SEMESTER -II

ADVANCED FLUID MECHANICS-II

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UNIT I HYDRAULICS OF PIPELINES AND PIPE NETWORKS

Review of fluid mechanics. Reynolds transport theorem and applications. Steady flow analysis of pipe network systems. Unsteady flows - basic equations of water hammer, solution by method of characteristics. Network Analysis

UNIT II STEADY VARIED FLOWS IN OPEN CHANNELS

Basic concepts of uniform flow. Specific energy and specific force concepts. Dynamic equation for spatially varied flows. Flow profile computations. Introduction to HEC-RAS. Spatially varied flows and rapidly varied flows – applications.

UNIT III UNSTEADY FLOWS IN OPEN CHANNELS

Equations of motion. Uniformly progressive wave. Rapidly varied unsteady flow – positive and negative surges. Dam break problem.

UNIT IV SEDIMENT TRANSPORT

Sediment properties – inception of sediment motion – bed forms. Bed load suspended load – Total sediment transport. Design of stable channels and regime channels. Reservoir sedimentation and trap efficiency.

UNIT V FLOW MEASUREMENTS AND HYDRAULIC MODELING

Sharp-Crested weirs, broad-crested weirs, critical depth flumes. Recent advancement in open channel flow measurements. Physical modeling in hydraulics. Dimensional analysis. Modeling closed flows and free surface flows. Distorted models. Design of physical models.

REFERENCES:

1. Wurbs R.A., and James W.P. Water Resources Engineering. Prentice Hall of India, Eastern Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007.
2. Subramanya K., Flow in Open Channels (2nd ed.) Tata McGraw Hill, ISBN 00-746-2446-6, New Delhi 2003.
3. Chaudhry M. H., Open Channel Flow. Prentice Hall of India, Eastern Economic Edition , . ISBN: 81-203-0863-8,New Delhi. 1994.
4. Chow Ven-te Open Channel Hydraulics McGraw Hill, New York NY 1959.
5. French, R. H., Open Channel Hydraulics McGraw Hill, New York NY 1985.
6. Srivastava R. Flow through Open Channels Oxford University Press New Delhi 2008.

WATERSHED CONSERVATION AND MANAGEMENT

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3	0	0	3

UNIT I WATERSHED CONCEPTS

Introduction – Significance – Geology – Soil – Morphological Characteristics – Elements – Land Capability Classification –Delineation – Codification – Factors Influencing Watershed Development

UNIT II SOIL CONSERVATION PRACTICE

Types of Erosion – Wind Erosion: Causes, Factors, Effects and Control – Water Erosion: Types, Factors, Effects – Engineering Measures for Erosion Control in Agricultural and Non-Agricultural Lands – Estimation of Soil Loss

UNIT III WATER HARVESTING AND CONSERVATION

Water Harvesting Techniques – Design of Small Water Harvesting Structures – Types of Storage Structures – Yield from a Catchment – Losses of Stored Water

UNIT IV WATERSHED MANAGEMENT

Strategies – Identification of Problems – Watershed Development Plan – Entry Point Activities –– Concept of Priority Watersheds – Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – Developing Collaborative know how – People's Participation – Evaluation of Watershed Management

UNIT V WATERSHED ASSESSMENT MODELS

Regulation and Restoration – A Brief Description and Significance of Watershed Models: SWAT, TMDL, AGNPS, BASINS, CREAMS – Case Studies

REFERENCES:

1. Debarry A. Paul, Watersheds, Wiley and Sons, 2004.
2. Devanport E. Thomas, Watershed Project Management Guide, Lewis Publishers, London, 2003.
3. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000.
4.. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley and Sons, 1981.
5. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982.
6. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982.

ELECTIVES – III
SYSTEMS ANALYSIS IN WATER RESOURCES

L	T	P	C
3	1	0	4

UNIT I SYSTEM CONCEPTS

Definition, classification, and characteristics of systems - Scope and steps in systems engineering - Need for systems approach to water resources and irrigation.

UNIT II LINEAR PROGRAMMING

Introduction to operations research - Linear programming, problem formulation, graphical solution, solution by simplex method - Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans - Case studies.

UNIT III DYNAMIC PROGRAMMING

Bellman's optimality criteria, problem formulation and solutions - Application to design and operation of reservoirs, Single and multipurpose reservoir development plans - Case studies.

UNIT IV SIMULATION

Basic principles and concepts - Random variant and random process - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models - Case studies.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES

Integer and parametric linear programming - Goal programming models with applications Discrete differential dynamic programming and incremental dynamic programming - Linear decision rule models with application - Stochastic dynamic programming models.

REFERENCES:

1. Gupta P.K and Man Mohan, Problems in Operations Research (Methods and solutions). Sultan Chand and sons, New Delhi, 1995
2. Hiller F.S and Liebermann G.J., Operations Research CBS Publications and distributions. New Delhi, 1992.
3. Chaturvedi. M.C., Water Resources Systems Planning and Management. Tata McGraw Hill, New Delhi, 1997.
4. Mays L.W., and Tung YK, Hydro systems Engineering and Management. McGraw Hill Inc., New York, 1992.
5. Goodman Alvin S., Principles of Water Resources Planning, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1995.
6. Course material, Micro Computer Application to Systems Analysis in Irrigation Water Management, CWR, Anna University, 1992.

RIVER ENGINEERING

L	T	P	C
3	1	0	4

UNIT I RIVER FUNCTIONS

Primary function of a river – River uses and measures – Water and Sediment loads of river – Rivers in India, Himalaya and Peninsular.

UNIT II RIVER HYDRAULICS

Physical Properties and Equations – Steady flow in rivers – uniform and non uniform – Turbulence and velocity profiles – resistance co efficients – Boundary conditions and back waters – Transitions – Rating Curve – Unsteady flow in rivers : Propagative of surface waves – Characteristics, flood waves – knematic and diffusion analogy – velocity of propagation of flood waves – Flood wave –Maximum

UNIT III RIVER MECHANICS

River Equilibrium : Stability of Channel – regime relations – river bend equilibrium – hydraulic geometry of downstream - Bars and meandering - River dynamics – degradation and aggradation of river bed – Confluences and branches – River Data base.

UNIT IV RIVER SURVEYS AND MODEL

Mapping – Stage and Discharge Measurements – Sediments – Bed and suspended load – Physical hydraulic Similitude – Rigid and mobile bed – Mathematical – Finite one dimensional – multi – dimensional – Water Quality and ecological model

UNIT V RIVER MANAGEMENT

River training works and river regulation works – Flood plain management – waves and tides in Estuaries - Interlinking of rivers – River Stabilization

REFERENCES:

1 Janson PL.Ph., Lvan BendegamJvanden Berg, Mdevries A. Zanen (Editors), Principles of River Engineering – The non tidal alluvial rivers – Pitman, 1979.
2. Pierre Y. Julien ., River Mechanics ,Cambridge University Press, 2002.
3. K.L Rao , INDIA’s WATER WEALTH – Orient Longman Ltd., 1979
4. Mechanics of Sediment transportation and Alluvial stream problem by R.J. Garde and K.G Ranga Raju – New Age Int. Publications.

GROUNDWATER MODELING AND MANAGEMENT

L	T	P	C
3	1	0	4

UNIT I GROUNDWATER PROSPECTING

Investigation and evaluation – Geophysical methods- Electrical Resistivity methods – Interpretation of data – Seismic method – Subsurface investigation – Test drilling – Resistivity logging – Application of remote sensing techniques.

UNIT II GROUNDWATER FLOW MODEL

Physical models – Analog models – Mathematical modeling – Unsaturated flow models Numerical modeling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method

UNIT III CONTAMINANT TRANSPORT MODEL

Contaminant transport theory – Advection, dispersion equation – Longitudinal and transverse dispersivity – Hydrodynamic dispersion – Analytical models – Numerical simulation of solute transport – Solution methods - Sorption model – Subsurface mass transport through the vadose zone - Density driven flow - Heat transport.

UNIT IV MODEL DEVELOPMENT

Data requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution : Grid design, Setting boundaries, Time discretization and Transient simulation – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation and prediction – Uncertainty in the model prediction

UNIT V GROUNDWATER MANAGEMENT MODEL

Optimal groundwater development – Indian GEC norms – Conjunctive use models Modeling multilayer groundwater flow system -Modeling contaminant migration – Modeling fracture flow system – Artificial recharge feasibility through modeling – Simulation of movements of solutes in unsaturated zone – Stochastic modeling of groundwater flow - Groundwater contamination, restoration and management

REFERENCES:

1. Anderson M.P., and Woessner W.W., Applied Groundwater Modelling : Simulation of flow and advective transport, Academic Press, Inc., 1992
2. Fetter C.W., Contaminant Hydrogeology, Prentice Hall, 1999
3. Rushton K.R., Groundwater Hydrology : Conceptual and Computational Models, Wiley, 2003
4. Elango L. and Jayakumar, R. Modelling in Hydrology, Allied Publishers Ltd., 2001
5. Remson I., Hornberger G.M. and Moltz F.J., Numerical Methods in Subsurface Hydrology, Wiley, New York, 1971
6. Robert Willis and William W.G.Yenth, Groundwater System Planning and Management, Prentice Hall, Englewood Cliffs, New Jersey, 1987.

WATER SUPPLY DISTRIBUTION AND BURIED PIPELINES

L	T	P	C
3	1	0	4

UNIT I WATER SUPPLY SYSTEMS

Water requirement – sources of water – water demand – reservoir storage – nodal hydraulic gradient level values - water supply consideration, Types of water supply systems- piping system- distribution network- labeling- network components – Network models – design – optimization in practice

UNIT II HYDRAULIC PRINCIPLES AND NETWORK PARAMETERS

Energy and hydraulic gradient lines – head loss in links – equivalent pipes – series – parallel pipes – path head loss and loop head loss – analysis of water distribution network- static node, dynamic node – network performance – flow analysis - Layout – in situ lining - pipes material – appurtenances – minimization of water losses – leak detection.

UNIT III STORM WATER DISTRIBUTION AND BURIED PIPES

Planning – runoff estimation – rainfall data analysis – storm water drain design Introduction to Buried pipes – external loads – gravity flow design, pressurized flow- rigid and flexible pipes – installation – trenchless technology

UNIT IV RELIABILITY ASSESSMENT AND DESIGN

Uncertainty and reliability – affecting events- assessment – reliability parameters- configurations. Design methodology - strengthening and expansion

UNIT V SOFTWARE APPLICATIONS

Use of software in water transmission, water distribution and sewer design – LOOP 4.0, SEWER, EPANET, BRANCH, SEWERCAD, WATERCAD, STROMNET

REFERENCES:

1. Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi, 2003
2. Bajwa. G. S, Practical handbook on Public Health Engineering, Deep publishers, Shimla 2003
3. Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999
4. B.A. Hauser, practical hydraulics Hand Book, Lewis Publishers, New York, 1991
5. Moser A. P, Buried pipe Design, 3rd Edition, American Water Works Association
6. Robert van Bentum and Lan K. Smout, Buried Pipe lines for surface Irrigation, The Water, Engineering and Development Centre, Intermediate Technology Publications,UK,1994

ELECTIVES – IV

ENVIRONMENTAL HYDRAULICS

L	T	P	C
3	1	0	4

UNIT I FUNDAMENTAL RELATIONSHIPS FOR FLOW AND TRANSPORT

Concentration and units of measure – Conservation laws – Systems and Control Volume approach – Differential element approach – Sources, Sinks and box-models – Mixing.

UNIT II DIFFUSION AND DISPERSION

Derivation of diffusion equation – Solution of diffusion equation – Advective diffusion – Turbulent diffusion – Shear flow diffusion.

UNIT III TRANSPORT PROCESSES IN RIVERS

Mixing in Rivers – Continuous point discharges – Two rivers mixing – Dispersion in rivers.

UNIT IV TRANSPORT PROCESSES IN LAKES AND RESERVOIRS

Reservoir classification – External energy sources – Surface layer – mixing in the hypolimnion – inflows and outflows.

UNIT V TRANSPORT PROCESSES IN THE ESTUARIES

Classification – Forces – wind, tides, rivers – Trapping and pumping – Estuarine Circulation.

REFERENCES:

1. Fischer, H.B., List, E.G., Koh, R.C.Y., Imberger, J and Brooks, N.H. Mixing in Inland and Coastal Waters Academic Press, New York, 1979.
2. Clark, M.M., Transport Modeling for Environmental Engineers and Scientists John Wiley and Sons, New York. 1996.
3. Martin J.L. and McCutcheon S.C. Hydrodynamics and Transport for Water Quality Modeling CRC Press, Inc. ISBN:0-87371-612-4, 1999.
4. Chapra, S.C. Surface Water Quality Modeling McGraw Hill Book Co. Singapore, 1997.
5. M.Thomann, R.V. and Mueller, J.A. Principles of Surface Water Quality Modeling and Control Harper and Row, New York, 1987.
6. Csanady, G.T., Turbulent Diffusion in the Environment D.Reidel Publishing Co. Holland, 1973.

WATER POLICIES, LAWS AND RIGHTS

L	T	P	C
3	1	0	4

UNIT I WATER RIGHTS: DOCTRINES/PRINCIPLES

Introduction – Policy, Law, Bill, Act, Rules, Notifications – Nature of Rights: Natural Rights – Customary Rights – Doctrine of Riparian Rights – Doctrine of Prior Appropriation – Doctrine of Equality – Doctrine of Equitable Apportionment – Public Trust Doctrine – Doctrine of Inter-Generational Equity –Absolute Ownership Theory

UNIT II WATER IN INDIAN CONSTITUTION AND OTHER STATUTES

History of Water Laws in India: Pre-Constitutional Water Laws – Constitutional Provisions: Article 14, Article 21, Directive Principles of State Policy, Fundamental Duties, State List-Entry 17 – 73rd and 74th amendments, Article 262 – Water Conflicts and Tribunals – Post-Constitutional Water Laws – National-Level Enactments.

UNIT III WATER LAWS: SURFACE WATER AND GROUNDWATER

Overview of State Acts with Case Laws: Irrigation: The Indian Easements Act – Land-Related Legislation –Tanks – Irrigation Management – Cess – Protection of Water Sources – Groundwater – Drinking and Domestic Water Supply – Industrial Use – Water Pollution – Torts and Crimes

UNIT IV POLICIES GOVERNING WATER

National Water Policy – National-Level Commissions – Irrigation Management Transfer Policies and Activities – Legal Registration of WUAs – Legal Changes in Water Allocation, Resource Mobilization and Dispute Resolution – Role of Local Institutions – Community Based Organizations – Water Policy Reforms: India, the Philippines, Bangladesh, and Indonesia

UNIT V TRANSNATIONAL LEGAL SYSTEM

International Law Commission – International Treaties and Protocols – Transboundary Water Conflicts: Indus Waters Treaty – India-Nepal Treaty – Indo-Bangladesh Cooperation – Sharing of Nile and Mekong River Basins

References:

1. Ali, Mohammed, George E. Radosevich and Akbar Alikhan, Water Resources Policy for Asia The Netherlands: A.A. Balkema, 1987.
2. Brewer, J., S. Kolavalli, A. H. Kalru, G. Naik, S, Ramnarayan, K.V. Raju and R. Sakthivadivel, Irrigation Management Transfer In India – Policies and Performance*,* Oxford and IBH Publishing Company, New Delhi,1999.
3. Bruns, Bryan Randolph and Ruth S. Meinzen-Dick. Ed. Negotiating Water Rights*,* Vistaar Publications, New Delhi,2000.
4. Iyer R. Ramaswamy , Towards Water Wisdom: Limits, Justice, Harmony*.* Sage Publications, New Delhi, 2007.
5. Mollinga, Peter P., and Alex Bolding, The Politics of Irrigation Reform – Contested Policy Formulation and Implementation in Asia, Africa and Latin America*,* Ashgate, England, 2004,
6. Report of the Expert Group, 'Groundwater Management and Ownership'. New Delhi: Government of India, Planning Commission, http://planningcommission.nic.in/reports/genrep/rep_grndwat.pdf, 2007.
7. Row, Sanjiva Commentaries on The Indian Easements Act, 1882 and Licences, 5th Edition,Delhi Law House, . New Delhi, 2006.

CONSTRUCTION PLANNING AND MANAGEMENT

L	T	P	C
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Engineering economics of project, including present economy, discounted case flow, basis of comparison, decision making amongst alternatives, benefits cost analysis, alternatives, replacement analysis, break-even analysis.

Principles of planning design construction and operation of civil engineering projects, Bar charts, CPM/CPERT, professional agreements, contract and specification, disputes, lease, etc., compensation, arbitration overhead charges risk analysis schedules, biddings, bye laws , safety measures and clauses, quality management, reliability arrangement information systems.

CONCERETE DAMS

L	T	P	C
3	1	0	4

Generals, forces acting on dams, requirements for stability, general procedure for the design of gravity dams, gravity analysis, internal stress distribution, stress concentration, internal stress calculating, graphical determination of shear stress, simplified gravity analysis, stress coefficients high and low dams, zoning in dams, galleries in dams, stress distribution, quality of materials, instrumentation in concrete dams, analysis of arch dams.

Reference Book:

1. R.S.Varshney: Concrete Dams.
2. Justin, Hinds, Creager Et Al: Engineering for dams, Wiley Eastern.

STOCHASTIC HYDROLOGY

L	T	P	C
3	1	0	4

Characteristics of hydrologic phenomena, random phenomena and their distribution, geometric probability, Marcov chains, mathematical expectation and variation of random variables, concept of risk and uncertainty in hydrology, empirical distribution of hydrologic variables, probability distribution, function in hydrology, sampling theory, testing of hypothesis, correlation and regression multivariate, analysis, auto correction and cross correlation, spectral components in hydrologic series, intermittent hydrological process.

REFERENECE BOOK:-

1. V.T.Chow: Hand Book of Applied hydrology.
2. V.Yevjevich: Probability and statistic in hydrology.
3. V.Yevjevich: Stochastic Process in hydrology.
4. P.Jayarami Reddy: Stochastic Hydrology, Laxmi Publications, Delhi.

DESIGN OF HYDRAULIC STRUCTURE

L	T	P	C
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Part (a)

Theory of elasticity.

Part (b)

1. Regulators: analysis and design.
2. Channel transitions.
3. Gages in hydraulic installations.
4. Navigational Locks: Methods of design of floor and foundation locks wall and gates.
5. Hydraulic models.

REFERENCE BOOKS:

1. Grishin MM: Hydraulic Structures, Vol-I & II.
2. Serge Lelliavsky: Design text book in civil engineering, Vol-I & II.

HYDRO ELECTRIC ENGINEERING

L	T	P	C
3	1	0	4

1. Basic postulates of turbine design, frequently used turbines, main dimensions of turbines.
2. Design of Power House: hydraulic and structural.
3. Vibration in hydroelectric installations.
4. Surge Chambers: analysis and design.
5. The water way: Intakes, canals, power tunnels, penstocks.

REFERECENCE BOOKS:-

1. Serve Liliavsky: Design text books in civil engineering, Vol-8.
2. Guthri Brown: Hydroelectric engineering practical, Vol-I.
3. H.K.Barrows: Water power engineering.