Water hammer and surge tanks, Gates in hydraulic installations, Spillways, River training and control works, Wind generated waves, Shallow and deep water waves, Storm surges, Harbour resonance, Hydraulic loading on structures – static and dynamic effects, Codes of practice, Design and construction of offshore structures, Water for hydroelectric generation, Tidal power – Principle, Components, Ebb-cycle, Tide-cycle, Estimate of energy and power, etc.

Books :

1. Hydraulics in Civil and Environmental Engineering : Andrew Chadwick, John Morfett and Martin Borthwick, Allen and Unwin; Spon Press London and New York
2. Engineering for Dams: William Pitcher Creager, Joel De Witt Justin, Julian Hinds (Vol. I, II, III), Chapman and Hall, Ltd.
3. Design of Dams Percolation and Erosion : Serge Leliavsky, Chapman and Hall
4. Concrete Dams: R.S. Varshney, Oxford and IBH Pub. Co.
5. Hydraulic Structures (Vol. I and II) : (Ed) M. M. Grishin, Mir Publishers, Moscow
6. Hydraulic Structures : Novak, Taylor and Francis
7. Water Power Engineering: Dandekar and Sharma, Vikas Publishing Houses Pvt. Ltd.

PG/DB/SWRE/05 Hydraulics and Sediment Transport

Real-fluid flow, viscous incompressible flow, Navier-Stokes equations, RANS, Laminar and turbulent boundary layer, Turbulence and coherent structure of flow, Reynolds stresses, Skin friction, Form drag and lift, Flow in pipes and closed conduits, Pressure surge in conduits, Hydraulic conduits. etc.

Sediment properties, Universal soil loss equation, Initiation of motion – Shields' diagram, Regime concept, Modes of sediment transport, Bed load, Bed form mechanics,, Effective bed roughness, Armouring, Suspended load, Total load, Transport of sediment due to unsteady flow, Meandering of rivers, Braided river, Local scour at different structures, Sediment sampling, Design of stable channels, Seepage effects, Mathematical models of sediment transport, etc.

Books :

1. Sediment Transport (Theory and Practice): C. T. Yang, McGraw Hill. International Edition
2. Sediment and Ecohydraulics (INTERCOH 2005) : Tetsuya Kusuda (Contributor: Hiroyuki Yamanishi, Jeremy Spearman, Joseph Z. Gailani), Elsevier Publisher
3. Viscous Fluid Flow : F. M. White, McGraw Hill International
4. Mechanics of Sediment Transportation and Alluvial Stream Problems: R. J. Garde, K. G. Ranga Raju, New Age International Publishers
5. Sediment Transport (in 3 parts), ASCE : Leo C. van Rijn
6. Hydraulics of Sediment Transport: Walter Hans Graf, McGraw-Hill Book. Company, Inc, New York
7. Loose Boundary Hydraulics: A.J. Roudkivi, Pergamon Press, 1967
8. Sediment Transport (A Geophysical Phenomenon) : A. Gyr, Klaus Hoyer and Albert Gyr, Springer
9. Fundamentals of Fluvial Geomorphology: Ro Charlton, Routledge, Taylor and Francis Group
10. Hydraulics in Civil and Environmental Engineering : Andrew Chadwick, John Morfett and Martin Borthwick, Allen and Unwin, Spon Press London and New York
11. Mechanics of Fluids: Bernard. Stanford Massey, revised by John Ward Smith, Taylor and Francis

Interdisciplinary Basket

PG/Int-B/SWRE/06 Principle of Water Resources Engineering

Water resources – global perspective, Fields of water resources engineering, Hydrological cycle, Precipitation and its measurement, Raingauge networking, Precipitation data processing and analysis, Abstractions of precipitation, Hydrological data and their measurements, Streamflow measurement and analysis, Runoff – flow-duration curve, Flow mass curve, Hydrograph – its components, UH, S-curve, IUH, Flood routing, Hydrologic storage routing and channel routing, Flood flows – estimation and control measures, Flood forecasting techniques, Surface water and storage reservoir, Conveyance of surface water through river intakes and dam outlet, Groundwater hydrology – Well hydraulics, Drainage and reclamation of water logged lands, Water quality,

Desalination of brackish water, Cost benefit considerations in water resources planning etc.

Books :

1. Water Resources Engineering : Larry W. Mays, John Wiley and Sons
2. Water Resources Engineering : Ray K Linsley, Joseph B Franzini, David L Freyberg and George Tchobanoglous, McGraw-Hill
3. Principles of Water Resources Planning : Alvin S. Goodman, Prentice Hall of India
4. Engineering Hydrology : R. S. Varshney, Nem Chand Publisher
5. Hand Book of Applied Hydrology: (Ed) Ven T. Chow, Tata McGraw Hill Publishing Ltd.
6. Remote Sensing in Hydrology : E.T. Engman and R.J. Gurney, Chapman and Hall
7. Engineering Hydrology: K. Subramanya, Tata McGraw Hill Publishing Ltd.
8. Water Resources Engineering : Linseley, Tata McGraw Hill International Editions
9. Flow in Open Channels: K. Subramanya, Tata McGraw Hill Publishing Ltd.
10. Elementary Hydrology : Vijay Pratap Singh, Prentice Hall of India

PG/Int-B/SWRE/07 Water Works Engineering

Water quality, Water treatment processes, Basic design consideration, Pre-design, Raw water intake, Screening and aeration, Water conveyance, Flow measurement and pumping, Coagulation, Flocculation and Precipitation, Sedimentation, filtration, colour, taste and odor control, Disinfections and fluoridation, Water quality, Clear well, High service pumps and distribution system, Residual processing and disposal, Plant siting, layout, Yard piping and hydraulic profile, Process control, Non conventional water treatment processes and design etc.

Books

1. Water Treatment Plant Design : ASCE and AWWA
2. Water Treatment Principle and Design: J.M. Montgomery, John Wiley and Sons, Inc.
3. Water Supply and Sewerage : T.J. McGhee, McGraw Hill International
4. Water Works Engineering – Planning, Design and Operation : Qasim Syed R., Motley Edward M., Zhu Guang, Prentice Hall of India
5. Water Treatment - Trouble Shooting and Problem Solving : G.M. Tillman, Taylor and Francis Ltd
6. Water Treatment Processes – Simple Optics: S. Vigneswaran and C. Visvanathan, CRC Press Inc.
7. Elements of Water Supply and Wastewater – Fair, G.M.; Gayer, J.C. and Okun, D.A. Willey
8. Manual of Water Supply and Treatment : CPHEEO, Ministry of Urban Development, Govt. of India, 1999
9. Water Treatment Principles and Design : Montgomery, J.M., John Willey and Sons.
10. Water Supply Systems : New Technologies; Edited by Maksimovic, Calomino and Snoxell : Springer
11. Water Quality and Treatment : AWWA, 5th Edition, 1999
12. Microbial Quality of Water Supply in Distribution System : Edwin E. Goldrich, Lewis Publishers
13. Chemistry of Environmental Engineering–Sawyer, C.N.; McCarthy, P.L.; Parkin, G.E., McGraw-Hill

PG/Int-B/SWRE/08 Free Surface Flow

Classification, Energy and momentum in free surface flow, Critical flow, Uniform flow, Design of non-erodible, Erodible channels and grassed channels, Concepts of boundary layer, Surface roughness, Velocity distribution and instability of uniform flow, Gradually varied flow – spatially varied flow, rapidly varied flow, Flow over spillways, Supercritical flows and oblique flows, Hydraulic jump, Gradually varied and rapidly varied unsteady flow, Wave propagation and surge in canals, Discharge measuring methods, Free surface flow in closed conduits, etc.

Books :

1. Open-Channel Hydraulics: Ven Te Chow, Tata McGraw Hill Publishing Co. Ltd.
2. Hand Book of Applied Hydraulics : Calvin Victor Davis and Kenneth E. Sorensen
3. Open-Channel Flow : M. Hanif Choudhury, Prentice Hall of India
4. Engineering Hydraulics: Hunter Rouse, John Wiley and Sons.
5. Flow in Open Channels: K. Subramanya, Tata McGraw Hill Publishing Co. Ltd.
6. Hydraulics in Civil and Environmental Engineering : Andrew Chadwick, John Morfett and Martin Borthwick, Allen and Unwin, Spon Press London and New York

Departmental Basket

PG/DB/SWRE/09 Advanced Hydrology

Hydrograph, Distribution graph for runoff generation, Complex storm hydrograph, Synthetic UH generation techniques, IUH generation techniques, UH generation from IUH, SCS runoff curve number method, Snow hydrology, Snow formation and accumulation, Melting of snowpack, Snowmelt indices, Effect of snowpack condition on runoff, Snowmelt hydrograph synthesis, Fluvial geomorphology, Models for hydrologic abstraction processes, Aspects of arid zone hydrology, Probable maximum precipitation – Estimation, Types of catchment model components and Construction, Analysis of time series data – Generation of synthetic hydrologic data, Forest hydrology, etc.

Books :

1. Urban Hydrology : A Multidisciplinary Perspective : Timothy R. Lazaro, CRC Press
2. Applied Hydrology: R. K. Linsley Jr., MA Kohler, and JLH Paulhus, McGraw-Hill Book Co.
3. Environmental Hydrology : Andy D. Ward and Stanley W. Trimble, Lewis Publishers
4. Applied Hydrology: Ven Te Chow, Tata McGraw Hill Publishing Ltd.
5. Hydrology and Water Resources Engineering : S. K. Garg, Khanna Publishers
6. Hydrology and Water Resources Engineering : K. C. Patra, Narosa Publishing House
7. Applied Hydrology: K. N. Mutreja, Tata McGraw Hill Publishing Ltd.
8. Facets of Hydrology : (Ed.) J. C. Rodda, John Wiley and Sons
9. Hydrology and Hydraulic Systems : Ram S. Gupta, Waveland Press Inc
10. Hydrology: An Introduction to Hydrologic Science : By Rafael L. Bras
11. Introduction to Hydrology : Warren Viessman, John W. Knapp, Gary L. Lewis, IEP Publisher
12. Engineering and Hydrology: Principles and Practices : V. M Ponce, Prentice Hall of India

PG/DB/SWRE/10 Computational Hydro Dynamics

Ordinary and Partial differential equations, Well-posed, ill-posed problem, Finite difference schemes, Stencil diagrams, Basic aspect of discretization, Truncation error, Implicit and explicit types, Accuracy, Convergence, Errors and stability analysis, von Neumann method, CFL condition, Some hydrodynamic techniques – Lax-Wendroff, MacCormack, Crank-Nicolson, staggered grid, ADI, ADE, pressure correction, SIMPLE and SOLA algorithm, Method of characteristics, Finite element method- variational and weighted residual formulations, Applications to steady and unsteady flows, Pollutant dispersion, flood wave propagation, Tidal model, Applications with computer programming, etc.

Books :

1. Computational Fluid Dynamics: John D. Anderson, Jr., Tata McGraw Hill International Editions
2. Computational Fluid Dynamics: T. J. Chung, Cambridge University Press
3. Computational Fluid Mechanics and Heat Transfer: Series in Computational and Physical Processes in Mechanics and Thermal Sciences : John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Taylor and Francis Publishers
4. Computational Methods in Surface/Subsurface Flow and Transport Problems: Computational Methods in Water Resources XI, Volume 1 and 2 : A. A. Aldama and J. Aparicio
5. Computational Fluid Dynamics: Principles and Applications : J. Blazek, Elsevier Science
6. Computational Methods for Fluid Dynamics: Joel H. Ferziger, Milovan Perić, Springer
7. Fundamentals of Computational Fluid Dynamics : Harvard Lomax, Thomas H. Pulliam, David W. Zingg, Springer

PG/DB/SWRE/11 Ground Water Dynamics

Occurrence of groundwater – origin and distribution of groundwater, Geologic formation as aquifers, Groundwater movement, Groundwater flow in unsaturated zones and fractured media, Hydro-geologic investigation, 3-D general flow equations, Groundwater and well hydraulics, Response of confined and unconfined aquifers to pumping, Leaky confined aquifers and partially penetrating wells, surface and subsurface investigation of groundwater, Artificial recharge, Saline water intrusion, Groundwater modeling, etc.

Books :

1. Ground Water Hydrology: David Keith Todd, John Wiley and Sons.
2. Fundamentals of Groundwater : Franklin W. Schwartz, Hubao Zhang, Publisher Wiley
3. Water Resources Engineering : Ralph A. Wurbs and Wesley P. James, Prentice Hall of India
4. Groundwater Flow and Mass Transport Modelling (Theory and Applications) : M. Thangarajan
5. Ground Water : H. M. Raghunath, New Age International Publishers
6. Ground Water : R. Allan Freeze, John A. Cherry, Prentice Hall of India
7. Environmental Geology-An Earth System Science Approach : Dorothy Merritts, Andrew De Wet and Kirsten Menking
8. Applied Hydrology of Fractured Rocks : B. B. S. Singhal and R. P. Gupta, Springer
9. Groundwater Resources Development : L. Hamill and F. J. Bell, Butterworth Publisher
10. Construction Dewatering and Groundwater Control: J.Patrick Powers, Arthur B. Corwin, Paul C. Schmall and Walter E. Kaeck, John Wiley and Sons. Inc.

PG/DB/SWRE/12 River Hydraulics and Engineering

River morphology, Meandering, Sediment transport, Measurement of stream flow and sediment, Stabilization and rectification of rivers, Dredging, Inland navigation, Canalization, Diversion and cofferdams, Levees and associated flood control works, River model, Channel control and Transitions, Discharge measurement methods, Flow resistance, Composite roughness and compound channels, Continuity and dynamic equations of unsteady flow, Method of characteristics, Dam-break problem, Density current, Flow in channel bends, Tides and surges in rivers, etc.

Books :

1. River Engineering : Margaret S. Petersen, Prentice Hall of India
2. Fundamentals of Fluvial Geomorphology: Ro Charlton, Routledge, Taylor and Francis Group
3. Loose Boundary Hydraulics: Arved. J. Raudkivi, Netherland: Balkema, 1998. ISBN : 90-5410-448-1
4. Fluvial Processes in River Engineering : H. H. Chng, John Wiley and Sons
5. River Mechanics : Pierre Y. Julien, Cambridge University Press
6. River Basin Planning: Theory and Practice: Suranjit K. Saha and Christopher J. Barrow, J. Wiley and Sons
7. Hydraulics in Civil and Environmental Engineering : Andrew Chadwick, John Morfett and Martin Borthwick, Allen and Unwin, Spon Press London and New York

PG/DB/SWRE/13 Design of Water Resources System

Feasibilities of water resources development, Planning alternatives, Storm water management: Design of storm sewers and detention, Highway drainage and culverts, Spillway and energy dissipater, Pipeline distribution network, Probability risk and uncertainty analysis, Design of water harvesting structures, Design of water intake stations, Design of water treatment plant, Design of irrigation systems, etc.

Books :

1. Water Resources Systems Engineering : Warren A. Hall, John A. Dracup, McGraw-Hill
2. Water Resources: Environmental Planning, Management, and Development: Asit Kumar Biswas, McGraw-Hill
3. River Basin Planning: Theory and Practice: Suranjit K. Saha and Christopher J. Barrow, J. Wiley and Sons
4. Water Resources Systems Planning and Management (Developments in Water Science) : Sharad Kumar Jain, V. P. Singh, Elsevier
5. Water Resources Engineering : Larry W. Mays, John Wiley and Sons
6. Water Resources Engineering : Ralph A. Wurbs and Wesley P. James, Prentice Hall of India

Interdisciplinary Basket

PG/Int-B/SWRE/14 Water Resources Management

Management of hydrological data, Linear Programming and its application in water resources development, Inventory control, Analysis of risk and uncertainties, Dynamics programming Statistical decision model, Water policies and institutional aspects of management of water resources, Hierarchical modeling of water resources development, Management of watersheds and water quality, Reservoir and stream flow routing, probability, Risk and uncertainty analysis, etc.

Urban water supply planning/management, Cost-benefit analysis in water resources planning, Planning of watersheds, Watershed behavior and conservation practices, Trans-boundary water resources, National water policy, water withdrawals and uses, etc.

Books :

1. Water Management (Technology and Institutions) : Warren Viessman Jr. and Claire Welty, Harper and Row Publisher
2. Water Resources Systems Planning and Management (Developments in Water Science) : Sharad Kumar Jain, V. P. Singh, Elsevier
3. Water Resources Engineering : Larry W. Mays, John Wiley and Sons
4. Water Resources Engineering : Ralph A. Wurbs and Wesley P. James, Prentice Hall of India
5. Modeling Water Qualities and Management : Asit K. Biswas
6. Hierarchical Analyses of Water Resources Systems: Modeling and Optimization: Yacov Y. Haimes, McGraw-Hill International Book Co.
7. Waste Water Engineering Treatment and Reuse: George Tchobanoglous, Metcalf and Eddy, Franklin L. Burton, Metcalf and Eddy, H. David Stensel, McGraw-Hill Professional
8. Sustainable Water Management Solutions for Large Cities : Dragan A. Savic and Mignel A.
9. Principle of Water Resources History, Development, Management, Policy: Thomas V. Cech, John Wiley

PG/Int-B/SWRE/15 Economics and Legal Aspects of Water Resources

Eco-system, Interrelation of ecological elements in cultural landscape, Ecological zoning, Ecology of river, lake,. Estuaries wetlands etc., Conservation of wetlands, Principles of law applied to water rights and water allocation, Analysis of the laws and administrative structure that constitute the institutional framework of the environmental aspects of water resources management, Order in priorities, Legislation of different uses of water, Legislation on harmful effects of water, Controlling the use of water, Environmental constraints on water development project, Declaration of protected areas of zones, Water quality standards for drinking water, Standards for water re-use, International aspects of water, International Water Resources Law, International case law, International and Bilateral Rivers.

Books :

1. Water rights and Principles of Water Resources Management : C. Singh, Indian Law Institute, New Delhi
2. Water Law in Historical Perspective: L.A. Teclaff, Hein and co., Buffalo, N.Y.
3. Environmental Law and Policy in India : S. Divam and A. Rosencranz, OUP
4. Environment and Pollution Law Manual : S. K. Mohanty, Universal Law Publishing House
5. Integrated Environmental Planning : James K. Lein, Blackwell publisher

Laboratory – I : Water and Wastewater Analysis Laboratory and Hydrology Laboratory

1. Rainfall Data collection by Natural Syphon Recording type Raingauge and determination of mass curve and hyetograph from the obtained chart
2. Determination of infiltration rate by Double Ring type Infiltrometer
3. Measurement of permeability
4. Determination of rate of evaporation through Pan Evaporimeter

Determination of following parameters:

1	Dissolved Oxygen (DO)	2	Turbidity
3	Bio-chemical Oxygen Demand (BOD)	4	Sulphate
5	Chemical Oxygen Demand (COD)	6	Phosphate
7	TSS (Total Suspended Solid)	8	Chloride
9	TDS (Total Dissolved Solid)	10	pH Value
11	Electrical Conductivity	12	Nitrate
13	Bacteriological Parameters	14	Iron

15	Arsenic	16	Hardness
17	Oil and Grease		

Books :

1. Vogel's Qualitative Inorganic Analysis (17th Ed.) : G. Svehla, Pearson Education
2. Chemistry for Environmental Engineering and Science: Calir N.Sawyer, Perry L. McCarty and Gene F. Parkin, Tata McGraw-Hill Publishing Company Ltd.
3. Standard Methods for the Examination of Water and Waste Water : American Public Health Association Inc., New York
4. Hand book of Advanced Waste Water Treatment: Russel L Culp and Gordan L Culp. Van Nostrand. Reinhold Co. New York

✚ Laboratory – II: Application Software Laboratory and Fluvial Hydraulics Laboratory

Application Software Laboratory:

1. G.I.S. Tool in Watershed Development
2. HEC -HMS Software
3. Water CAD Professional
4. Artificial Neural Network (ANN)
5. Surface Water Modelling System (SMS 9.0)
6. Ground Water Modelling System (GMS 6.0)
7. Visual Modflow

Fluvial Hydraulics Laboratory:

1. Field measurement of velocity by Current Meter (Propeller Type)
2. Velocity measurement by Pitot Tube
3. Velocity and Discharge measurement by Ultrasonic Flow Meter
4. Depth measurement by Echo-Sounder
5. Sieve Analysis Test

Field survey:

1. Field survey by Electronic Total Station
2. Bathymetric survey by Depth Echo Sounder
3. Groundwater level survey with Water Level Indicator
4. Field survey by Signal Stacking Resistivity Meter (VES)

Contact

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School of Water Resources Engineering,
Jadavpur University

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