DEPARTMENT OF CIVIL ENGINEERING

ANNA UNIVERSITY, CHENNAI

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and International levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by

1. Providing a firm scientific and technological base in Civil Engineering to achieve self-reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering.
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.

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UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. IRRIGATION WATER MANAGEMENT

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M E Irrigation Water Management will

PEO1	Gain knowledge and skills in irrigation water management which will enable them to have a career and professional accomplishment in the public or private sector organizations
PEO2	Become consultants in irrigation water management and solve complex real life issues related to analysis, design and maintenance of structures under various environmental conditions.
PEO3	Contribute to the enhancement of knowledge in irrigation water management by performing quality research in institutions of international repute or in Research organizations or Academia.
PEO4	Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.
PEO5	Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Water Resources Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
PO1	Engineering knowledge	Apply the knowledge of mathematics, science and engineering fundamentals to the formulation and conceptualization of irrigation water management theory
PO2	Problem analysis	Identify, formulate and solve engineering problems.
PO3	Design/development of solutions	Design structures, irrigation water management elements or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
PO4	Conduct investigations of complex problems	Conduct experiments and collect, analyze and interpret the data.
PO5	Modern tool usage	Create, select and apply appropriate techniques and modern engineering tools including analysis, modeling and design software, with due understanding of the limitations.
PO6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
PO7	Environment and sustainability	Design the structure with environment consciousness and sustainable development.
PO8	Ethics	Understand and commit to professional Ethics and responsibilities of Water Resources Engineers and to contribute to the society for sustainable development.

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PO9	Individual and team work	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings and demonstrating a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis.
PO10	Communication	Communicate effectively with the engineering community and with society at large, and write reports and make effective presentations.
PO11	Project management and finance	Demonstrate a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations
PO12	Life-long learning	Develop ability to engage in independent and life-long learning to improve competence by critical examination of the outcomes of one's actions and learning from corrective and preventive measures.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Water Resources Engineering will be able to

PSO1	Knowledge of Water Resources Engineering discipline	Demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development
PSO2	Critical analysis of Water Resources Engineering issues and innovation	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.
PSO3	Conceptualization and evaluation of Engineering solutions to Water Resources Design issues	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management

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4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	M	L	M	H	L	M	M	M	M	H	L	M	H	M	L
II	H	M	M	M	M	M	H	H	M	H	L	M	H	H	L
III	H	H	M	H	H	M	H	H	M	H	M	M	H	H	M
IV	M	M	M	M	H	M	H	H	H	H	M	M	H	H	M
V	H	H	H	H	H	M	H	H	H	H	H	H	H	H	M

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MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR I	SEMESTER I	Statistical Methods for Engineers															
		Advanced Irrigation Engineering and Management	H	H	M	M	L	H	M	H	M	H	M	L	H	M	L
		Integrated Water Resources Management	M	M	M	L	L	M	M	H	M	H	L	M	M	M	M
		Program Elective I															
		Research Methodology and IPR															
		Audit Course – I															
		Advanced Irrigation Engineering Laboratory	H	H	M	H	H	H	M	H	L	L		M	H	H	M
		Technical Seminar															
	SEMESTER II	Soil Science and Agronomy	H	M	M			M	M			L		M	M	M	M
		Micro Irrigation Engineering	H	H	H	H	H	H	M	H	L	H	H	M	H	L	H
		Participatory Field Research Methodology	M	H	M	H	H	M	M	H	M	L	L	H	H	H	H
		Remote Sensing and GIS for Water Resources	H	H	H	M	H	M	H	M	M	M	M	H	H	H	H
		Program Elective II															
		Program Elective III															
		Field Practice on PRA Tools	M	H	M	H	H	M	M	H	M	L	L	H	H	H	H
		Satellite Image Processing and GIS Laboratory	H	H	H	M	H	M	H	M	M	M	M	H	M	M	H
YEAR II	SEMESTER III	Gender and Water	M	M		H	L	M	M	H	M	L	L	H	H	H	H
		Water Quality	M	M	H	M	M	M	M	M	M	M	M	M	H	M	M
		Program Elective IV															
		Open Elective															
		Audit Course – II															
		Practical Training	H	H	H	H	H	H	M	H	M	M	H	H	H	H	M
		Dissertation I	H	H	H	M	H	M	H	M	M	M	M	H	M	H	H
	SEMESTER IV	Dissertation II	H	H	H	M	H	M	H	M	M	M	M	H	M	H	H

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CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5157	Statistical Methods for Engineers	FC	3	1	0	4	4
2.	IW5101	Advanced Irrigation Engineering and Management	PCC	3	0	0	3	3
3.	IW5102	Integrated Water Resources Management	PCC	3	0	0	3	3
4.		Program Elective I	PEC	3	0	0	3	3
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
7.	IW5111	Advanced Irrigation Engineering Laboratory	PCC	0	0	4	4	2
8.	IW5112	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**6**	**23**	**18**

* Audit Course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IW5201	Soil Science and Agronomy	PCC	3	0	0	3	3
2.	IW5202	Micro Irrigation Engineering	PCC	3	0	0	3	3
3.	IW5203	Participatory Field Research Methodology	PCC	3	0	0	3	3
4.	HW5251	Remote Sensing and GIS for Water Resources	PCC	3	0	0	3	3
5.		Program Elective II	PEC	3	0	0	3	3
6.		Program Elective III	PEC	3	0	0	3	3
PRACTICALS								
7.	IW5211	Field Practice on PRA Tools	PCC	0	0	2	2	1
8.	HW5261	Satellite Image Processing and GIS Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**6**	**24**	**21**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IW5301	Gender and Water	PCC	3	0	0	3	3
2.	IW5302	Water Quality	PCC	3	0	2	5	4
3.		Program Elective IV	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
5.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
6.	IW5311	Practical Training (4 Weeks)	EEC	0	0	0	0	2
7.	IW5312	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**14**	**0**	**14**	**28**	**21**

* Audit Course is optional

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IW5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 72

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA5157	Statistical Methods for Engineers	3	1	0	4	1

PROGRAM CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IW5101	Advanced Irrigation Engineering and Management	3	0	0	3	1
2.	IW5102	Integrated Water Resources Management	3	0	0	3	1
3.	IW5111	Advanced Irrigation Engineering Laboratory	0	0	4	2	1
4.	IW5203	Participatory Field Research Methodology	3	0	0	3	2
5.	IW5201	Soil Science and Agronomy	3	0	0	3	2

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6.	IW5202	Micro-Irrigation Engineering	3	0	0	3	2
7.	HW5251	Remote Sensing and GIS for Water Resources	3	0	0	3	2
8.	IW5211	Field Practice on PRA Tools	0	0	2	1	2
9.	HW5261	Satellite Image Processing and GIS Laboratory	0	0	4	2	2
10.	IW5301	Gender and Water	3	0	0	3	3
11.	IW5302	Water Quality	3	0	2	4	3
					TOTAL CREDITS	**30**	

PROGRAM ELECTIVE COURSES [PEC]

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	IW5001	Legal Aspects of Water Resources	3	0	0	3
2.	IW5002	Climate Change and Water Resources	3	0	0	3
3.	IW5003	Rehabilitation and Modernisation of Irrigation systems	3	0	0	3
4.	IW5004	Rainfed Agriculture and Tank Irrigation Management	3	0	0	3
5.	IW5005	Irrigation Economics	3	0	0	3
6.	IW5006	Drought Risk Assessment and Management	3	0	0	3
7.	IW5007	Watershed Conservation and Management	3	0	0	3
8.	IW5008	Water and Environment	3	0	0	3
9.	IW5009	Participatory Irrigation Management	3	0	0	3
10.	IW5010	Research Methodology for Water Resources	3	0	0	3
11.	IW5011	Irrigation and Drainage Structures	3	0	0	3
12.	IW5012	Environmental Impact Assessment for Water Resources	3	0	0	3
13.	IW5013	Water, Sanitation and Health	3	0	0	3
14.	IW5014	Surface and Groundwater Hydrology	3	0	0	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM5151	Research Methodology and IPR	2	0	0	2	1
					TOTAL CREDITS	**2**	

OPEN ELECTIVE COURSES [OEC]

*(Out of 6 Courses one Course must be selected)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/3
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
					TOTAL	**0**	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IW5112	Technical Seminar	0	0	2	1	1
2.	IW5311	Practical Training (4 Weeks)	0	0	0	2	3
3.	IW5312	Dissertation I	0	0	12	6	3
4.	IW5411	Dissertation II	0	0	24	12	4
					TOTAL CREDITS	**21**	

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SUMMARY

	Name of the Programme: M.E IRRIGATION WATER MANAGEMENT					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4	0	0	0	4
2.	PCC	8	15	7	0	30
3.	PEC	3	6	3	0	12
4.	RMC	2	0	0	0	2
5.	OEC	0	0	3	0	3
6.	EEC	1	0	8	12	21
7.	Non Credit/ Audit Course	✓		✓	0	0
8	**TOTAL CREDIT**	**18**	**21**	**21**	**12**	**72**

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MA5157 STATISTICAL METHODS FOR ENGINEERS L T P C
3 1 0 4

OBJECTIVES:

- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using suitable test statistics which follows standard sampling distributions.
- To establish a relationship that make it possible to predict one or more variable in terms of others using correlation and regression analysis.
- To introduce the various experimental designs and their corresponding analysis of variance which play vital role in many real time scenarios.
- To impart knowledge of handling random vectors which represent random variables in multi-dimensional space.

UNIT I ESTIMATION THEORY 12

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

UNIT II TESTING OF HYPOTHESIS 12

Tests based on Normal, *t*, χ^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 12

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 coefficients.

UNIT IV DESIGN OF EXPERIMENTS 12

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

UNIT V MULTIVARIATE ANALYSIS 12

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.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, students will be able to

- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Use various test statistics in hypothesis testing for mean and variances of large and small samples.
- Determine the regression line using the method of least square and also to calculate the partial and multiple correlation coefficient for the given set of data points.
- Test the hypothesis for several means using one way, two way or three way classifications.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:

1. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, 6th Edition, Boston, 2004.
2. Gupta, S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, Reprint, New Delhi, 2019.

3. Johnson, R. A. and Gupta, C. B., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, Eighth Edition, New Delhi, 2015.
4. Johnson, R.A., and Wichern, D.W., “Applied Multivariate Statistical Analysis”, Pearson Education, Sixth Edition, New Delhi, 2013.
5. Spiegel, M.R. and Stephens, L.J.,” Schaum’s outlines on Statistics”, Tata McGraw-Hill, 6th Edition, New York, 2018.

IW5101 ADVANCED IRRIGATION ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge and skill relevant to the role of irrigation in development of nation, irrigation needs of crops, methods of irrigation, related policies and engineering principles, design criteria, irrigation management transfer.

UNIT I DEVELOPMENT OF IRRIGATION 6

Water Resources of India - Irrigation- Need, Advantages and Disadvantages- Crop and Cropping seasons in India and Tamil Nadu-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 IRRIGATION METHODS 12

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

UNIT V IRRIGATION MANAGEMENT 9

Irrigation Management systems in India - Warabhandi, Shejpali and Localisation - Diagnostic Analysis of Irrigation systems - Performance Indicators - Main system management - Command area Development - OFD - Irrigation policies - Irrigation institution - Irrigation Management Transfer.

TOTAL:45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Explain the importance of irrigation in development of nation and national water policy and its relevance
CO2	Apply knowledge of science and engineering to Soil - Water - Plant relationship and estimation of soil moisture
CO3	Apply knowledge of science and engineering in estimating water requirement of crops and design water network
CO4	Analyse and evaluate irrigation method and identify suitable methods
CO5	Identify the relevant policies and interrelate irrigation management transfer

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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. Molden(ed)., "Irrigation Management Transfer" IWMI, 2005.

CO – PO Mapping - ADVANCED IRRIGATION ENGINEERING AND MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		H	H	H		H
PO2	Problem analysis		H	H	H	H	H
PO3	Design / development of solutions			M	M		M
PO4	Investigation				M	M	M
PO5	Modern Tool Usage					L	L
PO6	Individual and Team work		H	H	H	H	H
PO7	Communication	M			M	M	M
PO8	Engineer and Society	H				H	H
PO9	Ethics	M			L	M	M
PO10	Environment and Sustainability				H		H
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	L			L	L	L
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development	H	H	H	H	H	H
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.	L	H	H	H	L	M
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management	L	L	L	L	L	L

IW5102 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

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UNIT I CONTEXT FOR IWRM 9

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS 9

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS 9

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT 9

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM 9

Water for food production: 'blue' versus 'green' water debate – Water foot print - Virtual water trade for achieving global water and food security –- Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO3	Apply law and governance in the context of IWRM.
CO4	Discuss the linkages between water-health; develop a HIA framework.
CO5	Analyse how the virtual water concept pave way to alternate policy options.

REFERENCES:

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative 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, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

POs/PSOs		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	M	M	M	M	M
PO2	Problem analysis	L	H	M	M	M	M
PO3	Design / development of solutions		M	M	M	M	M
PO4	Investigation	L	M			L	L
PO5	Modern Tool Usage	L	L	M	L	L	L
PO6	Individual and Team work		M	M			M
PO7	Communication		M	M			M
PO8	Engineer and Society	M	M	H	M	H	H
PO9	Ethics		M	H	M	M	M
PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance	L	L	L		L	L
PO12	Life Long Learning		M	M	M	M	M
PSO1	Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management	H	M	M	M	M	M
PSO2	Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability	M	M	M	M	M	M
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management	M	M	M	M	M	M

RM5151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

IW5111 ADVANCED IRRIGATION ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To demonstrate the concepts of Soil-water-plant relationship.
- To determine evaporation, transpiration, evapotranspiration, infiltration and crop water requirement.
- 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.

Attested

TOTAL: 60 PERIODS

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OUTCOMES:

- To observe and record weather data, analyze and plot them.
- To understand the concept of infiltration and evapotranspiration.
- To analyze and interpret soil physical and chemical properties.
- To design irrigation systems.
- To evaluate performance of irrigation methods.

REFERENCES:

1. Sivakumar, M.V.K., C.J. Stigter and D. Rijks (eds), 2000: Agrometeorology in the 21st Century – Needs and Perspectives. Papers from the International Workshop held in Accra, Ghana, 15–17 February 1999. Agric. For. Meteorol., 103(1–2). Special Issue.

CO – PO Mapping - ADVANCED IRRIGATION ENGINEERING LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions					M	M
PO4	Investigation	H	H	H	H	H	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	H	M	M	M	L	M
PO8	Engineer and Society	M	H	H	H	H	H
PO9	Ethics					L	L
PO10	Environment and Sustainability					L	L
PO11	Project Management and Finance						
PO12	Life Long Learning	H			L	L	M
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development	H	H	H	H	H	H
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.	H	H	H	H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management	M	L	M	L	M	M

IW5201 SOIL SCIENCE AND AGRONOMY L T P C
3 0 0 3

OBJECTIVE:

- To give an introduction on various fundamental aspects of soil science applied in Agronomy.

UNIT I SOILS AND THEIR CLASSIFICATION 9

Importance of soil– soil genesis- weathering of rocks and minerals- Study of soil profile – Important soil physical properties and its importance; Soil Texture, structure, density, porosity, colour, organic matter, consistency and plasticity- Major soils of India, U.S. System of soil Taxonomic Orders and characterization of soils in Tamil Nadu –Elementary knowledge of soil survey, Land capability classification.

UNIT II SOIL NUTRIENTS AND PRODUCTIVITY 8

Plant nutrition-Essential and beneficial elements, Role, deficiency and toxicity symptoms of essential plant nutrients-Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants- Critical levels of different nutrients in soil-soil reaction –Life in the soil - soil fertility– Fertility vs. productivity.

UNIT III PRINCIPLES OF AGRONOMY 10

Introduction and its scope of Agronomy– Classification of crops – Influence of genetic and environmental factors on crop growth – effect of different weather parameters on crop growth and development—Crop seasons –Objects and types of tillage and tilth, factors affecting tillage – Tillage Implements- Modern concept of Tillage-Crop density and geometry.

UNIT IV NUTRIENT AND WEED MANAGEMENT 10

classification of organic manures, fertilizers, bio-Fertilizers, Green leaf manuring- Role of organic matter in fertility- Methods of fertilizers application -Factors affecting manures and fertilizers use-Integrated Nutrient Management-Principles and methods of weed management-Harmful effects of weeds-concept of Integrated Pest Management.

UNIT V CROP PRODUCTION OF FIELD CROPS 8

Crops and cropping pattern and production practices for crops of importance in Tamil Nadu: cereals; Rice, millets, pulses, oilseed crops; cash crops; sugarcane, cotton and banana.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Gain knowledge on concepts and principles of soil science. To know the soil forming process importance of soil and identify their key soil properties. Understand the soil classification and types of soil surveys. Understand the favorable traits and limitations of various soil orders.
CO2	Understanding the knowledge of various plant nutrients, deficiency and toxicity symptoms. They will know the influence of soil reaction on availability of plant nutrients.
CO3	Understanding the basic concepts and theory of agronomy. Know the crop types and seasons. To know about different tillage practices in the crop field.
CO4	Learn about various manure and fertilizers and to know how the soil fertility and productivity can be maintained for better crop production. Learn about different weed methods and how to control it. Distinguish the methods of weed control in the field.
CO5	To know the crop husbandry of field crops. 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.

CO – PO Mapping: SOIL SCIENCE AND AGRONOMY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	M	M	M	M	L	M
PO3	Design / development of solutions	M	M	L	M	L	M
PO4	Investigation	-	-	-	-	--	;
PO5	Modern Tool Usage	;	;	;	;	;	;
PO6	Individual and Team work	M	M	M	M	M	M
PO7	Communication	H	M	M	M	M	M
PO8	Engineer and Society		-	-	-	-	-
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance						
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Agricultural and Irrigation Engineering discipline	M	M	M	M	M	M
PSO2	Critical analysis of Agricultural and Irrigation Engineering problems and innovation	M	M	M	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Agricultural and Irrigation Engineering Issues	M	M	M	M	M	M

IW5202 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 including automation.

UNIT I INTRODUCTION TO MICRO-IRRIGATION 7

Importance – comparison between traditional and micro irrigation methods –types of micro irrigation – present status, scope, potentials, problems, promotion, implementation and constraints of micro irrigation – socio-economic consideration for adoption of micro irrigation - Adoption and up scaling – constraints for the farmers - economics in micro irrigation system

UNIT II DRIP IRRIGATION SYSTEM DESIGN AND LAYOUT 10

Drip irrigation – advantages and disadvantages – types – suitable crops – planning and layout of drip system – components. Principles and hydraulics for design of drip system - Darcy Weishbach equation – Hazen Williams equation – factors to be considered for the design of drip system – design procedure –design of emitters, laterals, sub mains and main lines – head works. Installation- O & M – trouble shooting - Dripper types - Wetting pattern- Chemigation - drip irrigation design and layout – model design – sub-surface drip system.

UNIT III SPRINKLER IRRIGATION SYSTEM DESIGN AND LAYOUT 10

Sprinkler irrigation - suitability, economic viability and adaptability of sprinkler system – advantages and disadvantages - Types of sprinkler system - Components – Layout – factors affecting sprinkler performance – water distribution pattern - Design of Sprinkler irrigation system – Cost estimation – O & M – trouble shooting – overlapping - Application of Fertilizers – Fertilizer injection – Micro Sprinklers.

UNIT IV FILTRATION, CHEMIGATION, CARE & MAINTENANCE OF MICRO IRRIGATION 10

Filters – importance and applications – types and selection of filters – filtration – flushing – plugging. Plant nutrients – uptake mechanism – Chemigation and Fertigation – advantages and disadvantages – fertilizers – selection, concentration, equipment for fertigation - Clogging – physical, chemical and biological clogging – control measures – maintenance of filters – trouble shooting.

UNIT V AUTOMATION IN MICRO IRRIGATION AND ITS COMPATIBILTIES 8

Automation – need, benefits and limitations – Automation systems – components, cost – trouble shooting – IoT in micro irrigation. Mulching – precision farming – application of micro irrigation under protected cultivation

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Understand the fundamental concepts of micro irrigation
CO2	Design drip irrigation system, install, operate and maintain
CO3	Design sprinkler irrigation system, install, operate and maintain
CO4	Understand filtration & chemigation in micro irrigation and their care and maintenance
CO5	Understand automation in micro irrigation and its compatibilities

REFERENCES:

1. Suresh R., “Principles of Micro-Irrigation Engineering”, Standard Publishers Distributors, New Delhi, 2010
2. Michael, A.M., “Irrigation Theory and Practice”, Vikas Publishers, New Delhi, 2000.
3. Dilip Kumar Majumdar., Irrigation Water Management, Prentice Hall Inc., 2004
4. Sivanappan R. K., “Sprinkler Irrigation”, Oxford and IBH Publishing Co., New Delhi, 1987.
5. Megh R Goyal, Sustainable Micro Irrigation: Principles and practices, Apple Academic Press, 2014.
6. Keller J. and Karmeli D., “Trickle Irrigation Design”, Rainbird Sprinkler Irrigation Manufacturing Corporation, Glendora, California, USA, 1975.
7. Jack Keller and Rond Belisher., “Sprinkler and Trickle Irrigation”, Van nastrand Reinhold, New York, 1990.

CO – PO Mapping: MICRO IRRIGATION ENGINEERING

PO/PSO		Course Outcome					Overall Correlation of COs to Pos
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	H	H	H	H	H
PO2	Problem analysis	L	H	H	H	M	H
PO3	Design / development of solutions		H	H	H	H	H
PO4	Investigation		H	H	M	M	H
PO5	Modern Tool Usage		H	H	H	H	H
PO6	Individual and Team work		H	H	H	H	H
PO7	Communication	L	M	M	M	M	M
PO8	Engineer and Society	M	H	H	M	H	H
PO9	Ethics	M	L	L	L	L	L
PO10	Environment and Sustainability	M	H	H	H	H	H

PO11	Project Management and Finance	H				H	H
PO12	Life Long Learning		M	M	M	H	M
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management meeting the current research and development	H	H	M	M	H	H
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.	M	L	L			L
PSO3	Produce and publish professional reports in peer reviewed journals on contemporary and state of art research in irrigation water management	L	H	M		H	H

IW5203 PARTICIPATORY FIELD RESEARCH METHODOLOGY L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I RESEARCH 9

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 9

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 9

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- case studies.Fi

TOTAL : 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Capture to fundamental concepts and terms on Scientific research which are to be applied and understood all through the study.
CO2	Acquire a clear insight into the subject matter of participatory Field research methods with its rudiments under the ;light of peoples knowledge

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CO3	Structure questions and collect data decide samples according to the requirement of their area of interest.
CO4	Learn and test participatory tools and internalise down to the earth knowledge in the subject matter.
CO5	Bestowed with hands on experience in the application of participatory tools in Field Research Methods

REFERENCES:

1. Anderson L. Borum, F., Kristensen. P.H and Karnoe, P.On the art of doing field studies: An experience based research methodology, Copenhagen Business School Press, Denmark, 1995.
2. Chambers, R., A. Pacey and L. Thrupp. Farmer First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications: London, 1989.
3. Martin Lengwiler, 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. Action and Reflection: A Guide for Monitoring and Evaluating Participatory Research. International Development Research Centre, Ottawa, ON, Canada, 1999.
5. Pauline V Young, Scientific Social Surveys and Research Prentice-Hall of India Ltd, New Delhi, 1984.
6. Wilkinson & Bhandarkar, Methodology and Techniques of social Research, 17th edition, Himalaya Publishing House, 2004.

CO – PO Mapping: PARTICIPATORY FIELD RESEARCH METHODOLOGY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	M	L	M
PO2	Problem analysis			M	H	H	H
PO3	Design / development of solutions				M	M	M
PO4	Investigation	H	H	H	M	M	H
PO5	Modern Tool Usage			H	H	H	H
PO6	Individual and Team work			M	M	M	M
PO7	Communication			H	M	M	M
PO8	Engineer and Society		H	H	H	H	H
PO9	Ethics			L	M	M	M
PO10	Environment and Sustainability					L	L
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management			H	H	H	H
PSO2	Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.		M	H	H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.			H	H	M	H

Attested

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HW5251 REMOTE SENSING AND GIS FOR WATER RESOURCES L T P C
3 0 0 3

OBJECTIVE

- To impart knowledge and skills of remote sensing and geographical information system for data interpretation, analysis, classification of images for formulation of methodology using remote sensing and GIS tools for various applications in water resources engineering

UNIT I BASICS OF REMOTE SENSING 9

Physics of remote sensing, Types of Remote sensing, electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation; Swath, Nadir, resolutions, image referencing system; Monitoring atmosphere, land and water resources - Indian Space Programme, Sensor characteristics LANDSAT, SPOT, ERS, IKONOS, IRS and others.

UNIT II INTERPRETATION AND ANALYSIS 9

Remote sensing data products – Visual image interpretation – interpretation keys; data formats of digital image - Digital image processing – Image preprocessing – Image enhancement – Image transformation – image classification – accuracy assessment - 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 – Data Encoding methods – encoding raster data, vector data and attribute data, linking spatial and attribute data- Integrated GIS database -common sources of error – Data quality: Macro, Micro and Usage level components - Meta data - Spatial data transfer standards.

UNIT IV GEOSPATIAL ANALYSIS 9

Thematic mapping – Geospatial Measurements, query analysis, buffering, overlay operations, network analysis, DEM, DSM, DTM, Interpolation - Geovisualisation - Object oriented GIS – Modern trends of GIS – WebGIS, 3DGIS, Real-time GIS.

UNIT V WATER RESOURCES APPLICATIONS 9

Water resources models – Rainfall runoff modelling – Groundwater modeling – Water quality modeling - Flood inundation mapping and modelling – Drought monitoring – Cropping pattern change analysis - Site selection for artificial recharge - Reservoir sedimentation - Case study in microwave remote sensing.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	describe the basics of remote sensing and distinguish the sensors and satellites characteristics
CO2	choose the appropriate data products and techniques for image analysis
CO3	Illustrate the basics of map preparation in GIS
CO4	Demonstrate the geospatial data analysis techniques
CO5	Formulate the methodology using remote sensing and GIS tools for various applications in water resources engineering

REFERENCES:

1. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation, III 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. Basudeb Bhatta, Remote Sensing and GIS, II Edition, Oxford University Press, New Delhi, 2011

5. George Joseph and C. Jeganathan: Fundamentals of Remote Sensing, Third Edition, Universities Press Pvt. Ltd., Hyderabad, India, 2018
6. Centre for Water Resources, Change in Cropping Pattern in Drought Prone Chittar Sub-basin, Project Report, Anna University, Chennai, 2002.

CO – PO Mapping: REMOTE SENSING AND GIS FOR WATER RESOURCES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	H	H	H
PO2	Problem analysis		H	M	H	H	H
PO3	Design / development of solutions				M	H	H
PO4	Investigation		M	M	M	M	M
PO5	Modern Tool Usage	L	M	H	H	H	H
PO6	Individual and Team work	L	M	M	M	H	M
PO7	Communication			H	M	H	H
PO8	Engineer and Society	M	M	M	M	H	M
PO9	Ethics				M	M	M
PO10	Environment and Sustainability	L	L	M	M	M	M
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	M	M	H	H	H	H
PSO1	Knowledge of Hydrology and water resources, Irrigation water management discipline				H	H	H
PSO2	Critical analysis of Hydrology and water resources, Irrigation water management problems and innovation				H	H	H
PSO3	Conceptualization and evaluation of Hydrology and water resources, Irrigation water management Issues			H	H	H	H

IW5211 **FIELD PRACTICE ON PRA TOOLS** **L T P C**
0 0 2 1

OBJECTIVE:

- To enable students understand and test the tools along with field practices at the ground level.

1. Transect Walk 2
2. Social Mapping 2
3. Resource Mapping 2
4. Focus Group Discussion 2
5. Time Line Charting 2
6. Time Trend Analysis 2
7. Cause and Effect Mapping 2
8. Seasonal Calendar 2
9. Daily Calendar 2
10. Matrix Ranking 2
11. Pair-wise Ranking 2
12. Key Informant Interview 2
13. Situation, Problems, Query and Response (SPQR) 6

TOTAL: 30 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Capture to fundamental concepts and terms on Scientific research which are to be applied and understood all through the study.
CO2	Acquire a clear insight into the field practices and testing Resource Identification ToolsFie
CO3	Apply various rural appraisal time based mapping tools in the field and analyse its results.
CO4	Learn and test participatory Ranking tools to prioritise the people and resource
CO5	Bestowed with hands on experience in the application of participatory tools in Field Research using SPQR

REFERENCES:

1. Robert Chambers, Whose Reality Counts, Putting the First Last, Oxford Publications,1997
2. NeelaMukerjee, Participatory Rural Appraisal Methodology and Applications, Concept Publishing Company, 2003
3. Henman V and Chambers R, Participatory Rural Appraisal in the book Planning Agricultural Research a source book, 2001
4. http://www: Cabi.org/Cabebooks / ebook.

CO – PO Mapping: FIELD PRACTICE ON PRA TOOLS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	M	L	M
PO2	Problem analysis			M	H	H	H
PO3	Design / development of solutions				M	M	M
PO4	Investigation	H	H	H	M	M	H
PO5	Modern Tool Usage			H	H	H	H
PO6	Individual and Team work			M	M	M	M
PO7	Communication			H	M	M	M
PO8	Engineer and Society		H	H	H	H	H
PO9	Ethics				M	M	M
PO10	Environment and Sustainability				L	L	L
PO11	Project Management and Finance				L	L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management			H	H	H	H
PSO2	Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.		M	H	H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.			H	H	M	H

Attested

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HW5261 SATELLITE IMAGE PROCESSING AND 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

Image processing

1. Satellite data products : commercial and open source
2. Land use land cover classification
    1. Unsupervised
    2. Supervised
    3. Accuracy assessment
3. Vegetation indices for vegetative cover analysis
4. Reservoir volume estimation using temporal satellite imageries

Geographical Information System

5. Georeferencing of topo sheet and creating vector layers, attribute tables and layout preparation
6. GPS Survey, data transformation into GIS, analysis of data and creation of maps using Google earth maps.
7. Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.
8. Interpolation of point data to create Spatial Maps.
    1. Theisson polygon method
    2. Natural Neibourhood method
    3. Triangular irregular network
    4. Kriging method
9. Derivation of integrated map using weighted overlay techniques (any one).
    1. Identifying suitable artificial recharge areas
    2. Identification of ground water potential zones
    3. Estimation of sedimentation yield using RUSLE method
10. Join and Relate tables, File conversion from .kml to .shp
11. Open source GIS – Demo

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Demonstrate the methodology used for satellite image processing for applications in water resource engineering
CO2	Illustrate the basics of map preparation in GIS through geo referencing , digitisation and attribute creation
CO3	Demonstrate the use of GIS for watershed delineation and creation of basic entities for application of various water resources problems
CO4	Demonstrate the geospatial data analysis techniques
CO5	Formulate the methodology using remote sensing and GIS tools for various applications in water resources engineering

REFERENCES

1. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation, IIIrd 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.

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CO – PO Mapping: SATELLITE IMAGE PROCESSING AND GIS LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	H	H	H
PO2	Problem analysis		H	M	H	H	H
PO3	Design / development of solutions				M	H	H
PO4	Investigation		M	M	M	M	M
PO5	Modern Tool Usage	L	M	H	H	H	H
PO6	Individual and Team work	L	M	M	M	H	M
PO7	Communication			H	M	H	H
PO8	Engineer and Society	M	M	M	M	H	M
PO9	Ethics				M	M	M
PO10	Environment and Sustainability	L	L	M	M	M	M
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	M	M	H	H	H	H
PSO1	Knowledge of Hydrology and water resources, Irrigation water management discipline	M	M	M	H	H	M
PSO2	Critical analysis of Hydrology and water resources, Irrigation water management problems and innovation	M	M	M	H	H	M
PSO3	Conceptualization and evaluation of Hydrology and water resources, Irrigation water management Issues	M	M	H	H	H	H

IW5301 GENDER AND WATER L T P C
3 0 0 3

OBJECTIVES:

- To investigate the causes of disparity, analyzing structural factors in addition to the social construct in Water Resources Management
- To analyse the roles of both men and women in water management.

UNIT I INTRODUCTION 9

Basic Concepts of Sociology - Definition - Gender – Social Perspectives -Historical Framework - Gender and Social Stratification - 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: A third world outlook

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 AND POLICY REFORMS 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:

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Comprehend the roles of men and women as stakeholders in domains such as agriculture, allied agriculture, salt industries and fisheries
CO3	Apply IWRM concepts and understand the intensity of womens involvement amidst the existing social discrimination in access, ownership and control pf the resource.
CO4	Articulate as how reforms can help build up the capacity of women to protect and sustain their rights and responsibilities.
CO5	Gain an overarching understanding of the global, regional and local issues stand atop of all other issues for women in water resources management.

REFERENCES:

1. Gender and Water Alliance. The Gender Approach to Water Management: 3TU, UK.,2002 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.), Managing Water Resources, Policies, Institutions, and Technologies, Oxford University Press., 2006
4. Eveline Bolt (Ed.), Together for Water and Sanitation: Tools to apply a gender approach. The Asian Experience , Edited by. IRC International Water and Sanitation Centre, 1994
5. Vasudha Pangare, et. al Global Perspectives on Integrated Water Resources Management: A Resource Kit, Academic Foundation, 2006

CO – PO Mapping: GENDER AND WATER

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		M	M	M	M	M
PO2	Problem analysis		M	M	L	M	M
PO3	Design / development of solutions		L				
PO4	Investigation			H	H	H	H
PO5	Modern Tool Usage			L	L	L	L
PO6	Individual and Team work		M	M	L	M	M
PO7	Communication				M	M	M
PO8	Engineer and Society		H	H	H	H	H
PO9	Ethics			L	L	L	M
PO10	Environment and Sustainability					L	L
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management			H	H	H	H

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PSO2	Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.		H	L	H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.			H	H	M	H

IW5302 **WATER QUALITY** **L T P C**
3 0 2 4

OBJECTIVES

- To impart knowledge on water quality concepts, its evaluation for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
- To comprehend 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.

UNIT VI WATER QUALITY LAB **15**

Demo of water quality field kit, Field measurements, Water sample collection and transport, introduction to analytical laboratory, Good Laboratory Practices and Quality Control, Hydro chemical methods, Measurement of turbidity, solids, pH and EC, major ions, nutrients, Demo of BOD and COD estimations, Calculation of SAR, Hardness, Alkalinity

TOTAL (45 + 15) : 60 PERIODS

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OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	describe the water quality parameters, its sampling design and methodology for data analysis
CO2	Describe the water quality standards for irrigation and the methods to assess irrigation water quality
CO3	Relate water quality and its dependence on sources of water pollution
CO4	Illustrate the options for reuse and recycling of water
CO5	Formulate the methodology for data analysis and demonstrate the usage of analytical lab for water quality testing

REFERENCES

1. Claude E. Boyd, *Water Quality: An Introduction*, Second Edition, Springer International Publishing Switzerland, 2015
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. George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, *Wastewater Engineering: Treatment and Reuse*, McGraw-Hill, 2002.
5. Stum, M and Morgan, A., *Aquatic Chemistry*, Plenum Publishing company, USA, 1985.
6. Lloyd, J.W. and Heathcote, J.A., *Natural inorganic chemistry in relation to groundwater resources*, Oxford University Press, Oxford, 1988.

CO – PO Mapping: WATER QUALITY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	L	M	M	M	M
PO2	Problem analysis		L	M	M	M	M
PO3	Design / development of solutions				M	H	H
PO4	Investigation		M	M	M	H	M
PO5	Modern Tool Usage	L	L	M	M	M	M
PO6	Individual and Team work	L	M	M	M	H	M
PO7	Communication			H	M	M	M
PO8	Engineer and Society			M	M	M	M
PO9	Ethics				M	M	M
PO10	Environment and Sustainability	L	L	M	M	M	M
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Hydrology and water resources, Irrigation water management discipline				H	H	H
PSO2	Critical analysis of Hydrology and water resources, Irrigation water management problems and innovation			M	M	H	M
PSO3	Conceptualization and evaluation of Hydrology and water resources, Irrigation water management Issues			M	M	M	M

IW5001 **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 rights.
- To understand how the policies, laws and judicial approaches tackle the recent developmental changes.
- 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 – Positive and Negative rights – Individual and Group 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 - Role of Law in Water Management – Conceptions of Water: Commodity, Service, Human Right – Political Ecology.

UNIT II WATER LEGISLATION IN INDIA AND TAMILNADU 9

Pre-Constitutional Water Laws – Constitutional Provisions: Article 14, Article 21, Directive Principles of State Policy, Fundamental Rights and Constitutional Rights, State List - Entry 17 – 73rd and 74th amendments, Article 262 – Legislative Process: Legislative, Judicial, Executive – Natural Justice – Delegation of Powers – 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 – Climate change and Law - Torts and Crimes – Constitutional Remedies.

UNIT III WATER GOVERANCE: POLICIES AND LEGAL FRAMEWORKS 9

Water Governance and Water Policies – Legal Framework of Water – 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.

UNIT IV 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.

UNIT V WATER CONFLICTS IN INDIA 9

Water conflicts - Contending Water Uses – Equity, Access and Allocation - Water Quality Conflicts - Sand Mining – Macro and Micro-level Conflicts, Dams and Displacement – Quality Issues – Head-Middle-Tail conflicts – New vs. Ayacutdhars - Inter-State water sharing - Tribunals - Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Discuss the historical background of formation of laws and the types of rights.
CO2	Explain the legal provisions existing in India and Tamil Nadu.
CO3	Analyze the policy reforms that have taken place in water management.
CO4	Illustrate the transboundary conflicts.
CO5	Asses the water conflicts based on the rights issue and reveal the gaps that need to be filled up.

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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. Iyer R. Ramaswamy , Towards Water Wisdom: Limits, Justice, Harmony. Sage Publications, New Delhi, 2007.
3. Mollinga, Peter P., and Alex Bolding, The Politics of Irrigation Reform – Contested Policy Formulation and Implementation in Asia, Africa and Latin America, Ashgate, England, 2004,
4. Singh, Chhatrapati. "Water Rights in India," Ed: Chhatrapati Singh. Water Law in India: The Indian Law Institute, New Delhi, 1992.
5. "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.

CO – PO Mapping: LEGAL ASPECTS OF WATER RESOURCES

POs/PSOs		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	L	M	M	M	M
PO2	Problem analysis	L	M	M	M	H	M
PO3	Design / development of solutions	L	L	M	M	H	M
PO4	Investigation	M	M	M	M	H	M
PO5	Modern Tool Usage	L	L	L	M	L	L
PO6	Individual and Team work	M	L	M	M	M	M
PO7	Communication	M	L	L	M	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	L		M	M	M	M
PO10	Environment and Sustainability	M				M	M
PO11	Project Management and Finance			M		M	M
PO12	Life Long Learning	M	L	M	L	M	M
PSO1	Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management	H	H	M	M	M	M
PSO2	Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability	M	L	M	L	H	M
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water management	M	M	M	M	M	M

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IW5002 CLIMATE ACHANGE AND WATER RESOURCES L T P C
3 0 0 3

OBJECTIVE

- To impart knowledge on the climate system, impact of climate change on different sectors, adaptation and mitigation options and the tools available for vulnerability assessment

UNIT I GLOBAL CLIMATE SYSTEM 9

Climate - Drivers of Climate change - Components of Global Climate System: Atmosphere, hydrosphere, Lithosphere, cryosphere and biosphere, atmospheric circulation- redistribution of heat; Global Energy Balance: Greenhouse effect; Hydrological cycle: Reservoirs, flows (or Fluxes), Residence Times, Water Vapor,

UNIT II CLIMATE VARIABITLIY AND CHANGE 9

Climate variability and change: Factors Responsible for Natural Climate Variability and Change: large scale variability - El Nino, La Nina – ENSO, Teleconnections, Sun-Moon-Earth interaction - Factors Responsible for Anthropogenic Climate Change, Detection and Attribution of Climate Change; Global and Indian Scenarios – Observed changes and projected changes of IPCC - Impacts on water resources – Scenarios: SRES and RCPs.

UNIT III TOOLS FOR VULNERABILITY ASSESSMENT 9

Need for vulnerability assessment - Approaches for assessment – Types of climate models, History of climate modelling, Sensitivity of climate models, parameterization of climate process, simulation. Box models - Zero-dimensional models - Radiative-convective models - Higher-dimension models - EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – Regional Models - Sectoral models - CMIP

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.

UNIT V IMPACTS ON WATER RESOURCES 9

General Circulation Models – downscaling – statistical downscaling – dynamic downscaling. Case studies on impacts of climate change on Water resources assessment, water quality, groundwater, irrigation and agriculture

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Describe the earth's climate system and the interaction among the subsystems of the earth components
CO2	Illustrate the basics of climate variability and change including the observations and projections
CO3	Demonstrate the tools for vulnerability assessment at global and at regional scale
CO4	Describe the options available for adaptation and mitigation for different sectors
CO5	Comprehend the methodology for using appropriate dataset for impact assessment on Water resources assessment, water quality, groundwater, irrigation and agriculture through case studies

REFERENCES

1. Sangam Shrestha, Mukand S. Babel and Vishnu Prasad Pandey,2014, *Climate* Change and Water Resources, CRC Press an imprint of the Taylor & Francis Group
2. John M. Wallace and Peter V. Hobbs,2006, Atmospheric Science: An Introductory Survey, Second Edition, Academic Press an imprint of Elsevier
3. David Neelin., J, 2011, Climate Change and Climate Modeling, University Press, Cambridge, United Kingdom.
4. McGuffie., K, and Henderson-Sellers.A, 2005, A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd
5. Thomas T. Warner, 2011, Numerical Weather and Climate Prediction, Cambridge University Press, New York
6. Intergovernmental Panel on Climate Change: https://www.ipcc.ch/

CO – PO Mapping: CLIMATE CHANGE AND WATER RESOURCES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	H	H	H
PO2	Problem analysis		H	M	H	H	H
PO3	Design / development of solutions				M	H	H
PO4	Investigation		M	M	M	M	M
PO5	Modern Tool Usage	L	M	H	H	H	H
PO6	Individual and Team work	L	M	M	M	H	M
PO7	Communication			H	M	H	H
PO8	Engineer and Society	M	M	M	M	H	M
PO9	Ethics				M	M	M
PO10	Environment and Sustainability	L	L	M	M	M	M
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	M	M	H	H	H	H
PSO1	demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development				H	H	H
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.				H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management			H	H	H	H

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IW5003	REHABILITATION AND MODERNISATION OF IRRIGATION SYSTEMS	L T P C 3 0 0 3

OBJECTIVE:

- To expose the students to identify the different types of maintenance issues, Constraints and methods to improve the performance by rehabilitation and modernisation and to train them in the related concepts and methods using case Studies.

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 – deferred maintenance - causes - Baseline survey – asset mapping using GIS and GPS - condition assessment of irrigation system - 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 – Role of Water Use Associations.

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 - Criteria used for taking Rehabilitation programmes –Service Delivery Concepts- Prioritization – Monitoring and evaluation.

UNIT IV MODERN IRRIGATION TECHNOLOGIGS 9

Canal Automation – Piped Irrigation – Solar Powered Micro irrigation - Smart Irrigation using IoT – Precision Farming – Protected Cultivation in the context of Climate Change- Shade net Irrigation – Green house and Poly house Irrigation – Hydroponics and Aquaponics Irrigation – Urban Landscape Irrigation, Green roof Irrigation.

UNIT V REHABILITATION AND MODERNISATION TECHNOLOGIES 9

Case Studies – Tank Modernisation Project – Periyar Vaigai Project – Water Resources Consolidation Project – DRIP poroject – RRR of water Bodies Project – Kudimaramath Scheme to restore Water Bodies – IAMWARM Project – Farm Pond Scheme – Government Subsidies – Successful Rehabilitation and Moderinisation Projects implemented in Asian Countries

TOTAL: 45 PERIODS

OUTCOMES:

CO1	Describe about Indian irrigation systems and discriminate between rehabilitation and modernization.
CO2	Analyse the different types of maintenance problems with respect to technical and social aspects using Different PRA tools
CO3	Carryout diagnostic analysis to identify the constraints in improving the performance of irrigation system
CO4	Illustrate the various types of modern irrigation technologies to attain sustainable Irrigated agriculture.
CO5	Explain the rehabilitation and modernization advancements achieved so far through the implemented projects in India and Asian Countries.

REFERENCES:

1. CWR, Baseline Survey of Irrigation Commands, Centre for Water Resources, Anna University, Chennai. 2000.
2. SU, Diagnostic Analysis of Irrigation Systems Volume 2: Evaluation Techniques. Water Management Synthesis Project, Colorado State University, USA. 1984.

3. WAPCOS, Technical Report No. 19-A, Handbook for Improving Irrigation System Maintenance Projects, WAPCOS, New Delhi. 1989
4. CWR, Tank Modernization Project EEC Assistance: Monitoring and Evaluation. Final Reports. Centre for Water Resources, Anna University, Chennai. 2000.
5. CWR, Planning and Mobilization of Farmers Organization and Turnover. Tamil Nadu Water Resources Consolidation Project. CWR and OM, Anna University, Chennai, 1997
.

CO – PO Mapping: REHABILITATION AND MODERNISATION OF IRRIGATION SYSTEMS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	H	M	M
PO2	Problem analysis	L	H	M	M	M	M
PO3	Design / development of solutions	L	L	M	H	M	M
PO4	Investigation	L	H	M	M	L	M
PO5	Modern Tool Usage	L	M	L	H	M	H
PO6	Individual and Team work	L	M	H	M	M	M
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	L	M	M	M	H	M
PO9	Ethics	L	M	M	M	M	M
PO10	Environment and Sustainability	M	L	M	H	M	M
PO11	Project Management and Finance	L	L	M	H	M	
PO12	Life Long Learning	M	M	H	H	H	H
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of Integrated Water Resources Management.	L	H	M	M	M	M
PSO2	Formulate, analyze Technically and comprehend the differences in social and economical variability in South Asian context with their peers and strive to work towards sustainability.	M	M	M	M	M	M
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of art research in water resources engineering	L	M	M	H	L	M

IW5004 RAINFED AGRICULTURE AND TANK IRRIGATION MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge and skills relevant to rainfed farming and technology of tank irrigation, through estimation of tank capacity, construction principles and design of components and participation of farmers in tank management.

UNIT I RAINFED AGRICULTURE 9

Types of Rainfed farming systems around the world - Past trends and Future Prospects- Increasing crop productivity and water use efficiency - Impact of climate change and adaptation strategies on rainfed agriculture - Integrated farm management practices.

UNIT II TANK IRRIGATION 9

Concept of tank irrigation - Classification - Components of tank irrigation- Water distribution network- Cascade of tanks- Degradation of Tank Irrigation Systems- Causes and Remedy.

UNIT III TANK CONSTRUCTION & CAPACITY ESTIMATION 9

Principles of Construction of tanks and rehabilitation of existing tanks - Site Selection- Surveying and Levelling in Tank Works- Computation of Water Yield-Runoff- Strange Table- Rational method.

UNIT IV DESIGN OF TANK COMPONENTS 9

Design of Supply & Feeder Channels - Bund for Tank- tank weirs- Design of Sluice Outlets and Surplus Weir- Guidelines for preparation of Completion Report

UNIT V FARMER'S PARTICIPATION IN TANK IRRIGATION SYSTEMS 9

On Farm Development – organization, operation and maintenance- Water User Association- People's participation in tank irrigation system and its maintenance - Turn over – Traditional Governance of tank system – Water rights (Ancestral rights)– Multiple users of tank water – Usufruct Rights- tank irrigation management dealings in collective management of tanks

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Interrelate the rainfed agriculture and tank irrigation systems
CO2	Sketch the components of tank systems and identify the need to upgrade
CO3	Compute capacity of tanks, design components of tanks
CO4	Evaluate and rank to prioritize tanks for rehabilitation
CO5	Assess the level of farmer participation in tank management

REFERENCES:

1. Wani P Suhas, John Rockstorm and Theib Oweis (2009), 'Rainfed agriculture: Unlocking the Potential', IWMI, CAB International, UK.
2. Shanmugham. C.R. and J. Kanagavalli (2013), 'Technology of Tanks', Kalanjium hozhilagam Limited, Madurai.
3. Wani P Suhas, Johan Rockstorm and K.L.Sharawat (2011), " Integrated Watershed in Rainfed Agriculture", Taylor and Francis Publishing Ltd.
4. Philip Tow, Ian Cooper, Ian Partridge (ed) (2011), " Rainfed farming systems" Springer.

CO – PO Mapping: RAINFED AGRICULTURE AND TANK IRRIGATION MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	M	M	H
PO2	Problem analysis	L	M	M	M	M	M
PO3	Design / development of solutions	L	M	H	H	L	H
PO4	Investigation				H	H	H
PO5	Modern Tool Usage	L	H	H	H	L	M
PO6	Individual and Team work		M	M	M	M	M
PO7	Communication	M				M	M
PO8	Engineer and Society			M		M	M
PO9	Ethics					L	L
PO10	Environment and Sustainability	H	M	H	H	M	H
PO11	Project Management and Finance		M	M		M	M
PO12	Life Long Learning	M				M	M
PSO1	Demonstrate knowledge and understanding in the field of irrigation	H	H			H	H

	water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development						
PSO2	comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.		M		M		
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management				H		H

IW5005 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 and 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.

UNIT II CONSUMPTION ECONOMICS 9

Concept of demand and supply – Tools of economic analysis – Price determination – Demand and consumer behaviour – 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:

- On completion of the course, the student is expected to be able to

CO1	Understand the meaning and scope of economics applied to agriculture and irrigation and economic development from past to present.
CO2	Analyse the tools of economics and its application to behavioural pattern of market dynamics.

CO3	Impart knowledge into concepts of production economics by understanding the principle and types of production functions.
CO4	Discuss the importance of farm management and expose to preparation of farm records and budgeting.
CO5	Analyse the financial aspects, water pricing and identify the justifiable irrigation project among different alternatives.

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. Bilgrami S.A.R, 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.

CO PO Mapping: IRRIGATION ECONOMICS

POs/PSOs		Course Outcome					Overall Correlation of COs to POs/PSOs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	M	M	M
PO2	Problem analysis		H	H	M	H	H
PO3	Design / development of solutions		H	M	M	M	M
PO4	Investigation	L	L	M	M	M	M
PO5	Modern Tool Usage		M	M		M	M
PO6	Individual and Team work		M	M			M
PO7	Communication		M	M	M	M	M
PO8	Engineer and Society	M	M	H	M	M	M
PO9	Ethics		H	H	M	H	H
PO10	Environment and Sustainability	L	M	M	M	H	M
PO11	Project Management and Finance		L	M	M	H	M
PO12	Life Long Learning		M	M	M	M	M
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development.	M	M	M	M	M	M
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.	M	M	M	M	M	M
PSO3	Produce and publish professional reports, peer reviewed journal, on contemporary and state of art research in irrigation water management.	M	M	M	M	M	M

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IW5006 DROUGHT RISK ASSESSMENT AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To impart the knowledge on Drought concepts and types, Drought vulnerability and risk assessment towards suggesting the mitigation measures to combat drought

UNIT I UNDERSTANDING DROUGHT 9

Hydro-illogical Cycle – Definitions based on rainfall, stream flow, vegetation and comprehensive aspects – Causes and Types of Drought – NCA classification – - Characterization of Drought/water shortage/aridity/desertification - History of droughts in Worldwide and Indian context - Climate change and Drought.

UNITII DROUGHT IMPACTS 9

Environmental, Social and Economical impacts – Impact on Rainfed and Irrigated Agriculture - Drought effects on poverty, unemployment, and food security – Drought induced Migration - Hydropower Production - Drought effects on agribusiness and industrial sector –- Case studies.

UNIT III DROUGHT HAZARD AND RISK ASSESSMENT 9

Drought Hazard Assessment – Meteorological, Hydrological and Agricultural Drought Indices – Drought Vulnerability and Risk Assessment -Drought Monitoring, Early Warning and Forecasting of Drought -Global and Regional Network - Application of Remote sensing and GIS in Drought Monitoring - Key Drought Indicators and Drought Declaration.

UNIT IV DROUGHT RELIEF MEASURES 9

Contingency Crop Planning – Support to Farmers - Relief Employment – Water Resources Management - Food Security - Tax Waiver – Cattle Camp and Fodder supply – Institutional Response – Role of Central, Sate, District and Panchayat Raj Institutions – Checklist for Drought Preparedness.

UNIT V DROUGHT MITIGATION AND MANAGEMENT 9

Drought Mitigation - Risk and Crisis Management –Water harvesting and Conservation – Drip and sprinkler Irrigation System – Long-term Irrigation Management – Afforestation – Crop Insurance – Community Participation – Climate Variability and Adaptation - DPAP, DDP and IWMP Programmes.

TOTAL: 45 PERIODS

OUTCOMES:

CO1	Students classify the different types and comprehend various definitions of drought and differentiate Drought with water shortage, aridity and desertification
CO2	Students discuss the impacts of drought on various sectors.
CO3	Students evaluate the drought severity, risk and vulnerability and the modern tools of drought monitoring
CO	Students prepare the drought plan and frame relief measures for the efficient reduction of drought risk.
CO5	Students comprehend the risk and crisis management of drought mitigation and design programs for drought risk management.

REFERENCES:

1. Yevjevich V., Drought Research Needs, Water Resources Publications, Colorado State University, USA, 1977.
2. Linda Courtenay Botterill, Geoff Cockfield., “Drought, Risk Management, and Policy: Decision-Making Under Uncertainty”, Drought and Water crises, CRC press, 2013.
3. National Disaster Management Authority, Government of India, “National Disaster Management Guidelines”, Management of Drought, 2010.
4. Wilhite**,** Donald A., “Drought Assessment, Management, and Planning: Theory and Case Studies”, Kluwer Academic Publishers, 1993.

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CO – PO MAPPING OF DROUGHT RISK ASSESSMENT AND MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	M	H	M	H	H
PO2	Problem analysis		L	M	M	M	M
PO3	Design / development of solutions	L	L	H	H	H	H
PO4	Investigation		M	M	H	H	H
PO5	Modern Tool Usage			M	M	M	M
PO6	Individual and Team work				L	L	L
PO7	Communication			L	L	L	L
PO8	Engineer and Society	M	M	M	H	H	M
PO9	Ethics					M	M
PO10	Environment and Sustainability	M	H	H	H	H	H
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning	M	H	H	H	H	H
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development	M	M	M	H	H	M
PSO2	Comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.	M	L	M	M	H	M
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management	M	M	M	M	M	M

IW5007 WATERSHED CONSERVATION AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I WATERSHED CONCEPTS 9

Watershed – Definition, Need and Elements – Principles - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization – Watershed Atlas.

UNIT II SOIL CONSERVATION MEASURES 9

Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Control – Soil Conservation Measures: Agronomical and Mechanical – Design of Terraces and Bunds - Estimation of Soil Loss – USLE Equation - Sedimentation.

UNIT III WATER HARVESTING AND CONSERVATION 9

Yield from a Catchment -.Traditional Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures – Farm Ponds – Percolation Tanks – Check dams – Grassed Water ways.

UNIT IV GIS FOR WATERSHED MANAGEMENT 9

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

UNIT V WATERSHED MANAGEMENT 9

Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – People's Participation – Evaluation of Watershed Management Programmes – Integrated Watershed Management – Case studies.

TOTAL: 45 PERIODS

OUTCOME :

- The students will able to apply the knowledge of overall concepts of watershed which would help to comprehend and analyze for better management.
- On completion of the course, the student is expected to be able to

CO1	Recognize and Interpret the morphological features of a watershed and describe the principles of watershed management.
CO2	State, design and sketch the soil conservation structures.
CO3	Describe the micro catchment and apply the concepts to design the small water harvesting structures.
CO4	Illustrate the application of modern tools and technology in the management of watershed.
CO5	Classify the management activities and to develop an integrated watershed development plan.

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 and Sons, 1981.
3. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, 1988.
4. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982.
5. Vir Singh, Raj, Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.

CO – PO MAPPING: WATERSHED CONSERVATION AND MANAGEMENT

POs/PSOs		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	M	H	H
PO2	Problem analysis	M	H	H	L	H	H
PO3	Design / development of solutions	L	M	M		M	M
PO4	Investigation	M	L	L		M	M
PO5	Modern Tool Usage	M	M	M	M	L	M
PO6	Individual and Team work	H	L	L	M	M	M
PO7	Communication	L			M		L
PO8	Engineer and Society		M	M			M
PO9	Ethics					M	M

PO10	Environment and Sustainability		M	M		M	M
PO11	Project Management and Finance					M	M
PO12	Life Long Learning					L	L
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management	L	L	L	L	M	L
PSO2	Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability	L				L	L
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water management	M	M	M	M	M	M

IW5008 **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

UNIT I ECOLOGICAL PRINCIPLES 7

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

UNIT II 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

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OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Explain the various ecological principles and interactions between water and environment.
CO2	Describe the different hydrological processes governing the water quality
CO3	Comprehend the sources, types of water pollution and find solution through water quality models
CO4	Explain the types and role of environmental impact assessment for improving water quality
CO5	Illustrate the various ecological management strategies for sustainable water resources management.

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, 2 nd 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.

CO – PO MAPPING OF WATER AND ENVIRONMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	L	M	M
PO2	Problem analysis	L	L	M	M	M	M
PO3	Design / development of solutions	M	M	M	M	L	M
PO4	Investigation	L	M	H	H	H	H
PO5	Modern Tool Usage	M	H	H	M	L	M
PO6	Individual and Team work	M	M	M	M	M	M
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	M	M	H	M	M	M
PO9	Ethics	H	H	H	H	M	H
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	M	M	M	M	M	M
PO12	Life Long Learning	M	M	H	M	M	M
PSO1	Defend the concepts in fluid mechanics, surface and groundwater hydrology, river hydraulics, research methodology, legal frame works and relate them to current challenges.	M	M	H	M	L	M
PSO2	Analyse hydrological data to model water quality, water supply distribution for optimizing water resources system and risk analysis for real world problems.	M	M	H	M	M	M
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of art research in water resources engineering.	L	M	H	M	M	M

IW5009	PARTICIPATORY IRRIGATION MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to understand the regional and global experiences of participatory ideology in irrigation water management
- To help students acquire knowledge on paradigms shiftsand reorientations with regard to stakeholder participation in water management in general and in irrigation management in particular.

UNIT I FUNDAMENTALS OF SOCIOLOGY AND PARTICIPATORY APPROACH 6

Basic Sociological concepts and Definitions - Objectives – Perspectives- Social stratification– Sociological understanding - Irrigation as a Sociotechnical Process - paradigm shift and Participatory approach

UNIT II UNDERSTANDING FARMERS PARTICIPATION 12

Need of farmers participation –Benefits of farmers participation – Comparisons of cost and benefit – Water User Association–-Membership -Kinds of participation –National and International Experiences -Activities on Water towards Organization and Structure - Context of participation-factors in the environment.

UNIT III ROLE OF STAKEHOLDERS AND THE UNDERLYING ISSUES 12

Multiple use of water – Issues in sectoral Water Allocation - Domestic, Irrigation, Industrial sectors – Woman as a water user –Constraints and Oppertunities. Role of Community Organisers – Constraints in Organising farmers Organisation.

UNIT IV IMPROVING AGENCY RELATIONSAND INSTITUTIONAL REFORMS 10

Supporting farmer organization and participation -Decision Making- Leadership and responsibilities – Development strategy – Channels for implementation –– Equity and Equality- Agency Incentives- Technical co-operation – Special roles – Agency Roles- Institutional Reforms

UNIT V POLICY CONSIDERATIONS AND EMERGING CHALLENGES 5

Water Policy-Irrigation Governance-Building from Below-Non-political Associations-Bureaucratic Reorientation- Policy options and Alternatives and Sustainability.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Acquire a clear insight into the subject matter of participatory ideology with its rudiments under the light of both national and international illustrative cases.
CO3	Comprehend the roles of different players as stakeholders with the ground reality of the underlying issues in farm community.
CO4	Articulate as how reforms can help build up institutional and irrigation agencies with the support obtained from the existing farm network in irrigation Management
CO5	Gain an overarching understanding of recommendation for improved irrigation management with a vision to transform the existinggovernance and policies with the novel approach of sustainability.

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. Sivasubramanium K., Water Management SIMRES Publication, Chennai 2009.
7. http://irapindia.org/IMTInIndia-Pa
8. http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf

CO PO MAPPING: PARTICIPATORY IRRIGATION MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	M	L	M
PO2	Problem analysis			M			M
PO3	Design / development of solutions				H	H	H
PO4	Investigation				M	M	M
PO5	Modern Tool Usage			L	L	L	L
PO6	Individual and Team work			M	L	M	M
PO7	Communication			H	M	M	M
PO8	Engineer and Society		H	H	H	L	H
PO9	Ethics			L	M	M	M
PO10	Environment and Sustainability					L	L
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through integrated water resources management, participatory irrigation management with gender perspective meeting the current research and development.			H	H	H	H
PSO2	Comprehend the various techniques for water applications, system performance and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.			L	L		L
PSO3	Produce and publish professional reports peer reviewed journal on contemporary and state of art research in irrigation water management.			H	H	M	H

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IW5010 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 and its application.

UNIT I SCOPE **10**

Meaning-Objectives and types of research –Characteristics of Research – Research and Scientific Research - Ethics of a good researcher - Research process.- Formulating a Problem.

UNIT II RESEARCH DESIGN **10**

Rudiments of Research Design- Formulation of Hypothesis- Different Research Design: Descriptive Design and Diagnostic - Exploratory Design or Formulative Design- Experimental Designs.

UNIT III SAMPLE **8**

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

UNIT IV DATA **12**

Measurement levels and scaling – Types of errors – Sampling adequacy – Data collection and editing – Coding of data – Analysis and statistical inference - Report preparation – Structure of report – graphs and illustration tools – Tables and charts – Draft – Finalizing research report.

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

A mini project design

TOTAL : 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Learn various methods to draft a clear cut blue print or design for their study.
CO3	Select the ample sample size and learn to apply the techniques of abstraction of samples from the universe.
CO4	Test, scale and analyse the data collected as per the requirements of their projects
CO5	Gain understanding of the subject matter by applying the approaches learned to the ground reality.

REFERENCES:

1. C.R. Kothari, “Research Methodology Methods & Techniques”, New Age International Pvt Ltd Publishers, 2nd Revised Edition, 2009,
2. Wilkinson & Bhandarkar, 2004. Methodology and Techniques of social Research, 17th edition, Himalaya Publishing House.

CO PO MAPPING: RESEARCH METHODOLOGY FOR WATER RESOURCES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		L	M	M	L	M
PO2	Problem analysis	H	H	L		M	H
PO3	Design / development of solutions				M	M	M

PO4	Investigation			M	H	H	H
PO5	Modern Tool Usage			L	L	L	L
PO6	Individual and Team work			M	L	M	M
PO7	Communication				M	M	M
PO8	Engineer and Society				M	L	H
PO9	Ethics	H	H	H	M	M	H
PO10	Environment and Sustainability					L	L
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Demonstrate knowledge and understanding in the field of irrigation water management through integrated water resources management, participatory irrigation management with gender perspective meeting the current research and development.			H	H	H	H
PSO2	Comprehend the various techniques for water applications, system performance and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management.		M	L	M		M
PSO3	Produce and publish professional reports peer reviewed journal on contemporary and state of art research in irrigation water management.					H	H

IW5011 IRRIGATION AND DRAINAGE STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- . To understand the basic concepts of various irrigation structures such as head works, canal fall, canal regulators structures involved in cross drainage works.
- To provide knowledge and skills required for design and maintenance of drainage systems. To educate the students n various engineering aspects of agricultural field drainage.

UNIT I IRRIGATION CANAL STRUCTURES 9

Irrigation channels- Weirs and Barrage -Components of diversion head works – selection of the suitable site for the headwork -Canal structures (falls/drops, intake/off take, spillways etc) --Cross-drainage structures (aqueduct, siphon, culvert, super-passage, level crossing, inlet/outlet, Fall or drop structures, etc) - necessity and location- Regulation and control structures: head gates, silt ejectors, gates, division boxes etc. -Canal outlets (pipe outlet, weirs, etc.)-Canal escapes-types of escapes.

UNIT II DESIGN OF IRRIGATION CHANNEL 9

Types of canals - canal alignment - Kennedy's silt theory - Lacey's silt theory - Design of canals using the above theories - economical depth of cutting - canal losses - canal maintenance - lined canals and their design - silt control measures.

UNIT III SURFACE DRAINAGE SYSTEM AND DESIGN 8

Introduction of Drainage- effects of waterlogging- objectives of drainage- drainage problems-classifications of surface drainage system -Drainage coefficient and its importance in drainage design- Design of surface drainage system maintenance of surface drainage system-Rational method of predicting Peak runoff rate- Estimation of runoff using curve number techniques.

UNIT IV SUBSURFACE DRAINAGE SYSTEM AND DESIGN 10

Sub-surface drainage benefits -Types of subsurface drainage structures- investigations of drainage parameters – Principles of flow through soils, Darcy's law-Dupuit-Forchheimer assumptions- Design of sub surface drainage system for Steady state condition (Hooghought Equation, Ernst Equation etc), derivation of Hooghoudt's and Ernst's drain spacing equations-solution of drain spacing using equivalent depth concept and Unsteady state condition (Glover-Dumm Equation, De Zeeuw-Hellinga Equation etc)- Layout of the Tile drains-Drainage materials.

UNIT V NON-CONVENTIONAL DRAINAGE AND SOIL SALINITY 9

Classification of non-conventional drainage system- drainage structures:vertical drainage, bio drainage, mole drains and pump drainage and their adaptability- salinisation and sodification problems-Salt balance equation- Reclamation of saline and alkaline soils-Leaching requirement for saline soils- conjunctive use of fresh and saline waters, Environmental aspects of drainage.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	To learn about basic concepts of irrigation and the construction of various canal hydraulic structures.
CO2	Analyzing and design of irrigation canal.
CO3	To estimates the surface runoff by different methods and design surface drainage with the help of drainage investigation data's.
CO4	Able to know the closed drainage system and also design drainage dimensions and the spacing and depth between the drains using steady and unsteady conditions. Identify the drainage materials and their strength prior to installation.
CO5	Know about the salt affected soils and their land reclamation methods.

REFERENCES:

1. Sharma, R.K., and Sharma, T.K., "Irrigation Engineering", S. Chand and Company, New Delhi, 2008.
2. Garg, S.K., "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.
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. Todd D.K. Ground Water Hydrology, John Wiley and sons, Inc, New York, 1976.
6. Raghunath, H.M., Ground Water, 2nd edition, Wiley Eastern Ltd., New Delhi, 1987.

CO – PO Mapping - IRRIGATION AND DRAINAGE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	H	H	H	M	H
PO2	Problem analysis	-	H	M	H	-	H
PO3	Design / development of solutions	-	H	M	H	-	H
PO4	Investigation	-	L	M	M	-	M
PO5	Modern Tool Usage	-	-	-	-	-	-
PO6	Individual and Team work	-	-	-	-	-	-
PO7	Communication	L	L	L	L	L	L

PO8	Engineer and Society	M	M	H	H	M	M
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	M	H	H	H	H	H
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Agricultural and Irrigation Engineering discipline	M	M	M	M	M	M
PSO2	Critical analysis of Agricultural and Irrigation Engineering problems and innovation	M	M	M	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Agricultural and Irrigation Engineering Issues	M	M	M	M	M	M

IW5012 ENVIRONMENTAL IMPACT ASSESSMENT FOR WATER RESOURCES 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 – Economic approaches –Environmental Impact Statement (EIS) preparation.

UNIT V EIA CASE STUDIES 10

Environmental issues of Irrigation systems – EIA of irrigation projects – Case studies – Hydropower projects – Command area problems - ICID checklist for water resources projects Environmental monitoring programs.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Explain the various environmental modifications and its social and economic impacts.
CO2	Describe various types of irrigation practices for proper water management

CO3	Apply the knowledge of various agriculture and irrigation practices to recognize the environmental impacts
CO4	Explain the issues of agriculture, environment and irrigation practices in a changing climate
CO5	Comprehend various management strategies and mitigation measures from the case studies for achieving sustainable agriculture and irrigation practices.

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 -Second Edition, 2002.

CO – PO Mapping - ENVIRONMENTAL IMPACT ASSESSMENT FOR WATER RESOURCES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	M	M	M
PO2	Problem analysis			M		M	M
PO3	Design / development of solutions						
PO4	Investigation	M			M	M	M
PO5	Modern Tool Usage	M	M	M	M	M	M
PO6	Individual and Team work	M	M		M	M	M
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	M	H	H	M	M	M
PO9	Ethics	M	H	H	M	M	H
PO10	Environment and Sustainability	L	H	H	H	H	H
PO11	Project Management and Finance		M	L		M	M
PO12	Life Long Learning	M	H	M	H	M	M
PSO1	Knowledge of Agricultural and Irrigation Engineering discipline	M	H	H	M	H	H
PSO2	Critical analysis of Agricultural and Irrigation Engineering problems and innovation	H	M	H	M	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Agricultural and Irrigation Engineering Issues	M	M	M	H	M	M

IW5013 **WATER, SANITATION AND HEALTH** **L T P C**
3 0 0 3

OBJECTIVES:

- Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH 9

Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT 9

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will.

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:-Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE 9

Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES 9

Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
CO3	Critically analyse and articulate the underlying common challenges in water, sanitation and health.
CO4	Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5	Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES

1. Bonitha R., Beaglehole R.,Kjellstorm, 2006, “Basic Epidemiology”, 2nd Edition, World Health Organization.
2. Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning, 2002: 91–98. doi: 10.1002/tl.83Improving the Environment for learning: An Expanded Agenda
3. National Research Council. *Global Issues in Water, Sanitation, and Health: Workshop Summary***.** Washington, DC: The National Academies Press, 2009.
4. Sen, Amartya 1997. On Economic Inequality. Enlarged edition, with annex by JamesFoster and Amartya Sen, Oxford: Claredon Press, 1997.
5. Intersectoral Water Allocation Planning and Management, 2000, World Bank Publishers www. Amazon.com
6. Third World Network.org (www.twn.org).

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CO PO MAPPING : WATER, SANITATION AND HEALTH

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		L	L	M	L	L
PO2	Problem analysis		M	M	M	M	M
PO3	Design / development of solutions			M	L	M	M
PO4	Investigation		M	H	H	H	H
PO5	Modern Tool Usage				L		L
PO6	Individual and Team work		M	M	L	M	M
PO7	Communication				M	M	M
PO8	Engineer and Society		H	H	H	H	H
PO9	Ethics			L	M	M	M
PO10	Environment and Sustainability		H			H	H
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	M	H	M	H	H	H
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management		H	H	H	H	H
PSO2	Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.		H	M	H	H	H
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.		H	H	H	M	H

IW5014 SURFACE AND GROUND WATER HYDROLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the knowledge on the precipitation and abstraction processes of the hydrological cycle and groundwater movement to make an assessment of surface and groundwater resources.

UNIT I HYDROLOGICAL CYCLE AND PRECIPITATION 9

Hydrological cycle, Hydrological budget – Hydro meteorological observation - Precipitation, Types and Forms - Measurement - Processing of precipitation data

UNIT II HYDROLOGICAL PROCESSES OF ABSTRACTION 9

Water losses – Initial abstraction – interception and Depression storage - Evaporation, Evapotranspiration and infiltration – Field Measurement – Estimation by empirical formulae

UNIT III RUNOFF PROCESS 9

Runoff – components of runoff – Factors affecting Runoff - Hydrograph, hydrograph separation, Unit hydrograph, Instantaneous unit hydrograph, Synthetic unit hydrograph, rainfall-runoff models – SCS method – SWAT model.

UNIT IV GROUNDWATER 9

Origin of groundwater, Types of aquifer, Aquifer properties affecting groundwater, Darcy's law, coefficient of permeability, laboratory and field measurement of permeability, Groundwater movement, Flow through layered soils – Stream Lines and Equipotential Lines – Boundary Conditions.

UNIT V WELL HYDRAULICS 9

General flow equation, Steady and unsteady flow, well flow near aquifer boundaries, partially penetrating wells, characteristics of well losses, specific capacity – Safe yield - Ground Water Recharge – GEC norms for Groundwater Assessment – Managed Aquifer Recharge.

TOTAL: 45 PERIODS

OUTCOMES:

CO1	The students describe the various processes of hydrologic cycle and hydro meteorological Measurements
CO2	The students quantify various abstractions by selecting appropriate field measurements and empirical equation.
CO3	The students apply their knowledge on runoff processes to assess the water balance and runoff potential.
CO4	The students identify and describe the various features of ground water system.
CO5	The students apply their knowledge on well hydraulics to estimate the safe yield and ground water potential.

REFERENCES:

1. Warren Viessman, et al., Introduction to hydrology, Thomas Y.Crowell , New York , 1972
2. Ven Te chow (editors), Handbook of applied hydrology, McGraw Hill Book company 1964
3. Subramanya K., Hydrology,Tata McGraw Hill Co., New Delhi, 1994.
4. Patra.K.C, Hydrology and Water Resources Engineering, Narosa Publications, 2008, Second Edition, New Delhi.
5. Jeya Rami Reddy.P, Hydrology, Laximi Publications, New Delhi, 2004.

CO – PO MAPPING OF SURFACE AND GROUND WATER HYDROLOGY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	M	H
PO2	Problem analysis	L	M	M	M	M	M
PO3	Design / development of solutions		M	M	M	M	M
PO4	Investigation		L	M	M	M	M
PO5	Modern Tool Usage		L	M	L	M	L
PO6	Individual and Team work		M	M		M	M
PO7	Communication						
PO8	Engineer and Society		M	M	M	M	M
PO9	Ethics		M				M
PO10	Environment and Sustainability	H	M	M	M	H	M
PO11	Project Management and Finance						
PO12	Life Long Learning		M	M	H	H	M
PSO1	demonstrate knowledge and understanding in the field of irrigation water management through Integrated Water Resources Management, Participatory Irrigation Management with gender perspective meeting the current research and development.	L	M	M	H	M	M

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PSO2	comprehend the various techniques for water application, system performance, and the ability to develop proficiency in sophisticated tools related to the analysis of quantity and quality of irrigation water for better management	L	M	M	L	M	M
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in irrigation water management	L	L	M	M	M	M

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

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Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.

5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

Business Data Analytics

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 **INDUSTRIAL SAFETY** **LT P C**
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

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UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008

OE5093 OPERATIONS RESEARCH LT P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

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UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL : 45 PERIODS

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making
CO2– Understand the project management concepts and their various aspects in selection
CO3– Interpret costing concepts with project execution
CO4– Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL : 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITII BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

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AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

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AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

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REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

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AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading
1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

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UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do‘s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses-71,73,75,78 (do’s)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.