

**Bloom's Taxonomy Levels:** 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

**Programme Name: M.E. (Civil) in Irrigation Water Management**

**Programme Specific Outcome (PSO)**

- PSO1 To demonstrate knowledge and understanding of principles of irrigation water management by using various tools and methodologies to provide application oriented solutions.
- PSO2 Design, Analyse, interpretation and evaluation of irrigation systems, on farm irrigation management techniques and planning of water distribution systems.
- PSO3 Understanding of soil-water-drop relationship, conservation measures, crop water requirement and to analyse agricultural drainage systems.
- PSO4 To develop and analyse the numeric techniques and soft computing models for irrigation water management and corresponding projects.




1	Water Relations of Soil, Kinds of soil water, Soil moisture constants, Energy relations of soil water, Soil water retention.	7	13	1,2	CO1	PSO3	Emp/ Ent/SD	L,N,R,G	ES, PE
2	Measurement of Soil Water and Rooting Characteristics, Moisture content measurements, Measuring devices based on energy relations, Rooting characteristics and moisture use of crops, Effective root zone, Moisture extraction pattern within root zone	5	11	1,2	CO2	PSO3			
3	Movement of Soil Water,. Saturated flow, Unsaturated flow, Wetting front, Soil permeability measurements, Intake characteristics of soils, Factors affecting infiltration rate, Measurement of infiltration, cylindrical Infiltrometer, Ponding methods, Inflow-outflow methods, Blocked furrow methods, Recycling furrow infiltrometers, Infiltration equations : Kostiakov equation, Phillip equation S.C.S. equation, Halton et al equation, Green and Ampt equation, Instantaneous infiltration rate, Average infiltration rate, Basic infiltration rate, Hydraulic conductivity, Measurement of hydraulic conductivity, Moisture movement under saturated conditions, Moisture movement under unsaturated conditions.	6	12	1,2,3	CO3	PSO3			
4	Evapotranspiration, Evaporation, Dalton's law, Thermal balance, Evaporation measurement, Transpiration, Evapotranspiration, Consumptive use, Direct measurements of Evapotranspiration	5	11	1,2,3,4	CO4	PSO3			
5	Estimating reference evapotranspiration from climatological data FAO recommended : (i) Blaney criddle method, (ii) Radiation method, (iii) Penman method, (iv) Modified Penman method, (v) Pan evaporation method and various other methods of estimating potential evapotranspiration. Introduction to CROPWAT, ETo Calculator & WEAP software and its applications.	8	14	1,2,3,4	CO5	PSO3			
6	Introduction and procedure to crop evapotranspiration (ETc), Crop coefficient approach, Determine single crop coefficient Kc, Kc for different crops for different growth stages, Determining maximum evapotranspiration.	7	13	1,2,3,4	CO6	PSO3			
7	Concept of field water balance, Effective rainfall, Ground water contribution and other factors, Net irrigation requirement, Gross irrigation requirement, Estimation of seasonal water requirement using farming practice as Full irrigation, Two irrigation and Rainfed irrigation.	7	13	1,2	CO7	PSO3			
8	Field Irrigation Schedules, Depth of irrigation application, Irrigation application interval, Calculation of field irrigation schedules.	7	13	1,2,3,4	CO8	PSO3			

#### Reference Books

1.	Michael A.M. "Irrigation Theory and Practice" Vani Educational Books.
2.	Cuenca R.H. "Irrigation System Design - An Engineering Approach" Prentice Hall.

3.	Hansen V.E., Israelsen O.W., Stringham G.E. "Irrigation Principles and Practices" John Wiley and Sons
4.	Finkel .H.J., Hand book of Irrigation Technology, Vol.I, C.R.C Press
5.	Walker, W.R., Skogerboe, G.V. "Surface irrigation theory and Practice", Prentice Hall Inc.
6.	Doorenbos, J. and Pruitt, W.O. "Guide lines for predicting crop water requirements" F.A.O Irrigation and Drainage paper No.24, F.A.O. of the U.N.
7.	Doorenbos J. and Kassam, A.H. "Yield response to water" F.A.O Irrigation and Drainage Paper No.33, F.A.O of the U.N.
8.	Crop Evapotranspiration : Guidelines for Computing Crop Requirements, Irrigation and Drainage, Paper No.-56, FAO Rome, Italy – Allen, R. G. Pereira, L.S. Rase, D. Smith, M, (1998)


		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b> <b>2025-26</b>	
<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>						
<b>Year</b>	<b>I</b>	<b>Core / <del>Elective</del> / Foundation</b> <b>WRE2136L : Laboratory Practical</b>			<b>Credits / Hours per week</b> <b>2P</b>	
<b>Semester</b>	<b>I</b>	Year of Introduction : 1991 Year of Syllabus Revision :2020			<b>Maximum Marks / Grade</b> <b>50</b>	
<b>Mode of Transaction</b>		Laboratory Experiments, discussion and viva				
<b>No.</b>	<b>Experiment</b>	<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Measurement of Infiltration by single ring infiltrometer.	4	WRE2136L	1,2,3,4	CO3	PSO3
2	Measurement of Infiltration by double ring infiltrometer.	4	WRE2136L	1,2,3,4	CO3	PSO3
3	Measurement of evaporation by Evaporimeter.	4	WRE2136L	1,2,3,4	CO4	PSO3
4	Various methods suggested by FAO to determine reference crop Evapotranspiration	4	WRE2136L	1,2,3	CO5	PSO3
5	Plotting of Kc Curve	4	WRE2136L	1,2,3	CO6	PSO3
6	Determination of Seasonal Water Requirement	3	WRE2136L	1,2,3	CO8	PSO3
7	Irrigation Scheduling	3	WRE2136L	1,2,3	CO8	PSO3




1.	Objective of Network Planning, Objective of structured irrigation network, Definition of terms, Regulated system and proportional system, On and off system, Basic principles of network planning, Planning of irrigation projects	6	12	1,2	CO1	PSO2	Emp/ Ent/SD	L/N/R/G	ES, PE
2.	Macro Network Planning, Survey and Investigation, Preliminary surveys, Detailed survey, Use and importance of topographic maps, Bench mark	6	12	1,2	CO2	PSO2			
3.	Planning of Command Area, C.C.A. of project, Peak demand, Concept of block, Minor service area, Computing chaksize	6	12	1,2	CO3	PSO2			
4.	Planning and Design of Irrigation Network, Water allowance, Fixing main canal capacity, Alignment of irrigation canals, Curves in canal, Duty of water, Canal losses, Design statements for distributory and minors	6	12	1,2,3,4	CO4	PSO2			
5.	Planning of Structures, Different type of structures, Selection criteria, Location and their design considerations, Micro level canal structures	6	12	1,2,3,4	CO5	PSO2			
6.	Micro Level Canal Network Planning, , Plot corner survey, Stepwise procedure for planning and designing of micro network system ,Management and Operation of micro network system,	7	13	1,2,3,4	CO6	PSO2			
7.	Rotational Water Supply (RWS), Principles of RWS system, Preparation of R.W.S., Drainage Planning for Command Area, Importance, , Assessment of the field drainage system, Link drain and collector drain, Design considerations for drains	7	13	1,2,3,4	CO7	PSO2			
8.	Project on Micro Network planning, Preparation of Chak map , division of chak to subchaks, alignment of subminor and field channels, To prepare FSL statement of subminor and to decide type and location of micro level canal structures	8	14	1,2,3	CO8	PSO2			

#### Reference Books

1.	“Irrigation Engineering” by G. L.Asawa,Wiley Eastern Limited
2.	“Guidelines forPlanningandDesignofMicroCanalNetworkSystem”,C.D.O.,Gandhinagar

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<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>		<b>I</b>		<b>Core / <del>Elective</del> / <del>Foundation</del></b> <b>WRE2141L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>		
<b>Semester</b>		<b>I</b>		Year of Introduction : 1991 Year of Syllabus Revision : 2021			<b>Maximum Marks / Grade</b>		<b>50</b>		
<b>Mode of Transaction</b>		Data Collection, Analysis, discussion and viva									
<b>No.</b>	<b>Experiment</b>						<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Design of unlined Canal by Lacey's Theory						4	2141L	1,2,3,4	CO4	PSO2
2	Design of unlined Canal by Kennedy's Theory						4	2141L	1,2,3,4	CO4	PSO2
3	Design of Lined Canal by Manning's Equation						4	2141L	1,2,3,4	CO4	PSO2
4	Micro network planning of chak using actual field data and preparation of chak map, alignment of subminor and field channel, FSL statements for subminor and decide micro level canal structures						6	2141L	1,2,3,4	CO8	PSO2
5	Preparation of RWS based on actual field data						4	2141L	1,2,3,4	CO7	PSO2
6	To prepare layout of drainage system on chak map						4	2141L	1,2,3,4	CO7	PSO2

## Syllabus of Courses


		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>				
<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2138 : IRRIGATION MANAGEMENT</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>				
<b>Semester</b>	<b>I</b>	Year of Introduction : 1991 Year of Syllabus Revision : 2020			<b>Maximum Marks / Grade</b>		<b>100</b>				
<b>Mode of Transaction</b>		Lectures and Tutorials									
<b>Course Outcome (CO) WRE2138</b>											
CO1 To understand the importance and purpose of irrigation management CO2 To understand participatory approach for irrigation management CO3 To understand need and management of water user association CO4 To emphasize on the process of training to WUA/WUC agencies officials, including monitoring their performance CO5 To familiarize with traditional tank management system with different case studies CO6 To study the lift irrigation system, its design for water allocation and its management CO7 To understand the water policy followed by Gujarat State CO8 To study the irrigations laws of Gujarat under Gujarat Act no. 6 of 2013											
<b>Unit No.</b>	<b>Topic</b>			<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>

1	Goals of irrigation management. Problems in irrigation management. Social scientists and irrigation engineers joint involvement in management of irrigation systems. Traditional irrigation management.	6	12	1,2	CO1	PSO2	Emp/ Ent/SD	L/N/R/G	G, ES, HV, PE
2	Participatory Irrigation management, Concept of PIM, Need of PIM, Benefits of PIM, Objectives of PIM, Status of PIM in India and Gujarat, Impacts of PIM, Approaches to PIM, Constraints in implementation on PIM, Support for PIM in India	6	12	1,2	CO2	PSO2			
3	Water user's association/cooperatives. Pre-requisites for sustainable WUA/WUC. Types of farmer's organization. Hierarchy of irrigation dept. and WUA/WUC. Management within organization considering RWS. Constraints to farmer's participation. Incentives for implementation of PIM. Organising steps for transfer of management to users. Steps of rehabilitation and maintenance work carried out by WUA/WUC. Allocation of water. Steps for charging of water within the organization. Agreement of MOU between WUA/WUC and Government. Formation, rights and functions of each committee. Rights and functions of irrigation department. Raising of funds and investment by WUA/WUC.	8	14	1,2,3	CO3	PSO2			
4	Training of PIM to WUA/ WUC. Organisers for implementing PIM. Designing a capacity building program for PIM. Role of trainer. Conducting training programme. Training of discharge measurement. Walk through survey/maintenance survey. Crop assessments and water charges collection. Training to agency officials. Workshops on agricultural production practices. Monitoring performances of WUA/ WUC, Impacts of PIM on irrigation efficiency & equity, Impact of PIM on agriculture	7	13	1,2	CO4	PSO2			
5	Tank management systems. Organisation structure. Maintenance schedule. Problems involved. Case studies.	6	12	1,2,3,4	CO5	PSO2			
6	Management of lift irrigation system. System design for water allocation. Economic appraisal of lift irrigation schemes.	7	13	1,2,3,4	CO6	PSO2			
7	Gujarat state water policy.	6	12		CO7	PSO2			
8	Irrigation laws of Gujarat.	6	12	1,2	CO8	PSO2			


#### Reference Books

1.	Barik, B. C. "Course Report on Participatory Irrigation Management". WALMI, Anand
2.	"Draft Gujarat State Water Policy". Narmada, Water Resources, Water Supply Dept.
3.	Guide for Preparation of Plans of Operation and Maintenance of Irrigation Systems in India – Indian National Committee on Irrigation and Drainage, INCID, New Delhi.
4.	Gujarat Government Orders on Participatory Irrigation Management, Development Support Centre, Ahmedabad
5.	Impact of Participatory Irrigation Management Training Programme. WALMI, Anand
6.	Hooja, R. "A Strategy for training for PIM in India, Working paper, Indianpim.


7.	Maitra, M. K. "Watershed Management –Project Planning, Development and Implementation" Omega Scientific Publisher, New Delhi.
8.	Maloney, C. and Raju, K. V. "Economic aspect of PIM". Additional readings on Farmer's Organisations for Irrigation Management, WAPCOS, New Delhi.
9.	Murray, H., Lashri, B. and Memon, Y. "How to Establish Water Users Association? Practical Steps for Social Mobilizers", IWMI.
10.	Pangare, G. A. "Scaling up PIM in India". Indian Network on PIM, New Delhi.
11.	Project Report of Narmada Based Surface Water Lift Irrigation Scheme. Ground Water Resources Department Corporation Limited and Narmada Water Resources Water Supply and Kalpsar Department, Government of Gujarat.
12.	Satnarayan, Singh. "Farmer Management of Terminal Sub-System in Public Irrigation Schemes". Wamana Consultants, Hyderabad, Andhra Pradesh.
13.	Puskar Jena, Mamata Swain, "Participatory Irrigation Management in India", Best Publishing House
14.	U.S. Gautam, A. K. Singh, A. K. Sikka, "Participatory Irrigation Management", Agrotech Publishing Agency

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<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>		<b>I</b>		<b>Core / Elective / Foundation</b> <b>WRE2138L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>		
<b>Semester</b>		<b>I</b>		Year of Introduction : 1991 Year of Syllabus Revision : 2020			<b>Maximum Marks / Grade</b>		<b>50</b>		
<b>Mode of Transaction</b>		Field visits, Discussion and viva									
<b>No.</b>	<b>Experiment</b>						<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Field visit to Water User's Association to discuss rights and functions of each committee of WUA and PIM						6	2138L	1,2,3	CO3	PSO2
2	Field visit to co-operative societies to discuss rights and functions of PIM						6	2138L	1,2,3	CO4	PSO2
3	Field visit to Tank Irrigation system and understand its components, functions and management						7	2138L	1,2,3,4	CO5	PSO2
4	Field visit to Lift Irrigation System and understand system design for water allocation and its management.						7	2138L	1,2,3,4	CO6	PSO2


## Syllabus of Courses

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>				
<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2123 : OPERATION RESEARCH IN IRRIGATION WATER MANAGEMENT</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>				
<b>Semester</b>	<b>I</b>	Year of Introduction : 2006 Year of Syllabus Revision :			<b>Maximum Marks / Grade</b>		<b>100</b>				
<b>Mode of Transaction</b>		Lectures and Tutorials									
<b>Course Outcome (CO) WRE2123</b>											
CO1 To get familiar with operation research and various optimization models CO2 to get familiar with linear programming, construction and analysis CO3 To solve the linear programming, problems using simplex method CO4 To carry out sensitivity analysis for the solutions obtained, solving linear programming problems CO5 To carry out optimal resource allocation & optimal transportation CO6 To get familiar with the concept of game theory used for determining strategies in different situation CO7 To get familiar with network diagrams and to be able to solve optimum path and minimum cost flow problems CO8 To solve complex problems by breaking it down into simpler sub problems using dynamic programming											
<b>Unit No.</b>	<b>Topic</b>			<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>

1.	Origin, nature and impact of operation research. Optimization and operation research process. System boundaries, sensitivity analysis, tractability and validity. Descriptive models and simulation. Numerical search and exact versus heuristic solutions. Deterministic versus stochastic models. Perspectives.	6	12	1,2	CO1	PSO1 PSO2 PSO4	Emp/ Ent/SD	L/N/R/G	ES, HV, PE
2.	Introduction to linear programming., Construction of the LP model. Graphical LP solution, Graphical sensitivity analysis. Computer solution of LP problems. Analysis of selected LP models.	6	12	1,2,3,4	CO2	PSO1 PSO2 PSO4			
3.	The Simplex method. Standard LP form and it's basic solution. The simplex algorithm. Artificial starting solution. Special cases in simplex method application.	6	12	1,2,3,4	CO3	PSO1 PSO2 PSO4			
4.	Duality and sensitivity analysis. Definition of the dual problem. Relationship between optimal primal and dual solutions. Economic interpretation of duality. Dual simplex method. Primal-dual computations. Post-optimal or sensitivity analysis.	6	12	1,2,3,4	CO4	PSO1 PSO2 PSO4			
5.	Transportation problem. Streamlined simplex method for transportation problem. Assignment problem.	6	12	1,2,3,4	CO5	PSO1 PSO2 PSO4			
6.	Game theory. Introduction. Definition of Game theory. Characteristics of Game theory. Basic definitions and terminology. Pure strategies. Mix strategies. Rules of dominance.	7	13	1,2,3,4	CO6	PSO1 PSO2 PSO4			
7.	Terminology of networks. Shortest path problem. Minimum spanning tree problem. Maximum flow problem. Minimum cost flow problem. Network simplex method.	7	13	1,2,3,4	CO7	PSO1 PSO2 PSO4			
8.	Characteristics of dynamic programming problems. Deterministic dynamic programming. Probabilistic dynamic programming.	8	14	1,2,3,4	CO8	PSO1 PSO2 PSO4			
<b>Reference Books</b>									
1.	Hiller, F. S. and Leiberman, G. J. "Introduction to Operations Research". Seventh Edition, Tata McGraw-Hill Publishing Company Ltd.								
2.	Taha, H. A. "Operations Research–An Introduction". Sixth Edition, Prentice Hall of India								

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<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>						
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2123L : Laboratory Practical</b>			<b>Credits / Hours per week</b> <b>2P</b>	
<b>Semester</b>	<b>I</b>	Year of Introduction : 2006 Year of Syllabus Revision :			<b>Maximum Marks / Grade</b> <b>50</b>	
<b>Mode of Transaction</b>		Data Collection, Analysis, discussion and viva				
<b>No.</b>	<b>Experiment</b>	<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Formulation of LP Problems based on field data	3	2123L	1,2,3,4	CO2	PSO1 PSO2 PSO4
2	Determination of optimal solution of a LP problem by using graphical method	3	2123L	1,2,3,4	CO2	PSO1 PSO2 PSO4
3	Determination of optimal solution of a LP problem by using simplex method	3	2123L	1,2,3,4	CO3	PSO1 PSO2 PSO4
4	Determination of optimal solution of a LP problem by using Big-M method	3	2123L	1,2,3,4	CO4	PSO1 PSO2 PSO4
5	Determination of optimal solution of a LP problem by using two phase method	3	2123L	1,2,3,4	CO4	PSO1 PSO2 PSO4
6	Assignments of various jobs by Hungarian method	3	2123L	1,2,3,4	CO5	PSO1 PSO2 PSO4
7	Determination of optimum solution using game theory	4	2123L	1,2,3,4	CO6	PSO1 PSO2 PSO4
8	Determination of optimal allocation using dynamic programming	4	2123L	1,2,3,4	CO8	PSO1 PSO2 PSO4

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<b>M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2125 : WATERSHED MANAGEMENT</b>			<b>Credits / Hours per week</b>		<b>3L + 1 T</b>					
<b>Semester</b>	<b>I</b>	Year of Introduction : 2010 Year of Syllabus Revision :			<b>Maximum Marks / Grade</b>		<b>100</b>					
<b>Mode of Transaction</b>		Lectures and Tutorials										
<b>Course Outcome (CO) WRE2125</b>												
CO1 To get familiar the concept of watershed, its delineation, characteristics & administrative aspects related to its management CO2 To study pre treatment & post treatment measures for conservation of soil CO3 To study soil erosion & its estimation, also study its related model CO4 To study soil erosion prevention and conservation practices CO5 To study soil erosion prevention and conservation practices CO6 To study the problems of sedimentation and measures to control it CO7 To get familiar with participatory rural appraisal for watershed management CO8 To get familiar with different softwares used for studying a watershed												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>

1	Watershed concept. What is watershed, Delineation of watershed, Watershed characteristics, Management, Integrated multidisciplinary approach, Master plan, Administrative aspects.	8	15	1,2,3,4	CO1	PSO1 PSO3	Emp/ Ent/SD	L/N/R/G	G, ES, HV, PE
2	Land Survey. Preparation and development, Soil and soil moisture conservation, Conservation measures, Gully control, Rainwater management, River reclamation of saline soils.	7	14	1,2,3,4	CO2	PSO1 PSO3			
3	Soil erosion. Geologic erosion, Accelerated erosion, Types of soil erosion, Wind erosion, Water erosion, Estimation of soil erosion, Soil loss models.	8	15	1,2,3,4	CO3	PSO1 PSO3			
4&5	Erosion Control. Soil Erosion by Wind, Soil Erosion by Water, Land Capability Classes, Soil Conservation Practices, Vegetative Practices, Mechanical Practices, Erosion Control in Torrents and Gullies.	7	14	1,2,3,4	CO4	PSO1 PSO3			
6	Sedimentation. Sources of Sediments, Factors affecting Sediment Yield, Sediment's Properties, Sediment's Transportation, Sediment Load, Estimation of Sediment load, Determination of Suspended Load, Aspects of Suspended Load Sampling, Instruments for Sediment Monitoring Station, Data Collection and Analysis, Analysis of Suspended Load, Sedimentation Problems of Different Indian Soil Conservation Regions, Reservoir Sedimentation, Distribution of Sediment in the Reservoir, Prediction of Sediment Distribution, Factors Affecting Reservoir Sedimentation, Annual Silting Rates of Reservoir. Problems Caused by Reservoir Sedimentation, Control Measures for Reservoir's Sedimentation.	6	12	1,2,3,4	CO6	PSO1 PSO3			
7	Participatory Rural Appraisal. Introduction, Functions of PRA, Basic Principles of PRA, Fundamentals of PRA, Assumptions and Basics of PRA, Important tips for PRA Practitioners, Myths Regarding PRA techniques, Benefits of PRA, Different PRA tools, Qualitative interviews, Observation of the Participants, Structured Survey Techniques, Participatory Mapping and Modeling.	8	15	2,3	CO7	PSO1 PSO3			
8	Computer Aided Applications. Watershed Modelling System: DEM Delineation, Editing DEMs, Time of Concentration Calculations and Computing a Composite Curve Number, HEC-1 Interface, HEC-HMS Interface, Rational Method Interface, National Flood Frequency (NFF) Interface. Hydrologic Calculator: Runoff Analysis	8	15	1,2,3,4,5,6	CO8	PSO1 PSO4			

#### Reference Books

1.	Ghanshyam Das. "Hydrology and Soil Conservation Engineering" Prentice Hall of India Pvt. Ltd., New Delhi
2.	Suresh, R. "Watershed Hydrology", Standard Publishers Distributors, New Delhi.
3.	Rajora, R. "Integrated Watershed Management", Field Manual for Equitable, Productive and Sustainable Development, Rawat Publications, New Delhi.
4.	Murthy, J. V. S., "Watershed Management in India", Willey Eastern Limited, New Delhi.
5.	Ministry of Water Resources Central Ground Water Board, "Rain water Harvesting Techniques to Augment Ground Water", Faridabad.
6.	WMS 8.0 Tutorials, Copyright © 2006 Brigham Young University - Environmental Modeling Research Laboratory



**The Maharaja Sayajirao University of Baroda**  
**Faculty Technology and Engineering**  
**Water Resources Engineering and Management Institute**


**Academic Year**

**2025-26**

**M.E. (CIVIL) Part-I in IRRIGATION WATER MANAGEMENT**

Year	I	<del>Core</del> / Elective / <del>Foundation</del> WRE2125L : Laboratory Practical	Credits / Hours per week				2P
Semester	I	Year of Introduction : 2010 Year of Syllabus Revision :	Maximum Marks / Grade				50
Mode of Transaction		Laboratory Experiments, discussion and viva					
No.	Experiment		Contact Hours	Course Code	BT Level	CO	PSO
1	Determination of watershed based on area		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
2	Demarcation of watershed based on shape		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
3	Delineation at watershed		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
4	Stream order numbering in an watershed		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
5	Determination of time at concentration in an watershed		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
6	Development of hydrograph through on watershed		3	2125L	1,2,3,4	CO1 CO8	PSO1, PSO3
7	Determination of soil loss by USLE (Universal Soil Loss Equation)		2	2125L	1,2,3,4	CO4 CO5	PSO1, PSO3
8	Determination of soil loss by MUSLE (Modified Universal Soil Loss Equation)		2	2125L	1,2,3,4	CO4 CO5	PSO1, PSO3
9	Design of terraces for soil and water conservation		2	2125L	1,2,3,4	CO4 CO5	PSO1, PSO3
10	Hands on practice for watershed analysis various softwares		2	2125L	1,2,3, 4,5,6	CO8	PSO1, PSO3


## Syllabus of Courses

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty of Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>					
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2239 : PRESSURIZED IRRIGATION SYSTEMS</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>					
<b>Semester</b>	<b>II</b>	Year of Introduction : 1991 Year of Syllabus Revision : 2021			<b>Maximum Marks / Grade</b>		<b>100</b>					
<b>Mode of Transaction</b>		Lectures and Tutorials										
<b>Course Outcome (CO) WRE2239</b>												
CO1 Basics of pipe flow, its behavior CO2 Pipe flow in multiple outlet system ,importance of F factor CO3 Understand components, advantages and disadvantages pressurized irrigation system CO4 Students will be able to prepare layout and design of sprinkler irrigation systems CO5 Students will be able to prepare layout and design of every component of drip system CO6 To understand the economic analysis of pressurized irrigation system CO7 To evaluate sprinkler irrigation system & simulation of sprinkler irrigation system CO8 To evaluate drip irrigation system and determination various uniformity for the selection of best DIS												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)</b>


1	Pipe Flow, Various equations to determine frictional head loss in pipe, Determination of friction factor, f; Determining diameter of pipe,	6	12	1,2,3	CO1	POS1 PSO2	Emp/ Ent/SD	L/N/R/G	ES, HV, PE
2	Determining loss of head through multiple outlet pipe, Pressure discharge relationship, Pressure distance relationship, Concept of “ F “ factor in multiple outlet pipe, New Approach to determine “F” factor	6	12	1,2,3	CO2	POS1 PSO2			
3	Classification of pressurized Irrigation system, Components, adaptability, advantages and disadvantages of drip and sprinkler irrigation systems, Layout of drip and Sprinkler Irrigation system, Important criteria to be considered for layout and Design, Advanced technology in pressurized irrigation system.	6	12	1,2,3	CO3	POS1 PSO2			
4	Design Of Sprinkler Irrigation System, Selection of type of sprinklers and spacings of sprinklers and laterals, Determination of operation time and number of sets, Sprinkler irrigation system layout, Design of lateral, manifold and submain.	6	12	1,2,3,4	CO4	POS1 PSO2			
5	Design Of Drip Irrigation System, Selection of emitter discharge and emitter spacing, Determination of operation time and number of sets, Drip irrigation system layout, Design of lateral, manifold and submain.	6	12	1,2,3,4	CO5	POS1 PSO2			
6	Capital cost of drip and Sprinkler Irrigation system, Operation and maintenance cost of drip and Sprinkler Irrigation System, Energy cost, Benefit Cost Ratio and Internal Rate of Return.	7	13	1,2,3,4	CO6	POS1 PSO2			
7	Evaluation Of Sprinkler Irrigation System, General requirement, Equipment needed, Field procedure, Utilization of field data, Uniformity coefficient, Distribution uniformity, Potential application efficiency of the low quarter, Application efficiency of the low quarter, Single lateral method, Alternate lateral method, Single sprinkler simulation, Radial line simulation.	7	13	1,2,3,4,5	CO7	POS1 PSO2			
8	Evaluation of Drip Irrigation System, Emitter discharge uniformity estimation, Hydraulic system and emitter performance, Soil water distribution and application efficiency, Fertilizer injection evaluation, Filter performance, water meter evaluation.	8	14	1,2,3,4,5	CO8	POS1 PSO2			

#### Reference Books

1.	FinkelH.J."HandbookofIrrigationTechnology"VolumeICRCPress,Inc.Bocaraton, Florida.
2.	Michael A. M." IrrigationTheory and Practice" Vani EducationalBooks, New Delhi.
3.	Newzealand Agricultural Engineering Institute " Trickle Irrigation Design Manual" Part I Miscellaneous Publication Welington.
4.	Melvyn Kay "Sprinkler Irrigation and Practice" Batsford Academic and educational Ltd., London.
5.	NakayamaF.S.andBucksD.A."TrickleIrrigationforCropProductionDesign,Operation andManagement" Elsevier, New-York, 1985.

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty of Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>		
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>									
<b>Year</b>		<b>I</b>		<b>Core / <del>Elective</del> / Foundation</b> <b>WRE2239L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>
<b>Semester</b>		<b>II</b>		Year of Introduction : 1991 Year of Syllabus Revision :2021			<b>Maximum Marks / Grade</b>		<b>50</b>
<b>Mode of Transaction</b>		Laboratory Experiments, discussion and viva			<b>PSO7 is common for all experiments</b>				
<b>No.</b>	<b>Experiment</b>				<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Design and Layout of Sprinkler Irrigation System				5	2239L	1,2,3,4	CO4	PSO1, PSO2
2	Design and Layout of Drip Irrigation System				5	2239L	1,2,3,4	CO5	PSO1, PSO2
3	Economic analysis of pressurized irrigation system				5	2239L	1,2,3,4	CO6	PSO1, PSO2
4	Evaluation of Sprinkler irrigation System				5	2239L	1,2,3,4,5	CO7	PSO1, PSO2
5	Evaluation of Drip irrigation System				6	2239L	1,2,3,4,5	CO8	PSO1, PSO2


## Syllabus of Courses

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>					
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2223 : SURFACE IRRIGATION SYSTEMS</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>					
<b>Semester</b>	<b>II</b>	Year of Introduction : 1991 Year of Syllabus Revision :			<b>Maximum Marks / Grade</b>		<b>100</b>					
<b>Mode of Transaction</b>		<b>I</b>										
<b>Course Outcome (CO) WRE2223</b>												
CO1 To study land grading of land leveling method for surface irrigation methods CO2 To study basic irrigation methods like basin, border, furrow, drip, sprinkler, also its merit demerit of this method CO3 To understand various phases of irrigation CO4 The study various irrigation efficiency as per standard of INCID CO5 To get familiar with basin irrigation system & its design CO6 To get familiar with border irrigation system, also study design of borders & its evaluation CO7 To be able to design furrows and evaluate application efficiency in furrow irrigation system CO8 To understand the farm land size elevation at grid point formation level for cut fill ratio												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>


1	Land Grading and Field Layout, Land grading, Criteria for land leveling and its design methods recommended safe limits of land scope, Survey and Design	6	12	1,2,3	CO1	PSO1 PSO2	Emp/ Ent/SD	L/N/R/G	Es, PE
2	Methods of Irrigation, Various methods of water application, Their adaptability, Merits-demerits, Design criteria and design variables- Roughness factors in surface Irrigation systems	6	12	1,2,3	CO2	PSO1 PSO2			
3	Phases of Irrigation, Advance, Recession, Storage and Depletion phases of Irrigation wetting front, Advance and recession curves, Advance-Efficiency ratio Effect of Advance on efficiency	6	12	1,2	CO3	PSO1 PSO2			
4	Irrigation Efficiencies, Irrigation efficiencies as per standards of INCID, Water Application efficiency, Conveyance, Project efficiency, Runoff, Deep percolation, Uniformity coefficient	6	12	1,2,3,4,5	CO4	PSO1 PSO2			
5	Basin Irrigation, Levis Milne Equation, Saint-Vanant's equations Hydraulics of basin irrigation Design of level basin Irrigation - volume & Balance Approach, Assumptions, Zero-Inertia Model, Use of design charts, Design of water course	8	14	1,2,3,4,5	CO5	PSO1 PSO2			
6	Border Irrigation, Design of Level and gradient border, Border specifications and stream size, Hydraulics of Border irrigation border, Runoff and erosion	7	13	1,2,3,4,5	CO6	PSO1 PSO2			
7	Furrow Irrigation, Types of Furrow systems - Level Furrow, Gradient Furrow and cut-back Furrow, Corrugation Irrigation contour Furrow, Basic equations for design of Furrow irrigation systems, Runoff- Deep percolation, Application Efficiency, Furrow Advance and Recession studies	6	12	1,2,3,4,5	CO7	PSO1 PSO2			
8	Design Of Farm Land, Farm size, Availability of water Infiltration characteristics, Soil characteristics design of farm distribution system, Head land and tail land facilities, Design of field channels and Return flow	7	13	1,2,3,4	CO8	PSO1 PSO2			

#### Reference Books

1.	Wynn R. Walker, G.V.Skogerboe, "Surface Irrigation (Theory & Practice)", Prentice Hall Inc.
2.	Jensen, "Design and Operation of Farm Irrigation systems
3.	Michael A. M., "Irrigation - Theory and Practice", Vani Educational Books
4.	Bruce, Withers and Vipond, "Irrigation - Theory and Practice", Elsier Publications
5.	S. K. Sharma, "Principles of Irrigation Engg.", S. Chand and Co.

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>				
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>		<b>I</b>		<b>Core / <del>Elective</del> / <del>Foundation</del></b> <b>WRE2223L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>		
<b>Semester</b>		<b>II</b>		Year of Introduction : 1991 Year of Syllabus Revision ::			<b>Maximum Marks / Grade</b>		<b>50</b>		
<b>Mode of Transaction</b>		Laboratory Experiments, discussion and viva									
<b>No.</b>	<b>Experiment</b>						<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Demonstration and Design of Border Irrigation System						6	2223L	1.2.3.4	CO6	PSO1, PSO2
2	Demonstration and Design of Basin Irrigation System						6	2223L	1.2.3.4	CO5	PSO1, PSO2
3	Demonstration and Design of Furrow Irrigation System						6	2223L	1.2.3.4	CO7	PSO1, PSO2
4	Evaluation of Border Irrigation System						4	2223L	1.2.3.4	CO4	PSO1, PSO2
5	Evaluation of furrow irrigation System						4	2223L	1.2.3.4	CO4	PSO1, PSO2

## Syllabus of Courses

	<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>					<b>Academic Year</b>	<b>2025-26</b>					
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2235 : COMPUTER AIDED DESIGN IN IRRIGATION WATER MANAGEMENT</b>			<b>Credits / Hours per week</b>	<b>3L + 1 T</b>						
<b>Semester</b>	<b>II</b>	Year of Introduction : 1991 Year of Syllabus Revision : 2020			<b>Maximum Marks / Grade</b>	<b>100</b>						
<b>Mode of Transaction</b>		Lectures and Tutorials										
<b>Course Outcome (CO) WRE2235</b> CO1 To get familiar with computer, its hardware and its software CO2 To study all the parameters to be used in computer programming CO3 To study the application of computer programming in irrigation water management CO4 To study various graphic devices and their applications in irrigation water management CO5 To understand database management along with its application in irrigation water management CO6 To study the application of simulation in irrigation water management CO7 To impart knowledge about various computer based IWM Models. CO8 To understand the working of RS and its application in GIS												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>

1	Computer Fundamentals. Introduction, Computer Types, Terminologies Related to Computers, System Software, PC Oriented General Purpose Software Programming – Word Processor, Spreadsheets, Access, Graphics and Communication Software.	6	12	1,2	CO1	POS3 PSO4	Emp/ Ent/SD	L/N/R/G	ES, PE
2	Computer Programming: Introduction, Variables and Data types, Operators, Introduction to Visual Basic 6.0, Input, Output, Function Arrays, Sub Programs, Programming in V.B. 6.0.	6	12	1,2,3,4	CO2	POS3 PSO4			
3	Typical Computer Applications: Introduction, Determination of Reynolds and Froude's Number, Optimal Cropping Pattern using Linear Programming, Pipe Network Analysis, Urban Storm Water Drainage, Unit Cost of Surface Water, Unit Cost of Ground Water, Irrigation Water Requirement, Irrigation Scheduling, Rotational Water Supply (R.W.S.) Scheduling.	8	14	1,2,3,4,6	CO3	POS3 PSO4			
4	Computer Graphics for Applications in Irrigation Water Management: Introduction to Computer Graphics, Interactive Computer Graphics, Creation of Symbols, Use of Graphics for Irrigated Area, Ground Water Levels, Different Land Use, Contours.	6	12	1,2,3,4,6	CO4	POS3 PSO4			
5	Database Management in Irrigation Water Management: Introduction to DBMS, RDBMS and ORDBMS, Database Design, Database Management for Hydro chemical and Ground Water Data, Relational Model, Structured Query Language, DBMS in Water Supply, Irrigation and Land Drainage.	6	12	2,3,4,5	CO5	POS3 PSO4			
6	Computer Simulation: Introduction, Tank Simulation for Minor Irrigation Project, Simulation of Irrigation System Evaluation, Water Management using Interactive Computer Simulation.	6	12	2,3,4,5	CO6	POS3 PSO4			
7	Organizations in model development, Ground water models, Watershed runoff models, Stream hydraulics models, River and reservoir water quality models, Reservoir / river system operation models	7	13	2,3,4,5,6	CO7	POS3 PSO4			
8	Remote Sensing and GIS: Introduction, Types of Remote Sensing, Components of Remote Sensing and GIS, Principles of Object Identification, Digital Image Processing, Digital Elevation Models, Data Acquisition and Registration, Analysis Technique, Applications in Irrigation Water Management.	7	13	2,3,4,5,6	CO8	POS3 PSO4			

#### Reference Books

1.	Brebbia C.A., Ovazar D. and Sari B., 1991, Computer Aided Engineering in Water Resources Vol. 3, Proceeding of Second International Conference held in Marrakesh, Morocco, Comoputational Mechanics Publications.
2.	Evangelos P., 1998, Mastering Visual Basic 6.0, BPB Publications, New Delhi.

3.	Govardhan V., 1993, Remote Sensing and Water Management in Command Areas - An Agro-ecological perspective, International Book Distributing Co., Lucknow.
4.	Gibson P.J., 2000, Introductory Remote Sensing - Principles & Concepts, Routledge, New York.
5.	Lillesand T.M. and Kiefer R.W., 1987, Remote Sensing and Image Interpretation, John Wiley and Sons.
6.	Paul Bonner, 1994, Visual Basic Utilities, BPB Publications, New Delhi
7.	Plastock R. A. and Kalley G., 1986, Theory and Problems of Computer Graphics, Schaum's Outline Series in Computers, Mc. Graw Hill Book Company
8.	Reddy A.M., 2001, Textbook of Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad
9.	Steve Brown, 1998, Visual Basic 6.0 in Record Time, BPB Publications, New Delhi
10.	Wurbs, R. A. (1994). Computer models for water resources planning and management (No. IWR-94-NDS-7). Army Engineer Institute for Water Resources Fort Belvoir VA.



**The Maharaja Sayajirao University of Baroda**  
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Academic Year

2025-26

**M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT**


Year	I	Core / Elective / Foundation WRE2235L : Laboratory Practical	Credits / Hours per week				2P
Semester	II	Year of Introduction : 1991 Year of Syllabus Revision : 2020	Maximum Marks / Grade				50
Mode of Transaction		Hands on Practice, Programming, discussion and viva					
No.	Experiment		Contact Hours	Course Code	BT Level	CO	PSO
	<b>Minor technical programs.</b>						
1	Calculation of four basic operations: Addition, Subtraction, Multiplication & Division.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
2	Determine manning's velocity.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
3	Determine the area of circle, square, rectangle and triangle.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
4	Determination of froude's number.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
5	Determine the Duty of water.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
6	To Determine the Leap Year (If else condition).		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
7	Determine the Leap Year (Using Select case).		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
8	To Determine the Greatest number out of three numbers entered by user.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
9	To check whether the entered number is odd or even.		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
10	To check if entered alphabet is a vowel or not (If else condition).		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
11	To check if entered alphabet is a vowel or not (using Select Case)		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
12	To check the result of a student (If else condition)		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
13	To check the result of a student (Select Case)		0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4

					CO4	PSO4
14	Sign in window by entering username and password From loading/unloading	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
15	Make a list which are perfectly divisible by 3, 5 and 6.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
16	Make a list of numbers between 5 and 555 which are perfectly divisible by 3 and 5	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
17	Add your current semester subjects in a list box.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
18	Make a separate list of even and odd number between 1 to 1000.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
19	Make a list of leap year between entered range of years given by user.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
20	Repeat 1 to 55 numbers 5 times (using for loop).	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
21	Write a program to repeat 5 to 55 numbers each 20 time (For Loop).	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
22	Write program to repeat 5 to 55 numbers each 20 time (do while loop)	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
23	Write a program to Repeat 5 to 55 number in order, 5 time (do.. while)	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
24	Write a program to find out factorial of a given number.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
25	Write a program to whether the number is prime or not.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
26	Write a program to allow the user to select their favorite fruit and vegetable.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
27	Write a program for swapping the number.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
28	Write a program for changing the color.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
29	Write program to find simple and compound interest.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
30	Write a program to arrange number in ascending and descending order.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
31	Write a program to find L.C.M of Given number.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
32	Write a program to find out G.C.F of given number.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
33	Write a program to find trigonometric function.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4

34	Write a program to find volume of cylinder, cone, and sphere.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
35	Write a program to answer of question using combo box.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
36	Write program to find out determinant and rank of the matrix 2X2, 3X3 and 4X4.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
37	Write a program to display the different shapes with different option.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
38	Write a program to make unit convertor.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
39	Write a program to conduct an objective exam and display the result within limited time of period (10 questions)	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
40	Write a program using message box.	0.25	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
	<b>Major programs</b>		2235L			
1	Write a program to determine gross soil erosion.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
2	Write a program to determine irrigation efficiencies in context of irrigation system.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
3	Write a program to find out reference crop evapotranspiration by radiation method.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
4	Design of border irrigation system.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
5	Design of furrow irrigation system.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
6	Design of basin irrigation method.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
7	Write a program to evaluate sprinkler irrigation system.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
8	Write a program to evaluate drip irrigation system.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
9	Write a program to determine estimated runoff using SCS CN.	1.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
10	Write a program to find out value of unknowns of three simultaneous equations by Gauss Jordan Method.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
11	Write a program to find out value of unknowns of three simultaneous equations Gauss Elimination Method.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
12	Determine Eigen Value of 3*3 Matrix.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
13	Write a program to find out value of unknowns of three simultaneous equations by gauss elimination method.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4

14	Write a program to find out best strategy using game theory.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
15	Write a program to select a type of outlet.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
16	Write a program to select type of C.D works.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
17	Write a program to find types of micro network area.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
18	Find the balancing depth of the canal.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
19	Canal design using lacey's theory.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4
20	Canal design using Manning's theory.	0.75	2235L	1,2,3,4,5,6	CO2, CO3, CO4	PSO3, PSO4


## Syllabus of Courses

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>					
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2224: DRAINAGE AND SALINITY CONTROL</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>					
<b>Semester</b>	<b>II</b>	Year of Introduction: 1991 Year of Syllabus Revision:			<b>Maximum Marks / Grade</b>		<b>100</b>					
<b>Mode of Transaction</b>		Lectures and Tutorials										
<b>Course Outcome (CO) WRE2224</b>												
CO1 To familiarize with the principle of drainage engineering and study the soil properties. CO2 To study various survey & investigation methods for drainage and various data required for design of drainage. CO3 To determine the hydraulics conductivity of soils using various methods. CO4 To develop conceptual rainfall runoff model. CO5 Study the working of surface drainage and its design. CO6 To be able to study the sub surface drainage systems & design of different sub surface drainage systems. CO7 To understand the pump drainage, its working, design, operation & maintenance. CO8 To understand the effects of salinity and sedimentation of salt affected areas												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional &amp; Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>


1	Introduction, Introduction to principles of Drainage Engineering. Soils and soil properties, salty soils, Physics of soil moisture, Elementary ground water hydraulics.	6	12	1,2	CO1	PSO1 PSO2	Emp/ Ent	L/N/R/G	ES, PE
2	Survey and Investigation, Surveys and investigations, Objectives, Analysis of rainfall data, Interpretation of soil types from soil survey marks. Determination of aquifer characteristics from pumping tests, Soil moisture measurements.	6	12	1,2,3	CO2	PSO1 PSO2			
3	Hydraulic Conductivity, Determination of Hydraulic conductivity of soils, Correlative methods, Laboratory methods of determination of Hydraulic conductivity, Field methods of determination of Hydraulic conductivity, Weighted Hydraulic conductivity, Porosity Drainable porosity and its importance in drainage design.	6	12	1,2,3,4	CO3	PSO1 PSO2			
4	Theories of Field Drainage, Theories of field drainage, Subsurface flow into drains Field drainage criteria, Drainage by pumping from wells, Rainfall - runoff relationships and computational models.	6	12	1,2,3,4	CO4	PSO1 PSO2			
5	Surface Drainage System, Surface Field drainage systems types, Surface drainage systems for flat areas, Surface drainage systems for sloping areas, Design discharge computations Design of Main drainage system	8	14	1,2,3,4	CO5	PSO1 PSO2			
6	Sub-Surface Drainage System, Sub surface drainage systems: Design of Mole drains, Design of tile drains, Various drainage spacing formulae in practice, Design of pipe drainage system, Design of subsurface drainage system in transient condition.	7	13	1,2,3	CO6	PSO1 PSO2			
7	Pump Drainage, Pump drainage, Types of pumps, selection of pumps, Pumping plant design, Multiple pump system, Operation and Maintenance, Tube well drainage, Types of well drainage systems Design of well drainage systems, Operation and maintenance of drainage projects	7	13	1,2,3	CO7	PSO1 PSO2			
8	Salinity Control, Salinity control and drainage water reuse, Types of salt affected soils, Water quality, Salt tolerance of crops, Salinity management techniques, Reclamation of salt affected soils, Drainage water use.	6	12	1,2,3,4	CO8	PSO1 PSO2			

#### Reference Books

1.	Drainage Principles and applications Vols I, II, III, IV Publication 16 ILRI, Netherlands, 1983
2.	Advances in Drainage Proc. A.S.A.E. 4th National Drainage Symposium December 1982
3.	J. Martinez Beltran - Drainage and Reclamation of Salt affected Soils, Publication 24, ILRI, Netherland, 1978
4.	Handbook for Drainage of Irrigated areas in India - Irrigation Management and Training Project Louis Berger International Inc. & Water and Power Consultancy Services(India) Ltd., March 1988

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>				
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>											
<b>Year</b>		<b>I</b>		<b>Core / Elective / Foundation</b> <b>WRE2224L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>		
<b>Semester</b>		<b>II</b>		Year of Introduction : 1991 Year of Syllabus Revision :			<b>Maximum Marks / Grade</b>		<b>50</b>		
<b>Mode of Transaction</b>		Field visit, discussion and viva									
<b>No.</b>	<b>Experiment</b>						<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Field visit to show agriculture surface drainage system						4	2224L	1,2,3,4	CO5	PSO1, PSO2
2	Determination of Runoff by US SCS CN Method						4	2224L	1,2,3,4	CO5	PSO1, PSO2
3	Field visit to show agriculture sub surface drainage system						4	2224L	1,2,3,4	CO6	PSO1, PSO2
4	Field visit to show water logged area, and their problems						4	2224L	1,2,3,4	CO8	PSO1, PSO2
5	Field visit to show salt affected areas and their reclamation						5	2224L	1,2,3,4	CO8	PSO1, PSO2
6	Determination of Leaching Requirements						5	2224L	1,2,3,4	CO8	PSO1, PSO2


## Syllabus of Courses

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>					
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>												
<b>Year</b>	<b>I</b>	<b>Core / Elective / Foundation</b> <b>WRE2237 : Advanced Computational Techniques in Irrigation Water Management</b>			<b>Credits / Hours per week</b>		<b>3L + 1T</b>					
<b>Semester</b>	<b>II</b>	Year of Introduction : 1991 Year of Syllabus Revision : 2020			<b>Maximum Marks / Grade</b>		<b>100</b>					
<b>Mode of Transaction</b>		Lectures and Tutorials										
<b>Course Outcome (CO) WRE2237</b>												
CO1 To have better understanding about applications of matrices. CO2 To analyze and evaluate various finite element approximation methods. CO3 To analyze finite element techniques including interpolation functions, variational functions and shape functions and formulation of local and global matrix. CO4 To analyze and evaluate ground water flow problems using finite element techniques. CO5 To gain knowledge and better understanding about Artificial Intelligence based expert system models. CO6 To gain knowledge and better understanding about Artificial Neural Network and its application in irrigation water management. CO7 To gain knowledge and better understanding about Fuzzy Logic and its application in irrigation water management. CO8 To gain knowledge and better understanding about Genetic Algorithm and its application in irrigation water management.												
<b>Unit No.</b>	<b>Topic</b>				<b>Contact Hours</b>	<b>Weightage (%)</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>	<b>Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)</b>	<b>Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)</b>	<b>Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)</b>

1	Elementary concepts of matrices Introduction, Introduction to matrices, special matrices, matrix equality, addition and multiplication by a scalar, Multiplication of matrices, The inverse matrix, Methods to solve matrices Eigen values & Eigen vectors	8	14	1,2,4	CO1	PSO4	Emp/ Ent/SD	L,N,R,G	ES, PE
2	History and development of finite element method Introduction, General applicability, Weak formulation of boundary value problems in fluid mechanics, Approximate methods, Point collocation, Least square, Galerkin's, Raleigh-Ritz method	8	14	1,2	CO2	PSO4			
3	Finite Element Analysis Weighted residual technique, Discretization of domain, Shape, and size of element, Interpolating polynomials, Iso-parametric elements, Triangular elements, Integration of shape function over element, Formulation of global matrix, Solution procedures and sparse matrix storage techniques	6	12	1,2,4	CO3	PSO4			
4	Ground Water Flow Problems Ground Water Flow Problems, Finite element formulation of two-dimensional steady state flow, Pump and streams, Impervious boundaries, and constant head boundaries	6	12	1,2,4	CO4	PSO4			
5	Artificial Intelligence and Expert System for Water Resources Artificial Intelligence and Expert System for Water Resources, Introduction, Components of an expert system, Developing a knowledge base, Interface engine, Backward chaining, Forward chaining, Soil erosion & evapotranspiration models	6	12	1,2,4	CO5	PSO4			
6	Artificial Neural Network Introduction, History, Overview or biological neuro-system, Mathematical models of neurons, ANN architecture, Learning rules, Learning paradigms supervised, Unsupervised & reinforcement, Learning, Learning task, ANN training algorithms, Application of ANN in IWM	6	12	1,2,3,4,5,6	CO6	PSO4			
7	Fuzzy Logic Introduction, Importance of fuzzy logic, Applications of fuzzy logic, Crisp and linguistic variables, Membership functions, Fuzzy logic rules, Fuzzy inference system, Application of fuzzy logic in WRE	6	12	1,2,3,4,5,6	CO7	PSO4			
8	Genetic Algorithm Genetic Algorithm Introduction, Advantages & limitations of GA, Background, Natural selection, Evolution in biology, Concept of genetic algorithm, Steps involved in GA method, Encoding, Creating fitness function, Operators, Cross over, Permutations, Mutations, Parameters in GA, Initialization method & stopping criteria, Application of GAs in IWM	6	12	1,2,3,4,5,6	CO8	PSO4			

**Reference Books**

1.	O. C. Zienkiewicz, The Finite Element Method, Tata-McGraw Hill
2.	Brebbia C. A., Computer Methods in Water Resources, Vol-I, II and III Computational Mechanics Publications
3.	Neural Network : A Comprehensive Foundation, Simon Haykin, PHI
4.	Elements of Artificial Neural Networks; Kishan Mehtrotra, S. Ranka, Penram International Publishing (India)
5.	Neural Networks and Fuzzy Systems, Bart Kosko, PHI

		<b>The Maharaja Sayajirao University of Baroda</b> <b>Faculty Technology and Engineering</b> <b>Water Resources Engineering and Management Institute</b>			<b>Academic Year</b>		<b>2025-26</b>		
<b>M.E. (CIVIL) Part-II in IRRIGATION WATER MANAGEMENT</b>									
<b>Year</b>		<b>I</b>		<b>Core / Elective / Foundation</b> <b>WRE2237L : Laboratory Practical</b>			<b>Credits / Hours per week</b>		<b>2P</b>
<b>Semester</b>		<b>II</b>		Year of Introduction : 1991 Year of Syllabus Revision :2020			<b>Maximum Marks / Grade</b>		<b>50</b>
<b>Mode of Transaction</b>		Laboratory Experiments, discussion and viva							
<b>No.</b>	<b>Experiment</b>				<b>Contact Hours</b>	<b>Course Code</b>	<b>BT Level</b>	<b>CO</b>	<b>PSO</b>
1	Tutorials on elementary concepts of matrices.				3	WRE2237L	1,2,4	CO1	PSO4
2	Tutorials on finite element approximation methods.				3	WRE2237L	1,2	CO2	PSO4
3	Tutorials on interpolation functions, variational functions, and shape functions				3	WRE2237L	1,2,4	CO3	PSO4
4	Tutorials on groundwater flow problems.				3	WRE2237L	1,2,4	CO4	PSO4
5	Tutorials on artificial intelligence and expert system for IWM				3	WRE2237L	1,2,4	CO5	PSO4
6	Hands on practices on Artificial Neural Network				3	WRE2237L	1,2,3,4,5,6	CO6	PSO4
7	Hands on practices on Fuzzy Logic				4	WRE2237L	1,2,3,4,5,6	CO7	PSO4
8	Hands on practices on Genetic Algorithm				4	WRE2237L	1,2,3,4,5,6	CO8	PSO4