LIST OF SUBJECTS

Subject Code	Name of the Subject	Credits
14CE3053	Wetland Hydrology	3:0:0
14CE3054	Fundamentals of Coastal Engineering	3:0:0

14CE3053 WETLAND HYDROLOGY

Credits: 3:0:0

Course Objectives:

- To impart knowledge on hydrology of wetland ecosystems
- To introduce the students to the management and conservation of wetlands

Course Outcomes:

- Students are enabled to learn aspects of wetland management and conservation
- Students learnt the significance of wetlands in catchment and coastal hydrology

Definition of wetland; Classification of wetlands; Wetlands types according to Ramsar Bureau; Hydrologic features of aquatic ecosystems, terrestrial ecosystems and wetland ecosystem; Significance of hydrology in wetland studies; Hydroperiod-Signature of a wetland; Water balance of wetland, residence time, turnover time; Conceptual model showing relationship between hydrologic, chemical and biological processes; Chemical cycles in wetlands; Water management and conservation values of wetlands – recharging, flood containing, water purification, agriculture, aquatic tourism, drinking water, inland navigation, fisheries, biodiversity; Concept of wise use of wetlands; Integrated river basin management in relation to wise use of wetlands; Sustainability concept in relation to wetland management; Estimation of exchange processes in estuaries-modified tidal prism method, coefficient of eddy diffusivity, flushing time; Sediment dynamics; Case studies: Impact of manmade structures on downstream wetlands, Success stories in wetland conservation- Chilika and Loktak.

Reference Books

1. William J. Mitsch, James G. Gosselink, "Wetlands", John Wiley & Sons. Copyright. Inc, 2007.
2. S.E. Jorgensen,"Wetland Modelling", Elsevier Science Publishers B.V, 1988.
3. Gilman,"Hydrology and wetland conservation", Wiley, 1994.
4. Deanne Hickey,'The Role of Wetland Hydrology on Vegetative Structure in a Coastal Wetland Environment', University of Sydney, 2009.
5. Jos T.A. Verhoeven, Boudewijn Beltman, Roland Bobbink, Dennis F. Whigham., 'Wetlands and Natural Resource Management', Springer-Verlag Berlin Heidelberg,2006
6. Warwick Bishop, "Modelling Wetland Hydrodynamics",Monash University, 1999.

14CE3054 FUNDAMENTALS OF COASTAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To introduce the basics of coastal engineering
- To enable students to appreciate coastal management problems

Course Outcomes:

- Students learnt the design of basic harbour structures
- Students enabled to have better understanding of hydrodynamics and coastal processes

Coastal geomorphology; Introduction to winds, waves and maritime structures;Classification of waves; Formation of waves; Simple wave theories-Cnoidal theory; SMB and energy based methods of wave prediction; Wave reflection; Wave refraction; Wave diffraction; Coastal erosion and accretion processes; Coastal protection structures – breakwaters and sea walls; Consideration of hydrodynamics in the design of harbour structures; Harbour protection works-breakwaters and jetties; Case studies of Cochin, Madras, Vishakhapatnam harbours; Case studies on erosion and accretion – Malabar and Coromandel coasts.

Reference Books:

1. Robert M. Sorensen, "Basic Coastal Engineering", 2nd edition, Springer Science+ Business Media, Inc, 1997.
2. A. Vallega, "Fundamentals of Integrated Coastal Management", Kluwer Academic Publishers, Netherlands, 1999.
3. Timothy Beatley, David Brower, Anna K. Schwab, "An Introduction to Coastal Zone Management", 2nd edition, Island Press,2002.
4. J. W. Kamphuis, "Introduction to Coastal Engineering and Management", 2nd edition, World Scientific Publishing Co. Pte.Ltd.,2010
5. A. M Muir Wood,"Coastal hydraulics".,New York, Gordon and Breach, 1969.
6. Dominic Reeve, Andrew Chadwick, Christopher Fleming, "Coastal Engineering: Processes, Theory and Design Practice", Spon press, 2004.
7. Shore Protection Manual Vol 1, Coastal Engineering Research Centre, Department of the Army, Wachrieays Experiment Station, Corps of Engineering, Wichsbarg, Mississippi, the US, 1984

LIST OF SUBJECTS

Subject Code	Name of the Subject	Credits
14CE3026	Introduction to IWRM	3:0:0
14CE3027	Hydrologic Processes	3:0:0
14CE3028	Groundwater Hydrology	3:0:0
14CE3029	Systems Analysis	3:0:0
14CE3030	Computational Methods and Techniques	3:0:0
14CE3031	Participatory Water Management	3:0:0
14CE3032	Water Resources Planning and Development	3:0:0
14CE3033	Irrigation Water Management	3:0:0
14CE3034	Fundamentals of MATLAB programming	3:0:0
14CE3035	Water Quality Laboratory	0:0:2
14CE3036	Hydrology Practicals	0:0:2
14CE3037	Computational Laboratory	0:0:2
14CE3038	Environmental Impact Assessment	3:0:0
14CE3039	Isotope Techniques in Water Resources Management	3:0:0
14CE3040	Water and Wastewater Treatment	3:0:0
14CE3041	IWRM Implementation - Case Studies	3:0:0
14CE3042	Open Channel Flow & Sediment Transport	3:0:0
14CE3043	Basic Hydraulic Structures	3:0:0
14CE3044	Remote Sensing and GIS	3:0:0
14CE3045	Forest, Urban and Agricultural Watershed Management	3:0:0
14CE3046	Advanced Remote Sensing	3:0:0
14CE3047	Ecosystem Management	3:0:0
14CE3048	Electrochemical Water Processing and Water Treatment	3:0:0

14CE3026 INTRODUCTION TO IWRM

Credits 3:0:0

Course Objectives:

- Concepts of IWRM to be introduced and the inter-disciplinary nature highlighted
- Students will be exposed to sustainable water resources management, water security and public-private partnership issues
- Briefed about integrated multi-sectoral and multi-dimensional issues in developing water resource management plans

Course Outcomes:

- Students enabled to plan integrated water resources development projects considering sustainability aspects
- Students capacitated to take up water management projects from a multi-objective and multi-purpose perspective
- Students prepared for taking up other subjects related to IWRM

IWRM: definition and principles; water crisis-national and global; concepts of ‘blue’ and ‘green’ water; holistic or ecosystem approach; impact of global climate change on water resources; sustainable water resources development: Dublin conference and national water policy, river basin and small watershed approach, water allocation, environmental flows; water related environmental problems: floods, droughts, sedimentation, water logging, groundwater depletion, pollution due to urban sewage and industrial effluents as well as agro-chemicals; water borne and related diseases; water conservation and development: rainwater harvesting, artificial recharge, conjunctive use, interbasin transfer; sanitation and health care; water economics: virtual water and water security, PPP, conflict resolution, private water market; awareness creation and participatory approach.

Reference Books

1. Negi S.S., "Integrated Watershed Management", Oriental Enterprises, 2001
2. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York, 2003.
3. Cap-Net, Tutorial on Basic Principles of Integrated Water Resources Management, Cap-Net, IRC, IWMI, HRWallingford, IUCN, WSS, UNDP (www.cap.net.org).
4. Integrated Water Resources Management Plans, Training Manual and Operational Guide, CIDA, 2005.
5. Training Course Report in Water Assessment in Sub-Saharan Africa: Prediction in Unguaged and Data Scarce Basins, 21-25 January 2008, Cap – Net
6. Vinita Bhati. "India's Water Resources: Planning and Management", Universal Scientific, 2003
7. Technical Advisory Committee, "Integrated Water Resources Management", Technical Advisory Committee Background Paper 4. Global Water Partnership, Stockholm, Sweden. 2002.
8. Technical Advisory Committee, "Poverty Reduction and IWRM" Technical Advisory Committee, Background paper 8. Global Water Partnership, Stockholm, Sweden, 2003.

14CE3027 HYDROLOGIC PROCESSES

Credits: 3:0:0

Course Objectives:

- To provide a basic knowledge on different components of hydrologic cycle
- To impart practical experience in hydrological data acquisition, analysis and interpretation on temporal and spatial scales

Course Outcomes:

- Students enabled to analyse basic hydrologic data
- Students learnt basics of data management system
- Students capacitated to estimate water availability

Introduction to earth sciences; hydrologic cycle; Precipitation:types of precipitation, conventional and modern techniques of measurement,analysis and interpretation of data- missing data, double-mass analysis, isohyets, Thiessen polygon, unit-hydrograph; basics of land based hydrologic cycle; evaporation: estimation using Thornthwaite and Penman-Monteith methods; estimation of evapotranspiration using Lysimeter; infiltration: infiltration index, losses; interception;runoff estimation; streamflow measurement; unit hydrograph; flood estimation: unit hydrograph, flood frequency analysis, flood routing; sedimentation in reservoirs;

Reference Books

1. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, I994 (II Edition).
2. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.
3. Maidment, D.R. (editor), "Handbook of Hydrology". McGraw-Hill, New York,I993
4. Linsley, R., M. K., and Paulhus, J., "Hydrology for Engineers", McGraw Hill, I975.
5. Ragunath H.M., "Hydrology", Wiley Eastern Ltd., New Delhi, 1994.
6. Singh V.P., "Elementary Hydrology", Prentice Hall of India, New Delhi, I994.

14CE3028 GROUNDWATER HYDROLOGY

Credits: 3:0:0

Course Objectives:

- To introduce the students to the processes of groundwater occurrence, distribution and movement of ground water
- To equip the student with analytical techniques to solve basic groundwater problems

Course Outcomes:

- Students enabled to solve groundwater related problems including response of aquifers to pumping wells
- Students made capable to develop a basic model for contaminant transport in subsurface media

Occurrence and movement of groundwater; groundwater in hydrologic cycle; subsurface distribution; groundwater budget; classification of aquifers; physical properties: Darcy's law, hydraulic head, permeability, hydraulic conductivity, porosity, void ratio, transmissivity, storativity, steady state flow and transient flow; groundwater hydraulics: uniform and radial flow, Theis, Dupit and Theim methods for estimation of drawdown; pumping test ; contaminant transport processes: advection, dispersion, diffusion, reactions; ; surface and groundwater interactions; types of wells, measurement and interpretation of groundwater level data; ; saltwater intrusion;

Reference Books

1. Fetter C. W., "Applied Hydrogeology", Merril Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Willey & Sons Inc., 2007.
4. Bear, J.," Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Thangarajan,M., "Groundwater: Resource Evaluation, Augmentation, Contamination, Restoration, Modeling and Management", Capital Pub., 2006.
6. Freeze A. R., and Cherry J. A., "Groundwater", John Willey Publishers, 1979.

14CE3029 SYSTEMS ANALYSIS

Credits: 3:0:0

Course Objectives:

- Students will be introduced to application of systems concept to water resources planning and management
- Students will be exposed to optimization techniques for modeling water resources systems

Course Outcomes:

- Students learnt to simulate the operation of a reservoir system
- Students enabled to frame operation policies

Concepts of systems analysis: definition, approach to water resources planning and management; optimization: objective function and constraints, types of optimization; linear programming: formulation, simplex method, applications in reservoir operation; dynamic programming: forward and backward recursive dynamic programming, curse of dimensionality, application in resource allocation and reservoir capacity expansion; simulation: basic concepts, Monte Carlo techniques, reservoir simulation models; water resources management: reservoir operation and water allocation policy

Reference Books

1. Vedula, P.P., and Mujumdar, S., "Water Resources Systems: Modelling Techniques and Analysis", Tata-McGraw Hill, 2005
2. Gupta, P.K., and Man Mohan, "Problems in Operations Research (Methods and Solutions)", Sultan Chand and sons, New Delhi (Seventh Edition). I995.
3. Leonard Douglas James and Robert Rue Lee, "Water Resources Economics" Oxford Publishers, 2005.
4. Bhave, P. R., "Optimal Design of Water Distribution Networks", Narosa Publishing house, 2003.
5. Hiller F.S., and Liebermann G.J., "Operations Research", CBS Publications and Distributions, New Delhi (IInd edition). 1992.
6. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill Inc., New Delhi. I997.
7. Rao, S. S., "Optimization: Theory and Applications", Wiley Eastern, 1978.

14CE3030 COMPUTATIONAL METHODS AND TECHNIQUES

Credits: 3:0:0

Course Objectives:

- To develop skills in computational techniques and programming for developing and validating simple models in hydrology
- To improve computing knowledge for applications in water resources management

Course Outcomes:

- Students enabled to solve the water resources management issues using computational techniques and application software
- Students learnt to assess, predict and forecast water quality using heuristic techniques

Description:

Numerical methods: Taylor series, initial and boundary value problems, finite difference scheme; curve fitting: linear, multiple and polynomial regression; data reduction technique: factor analysis; histogram; scatter diagram; soft computing techniques: basics of artificial neural networks, fuzzy logic and their application in water resources management; modeling: types of models, steps in modeling, calibration, verification and validation; parameter estimation; sensitivity analysis; application softwares: basics of hydrologic models, introduction to Visual MODFLOW, SWAT, WEAP.

Reference Books

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. Rao,S.S., "Applied Numerical Methods for Engineers and Scientists", Prentice-Hall, 2002.
3. John E. G., "Introduction to Hydraulics and Hydrology with Applications for Stormwater Management", DELMAR, Thomson Learning, USA, 2002.
4. Remson I., Hornberger G.M., and Moiz F.J., "Numerical Methods in Sub-Surface Hydrology", Wiley Inter Science, 1985.
5. Stephen A, T., "Hydrology for Water Management", A.A.Balkema Rotten Publications,1999.
6. Vijay P. S., "Kinematic Wave Modelling in Water Resources-Surface Water Hydrology", John Wiley and Sons Inc, 1996.

14CE3031 PARTICIPATORY WATER MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To introduce students to the concept of participation, participatory development and practice of participation in management of water resources
- To help students to learn the practice of participatory appraisal, planning, implementation and management of water resources

Course Outcomes:

- Students realized the importance of participatory approach in water resources sector
- Students enabled to plan and monitor water management projects in a participatory mode
- Students capacitated to introduce social concepts in water management

Description:

Basic concepts of sociology: social system, development, concept and stages; concept of participation and principles, Participatory Rural Appraisal (PRA): principles, pillars of PRA, SHG and their roles, participatory development; water user association in irrigation; participation in drinking water sector, planning of watershed projects; tools and techniques: semi-structured interview, times lines, participatory mapping, livelihood analysis; SWOT analysis; micro lift irrigation system; report writing; process reporting and documentation; field visit and appraisal.

Reference Books

1. Neela Mukherjee, "Participatory Rural Appraisal: Methodology and Applications", Concept Publishing Company, 1993ISBN8170226376, 9788170226376
2. Narayanasamy N., "Participatory Rural Appraisal-Principles, Methods and Application", Gandhigram Rural University, Tamil NaduSAGE Publications Pvt. Ltd
3. Andrea Cornwall, "Pathways to Participation-Reflections on Participatory Rural Appraisal", Garrett Pratt Publishers.
4. Robert Chambers, "The Origins and Practice of Participatory Rural Appraisal", Institute of Development Studies, Brighton.
5. Robert Chambers, "Rural Appraisal", 1997.
6. ABC of PRA: Attitude Behavior Change, 1996.
7. Robert Chambers, "Rural Appraisal: Rapid, Relaxed and Participatory", University of Sussex, IDS.

14CE3032 WATER RESOURCES PLANNING AND DEVELOPMENT

Credits: 3:0:0

Course Objectives:

- To impart knowledge on national water policy envisaged to develop water resources
- To introduce the diversion and storage schemes in water resources development

Course Outcomes:

- The students capacitated to implement conventional and non-conventional methods in planning water resources projects
- The students enabled to apply management strategies in the areas of excess and deficit water imbalances

Description:

Water resources planning: concepts, functions, phases, data requirement; National policy objectives; planning strategies and implementation of water resources projects; constitutional provisions; economic policy: shadow pricing on project cost; calculation of shadow pricing of water supply; international funding agencies; distribution of water; reservoir planning and sizing; mass flow methods; reservoirs in parallel and series; flood routing; types of dams; flood control and management: flood cushioning, embankment and dykes, forecast, flood proofing; preliminary concepts in development of Decision Support System in water resources projects.

Reference Books

1. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, 1987
2. Cech Thomas V.," Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York. 2003
3. Goodman, A.S., and David, C., " Principles of Water Resources Planning", Prentice Halle College Div., 1983
4. Stephenson, D., and Petersen,M.S., "Water Resources Development in Developing Countries", Elsevier Science, 1991.

14CE3033 IRRIGATION WATER MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To introduce soil-water-plant relationships in the context of irrigation
- To introduce the concepts of scheduling, water distribution, design and methods of irrigation

Course Outcomes:

- Students learnt estimation of crop water and irrigation requirements
- Students enabled in implementing major medium irrigation projects

- Students capacitated in selecting appropriate irrigation methods

Description:
Irrigation: need, importance, impact on development of humanity, development in India; National Water Policy and irrigation, canal, tank irrigation; crop water requirement of different crops; infiltration; soil-water-plant relationships; soil quality; Duty of water; supply and demand based water distribution; irrigation scheduling; frequency and interval of irrigation;Warabandhi system; different irrigation methods: border irrigation, furrow irrigation, basin irrigation, drip and sprinkler irrigation; irrigation methods: consideration of slope, soils and climate, evaluation, wetting pattern and planting techniques, efficiency; case studies

Reference Books

1. Majumdar D. P., "Irrigation Water Management: Principles and Practices", Prentice Hall of India, New Delhi, 2005.
2. DewasishChoudhary, "Irrigation Theory and Practice", Anmol Pub., 2008.
3. Michael A.M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.
4. Van den Bosch B.E., Hoevenaars J. and Broumer C., "Irrigation Water Management Training Manual" No.1 to 7, FAO, Rome, 1999.
5. Asawa G.L., "Irrigation Engineering", New Age International Private Limited, New Delhi, 1996.

14CE3034 FUNDAMENTALS OF MATLAB PROGRAMMING

Credits 3:0:0

Course Objectives:
- To introduce the elements and application of computer programming through the MATLAB mathematical computing environment

Course Outcomes:
- Students enabled to apply MATLAB in their project work
- Students learnt to tackle other procedural languages for computing,

Description:
Basic Matlab programming: algorithm, pseudo-code, flowchart, interface, data types -expressions, constants, variables, assignment statement, arrays; control statements: if,else,then, while, for loop, nested loop, swtich/case; functions and scripts; formatted input and output statements; reading from and writing to a text file; sorting; basic plotting: 2D and 3D plots, figures and sub plots; introduction to GUI: graphics handling, objects, uicontrol.

Reference Books

1. Holly M., "MATLAB for Engineers", Prentice Hall, 3rd Edition, 2012.
2. Rudra P., "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
3. Duane, C.H., "Mastering MATLAB", Pearson Education Inc., 2012
4. Amos, G., "MATLAB: An Introduction with Applications", 4rth Edition, 2011.

14CE3035 WATER QUALITY LABORATORY

Credits: 0:0:2

Course Objectives:
- To make the students carry out the water quality analysis using analytical methods in the laboratory
- To help the students to understand the principles of instrumentation in water quality analysis

Course Outcomes:
- Enabled the students to carry out water quality assessment in project work
- Enabled the students to come out with suitable water treatment methods

EXPERIMENTS

Water sampling; physical and chemical analysis of water and wastewater quality: pH, conductivity , total dissolved solids, turbidity, colour, total, suspended, dissolved solids and volatile soilds, chloride, sulphate, hardness, alkalinity, acidity, dissolved oxygen, BOD, COD, iron, copper, chromium, nitrate, fluoride, sodium and potassium.

Reference Books

1. "Standard Methods for the Examination of Water and Wastewater", 14th ed, American Public Health Association, Washington, DC.
2. Vogel, A.I., "Inorganic Quantitative Analysis", - VI Edition, Prentice Hall Inc., 1998
3. Sawyer, C.N., McCarty, P.L., and Parkin, G.F.," Chemistry for Environmental Engineers", IV Edition, McGraw Hill, New Delhi, 1994

14CE3036 HYDROLOGY PRACTICALS

Credits: 0:0:2

Course Objectives:

- To impart practical knowledge in hydrologic processes
- To help the students in understanding the practical implications of aquifer parameters

Course Outcomes:

- Students gained better understanding of physical processes and phenomena involved in the evaluation and prediction of water movement in all phases of the hydrologic cycle
- Students capacitated to develop groundwater flow and transport models

EXPERIMENTS

Rainfall measurement and determination of mass curve and hyetograph from obtained data; Φ- index by double ring type infiltrometer; measurement of permeability; rate of evaporation; pumping test; crop water requirement; grain size analysis; hydraulic conductivity; tracer test; electrical resistivity method

Reference Books:

1. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, I994 (II Edition).
2. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.
3. Maidment, D.R. (editor), "Handbook of Hydrology". McGraw-Hill, New York,I993
4. Linsley, R., M. K., and Paulhus, J., "Hydrology for Engineers", McGraw Hill, I975.
5. Ragunath H.M., "Hydrology", Wiley Eastern Ltd., New Delhi, 1994.
6. Singh V.P., "Elementary Hydrology", Prentice Hall of India, New Delhi, I994.

14CE3037 COMPUTATIONAL LABORATORY

Credits; 0:0:2

Course Objectives:

- To apply computational techniques in the analysis of interactions of hydrology in regional water resources systems

Course Outcomes:

- Students learnt to develop programs to better understand and analyse numerical solutions for linear and nonlinear hydrologic systems
- Students enabled to develop forecasting and prediction models using statistical methods and artificial intelligence techniques

EXPERIMENTS

Regression and correlation; numerical analysis; factor analysis; artificial neural network; fuzzy logic; application of SPSS; WEAP; curve fitting; contaminant transport using finite difference scheme.

Reference Books

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. John, E. G., "Introduction to Hydraulics and Hydrology with Applications for Stormwater Management", DELMAR, Thomson Learning, USA, 2002.

14CE3038 ENVIRONMENTAL IMPACT ASSESSMENT

Credits: 3:0:0

Course Objectives:

- To enable students to acquire necessary skills to assess the impact of water resources projects
- To help students in taking necessary steps to bring down the adverse impacts

Course Outcomes:

- Students developed skills to assess the environmental impacts of different projects
- Students gained knowledge to suggest suitable recommendations to reduce the impacts on the environment

Description:

Introduction to EIA: elements of EIA, factors affecting; preparation of base map; methods of EIA: criteria selection; Ad-hoc methods, matrix and network method, overlay method; cost benefit analysis; hydrological, ecological, social, cultural and human health impacts; soil, landscape and ecosystem changes; environmental auditing: objectives, types, protocol, stages of environmental audit, evaluation of audit data and preparation of report; case studies and EIA statement.

Reference Books

1. John, G., Riki, T., Andrew, C., "Introduction to Environmental Impact Assessment", Routledge Taylor& Francis Group, III Edition, 2005.
2. Prabhakar, V.K., "Environmental Impact Assessment", Anmol Publications, 2001.
3. Marriott, Betty B., "Environmental Impact Assessment: a Practical Guide", McGraw-Hill, 1997.
4. Richard, K.M., "Environmental Impact Assessment- a Methodological Perspective", Kluwer Academic Publishers, 2002.

14CE3039 ISOTOPE TECHNIQUES IN WATER RESOURCES MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To introduce the student to emerging tools such as isotope hydrology
- To demonstrate the application of this tool to solve simple practical problems in hydrology and water resources engineering

Course Outcomes:

- Students enabled to apply isotope footprints in identifying the recharge sources, pollution source, salt water intrusion
- Students learnt to estimate isotope footprints for water resources study

Description:

Introduction to isotopes: elements, stable and radio active isotopes, isotopic characteristics, isotopic fractionation; Isotope measurement techniques: mass spectrometer, isotopic footprints; partitioning of isotopes; Deuterium excess and source identification; tracing the hydrologic cycle; Rayleigh distillation; application of isotopes in surface and

groundwater hydrology: streamflow measurement, lake dynamics, groundwater recharge process, saltwater intrusion, migration of pollutants, groundwater velocity.

Reference Books

1. Rao, S.M., "Practical Isotope Hydrology", New India Publishing Agency, 2006.
2. Mook W.G. (Editor), "Environmental Isotopes in Hydrological Cycle, Principles and Applications", IHP-V, Technical Documents in Hydrology, No 39, Vol 1, UNESCO, Paris, 2000.
3. "Use of Artificial Tracers in Hydrology", Proc. Adv. Group Meeting, Vienna, IAEA, 1990.
4. Kendall, C.,and McDonnell J.J., "Isotopes in Catchment Hydrology", Elsevier, 1998.

14CE3040 WATER AND WASTEWATER TREATMENT

Credits: 3:0:0

Course Objectives:

- To make the student learn about the issues involved in water and wastewater quality aspects
- To make the student understand the physical, chemical and biological techniques available for managing water quality.

Course Outcomes:

- Students enabled to undertake projects on water and waste water management and also to design the treatment units.

Description:

Water and wastewater characteristics; population forecast; water demand analysis; temporal and spatial variation of quantity in water; water supply/distribution system; wastewater collection systems; introduction to primary, secondary and tertiary treatment units; physical unit operations: screeing, commutation, grit chamber, sedimentation tank; secondary treatment units: aerobic and anaerobic processes, activated sludge process, trickling filter, rotating biological contactor, nitrification, fluidized bed; tertiary treatment system: coagulation, flocculation, filtration, disinfection, aeration, precipitation, softening, adsorption, ion exchange, membrane technology; natural wastewater treatment units: ponds and lagoons, surface and groundwater treatment, low cost sanitation, soak pits, bioremediation.

Reference Books

1. Metcalf and Eddy, "Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition , Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995.
2. Casey T.J., "Unit Treatment Processes in Water and Wastewater Engineering", John Wiley & Sons England 1993.
3. Stuetz R., T Stephenson, "Principles of Water and Wastewater Treatment Processes", IWA Publications, 2009
4. Kuruvilla M., Stewart D., Goen Ho, "Decentralized Water and Wastewater Systems", IWA Publications, 2008.

14CE3041 IWRM IMPLEMENTATION: CASE STUDIES

Credits: 3:0:0

Course Objectives:

- To improve the understanding and awareness of gender concepts, the water law and policy, economic and social drivers for effective and efficient water sector management
- To provide a general idea on emerging issues in the field of water resources management.

Course Outcomes:

- Students enabled to implement IWRM in the field
- Students capacitated to achieve sustainable development of water resources through IWRM principles

Description:
Gender issues: historical framework, gender perspective, approach; institutional capacity; water economics: need for financial tools, water pricing, full water costs and values; cost benefit analysis for water related projects, cost recovery ; water uses and rights; water law and policy: goal and strategies, water policy in India, power, function and regulatory role of government departments, water auditing and monitoring, institutional mechanisms: laws and administrative structure, corporate organization, participatory planning, incentives for water quality enhancement, PPP; rehabilitation and resettlement.

Reference Books

1. "Gender Analysis and Reform of Irrigation Management: Concepts, Cases, and Gaps in Knowledge", Proceedings of the Workshop on Gender and Water, 15-19 September 1997, Habarana, Sri Lanka. IWMI, 1998. Environmental Publications from UNEP
2. "The Gender Approach to Water Management", Findings of an Electronic Conference Series, Gender and Water Alliance. January - September 2002. Published for the Gender and Water Alliance by WEDC.www://wedc.lboro.ac.uk/ publications/]
3. Technical Advisory Committee, "Regulation and Private Participation in Water and Sanitation sectors", Technical Advisory Committee Background paper No: 1. Global Water Partnership, Stockholm, Sweden. 1998.
4. Technical Advisory Committee, "Dublin Principles for Water as Reflected in Xomparative Assessment of Institutional and Legal Arrangements for Integrated Water Resources Management", Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
5. Technical Advisory Committee, "Water as Social and Economic Good: How to Put the Principles to Practice". Technical Advisory Committee Background paper No: 2. Global water Partnership, Stockholm, Sweden. 1998.
6. Technical Advisory Committee, "Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global Water Partnership, Stockholm, Sweden. 2003.

14CE3042 OPEN CHANNEL FLOW & SEDIMENT TRANSPORT

Credits: 3:0:0

Course Objectives:

- To impart knowledge on qualitative and quantitative understanding of water and sediment flows in natural rivers
- To understand the concepts of stream hydraulics

Course Outcomes:

- Students enabled to predict and model the basic hydrologic and geomorphologic processes, erosion, sediment transport

Description:
Introduction to fluvial hydraulics; stream networks; environmental and hydraulic variables; meandering and braided reaches; basic mathematical concepts in fluid continuum and fluid element; kinematics and dynamics; microscopic and macroscopic continuity relation; momentum and energy conservation equations; diffusion equation; dimensional analysis; water surface profiles: normal and critical depth, computation using theoretical basis and standard step method; basics of sediment movement: bed and suspended load, sediment yield, forces on sediment particles; Universal Soil Loss Equation; reservoir sedimentation.

Reference Books

1. Lawrence Dingman, S., "Fluvial Hydraulics", Oxford University Press, 2009
2. Chaudry, M.H., "Open-Channel Flow", Prentice Hall, New Jercy, 1993
3. Chow, V.T., "Open Channel Hydraulics", McGraw- Hill, 1959.
4. Graf, W.H., 'Fluvial Hydraulics: Flow and Transport Processes in Channels of Simple Geometry", John Wiley and Sons, 1998.
5. Jain, S.C., "Open-Channel Flow", John Wiley and Sons, New York, 2001.

6. Chein, N., Wan, Zhaohui, "Mechanics of Sediment Transport", ASCE press, 1999.

14CE3043 BASIC HYDRAULIC STRUCTURES

Credits: 3:0:0

Course Objectives:

- To introduce the basic concepts of flow
- To understand the canal networks and onfarm structure operation and maintenance

Course Outcomes:

- Students enabled to design canals and canal networks
- Students learnt to design water conservation structures

Description:
Basics of fluid mechanics; spatially and rapidly varied flow computations; sediment transport: bed load and suspended load; groundwater movement: Darcy's law, drawdown, influent and effluent streams; basic design: canals and drainage, irrigation channels, canal masanory work; basic design of water conservation structures: artificial recharge, rainwater harvesting, yield, losses; minor irrigation structures: river intakes, canal network, canal sluice, canal outlet; introduction to major hydraulic structures

Reference Books

1. Varshney. R.S., Gupta. S.C. and Gupta.R.L., "Theory and Design of Irrigation Structures", Nemchand& Brothers ,Roorkee, 1992.
2. Sharma. R.K., "Irrigation Engineering and Hydraulic Structures", Oxford and IBH Publishing Co., New Delhi, 1984.
3. Garg. S.K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, NewDelhi, 2002.
4. Arora, K.R. "Irrigation Water Power and Water Resources Engineering", Standard Publishers Distributors, Delhi, 2002.

14CE3044 REMOTE SENSING AND GIS

Credits: 3:0:0

Course Objectives:

- To teach the principles and applications of remote sensing, GPS and GIS in the context of water resources.

Course Outcomes:

- Student enabled to apply Remote sensing and GIS tools to solve the spatial problems in water resources.

Description:
Basics of remote sensing: concepts, EMR and its interaction with atmosphere, soil, surface, water and vegetation; remote sensing platforms: LANDSAT, SPOT, ERS, IKONOS, scanners, radiometers; digital image processing: preprocessing, enhancement, classification, merging; introduction to GIS: components, map projections, raster and vector data, topology; hierarchical, network, relational models; data types, quality and meta data; spatial analysis: thematic layers, query analysis, measurement, reclassification, buffering, interpolation; raster and vector overlay; network analysis, DEM, TEM; applications: rainfall-runoff modeling, water quality mapping, landuse/landcover change/flood inundation mapping, site selection.

Reference Books

1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation", 3rd Edn., John Wiley and Sons, New York. 1993.
2. Burrough. P.A. and McDonnell. R.A., "Principles of Geographical Information Systems", Oxford University Press, New York. 1998.

3. Ian Heywood Sarah, Cornelius and Steve Carver, "An Introduction to Geographical Information Systems", Pearson Education, New Delhi, 2002.
4. John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, 1995.
5. Paul Curran P.J., "Principles of Remote Sensing", ELBS, 1995.
6. Burgh P.A., "Principles of Geographic Information System for Land Resources Assessment", Clarendon Press, Oxford, 1986.
7. Lo.C.P., Yeung. K.W. Albert, "Concepts And Techniques of Geographic Information Systems", Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

14CE3045 FOREST, URBAN AND AGRICULTURAL WATERSHED MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To make the student learn the underlying hydrologic science and processes associated with the flow of water through forested watersheds
- To impart knowledge on the nutrient budget, agricultural management practices

Course Outcomes:

- Students enabled to plan and develop a watershed
- Students learnt techniques for soil erosion control, flood management and storm management

Description:

Watershed development: definitions, integrated and multidisciplinary approach; watershed characteristics: size, slope, shape, physiography; watershed delineation; forest watershed management: forests and hydrologic processes, forests and water flows; agricultural watershed management: impacts of agricultural activities on soil and water, nutrient budget; soil and water conservation; monitoring and evaluation of water development projects; urban watershed management: urbanization and hydrology, water supply and stormwater management, landuse planning; water and green building.

Reference Books

1. Murthy, J.V.S., "Watershed Management "New Age International Publishers, 1998.
2. Martin, M.K., Daniel T.R., and Kent, S.M., "Urban Watersheds: Geology, Contamination, and Sustainable Development", CRC press, Taylor & Francis Group, 2011
3. Bernier, P.Y., Woodard, P.D., "Forest Hydrology and Watershed Management", IAHS Press, 1987,
4. Ghanshyam D., "Hydrology and Soil Conservation Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi. 2000.
5. Tideman E. M., "Watershed Management". Omega Scientific Publishers", New Delhi. 1996.

14CE3046 ADVANCED REMOTE SENSING

Credits: 3:0:0

Course Objectives:

- To familiarize the students of the principles of remote sensing
- To know the procedures of data acquisition and analysis of satellite data

Course Outcomes:

- Students enabled to interpret digital images and use it in GIS softwares
- Students learnt toanalyse satellite images for various studies.

Description:
Electromagnetic interactions (EMR): radiance, incident, reflected; scattering of EMR: Rayleigh, Mie, Raman scattering; spectral signatures; image interpretation; false colour composites; data acquisition: types of aircrafts, platforms, sensors and scanners: sun synchronous and geo-synchronous satellites, across track and along track scanners, thermal scanners, calibration; principles of hyper spectral remote sensing: imaging spectroscopy; spectral library; RADAR: basics, SAR interferometry, polarimetry, grammetry; altimeter; scatterometer; digital image processing: visual interpretation, spatial, spectral and temporal resolution, ratiometric correction.

Reference Books

1. Lillesand T.M. and Kiefer,R.W., "Remote Sensing and Image interpretation", VI edition of John Wiley & Sons-2000.
2. John R. Jensen , "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, 1995.
3. John A.Richards, "Remote Sensing Digital Image Analysis", Springer –Verlag, 1999.
4. Paul Curran P.J., " Principles of Remote Sensing", ELBS; 1995.
5. Charles Elachi and Jakob J. van Zyl , "Introduction to the Physics and Techniques of Remote Sensing" , Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F.Jr., "Remote Sensing Principles and Image interpretation",W.H.Freeman& Co, 1978.

14CE3047 ECOSYSTEM MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To develop an understanding on the ecosystem and its management to natural resources stewardship.
- To develop preliminary knowledge of ecosystem modeling for developing management plans

Course Outcomes:

- Students developed skills to examine the ecologic, economic and social processes and apply sustainable practices into management plan and policies

Description:
Aquatic ecosystems: lentic, lotic, marine ecosystems; functions and biodiversity; food chain and food web; nutrient and energy flow; carbon sequestration; forest, land, desert ecosystems; wetlands and ponds, Detrius based treatment; chemistry of ecosystem; properties of water: pE-pH diagram, acid –base chemistry; instrumentation: ecosystem models; sustainable loading; self orgainisng design and process.

Reference Books

1. Kangas, P.C., and Kangas, P., "Ecological Engineering: Principles and Practice", Lewis Publishers, New York, 2003.
2. Sawyer, C.N., McCarty, P.L., and Parkin, G.F.," Chemistry for Environmental Engineers", IV Edition, McGraw Hill, New Delhi, 1994
3. Etnier, C. and Guterstam, B., "Ecological Engineering for Wastewater Treatment", Lewis Publishers, New York, 1997.
4. Odum, E.P., "Basic Ecology", Saunders & Co., Philadelphia. 1984
5. Gary K. M., Larry A. N., Richard L. K., and Dennis A. S., "Ecosystem Management Adaptive, Community-Based Conservation". Island Press, Washington, DC. 2002.

14CE3048 ELECTROCHEMICAL WATER PROCESSING AND WATER TREATMENT

Credits: 3:0:0

Course objectives:

- To introduce the basic concepts of electrochemistry
- To help the students understand the electrochemical approaches for waste water treatment

Course Outcomes:

- Students would be enabled to undertake projects on waste water treatment by electrochemical approaches.

Description:

Basic aspects of electrochemistry; chemistry and electricity: electrochemical cells; transport of charge potentials and the electromotive series; biociding technology; electrolytic production of free halogens-chlorination; metal ion removal and metal recovery; electrochemical process for the removal of iron in acid baths; electrodialysis: performance characteristics, applications; chemical coagulation and electrocoagulation in water treatment; electroflotation: electrochemical reactions and gas generating rate; electrodes arrangement; typical cell design combination of ED with EC.

.

Reference Books

1. Ralph Zito, "Electrochemical Water Processing", Wiley 2011
2. Derek Pletcher, "Industrial Electrochemistry", Chapan and Hall Ltd 1982.
3. Stephen K. Lower, "Electrochemistry- Chemical reactions at an electrode, galvanic and electrolytic cells", 2004.
4. C. Comninellis and G. Chen., "Electrochemistry for the environment" Springer 2010.