M.E. IRRIGATION WATER MANAGEMENT

OBJECTIVES

1. To enable the students for a successful career as water management professionals.
2. To create a potential among students in the area of irrigation management with specific enrichment to synthesis of data and their analysis.
3. To expose the students the need for an interdisciplinary approach in irrigation water management and providing a platform to work in an interdisciplinary team.
4. To provide students an ability to understand the applications of mathematical and scientific concepts to analyse intricate technical, social and environmental problems in irrigation water management and finding solutions for them.
5. To promote student awareness for a life-long learning process and inculcate professional ethics and codes of professional practice in water management.

OUTCOME

At the end of this P.G Programme the students will be in a capacity to

1. Understand the concepts of soil-water-plant relationship as well as to expose them to the principles and practices of crop production.
2. Exposure to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related irrigation system management
3. Understand the various principles of irrigation management and to analyse the different types of irrigation systems and their performances based on service oriented approach.
4. To gain insight on local and global perceptions and approaches to participatory water resource management and to learn from successes and failures in the context of both rural and urban communities of water management.
5. Exposure on the use of economic concepts in irrigation development and to impart knowledge on economic planning so as to enable viable allocation of resources in the irrigation sector.

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M. E. IRRIGATION WATER MANAGEMENT

CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	IW8101	Advanced Irrigation Engineering	3	0	0	3
2	IW8102	Soil Science and Agronomy	3	1	0	4
3	IW8152	Water Quality	3	0	0	3
4	MA8161	Statistical Methods for Engineers	3	1	0	4
5		Elective I	3	0	0	3
6		Elective II	3	0	0	3
PRACTICAL						
7	IW8111	Advanced Irrigation Engineering Laboratory	0	0	2	1
8	IW8161	Water Quality Laboratory	0	0	2	1
		TOTAL	**18**	**2**	**4**	**22**

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	HW8253	Remote sensing and GIS for Water Resources	3	0	0	3
2	HW8254	Systems Analysis in Water Resources	3	0	0	3
3	IM8251	Climate Change and Water Resources	3	0	0	3
4	IW8251	Irrigation Management	3	0	0	3
5	IW8252	Groundwater and Drainage Engineering	3	0	0	3
6		Elective III	3	0	0	3
PRACTICAL						
7	HW8262	GIS Laboratory	0	0	4	2
		TOTAL	**18**	**0**	**4**	**20**

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	IW8301	Participatory Irrigation Management	3	0	0	3
2	IW8351	Irrigation Economics	3	0	0	3
3		Elective IV	3	0	0	3
PRACTICAL						
4	IW 8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

Attested

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SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	IW8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 69

ELECTIVES FOR M. E. IRRIGATION WATER MANAGEMENT

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	IW8001	Micro Irrigation Engineering	3	0	0	3
2	CM8151	Wave Hydrodynamics	3	0	0	3
3	CM8251	Coastal Engineering	3	0	0	3
4	HW8071	Flood Modelling and Drought Assessment	3	0	0	3
5	HW8072	Research Methodology for Water Resources	3	0	0	3
6	HW8073	River Engineering	3	0	0	3
7	HW8075	Water Supply and Buried Pipelines	3	0	0	3
8	HW8076	Water Power and Dam Engineering	3	0	0	3
9	HW8351	Computational Intelligence for Hydro Systems	3	0	0	3
10	HW8353	Water and Environment	3	0	0	3
11	IM8071	Environmental Impact Assessment of Water Resources Development	3	0	0	3
12	IM8153	Gender and Water	3	0	0	3
13	IM8155	Water and Ecosystems	3	0	0	3
14	IM8252	Participatory Field Research Methodology	3	1	0	4
15	IM8351	Legal Aspects of Water Resources	3	0	0	3
16	IM8352	Watershed Conservation and Management	3	0	0	3
17	IW8071	Rehabilitation and Modernisation of Irrigation systems	3	0	0	3

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M. E. IRRIGATION WATER MANAGEMENT

CURRICULUM AND SYLLABUS I TO VI SEMESTERS (PART TIME)

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA8161	Statistical Methods for Engineers	3	1	0	4
2	IW8152	Water Quality	3	0	0	3
3		Elective I	3	0	0	3
PRACTICAL						
4	IW8161	Water Quality Laboratory	0	0	2	1
		TOTAL	**9**	**1**	**2**	**11**

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	HW8254	Systems Analysis in Water Resources	3	0	0	3
2	IW8252	Groundwater and Drainage Engineering	3	0	0	3
3		Elective II	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	IW8101	Advanced Irrigation Engineering	3	0	0	3
2	IW8102	Soil Science and Agronomy	3	1	0	4
3		Elective III	3	0	0	3
PRACTICAL						
4	IW8111	Advanced Irrigation Engineering Laboratory	0	0	2	1
		TOTAL	**9**	**1**	**2**	**11**

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	HW8253	Remote sensing and GIS for Water Resources	3	0	0	3
2	IW8251	Irrigation Management	3	0	0	3
3	IM8251	Climate Change and Water Resources	3	0	0	3
PRACTICAL						
4	HW8262	GIS Laboratory	0	0	4	2
		TOTAL	**9**	**0**	**4**	**11**

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SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	IW8351	Irrigation Economics	3	0	0	3
2	IW8301	Participatory Irrigation Management	3	0	0	3
3		Elective IV	3	0	0	3
PRACTICAL						
4	IW8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	IW8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 69

M. E. IRRIGATION WATER MANAGEMENT

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	IW8001	Micro Irrigation Engineering	3	0	0	3
2	CM8151	Wave Hydrodynamics	3	0	0	3
3	CM8251	Coastal Engineering	3	0	0	3
4	HW8071	Flood Modelling and Drought Assessment	3	0	0	3
5	HW8072	Research Methodology for Water Resources	3	0	0	3
6	HW8073	River Engineering	3	0	0	3
7	HW8075	Water Supply and Buried Pipelines	3	0	0	3
8	HW8076	Water Power and Dam Engineering	3	0	0	3
9	HW8351	Computational Intelligence for Hydro Systems	3	0	0	3
10	HW8353	Water and Environment	3	0	0	3
11	IM8071	Environmental Impact Assessment of Water Resources Development	3	0	0	3
12	IM8153	Gender and Water	3	0	0	3
13	IM8155	Water and Ecosystems	3	0	0	3
14	IM8252	Participatory Field Research Methodology	3	1	0	4
15	IM8351	Legal Aspects of Water Resources	3	0	0	3
16	IM8352	Watershed Conservation and Management	3	0	0	3
17	IW8071	Rehabilitation and Modernisation of Irrigation systems	3	0	0	3

Attested

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IW8101 ADVANCED IRRIGATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To expose the students, the concept of Irrigation management.
- To introduce the concepts of Soil-water-plant relationship from the context of irrigation water management.
- To train the students to evaluate the efficiency of surface irrigation systems, Productivity of irrigation systems and their performance.
- To train the students to design different micro irrigation systems and select suitable methods.

UNIT I DEVELOPMENT OF IRRIGATION 6

Water Resources of India - Irrigation- Need, Advantages and Disadvantages, History of Irrigation development in India- National Water Policy- Inadequacy of Irrigation Management- Criteria for good Irrigation management.

UNIT II SOIL WATER PLANT RELATIONSHIP 9

Soil physical properties influencing Soil-water relationship-Forms and occurrence of Soil Water- Classification of Soil Water- Soil Water Constants- Energy concept of Soil Water-Forces acting on Soil Water- Soil Water Potential concept- Soil Water retention- Soil Moisture Measurement.

UNIT III CROP WATER REQUIREMENT 9

Water requirement of crops- Evapotranspiration and Consumptive use- Methods of estimating Evapotranspiration- Effective Rainfall- Irrigation Requirement-Duty of Water- Irrigation Efficiencies- Irrigation Scheduling- Irrigation measurement.

UNIT IV SURFACE IRRIGATION METHODS 9

Canal network and canal design- Surface irrigation methods- Types- Border irrigation, Furrow irrigation and Strip irrigation- Specifications, Hydraulics and Design.

UNIT V DRIP AND SPRINKLER IRRIGATIN METHOD 12

Sprinkler and Drip- History and development, Types, Components, Design and Layout, Performance Evaluation, Operation and Maintenance.

TOTAL:45 PERIODS

OUTCOMES:

- Students will understand the concept of soil-water-plant relationship and can apply it to schedule irrigation.
- Students can design surface, drip and sprinkler irrigation systems for various crops

REFERENCES:

1. Majumdar D. P., "Irrigation Water Management Principles and Practices", Prentice Hall of India, New Delhi, 2004.
2. Michael A. M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 2009.
3. "Irrigation and Drainage", Paper 24. "Crop Water Requirement". FAO, Rome, 1992 Reprint.
4. "Irrigation and Drainage" paper 56. "Crop Evapotranspiration: guidelines for computing crop water requirements", FAO, Rome 1998.
5. Sharma R.K and Sharma T.K., "Irrigation Engineering", S.Chand, New Delhi, 2008.

IW8102 SOIL SCIENCE AND AGRONOMY L T P C
3 1 0 4

OBJECTIVE:

- To introduce the students to soils from a crop production perspective, as well as to expose them to the principles and practices of crop production.

UNIT I SOILS AND THEIR CLASSIFICATION 10

Introduction– soil forming rocks and minerals- Soil forming processes, profile development – Major soil types of India and U.S. System of soil Taxonomic classification - Soil survey, Land capability classes and Remote sensing techniques.

UNIT II SOIL-WATER-RELATIONSHIPS 9

Soil physical properties – Soil water relation - Soil water potential and its components – Kinds of water in soil - Soil moisture characteristic curve – Moisture constants – Entry, retention and flow of water in the root zone – Concept of plant-available water – Methods of measurement of soil moisture and matric tension- soil irrigability

UNIT III SOIL FERTILITY AND PRODUCTIVITY 9

Plant nutrition-Essential and beneficial elements, Physiological role of nutrients, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants- soil reaction –Life in the soil - soil fertility– Fertility vs. productivity – Problems of salinity and sodicity.

UNIT IV PRINCIPLES OF AGRONOMY AND CROP PRODUCTION 12

Meaning and scope of Agronomy, Relationship with other sciences– Role of agronomy – Influence of genetic and environmental factors on crop growth – Growth stages of crops – Biological and economic yield– Cropping systems – Tillage and tilth – Seeds and sowing – Density and plant arrangement – Manures and fertilizers – Weed management – Plant protection, including the concept of Integrated Pest Management - Harvesting.

UNIT V CROP PRODUCTION PRACTICES 5

Crops and cropping pattern and production practices for crops of importance in Tamil Nadu: rice; cereals and millets; grain legumes; oilseed crops; and cash crops such as sugarcane, cotton and banana - Agroclimatic zones of Tamil Nadu.

THEORY 45+ TUTORIAL 15 = TOTAL 60

OUTCOME:

- Students would have knowledge of soils and crops, which they can beneficially use as specialists in irrigation water management.

REFERENCES:

1. Brady N.C., "The Nature and Properties of Soil". Prentice-Hall of India Pvt. Ltd. New Delhi. 1995.
2. Raymond W., Miller., Roy L. and Donahue. "Soils In Our Environment". Prentice-Hall of India Pvt. Ltd. New Delhi. 1997.
3. Edward J. Plaster. "Soil Science. Cengage" Learning India Pvt. Ltd. New Delhi. 2009.
4. ICAR, "Hand Book of Agriculture". Indian Council of Agricultural Research, New Delhi. 1999.
5. Chapman S.R. and Carter L.P., "Crop Production Principles and Practices," W.H. Freeman and Co., New York. 1976.
6. Morachan Y.B., "Crop Production and Management". Oxford and IBH Publishing Co., New Delhi. 1984.
7. DOA, Crop Production Guide. Directorate of Agriculture, Government of Tamil Nadu, Chepauk, Chennai. 1999.

Attested

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IW8152 **WATER QUALITY** **L T P C**
3 0 0 3

OBJECTIVES:

- These courses introduce water quality concepts, its evaluation for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
- At the end of the course, the students will understand the importance of water quality for irrigation and major uses of water and the role environmental issues.

UNIT I WATER QUALITY **10**

Physical and chemical properties of water – Suspended and dissolved solids – EC and pH – major ions –. Water quality investigation – Sampling design - Samplers and automatic samplers - Data collection platforms – Field kits – Water quality data storage, analysis and inference – Software packages

UNIT II IRRIGATION WATER QUALITY **9**

Water quality for irrigation – Salinity and permeability problem – Root zone salinity - Irrigation practices for poor quality water – Saline water irrigation – Future strategies

UNIT III WATER POLLUTION **10**

Sources and Types of pollution – Organic and inorganic pollutants - BOD – DO relationships – impacts on water resources – NPS pollution and its control – Eutrophication control - Water treatment technologies - Constructed wetland.

UNIT IV RECYCLING AND REUSE OF WATER **8**

Multiple uses of water – Reuse of water in agriculture – Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units – Reverse osmosis and desalination in water reclamation.

UNIT V WATER QUALITY MANAGEMENT **8**

Principles of water quality – Water quality classification – Water quality standards - Water quality indices – TMDL Concepts – Water quality models.

TOTAL 45 PERIODS

OUTCOMES:

- Students could relate water quality and its dependence on sources of water pollution.
- Students would understand and interpret water quality data for beneficial uses and in water quality models.

REFERENCES:

1. George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Wastewater Engineering: Treatment and Reuse", McGraw-Hill, 2002.
2. Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2nd edition, John Wiley & Sons, , 2003
3. Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGraw-Hill 2006.
4. Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985.
5. Lloyd, J.W. and Heathcote, J.A., "Natural inorganic chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988.

MA8161 STATISTICAL METHODS FOR ENGINEERS L T P C
3 1 0 4

OBJECTIVES:

- To study and understand the concepts of Statistical methods and its applications in Engineering.
- To study the effect of estimation theory, testing of hypothesis, correlation and regression, randomized design, and multivariate analysis.

UNIT I ESTIMATION THEORY 9+3

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS 9+3

Tests based on Normal, t, X^2 and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION 9+3

Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties of Residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and Partial correlations in terms of lower order co-efficient.

UNIT IV DESIGN OF EXPERIMENTS 9+3

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS 9+3

Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

L: 45 + T : 15 TOTAL : 60 PERIODS

OUTCOME:

- On completion of this course the students will be able to solve various problems in the field of engineering employing probability and statistical methods.

REFERENCES:

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, 2002
2. J.E. Freund, "Mathematical Statistical”, 5th Edition, Prentice Hall of India, 2001.
3. Jay L.Devore, “Probability and statistics for Engineering and the Sciences”, 5th Edition, Thomson and Duxbury, Singapore, 2002
4. Murray.R. SpiegelandLarry J.Stephens, “Schaum’sou Tlines- Statistics”, Third Edition, Tata McGraw-Hill, 2000
5. R.A.Johnson and C.B.Gupta, “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 7th Edition, 2007
6. Richard A.Johnson and Dean W.Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2007

IW8111 ADVANCED IRRIGATION ENGINEERING LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To train the concepts of Soil-water-plant relationship.
- To train the students to evaluate the efficiency of surface irrigation systems and their performance.
- To train the students to design different micro irrigation systems and evaluate the same.

LIST OF EXPERIMENTS

1. Collection of data on Agro-meteorological parameters.
2. Determination of Bulk density and Specific gravity of Soil
3. Determination of Textural classification of Soil
4. Determination of Soil Moisture for Irrigation Scheduling
5. Measurement of Infiltration in Soil
6. Demonstration on measurement of plant Transpiration
7. Flow measurement in irrigated Channels
8. Flow measurement in Close Conduits
9. Evaluation of surface and micro irrigation systems.

TOTAL : 30 PERIODS

OUTCOMES:

- Students will be able to observe and record weather data and analyse them. They could measure the flow, estimate the evapotranspiration etc.
- Students will be able to analyse and interpret soil physical and chemical properties.
- Students will be able to evaluate performance of irrigation systems.

IW8161 WATER QUALITY LABORATORY L T P C
0 0 2 1

OBJECTIVE:

- To expose students in field and laboratory methods in water quality.

LIST OF EXPERIMENTS

1. Demo of water quality kit
2. Field estimations
3. Water sample collection and transport
4. Introduction to analytical laboratory
5. Hydrochemical methods
6. Selection of suitable methods
7. Measurement of turbidity, solids, pH and EC
8. Measurement of major ions
9. Measurement of minor ions / nutrients
10. Demo of BOD and COD estimations
11. Calculation of SAR, Hardness, Alkalinity
12. Evaluation of water quality for irrigation purposes

TOTAL : 30 PERIODS

OUTCOME:

- Students will able to estimate water quality using current methods and make evaluation of it for beneficial uses.

REFERENCE

1. US EPA, APHA, AWWA, "Standard Methods for the Examination of Water and Wastewater", 22th edition, APHA, NY, 2012.

HW8253 REMOTE SENSING AND GIS FOR WATER RESOURCES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To teach the principles and applications of remote sensing, GPS and GIS in the context of water resources. At the end of the course, the student will appreciate the importance of remote sensing and GIS in solving the spatial problems in water resources.

UNIT I REMOTE SENSING **8**

Physics of remote sensing, electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation; Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS and others, Indian Space Programme.

UNIT II DIGITAL IMAGE PROCESSING **8**

Satellite Data analysis - Visual interpretation – Digital image processing – Image preprocessing – Image enhancement – Image classification – Data Merging.

UNIT III GEOGRAPHIC INFORMATION SYSTEM **9**

Definition – Basic components of GIS – Map projections and co-ordinate system – Spatial data structure: raster, vector – Spatial Relationship – Topology – Geodatabase models: hierarchical, network, relational, object oriented models – Integrated GIS database -common sources of error – Data quality: Macro, Micro and Usage level components - Meta data - Spatial data transfer standards.

UNIT IV SPATIAL ANALYSIS **9**

Thematic mapping – Measurement in GIS: length, perimeter and areas – Query analysis – Reclassification – Buffering - Neighbourhood functions - Map overlay: vector and raster overlay – Interpolation – Network analysis –Digital elevation modelling. Analytical Hierarchy Process, – Object oriented GIS – AM/FM/GIS – Web Based GIS

UNIT V WATER RESOURCES APPLICATIONS **11**

Spatial data sources – 4M GIS approach water resources system – Thematic maps - Rainfall-runoff modelling – Groundwater modeling – Water quality modeling - Flood inundation mapping and Modelling – Drought monitoring – Cropping pattern change analysis –Performance evaluation of irrigation commands. Site selection for artificial recharge - Reservoir sedimentation.

TOTAL : 45 PERIODS

OUTCOMES:

- Introduce the technology and principles of Satellite Imaging
- Theoretical explanations on Image processing and information extraction from Satellite Data Products
- Functional elucidation of GIS integrating Satellite Data Products into the GIS platform for Decision making
- Potential of remote sensing and GIS is solving problems in water resources through case studies.

REFERENCES:

1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation" 3rd Edition. 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. Centre for Water Resources, Change in Cropping Pattern in Drought Prone Chittar Sub-basin, Project Report, Anna University, Chennai, 2002.
5. Centre for Water Resources, Post-Project Evaluation of Irrigation Commands

HW8254 **SYSTEMS ANALYSIS IN WATER RESOURCES** **L T P C**
3 0 0 3

OBJECTIVE:

- Students will be introduced to application of systems concept to water resources planning and management. Optimization technique for modeling water resources systems and advanced optimization techniques to cover the socio-technical aspects will be taught.

UNITI SYSTEM CONCEPTS **7**

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 **9**

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 **9**

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 **9**

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 **11**

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.

TOTAL: 45 PERIODS

OUTCOME:

- At the completion of the course the students will be able to understand the system behaviors and know how to apply the various simulation and optimization techniques to resolves the various socio-technical aspects of water resources systems.

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.
7. Wagner H.M., "Principles of Operations Research with Application to Management Decisions", Prentice Hall, India, New Delhi, 1993.

IM8251	CLIMATE CHANGE AND WATER RESOURCES	L T P C 3 0 0 3

OBJECTIVES:

- Understanding the climate system, being aware of the impact of climate change on society, Understanding of adaptation in relation to water and climate change.
- At the end of the course, students must be in a position to describe the possible impacts, adaptations and remedies in relation to water resources and climate change.

UNIT I THE CLIMATE SYSTEM 9

Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate system components - Green house effect – Carbon cycle – Wind systems - Trade Winds and the Hadley Cell – Ozone hole in the stratosphere - El Nino, La Nina – ENSO, Teleconnections

UNIT II IMPACTS OF CLIMATE CHANGE – OBSERVED AND PROJECTED 9

Global Scenario – Indian Scenario – Observed changes and projected changes of IPCC - Impacts on water resources – NATCOM Report –Impacts on sectoral vulnerabilities – SRES – Different scenarios

UNIT III TOOLS FOR VULNERABILITY ASSESSMENT 9

Need for vulnerability assessment – Steps for assessment –Approaches for assessment – Models – Quantitative models, Economic model, Impact matrix approach - Box models - Zero-dimensional models - Radioactive-convective models - Higher-dimension models - EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – Sectoral models

UNIT IV ADAPTATION AND MITIGATION 9

Water-related adaptation to climate change in the fields of Ecosystems and biodiversity, - Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) - Adaptation, vulnerability and sustainable development Sector-specific mitigation - Carbon dioxide capture and storage (CCS) , Bio-energy crops, Biomass electricity, Hydropower, Geothermal energy, Energy use in buildings, Land-use change and management, Cropland management, Afforestation and Reforestation - Potential water resource conflicts between adaptation and mitigation - Implications for policy and sustainable development.

UNIT V CASE STUDIES 9

Water resources assessment case studies – Ganga Damodar Project , Himalayan glacier studies, Ganga valley project - Adaptation strategies in Assessment of water resources- Hydrological design practices and dam safety- Operation policies for water resources projects - Flood management strategies - Drought management strategies - Temporal & spatial assessment of water for Irrigation - Land use & cropping pattern - Coastal zone management strategies.

TOTAL: 45 PERIODS

OUTCOMES:

- To orient towards the global climate change and its impact on water resources.
- To understand the climate change phenomenon and its related issues on water, irrigation and its social implications.

REFERENCES

1. IPCC Report Technical Paper VI – "Climate change and water" , 2008.
2. "UNFCC Technologies for Adaptation to climate change, 2006.
3. P R Shukla, Subobh K Sarma, NH Ravindranath, Amit Garg and Sumana Bhattacharya, Climate Change and India: Vulnerability assessment and adaptation, University Press (India) Pvt Ltd, Hyderabad.
4. Preliminary consolidated Report on Effect of climate change on Water Resources, GOI, CWC, MOWR, 2008.

IW8251 **IRRIGATION MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:
- To expose the students the various principles of irrigation methods
- To inculcate the different types of irrigation systems and their performance based on service oriented approach.

UNIT I IRRIGATION DEVELOPMENT IN INDIA 9
Importance of Irrigation in Agriculture - Historical evolution of irrigation in India – Irrigation development during pre-colonisation – Colonisation and post-colonization – Different types of Irrigation prevalent in India: Warabandi, Shejpali and South Indian systems - Focus of Irrigation in India – Command area development approach and farmers' participation.

UNIT II IRRIGATION SYSTEMS AND PERFORMANCE INDICATORS 9
Systems classification - Institutions for irrigation management–Diagnostic Analysis of Irrigation Systems -Rehabilitation and modernization – Performance indicators – Improving system performance – Conjunctive management – constraints faced.

UNIT III MAIN SYSTEM MANAGEMENT 9
Main system components – Reservoir allocation rule, Operating rule and optimization methods to improve main system performance - irrigation scheduling – Constraints.

UNIT IV COMMAND AREA DEVELOPMENT AND PARTICIPATORY IRRIGATION MANAGEMENT 9
Command area development principles – Participatory Irrigation Management and Irrigation management transfer – Case studies – Constraints.

UNIT V IRRIGATION POLICY AND INSTITUTIONS 9
Present status of irrigation policy and institutions – Irrigation related conflicts – Institutional transformation needed – Constraints in effecting institutional transformation – Irrigation financing – Water pricing – Water market – Policy changes.

TOTAL: 45 PERIODS

OUTCOMES:
- The students will be able to understand an irrigation system, its components, its performance, and management of irrigation complexities to tackle different issues.
- The students will acquire knowledge about the need for participatory approach and irrigation management transfer along with irrigation policy and institutional aspects.

REFERENCES:

1. "Rakesh Hooja, Management of Water for Agriculture: Irrigation, Water sheds and Drainage" Rawat Publications, New Delhi, 2006.
2. Kijne, J.W., Barker, R and Molden, D ,"Water Productivity in Agriculture; Limits and Opportunities for improved" CABI Publishing, Walling ford, U.K, 2003.
3. Giodano.M and Villbolth K.G, "The Agricultural Ground Water Revolution -Opportunities and threats to development" CABI Publishing, Walling ford, U.K, 2007.

IW8252 **GROUNDWATER AND DRAINAGE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:
- Students will be exposed to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related work.
- They will learn about the latest developments in ground water applications to drainage on the basis of a clear understanding of the principles of drainage engineering.

UNIT I GROUND WATER COMPONENT AND MOVEMENT 8

Occurrence of Ground water – Utilization – Ground water component in hydrologic cycle – Geological formations – Types of aquifers and their characteristics – Ground water movement – Darcy's Law – Flow through layered soils – Stream Lines and Equipotential Lines – Boundary Conditions.

UNIT II GROUND WATER HYDRAULICS 10

Steady and unsteady flow of ground water– Ground water recharge – Dupuit-Forchheimer assumptions - Subsurface flow into drains – Steady and unsteady state drainage equations – Seepage from river into aquifers – Seepage from open channels.

UNIT III DRAINAGE PRINCIPLES AND CRITERIA 9

Factors to be considered in land drainage – Combined irrigation and drainage systems - Water balance – Equations for water balance – Drainage surveys – Agricultural drainage criteria – Effect of field drainage systems on agriculture.

UNIT IV SALINITY CONTROL 9

Salinity in relation to irrigation and drainage – Soil Salinity and Sodicity- Salt balance of the root zone – Salinisation due to capillary rise - Leaching process – Long term salinity level – Sodium Hazard of Irrigation Water – Reclamation of salt affected soils – Bio drainage – Environmental aspects of drainage.

UNIT V DESIGN AND MANAGEMENT OF DRAINAGE SYSTEMS 9

Drainage materials – Surface drainage systems, their components and applications in sloping areas – Subsurface drainage systems – Mole drainage - Tube well irrigation - Drainage application and design – Management and maintenance of drainage systems.

TOTAL: 45 PERIODS

OUTCOMES:

- This course impacts knowledge about the need for irrigation drainage system and its design.
- In addition it enabled to manage the salinity problems and leaching process.

REFERENCES:

1. Todd D.K. "Ground Water Hydrology", John Wiley and sons, Inc, New York, 1976.
2. Raghunath, H.M., "Ground Water, 2nd edition, Wiley Eastern Ltd., New Delhi, 1987.
3. Kessler J., "Drainage Principles and Applications" Vol. II and IV, International Institute of Land Reclamation and Improvement, Netherlands. 1979.
4. Ritzema H.P., 'Drainage Principles and Applications", Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands. 1994.
5. Bhattacharya A.K. and Michael A.M., "Land Drainage Principles, Methods and Applications", Konark Publishers Pvt. Ltd., New Delhi. 2003.

HW8262 GIS LABORATORY L T P C

0 0 4 2

OBJECTIVE:

- The hands on experiments in the image processing, GIS platforms and GPS will make the students to appreciate their importance in hydrology and water resource.

LIST OF EXPERIMENTS

- Georeferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
- Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
- Creation of Digital Elevation Model using Vertical Mapper.
- GPS Survey and its data transformation into GIS environment.
- Converting *.tab file to *.shp & vice versa using Universal Translator.
- Transformation of Google files to GIS environment.

- Creation of Vorronoi / Theissan diagram for points using MapInfo/ArcGIS.
- Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.
- Interpolation of point data to create Spatial Maps.
- Overlay Analysis using ArcGIS.

TOTAL: 60 PERIODS

OUTCOMES:

- Expertise in digital image processing
- Good exposure to the Global positioning system in real time data processing
- Potential of Geographical Information System
- Data integration between Satellite data, GPS and GIS in Decision Making

IW8301 PARTICIPATORY IRRIGATION MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- At the completion of the course the students should be able to gain insight on local and global perceptions and approaches to participatory water resource management
- Learn from successes and failures in the context of both rural and urban communities of water management.

UNIT I FUNDAMENTALS OF SOCIOLOGY AND PARTICIPATORY APPROACH 6

Basic Sociological concepts and Definitions – Perspectives- Social inequality – Sociological understanding. - Irrigation as a Sociotechnical Process - Participatory approach – Necessity – Objectives of participatory approach

UNIT II UNDERSTANDING FARMERS PARTICIPATION 10

Why farmers participation –Benefits of farmers participation – Comparisons of cost and benefit - Sustained system performance - Kinds of participation –Activities on Water towards Organization and Structure - Context of participation, factors in the environment.

UNITIII ORGANIZATIONAL DESIGN AND IMPROVING AGENCY RELATIONS 9

Membership and decision making – Leadership and responsibilities – Development strategy – Channels for implementation –– Equity and Equality- Agency Incentives- Technical co-operation – Special roles – Agency Roles.

UNIT IV POLICY CONSIDERATIONS 10

Building from Below-Existing Organisation- Ownership-Non-political Associations-Bureaucratic Reorientation

UNIT V ROLE OF STAKEHOLDERS IN IRRIGATION 10

Multiple use of water – Issues in Intersectoral Water Allocation - Domestic, Irrigation, Industrial sectors – Participation of women –. Role of Community Organisers – Constraints in Organising farmers Organisation – Supporting farmer organization and participation.

TOTAL: 45 PERIODS

OUTCOME:

- The organizational skills to manage resources can be acquired with coordinating and integrating both resources and stakeholders through participatory ideology.

REFERENCES

1. Desai A.R., "Rural sociology" in India, Popular Prakashan, Bombay, 1969.
2. Michael C.M., Putting people first, Sociology variables in Rural Development, Oxford University press, London 1985.

3. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, New West - View press, Boulder and London, 1986.
4. Chambers R., Managing canal irrigation, Oxford IBM publishing Co. Pvt. Ltd., New Delhi, 1998.
5. Korten F.F and Robert Y. Siy, Jr.,,Transforming a Bureaucracy – "The experience of the Philippines National Irrigation Administration", Ateneo De Manila University Press, Manila, 1989.
6. K. Sivasubramanium, "Water Management SIMRES Publication, Chennai 2009.
7. http://irapindia.org/IMTInIndia-PaperforCSD.pdf
8. http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf

IW8351 IRRIGATION ECONOMICS L T P C
3 0 0 3

OBJECTIVES:

- To provide an overall exposure on the use of economic concepts in irrigation development.
- To impart knowledge on economic planning so as to enable viable allocation of resources in the irrigation sector.

UNIT I SCOPE OF ECONOMICS 8

Scope of irrigation economics – Role of irrigation in economic development – Performance of agriculture in Indian economy: pre independent, post independent and post liberalisation scenario.

UNITII CONSUMPTION ECONOMICS 9

Concept of demand and supply – Tools of economic analysis – Price determination – Demand and consumer behavior – consumer surplus - Market analysis – Economic efficiency – Applications.

UNIT III PRODUCTION ECONOMICS 10

Production economics – Conventional approach – Non-conventional approach – Cobb Douglas, Spillman and other types of production functions – Data analysis for production function estimation - Cost, revenue, production and profit maximization approach.

UNIT IV FARM ECONOMICS 8

Concept of farm management – Farm records and budgeting – Whole farm and partial budgeting – Risk and uncertainty in farming – Case studies.

UNIT V FINANCIAL ANALYSIS 10

Role of financial analysis – Central and State financing – Economic instruments: water charges, cess, taxes, subsidies and compensation - Irrigation water pricing - Concept and methods of irrigation water pricing - Discounting factors and techniques – Applications of discounting techniques for irrigation project viability.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will understand the economic concepts useful for overall irrigation development based on the current trends of production, consumption and farm economics.
- The students will acquaint themselves in the allocation of resources and financial analysis in the irrigation sector.

REFERENCES:

1. Allan C. Deserpa, "Micro-economic theory – Issues and applications". Allyn and Bacon, Inc. Massachusetts. 1997.
2. Paul A. Samuelson and William D. Nordhaus, Economics. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2004.
3. S.A.R. Bilgrami, An introduction to Agricultural Economics. Himalaya Publishing House, Mumbai. 2006.

4. Douglas James L and Robert Lee, Economics of Water Resources Planning. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 1971.
5. Ronald D. Kay, Farm Management, Planning, Control and Implementation, McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.

IW8001 MICRO IRRIGATION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To stress the importance of micro irrigation methods, design and operation of sprinklers and drip irrigation methods
- To emphasize current developments in irrigation methods and the adoption of micro irrigation in the field.

UNIT I INTRODUCTION TO MICRO-IRRIGATION 7

Importance – classification of irrigation methods – classification of micro-irrigation methods – principles and selection of micro-irrigation systems – low pressure mini spray systems – bubbler system – sprinkler and drip system – irrigation efficiencies.

UNIT II SPRINKLER IRRIGATION SYSTEM AND DESIGN 10

Development – Use – Types – Portable, Semi portable and Permanent systems – Components – pumping – Main line – Lateral line – Sprinkler heads – Moisture distribution pattern and uniformity of coverage – Testing of water distribution pattern – Design of Sprinkler irrigation systems – Types of system and layout - Selection and spacing – Capacity of sprinkler system – Hydraulic design – Design of laterals – Cost estimation – Operation and Maintenance – trouble shooting – Application of Fertilizers – Fertilizer injection methods and Devices.

UNIT III DRIP IRRIGATION SYSTEM, DESIGN AND LAYOUT 10

Drip effect on water use – description of drip irrigation system – types – various methods – manufacturing drip equipments – low and high density polythene – main pipe – submains – laterals – emitters – dripper with hole and socket – micro tube emitters – nozzles – self adjusting drippers – double wall pipe – leaky pipe. Principles for design of drip system – hydraulic formulae Darcy Weishbach equation – Hazen Williams formulae – factors to be consider to the design of the system – design procedure –design of emitters, laterals, submains and main lines – head works – drip layout for different crops – field crops – close spaced crops – orchard crops – drip irrigation design and layout – model design.

UNIT IV WATER DISTRIBUTION AND FERTILIZER APPLICATION IN DRIP IRRIGATION 10

Effects of discharge rate of drip emitter – water movement under drip system – soil moisture distribution – soil water content – drainage flux – irrigation control by soil physical methods - Clogging – water quality and preventive measures – cleaning of clogged system – filtration problems and measures – gravel filters – vortex filters – other methods of filtering and prevention – clogging of outlets. Introduction and list of fertilizers – application of fertilizer – influence on general nutritional problems – fertilizers movement – fertilizing – existing fertilizer practices – continuous fertilizers – methods of applying fertilizers – volume of fertilizer tank – dilution ratio.

UNIT V ECONOMICS AND ADOPTION OF DRIP IRRIGATION IN INDIA 8

Adoption and Up scaling – Constraints for the farmers - Irrigation investment - possible economics in drip system – engineering design – Agronomic manipulation – commercial production – factors influencing economics of drip system – cost estimates – optimum farm size – economics and financial analysis – present status and application – case studies.

TOTAL: 45 PERIODS

OUTCOME:

- Students can design the micro irrigation systems (low cost and commercial) at the field level.

REFERENCES
1. Michael, A.M., “Irrigation Theory and Practice”, Vikas Publishers, New Delhi, 2000.
2. Dilip Kumar Majumdar., Irrigation Water Management, Prentice Hall Inc., 2004.
3. Dr. R. Suresh , “Principles of Micro-Irrigation Engineering”, Standard Publishers Distributors, New Delhi, 2010.
4. R.K. Sivanappan, “Sprinkler Irrigation”, Oxford and IBH Publishing Co, New Delhi, 1987.
5. J.Keller and D. Karmeli, “Trickle Irrigation Design”, Rainbird Sprinkler Irrigation Manufacturing Corporation, Glendora, California, USA.
6. Jack Keller and Rond Belisher., “Sprinkler and Trickle Irrigation”, Van nastrand Reinhold,New York, 1990.

CM8151 WAVE HYDRODYNAMICS L T P C
3 0 0 3

OBJECTIVE :
- To make the students be aware of the mass, moment and wave energy transformations, Wave kinematics and wave loads that are happening in nature and enable them in the prediction and analysis of sediment distribution along coastal areas, shore protection and hazard management.

UNIT I CONSERVATION OF MASS, MOMENT AND ENERGY 9
Conservation of mass, moment and Energy; Euler Equation – Bernoullis Equation. Potential and Stream function.

UNIT II CLASSIFICATION OF OCEAN WAVES 9
Linear wave theory : Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.

UNIT III WAVE KINEMATICS 9
Wave celerity, water particle velocities, accelerations, displacements and pressures. Approximations for deep and shallow water conditions. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.

UNIT IV WAVE TRANSFORMATIONS 9
Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number.

UNIT V WAVE LOADS 9
Non breaking wave forces on slender structures – Morison equation; Diffraction theory, source distribution method. Introduction to non-linear wave theories-Strokes, Cnoidal and Solitary wave theory. Mass transport velocity, Introduction to Random and directional waves.

TOTAL: 45 PERIODS

OUTCOME:
- Students become aware of wave energy transformations, wave kinematics and enable them in the prediction / analysis of sediment distribution along coastal areas, shore protection and hazard management.

REFERENCES:
1. Sarpkaya, T. and Isaacson, M., "Mechanics of Wave Forces on Offshore Structures", Van Nostrand Reinhold Co., New York, 1981
2. Dean, R.G. and Dalrymple, R.A., "Water wave mechanics for Engineers and Scientists", Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994

3. Ippen, A.T., "Estuary and Coastline Hydrodynamics", McGraw-Hill Book Company, inc., New York, 1978
4. "Shore Protection Manual Volume I and II, Coastal Engineering Research Centre, Dept, of the Army, US Army Corps of Engineers, Washington DC, 1984
5. Sorenson, R.M., "Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.
6. Goda,Y. 2000."Random seas and Design of Maritime Structures". 2nd ed. Advance Series on Ocean Engineering. Vol.15. World Scientific Publishers Pvt.Ltd. 443pp.
7. Young,I.R.1999. "Wind generated Ocean Waves". Ocean Engineering Book Series. Vol.2. Elsevier. The Netherlands. 288pp.
8. Narasimhan,S., S.Kathiroli,S.and B.Nagendra Kumar (Eds). 2002. "Harbour and Coastal Engineering (Indian Scenario)" Vol.I. NIOT, Chennai. 729pp.
9. Reeves, D, Chadwick,A and Fleming,C. 2004. Coastal Engineering. Processes "Theory and Design Practice". SPON Press, London. 461pp.

CM8251 COASTAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- The main purpose of coastal engineering is to protect harbors and improve navigation. The students to the diverse topics as wave mechanics, wave climate, shoreline protection methods and laboratory investigations using model studies.

UNIT I INTRODUCTION TO COASTAL ENGINEERING 9

Indian Scenario – Classification of Harbours. Introduction - wind and waves – Sea and Swell - Introduction to small amplitude wave theory – use of wave tables- Mechanics of water waves – Linear (Airy) wave theory, Introduction to Tsunami

UNITII WAVE PROPERTIES AND ANALYSIS 9

Behaviour of waves in shallow waters, Introduction to non-linear waves and their properties – Waves in shallow waters – Wave Refraction, Diffraction and Shoaling –Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.

UNIT III COASTAL SEDIMENT TRANSPORT 9

Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement

UNIT IV COASTAL DEFENSE 9

Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures –Case studies.

UNIT V MODELING IN COASTAL ENGINEERING 9

Physical modeling in Coastal Engineering – Limitations and advantages – Role of physical modeling in coastal engineering – Numerical modeling – Modeling aspects – limitations – Case studies using public domain models, Tsunami mitigation measures

TOTAL: 45 PERIODS

OUTCOME:

- Students will understand coastal engineering aspects of harbors methods to improve navigation, shoreline protection and other laboratory investigations using model studies and to use the skills and techniques in ICM.

REFERENCES:

1. Mani J.S., Coastal Hydrodynamics. PHI Pvt.Ltd. New Delhi – 2012.
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
3. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill, Inc., New York, 1978.
4. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Pub. New York, 1978.
5. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC, 2006.
6. Kamphuis, J.W., Introduction to Coastal Engineering and Management
7. Sorensen, R.M., "Basic Coastal Engineering", 3rd Edition, Springer, 2006.
8. Coastal Engineering Manual (CEM). US Army Coastal Engineering Research Center, 2002-2006. (http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;104)
9. Narasimhan S., Kathiroli S. and Nagendra Kumar B. "Harbour and Coastal Engineering (Indian Scenario)" Vol.I and II.NIOT Chennai 2002.

HW8071 FLOOD MODELLING AND DROUGHT ASSESSMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- This subject aims at making the students to understand the hydrologic extremes of floods and droughts, estimation of severity and extent of damages and the mitigation measures to combat them.

UNIT I FLOOD ESTMATION **9**

Hydrologic extremes – Flood – Types of Flood – Effects of Flood – Design Flood - SPF/MPF - Estimation of design flood – Physical Indicators - Envelope curves - Empirical methods – Rational method - Statistical methods – Frequency analysis – Unit hydrograph method.

UNIT II FLOOD MODELLING AND MANAGEMENT **9**

Hydrologic and Hydraulic Routing – Reservoir and Channel Routing - Flood Inundation Modelling – HEC HMS and HEC RAS softwares - Flood control methods – Structural and non structural measures - Flood Plain Zoning – Flood forecasting – Flood Mitigation - Remote Sensing and GIS for Flood modelling and management.

UNIT III DROUGHT AND IMPACTS **9**

Definition – Definitions based on rainfall, stream flow, vegetation and comprehensive aspects - Characterisation of Drought/water shortage/aridity/desertification - Types of Drought – NCA classification – Impacts of Drought – Environmental, Social and Economical aspects

UNIT IV DROUGHT ASSESSMENT **9**

Drought Severity Assessment – Meteorological Hydrological and Agricultural methods – Drought Indices – GIS based Drought Information system – Drought Vulnerability Assessment and Mapping Using GIS.

UNIT V DROUGHT MONITORING AND MANAGEMENT **9**

DPAP Programme - Drought Monitoring – Application of Remote sensing – Drought Mitigation – Proactive and Reactive Approach – Supply and Demand Oriented Measures – Long term and Short term Measures – Water Scarcity Management in Urban, Industrial and Agricultural sectors

TOTAL: 45 PERIODS

OUTCOMES:

- Students know the different methods of design flood estimation and perform channel reservoir routing. They carryout flood inundation modeling and suggest suitable flood control measures.
- Student acquires the knowledge about different types of drought and their impacts. They asses the severity, duration and frequency of drought using drought using drought indices.
- Students exposed to various approaches, measures and case studies of drought indices.

Attested

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Anna University, Chennai-600 025.

REFERENCES:

1. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.
2. Vijay P.Singh., "Elementary Hydrology", Prentice Hall of India, New Delhi, 1994.
3. Yevjevich V., "Drought Research Needs", Water Resources Publications, Colorado State University, USA, 1977.
4. Rangapathy V., Karmegam M., and Sakthivadivel R., Monograph in "Flood Routing Methods as Applied to Indian Rivers", Anna University Publications

HW8072 RESEARCH METHODOLOGY FOR WATER RESOURCES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce concepts of research process in hydrology and water resources and water management.
- To enable students to get basic understanding of scientific research methods.
- To develop capacity to independently analyse and define a research problem.

UNIT I SCOPE **10**

Objectives and types of research – Identification of research problem – Research process – Research design – Bibliography.

UNIT II SAMPLE **8**

Sampling theory and sampling design – Types of samples – Sources of data – Qualitative and quantitative data – Data collection methods.

UNIT III DATA **8**

Measurement levels and scaling – Types of errors – Sampling adequacy – Data collection and editing – Coding of data – Analysis and statistical inference.

UNIT IV REPORT **4**

Report preparation – Structure of report – graphs and illustration tools – Tables and charts – Draft – Finalising research report.

UNIT V DESIGN OF A RESEARCH PROJECT **15**

A mini project design

TOTAL : 45 PERIODS

OUTCOME:

- Students will understand applied research methods in Science and Engineering and will able to define and formulate a research problem independently.

REFERENCES:

1. Upagade. V and A.Shende, "Research Methodology", S.Chanda & Co., New Delhi, 2010.
2. Pannerselvam. R "Research Methodology", Prentice-Hall of India Private Ltd., New Delhi, 2007.

HW8073 RIVER ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand theoretical concepts of water and sediment movements in rivers
- To inculcate the benefits of fluvial system to the society

UNIT I RIVER FUNCTIONS 8

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 10

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

UNIT III RIVER MECHANICS 9

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 9

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 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to appreciate the complex behavior of rivers.
- They will gain the skills to take up research activities in river engineering.

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.

HW8075 WATER SUPPLY AND BURIED PIPELINES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To educate the students in detailed design concepts related to water transmission mains, water distribution system and buried pipes with emphasis on computer application

UNIT I WATER SUPPLY SYSTEMS 9

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 10

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.

Attested

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Anna University, Chennai-600 025.

UNIT III STORM WATER DISTRIBUTION AND BURIED PIPES 9

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 8

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

UNIT V FLUID TRANSIENTS 9

Basic equations of unsteady flows through closed conduits. Method of characteristics. Transients caused by centrifugal pumps and hydroelectric power plants.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to get a basic knowledge of the design of pipe networks.
- They will be able to analyze pipe network problems using computer software like EPANET2.0

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
7. 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

HW8076 WATER POWER AND DAM ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- The student is exposed to the design aspects of hydro-power plants, various components of hydropower plants and their layout.
- Different types of dams design taking into account the suitability of the site and the different type loads that are likely to be encountered.

UNIT I HYDROELECTRIC POWER DEVELOPMENT 9

Introduction – Types of power development – Classification. Planning – Environmental Considerations - Data requirement for assessment of hydropower. Components of hydropower.

UNIT II DESIGN OF HYDROPOWER INSTALLATION 9

Components – Intake structure – water conductor systems – tunnels – surge tanks – penstocks – valves – anchor blocks.

UNIT III TYPES OF POWER HOUSE 8

Underground – semi-underground. Turbines and their foundations – structural and geotechnical aspects of power house design.

UNIT IV EMBANKMENT DAM ENGINEERING 9

Introduction. Nature and classification of engineering soils. Principles of design. Materials and construction. Internal seepage. Stability and stress. Settlement and deformation. Rockfill and rockfill embankments.

UNIT V CONCRETE DAM ENGINEERING 10

Loading: Concepts and criteria. Gravity dam analysis. Buttress dam analysis. Arch dam analysis. Design features and construction. Concrete for dams. Roller Compacted Concrete (RCC) Dams. Dam safety and instrumentation. Foundation measurements. Analysis of strain data.

TOTAL: 45 PERIODS

OUTCOME:

- The students will be able to get a basic knowledge of planning and designing hydropower plants.

REFERENCES:

1. Novak, P., Moffat, A.I.B., Nalluri, C. and Narayanan, R. Hydraulic Structures Unwin Hyman Ltd., London 1989.
2. Dandekar, M.M. and Sharma, K.N. Water Power Engineering Vikas Publishing House, New Delhi 1994.
3. USBR Design of Small Dams Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 1974.
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HW8351 COMPUTATIONAL INTELLIGENCE FOR HYDROSYSTEMS L T P C

3 0 0 3

OBJECTIVE:

- To develop skills of the students in software usage for simulation and water resources management. To enable the students to understand application of the latest information technology to water resources engineering

UNIT I ADVANCED COMPUTING TECHNIQUES 10

Computer methods in water resources - Computing techniques - Solution to ordinary and partial differential equation using Finite difference and Method of Characteristics- Numerical integration and differentiation Design of digital models - Visual programming - Graphical user interface - Interactive model concepts.

UNIT II ARTIFICIAL INTELLIGENCE 10

Heuristic search - Principle of Artificial Neural Network (ANN) - Application of ANN Model to Hydrology and Crop Water Requirement model. Fuzzy Logic concepts and Applications – Genetic Algorithms-Heuristic Optimization techniques.

UNIT III DIGITAL DATA MANAGEMENT 10

Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

UNIT IV SIMULATION SOFTWARE IN WATER RESOURCES 8

Surface water models (HMS) - Storm Water Management Models (SWMM) –culvert hydraulic design(HY) – River Analysis system models (HEC-RAS)-Ground Water Flow models – Groundwater transport models.

Attested

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UNIT V SIMULATION MODELS IN IRRIGATION WATER MANAGEMENT 7

Soil water assessment simulation models (SWAT) - Basin simulation models (MITSIM, VASIM) Real time operation models - Water Resources Information System, Management Information System. Decision support system for Irrigation management.

TOTAL: 45 PERIODS

OUTCOMES:

- Students can able to enhance the computational knowledge in the field of water resources systems.
- Students could themselves develop the simulation models and use the latest intelligent technology and algorithms.

REFERENCES:

1. Aliev R. A, and Aliev Rashad "Soft Computing and its Applications" World Scientific Publications Co. Pte. Ltd. Singapore, 2001.
2. Janusz Kacprzyk *Applied Decision with Soft Computing* Springer, 2003
3. Carlos A. Coello Coello, David A Van Veldhuizen, Gary B Lamont, "Evolutionary Algorthms for Solving Multi-objective problems", Springer, 2002.
4. Tayfur Gökmen "Soft computing in water resources engineering", WIT Press, Great Britain,UK,20124.
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HW8353 WATER AND ENVIRONMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the role of environment in conditioning water resources and study methods to assess them
- To expose basic management tools available to manage the quality of water

UNITI ECOLOGICAL PRINCIPLES 7

Water as living medium – Aquatic ecosystems - Population and Communities – Nutrient Cycle – Energy flow – Water and Environment Interactions.

UNITII WATER QUALITY 9

Chemical composition of water - Hydrological processes and water quality – Suspended and dissolved loads - Sediments and their composition – Eutrophication and its impacts - – Water quality standards.

UNIT III WATER POLLUTION 10

Sources and Types of water pollution – Organic and inorganic pollutants - BOD – DO relationships —NPS pollution – Waste water treatment - TMDL Concepts – Water quality models

UNIT IV ENVIRONMENTAL ASSESSMENT 10

Environmental regulations and requirements – Types and role of EIA – Environment in water resources project planning – Methods of EIA – Hydrological and water quality impacts – Ecological and Biological assessments – ICID check list – EIS statement.

UNIT V ECOLOGICAL MANAGEMENT 9

In stream ecological water needs – Eco restoration strategies – Ecosystem services – Environmental monitoring programs - Public awareness and participation in decision making – Sustainable water resources management – Environmental Governance.

TOTAL: 45 PERIODS

OUTCOME:

- Students will understand the intricate relationship of water resources with the environmental interactions and appreciate the need to manage water quality.

REFERENCES:

1 Odum, E. P. and G. W. Barrett, Fundamentals of Ecology, India Edition, Thomson Brooks/cole, India, 2005

2 Canter L. W., Environmental impact assessment, 2nd edition, Mc Graw Hill & Co., NY, USA, 1996

3 Vladimir Novonty, Water Quality: Diffuse pollution and watershed Management, 2nd edition, John Wiley & Sons, , 2003

4 Jorgensen, S., J. G. Tundisi, J. M. Tundisi, Handbook of inland aquatic ecosystem management, CRC Prerss, FL, USA, 2013.

5 Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, McGraw-Hill 2006.

IM8071	ENVIRONMENTAL IMPACT ASSESSMENT OF WATER RESOURCES DEVELOPMENT	L T P C 3 0 0 3

OBJECTIVE:

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment in water resources development.

UNIT I ENVIRONMENTAL ISSUES 7

Water resources development and environmental issues – Environment in water resources project planning – Environmental regulations and requirements – The EIA (Environmental Impact Assessment) notification.

UNIT II EIA FUNDAMENTALS 8

Environmental Impact Assessment (EIA) – EIA in Project Cycle – Legal and Regulatory aspects in India according to Ministry of Environment and Forests – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA –Participation of Public and Non-Governmental Organizations in environmental decision making

UNIT III ENVIRONMENTAL IMPACTS 10

Hydrological and water quality impacts – Ecological and biological impacts – Social and cultural impacts – Soil and landscape changes – Agro economic issues – Human health impacts – Ecosystem changes.

UNIT IV METHODS OF EIA 10

EIA team formation – Development of scope, mandate and study design – Base line survey – Check lists – Ad hoc procedures – Network and matrix methods – Semi-quantitative methods – ICID checklist – Economic approaches – Environmental Impact Statement (EIS) preparation.

Attested

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UNIT V ENVIRONMENTAL MANAGEMENT PLAN 10

In-stream ecological water requirements - Public participation in environmental decision making – Sustainable water resources development – Ecorestoration – Hydrology and global climate change – Human ecology – Ecosystem services – Environmental monitoring programs.

TOTAL: 45 PERIODS

OUTCOMES:

- The student will appreciate the importance of environment in water resources development and understand current methods of environmental assessment.
- Students will become aware of future challenges facing water resources management.

REFERENCES

1. Canter, L.W., Environmental Impact Assessment. McGraw Hill International Edition, New York. 1995.
2. Barathwal, R.R., Environmental Impact Assessment. New Age International Publishers, New Delhi. 2002.
3. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science London. 1999.
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Inter Science, New Jersey. 2003.
5. Arnel, N., Hydrology and global environmental change. Prentice Hall, Harlow. 2002.
6. Chari. B., Richa Sharma and S.A. Abbasi, Comprehensive Environmental Impact Assessment of Water Resources Projects : With Special Reference to Sathanur Reservoir Project (Tamil Nadu)/K. Discovery Pub., New Delhi, 2005.
7. UNEP's Environmental Impact Assessment Training Resource Manual -2nd Edition, 2002.

IM8153 GENDER AND WATER L T P C
3 0 0 3

OBJECTIVES:

- To enable the understanding which seeks to improve gender relations and role how they affect and are affected by water.
- To improve the understanding and awareness of gender concepts through an easy reference to existing materials and tools.

UNIT I INTRODUCTION 9

Basic Concepts of Sociology - Definition - Gender – Social Perspectives -Historical Framework - Gender and Early Sociological Thought – Social Stratification and Roles - Power and authority - Equity and Equality - Gender Empowerment

UNIT II GENDER IN DEVELOPMENT SECTORS 9

Gender Issues in Agriculture and Irrigation - Gender and Allied and Other Agricultural Activities - Gender in Coastal Region: Salt Production - Gender and Health

UNIT III GENDER AND INTEGRATED WATER RESOURCES MANAGEMENT 9

Gender Approach to Water Management - Drinking and Domestic Water - Sanitation and Hygiene – Gender and Food Security - Indicators for Development -Gender Policies in Water Management - Country Experiences

UNIT IV GENDER COMPETENCY ISSUES 8

Gender and Technology - Gender in Water Shed Management –Protection of fresh Water Resources- Water Rights- Water Privatization –Legal Frameworks

UNIT V GENDER IN GLOBAL SCENARIO **10**

Impacts in Water Sector: Globalisation- - Liberalisation – Millennium Development Goals -Global Warming and Climate Change - Gender and Capacity Building-– Gender Analysis Tools- Mainstreaming gender in Water Management – A sustainability perspective

TOTAL: 45 PERIODS

OUTCOMES:

- By taking this course the students can have better insight into the interpersonal relationship in society; analyze the contemporary status of gender in all walks of their life.
- The course offers better anchorage of ideas, knowledge and practice in the respective field.

REFERENCES

1. Gender and Water Alliance 2002. The Gender Approach to Water Management: 3TU, UK. http://www.genderandwateralliance.org
2. Mainstreaming Gender in Water Management, Resource Guide, Version 2.1 November 2006. http://www.genderandwaterresourceguide.
3. Ratna V. Reddy and S. Mahendra Dev. (Ed.), 2006, Managing Water Resources, Policies, Institutions, and Technologies, Oxford University Press.
4. Eveline Bolt (Ed.),1994, Together for Water and Sanitation: Tools to apply a gender approach. The Asian Experience , Edited by. IRC International Water and Sanitation Centre.
5. Vasudha Pangare, et. al 2006. Global Perspectives on Integrated Water Resources Management: A Resource Kit, Academic Foundation.

IM8155 WATER AND ECOSYSTEMS **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the principles of natural ecosystems, the social dimensions and approaches to water, the benefits to the society and the need for conservation of aquatic ecosystems.

UNIT I ECOLOGICAL PRINCIPLES **8**

Levels of organization - Concept of Ecosystems – Ecosystem structure and function – Ecosystem development - Freshwater ecosystems – Agro ecosystems.

UNIT II AQUATIC ECOSYSTEMS **8**

Ecosystem processes – Agricultural vs Ecosystem productivities – Riparian processes and interactions – Eco hydrology – Impacts of human intervention – Water-food-ecosystem linkages.

UNIT III ECOSYSTEM SERVICES **9**

Water for irrigation – Livelihoods – Industrial / developmental needs – domestic and drinking water sector – Green, Blue and Grey water concepts – Economic instruments – Virtual water and trade.

UNIT IV ACCESS AND EQUITY **10**

Water access and equity – Urban-Rural and Gender dimensions - Adjusting to water scarcity – Water allocation principles - Upstream-downstream perspectives – Institutions and democracy – Stakeholder involvement.

UNIT V ECOSYSTEM MANAGEMENT **10**

Ecosystem assessments – Environmental flows – Future freshwater challenges - Eco tourism -– Social and political issues of water use - Sustainable Ecosystems - Environmental governance.

TOTAL: 45 PERIODS

OUTCOME:

- Students will understand development pressures on distribution, ecological relations and the emerging social and economical dimensions of water resources today.

Attested

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REFERENCES

1. Malin Falkenmark and Johan Rockstrom, Balancing water for Humans and Nature, Earthscan, VA, USA, 2005.
2. Caroline M Figueres, Cecilia Tortajada and Johan Rockstrom (ed), Rethinking Water Management, EarthScan, VA, USA, 2005.
3. Eugene P Odum, Basic Ecology, Holt-Saunders International Edition, Philadelphia, US, 1983.
4. Gooch, G. D., A. Rieu-Clarke and P. Stalnacke (eds), Integrating Water Resources Management: Interdisciplinary methodologies and strategies in Practice, IWA Publishing, London, UK, 2012.
5. Jorgensen, S., J. G. Tundisi, J. M. Tundisi, Handbook of inland aquatic ecosystem management, CRC Prerss, FL, USA, 2013
6. Sithamparanathan, J., Rangasamy, A. and Arunachalam, N., Ecosystem principles and sustainable agriculture, Scitech Publishers, Chennai, 1999.

IM8252 PARTICIPATORY FIELD RESEARCH METHEDOLOGY L T P C
3 1 0 4

OBJECTIVE:

- To teach interdisciplinary field research skills and enable the students to conduct field research within IWRM outlook.

UNIT I RESEARCH 10

Meaning – Purpose – Types of Research – Stages of Research – How to conduct a Research: Formulation of Problem, Hypothesis- Sampling - Designs - Method - Techniques of Data Collection - Analysis and Reporting - Ethical Responsibilities in Social Research

UNIT II PARTICIPATORY AND FIELD RESEARCH 7

Types of Participation - Participatory meaning - Importance of Peoples Knowledge - Emergence of Participatory Research - Participatory Research Approaches in Science and Technology- Participatory Research and Development

UNIT III TECHNIQUES IN FIELD RESEARCH 9

Primary data collection- Qualitative and Quantitative - Survey – Observation - Semi Structured Interview - Questionnaire Schedule and Field Trials – Analysis and Evaluation

UNIT IV METHODS OF FIELD RESEARCH 10

Research Methods: Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), Participatory Learning and Action (PLA) – Diagramming and Mapping - Field Observation and Field Trials – Analysis and Evaluating Participatory Research and Development: Some Key Elements

UNIT V PARTICIPATORY TOOLS 9

Situation Query Problem and Response (SPQR) – Statistical Analysis- Exercises in the use of concepts and methods – Methodology

UNIT VI FIELD PRACTICE ON PRA TOOLS 15

The real time experiences will be tested using the PRA tools on the ground. The strategies of tapping the local knowledge will be imparted with exemplary practice. The tools will give a comprehensive outlook to identifying resources, ranking priorities and analyzing impact at the ground level.

THEORY 45+ TUTORIAL 15 = TOTAL 60

OUTCOMES:

- The students would be put to observe the environment, capture the local knowledge and incorporate it to the main stream research.
- This subject matter could help students to enhance their knowledge both theoretical and practical with a comprehensive outlook for research.

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REFERENCES

1. Anderson L. Borum, F., Kristensen. P.H and Karnoe, P.1995. On the art of doing field studies: An experience based research methodology, Copenhagen Business School Press, Denmark.
2. Chambers, R., A. Pacey and L. Thrupp. 1989. Farmer First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications: London.
3. Martin Lengwiler, 2008. Participatory Approaches in Science and Technology: Historical Origins and Current Practices in Critical Perspective Science Technology Human Values 2008; 33; 186 http://sth.sagepub.com/cgi/content/abstract/33/2/186.
4. McAllister, K. and R. Vernooy. 1999. Action and Reflection: A Guide for Monitoring and Evaluating Participatory Research. International Development Research Centre, Ottawa, ON, Canada.
5. Pauline V Young,1984. Sientific Social Surveys and R*esearch* Prentice-Hall of India Ltd, New Delhi.
6. W*ilkinson* & B*handarkar*, 2004. Methodology and Techniques of social Research, 17th edition, Himalaya Publishing House.

IM8351 LEGAL ASPECTS OF WATER RESOURCES L T P C
3 0 0 3

OBJECTIVES :

- To learn the basics of water law, in a context of historical development and evolving recognition of issues related to human and ecological needs of water.
- To understand how the policies, laws and judicial approaches tackle the recent water issues.
- To help formulate recommendations/responses that could resolve/avoid disputes.
- To emphasize water as a finite common property resource that must be used in public interest.
-

UNIT I HISTORICAL BACKGROUND AND CURRENT CHALLENGES 9

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 - Challenges in Water Management – Physical and Technical Challenges – Social and Economic Challenges - Role of Law in Water Management – Conceptions of Water: Commodity, Service, Human Right

UNIT II WATER LEGISLATION IN INDIA AND TAMIL NADU 9

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 – Legislative Process: Legislative, Judicial, Executive – Natural Justice – Delegation of Powers - Tribunals – Post-Constitutional Water Laws – National-Level Enactments - The Overview of State Acts with Case Laws: 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 III WATER GOVERANCE: POLICIES AND LEGAL FRAMEWORKS 9

Water Governance and Water Policy – Legal Framework of Water – Substance of National Water Laws – Other key issues – Changing incentives through Regulation - National Water Policy – National-Level Commissions – Irrigation Management Transfer Policies and Activities – Legal Registration of WUAs – Legal Changes in Water Allocation, – Role of Local Institutions – Community Based Organizations – Water Policy Reforms: India, the Philippines, Bangladesh, and Indonesia

Attested

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UNIT IV WATER CONFLICTS IN INDIA 9

Water conflicts and Tribunals - Contending Water Uses – Equity, Access and Allocation - Water Quality Conflicts - Sand Mining - Micro-level Conflicts, Dams and Displacement – Privatization – Case Studies

UNIT V TRANSBOUNDARY WATER ISSUES 9

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

TOTAL: 45 PERIODS

OUTCOMES :

- Knowledge in legal perspective of Water Resources Management would be strengthened**.**
- Critical analysis of water conflicts is made possible, which could reveal the gaps that need to be filled up.

REFERENCES

1. 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.
2. Bruns, Bryan Randolph and Ruth S. Meinzen-Dick. Ed. Negotiating Water Rights*,* Vistaar Publications, New Delhi, 2000.
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5. 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.
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9. "Water Conflicts in India – A Million Revolts in the Making" , Ed: K. J. Joy, Biksham Gujja, Subas Paranjape, Vinod Goud, Shruti Vispute, Rourledge, New Delhi, 2008.
10. "The Politics of Water – A Survey", Ed: Kai Wegerich and Jeroen Warner, Taylor and Francis Group, London, 2010.
11. Philippe Cullet (2010), Groundwater Regulation Need for Further Reforms International Environmental Law Research Centre, Geneva, Switzerland.
12. Heather L. Beach et. al., (2000), Transboundary Freshwater Dispute Resolution – Theory, Practice and Annotated References, UN University Press.

IM8352 WATERSHED CONSERVATION AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES :

- To provide the technical, economical and sociological understanding of a watershed.
- To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.

UNIT I WATERSHED CONCEPTS 9

Watershed - Need for an Integrated Approach - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization of Watershed – Indian Scenario

UNIT II SOIL CONSERVATION MEASURES 9

Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Control – Soil Conservation Measures: Agronomical and Mechanical - Estimation of Soil Loss - Sedimentation

UNIT III WATER HARVESTING AND CONSERVATION 9

Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures – Farm Ponds – Percolation Tanks – Yield from a Catchment

UNIT IV WATERSHED MANAGEMENT 9

Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Estimation – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes –Developing Collaborative know how – People's Participation – Evaluation of Watershed Management

UNIT V GIS FOR WATERSHED MANAGEMENT 9

Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies

TOTAL: 45 PERIODS

OUTCOME :

- The students will be able to apply the knowledge of overall concepts of watershed which would help to comprehend and analyze for better management.

REFERENCES

1. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000.
2. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley andSons, 1981.
3. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982.
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IW8071 REHABILITATION AND MODERNISATION OF IRRIGATION SYSTEMS L T P C

3 0 0 3

OBJECTIVE:

- To expose the students to the need and importance of the rehabilitation and modernization of irrigation systems and to train them in the related concepts and methods.

UNIT I IRRIGATION SYSTEMS 9

Historical evolution of irrigation systems in India; its importance to agricultural production. Irrigation system classification – Nature of system modernization and rehabilitation. Distinction between rehabilitation and modernization; Rehabilitation and modernization objectives – Theory and Practice.

UNIT II SYSTEM MAINTENANCE 9

Maintenance: essential, catch up, preventive and normal – Diagnostic analysis of flow, seepage and other parameters through Participatory Rural Appraisal, Rapid Rural Appraisal and Walk-through Survey – Development and maintenance programme – Kudimaramath **–** Turnover – WUA.

UNIT III DIAGNOSTIC ANALYSIS OF IRRIGATION SYSTEMS 9

System performance: history of inflow, cropping pattern, system alterations, distribution performance – Operational constraints – Management constraints – Resources constraints.

UNIT IV REHABILITATION 9

Baseline survey – Deferred maintenance – Causes – Criteria used for taking rehabilitation programmes –Service Delivery Concepts- Software and hardware improvements – Prioritization – Role of water users' association – Monitoring and evaluation.

UNIT V CASE STUDIES 9

Rehabilitation and modernization programmes – Periyar Vaigai Project – Walawe Project – Tank Modernization Project – Water Resources Consolidation Project. IAM WARM Project - DRIP - Case study of Rehabilitation using Water Delivery Concept.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be familiar in understanding the different types of maintenance problems with respect to technical and social aspects, its occurrence and to overcome these problems by rehabilitation and modernisation methods.
- The students will get an overall exposure to different types of irrigation system maintenance issues and to solve them for improving their performance based on service oriented approach.

REFERENCES:

1. CWR, Baseline Survey of Irrigation Commands, Centre for Water Resources, Anna University, Chennai. 2000.
2. IIMI and WALMI, The Case of Mahi Kadana, WALMI, Gujarat, India, 1994.
3. CSU, Diagnostic Analysis of Irrigation Systems Volume 2: Evaluation Techniques. Water Management Synthesis Project, Colorado State University, USA. 1984.
4. WAPCOS, Technical Report No. 19-A, Handbook for Improving Irrigation System Maintenance Projects, WAPCOS, New Delhi. 1989
5. CWR, Tank Modernization Project EEC Assistance: Monitoring and Evaluation. Final Reports. Centre for Water Resources, Anna University, Chennai. 2000.
6. CWR, Planning and Mobilization of Farmers Organization and Turnover. Tamil Nadu Water Resources Consolidation Project. CWR and OM, Anna University, Chennai, 1997.