

Course title: Irrigation water and drainage management				
Course code: WSW 136	No. of credits: 4	L-T-P distribution: 49-0-14	Learning hours: 56	
Pre-requisite course code and title (if any)				
Department: Department of Regional Water Studies				
Course coordinator(s): Ms Ranjana Ray Chaudhuri		Course instructor(s): Ms Ranjana Ray Chaudhuri		
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Course type: Compulsory Core		Course offered in: Semester 2		
Course Description Agriculture serves as the backbone of economy where water is key input for food production. Agriculture depends upon the timely monsoon and the amount of rainfall in any year. To overcome the uncertainty and vagaries of the monsoon, farmers resort to various methods of irrigation. Irrigated agriculture is the biggest consumer of water in the world. About 70% of the world's freshwater is used for agriculture. Sustainable water use for food production, human consumption and industrial use are prime global challenges at present. Agriculture as the biggest water users will have to accept the challenge of becoming far more efficient in a food secure world. Water scarcity and stiff competition for water between different sectors has resulted in reduced water availability for irrigation. Hence, production of food, fibre, fuel and other industrial inputs with less water availability is major challenge for both rainfed and irrigated agriculture. Considering these facts, this course is designed to give thorough knowledge of water, agriculture and their multifaceted relationships so that associated challenges can be overcome.				
Course objectives				
<ul style="list-style-type: none"> ▪ To familiarize students with concepts and fundamentals of agricultural production system ▪ To enable students, thorough understand soil-water-plant relationships ▪ To give students comprehensive knowledge of crop water requirement and its estimations ▪ To introduce students with basic criterions of irrigation project evaluation 				
Course content				
Module	Topic	L	T	P
1	Genesis, Water Resources, Principle Crops and Irrigation Introduction: Need for sustainable development; Global water resources; India: water budget; Irrigation: Impact of irrigation on human environment; Some major and medium irrigation schemes of India; Sources of irrigation water; Present status of development and utilization of different water resources of the country; Principle crops in India: Classification of crops; Principle crop seasons; Resource conservation crop production technology; Field Visit-1	6	0	2
2	Module Soil-plant-water relationship: Soil Properties: Soil physical properties influencing irrigation such as soil texture, soil structure, bulk density; capillary and non-capillary pores; soil profile; Soil taxonomy; Volume and mass relationships of soil constituents; Water relations of soil: Kinds of soil water; Movement of water into soils: Infiltration; Factors affecting infiltration rate; measurement of infiltration; Infiltration equations; Soil moisture constants: Saturation capacity, field capacity, moisture equivalent; Permanent wilting percentage, available water; Soil moisture characteristics curves; Plant water relations; Practical 1 & 2	6	0	4
3	Water Requirement of crops Evapotranspiration: Evaporation; Transpiration; Consumptive use; Evapotranspiration concept and Standard terminologies; Measurement of evapotranspiration: Lysimeter experiment; Field experimental plots; Soil moisture depletion studies; Water balance method; Estimation of evapotranspiration from climatological data: Thornthwaite Method; Hargreaves Method; Modified Penman Method; Selection of crop coefficient for estimation of ET_{crop} ; Practical 3 & 4	8	0	4
4	Irrigation management including micro-irrigation methods Measures for irrigation: Net irrigation requirement; gross irrigation requirement; Irrigation frequency; Irrigation period; Irrigation efficiencies; Irrigation methods: Surface irrigation methods: Border irrigation; Check basin irrigation; Furrow irrigation; Water saving irrigation technologies(micro irrigation system design); Sub-irrigation; Pressurised irrigation methods (drip and sprinkler): Merits and demerits of micro-irrigation system; Types and components of micro-irrigation system; Basic variables involved in design; Past, present and future need of micro-irrigation systems; Role of Govt. for the promotion of micro-irrigation in India	10	0	0

5	Design of irrigation and drainage management structures Reservoir planning, design capacity of reservoirs, reservoir sedimentation-causes and control, useful life of reservoir. Water losses and control Design of small earthen dams, check dams, low gravity dams, selection criteria of spill ways and energy dissipators. Alignment of canals, design of unlined canals in alluvial and non-alluvial soils and design of lined canals, comparisons and limitations Techniques for drainage management and design of agricultural returnflow including nitrogen and phosphorus management	10	0	4
6	Economic evaluation of Irrigation Projects and Water Pricing Basic terminology and concepts; Economic and Financial Analysis; Irrigation Project Costs; Study of actual evaluation of Irrigation Project; In class written assignment; Water pricing and current scenario of water pricing in different states of India;	9	0	0
		49	0	14
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Practical's: 20% ▪ Assignments: 20% ▪ Minor Test: 20% ▪ End-term exam: 40% 				
Learning outcomes				
After successful completion of course, student will:				
<ul style="list-style-type: none"> ▪ Be able to identify, discuss and evaluate principle crops, seasons & production and their interrelated set-up in agriculture ▪ Properly understand, critically analyse and quantitatively evaluate weather parameters, natural resources input, artificial inputs and their contribution and importance in agriculture ▪ Professionally developed for irrigation water estimation under various conditions of data availability, scales and proper methodologies and master the skills for their applications ▪ Technically understand, design of irrigation structures including for drainage management and comment on irrigation project evaluation 				
Pedagogical approach				
With focused approach on thorough understanding of subject, various educational techniques will be used. Main emphasis of teaching will be on using traditional method of black board teaching which will be supported by frequent multimedia presentations. In addition to this, field visits and demonstrations (seeing is believing), practical's (learning by doing), assignments (practise and analytical techniques) will be used. To give scope for imagination and creative skills, use of short subject related documentaries, discussions, and presentation by renowned subject matter specialist will be done. To check writing, memorization and subject related knowledge one major examination will be conducted.				
Materials				
Text books				
Michael A.M. (2008). Irrigation: Theory and Practice (2 nd Edition). Vikas Publishing House Pvt. Ltd, New Delhi.				
Hillel Daniel (1998). Environmental Soil Physics (1 st edition). Academic Press.				
Brady N. C. and Weil R. R. (2008). The Nature and Properties of Soils (14 th Edition). Pearson-Prentice Hall,NJ.				
Singh Bharat, Fundamentals of Irrigation Engineering, Nemchand and Bros,Roorkee,Uttarakhand				
Garg,S.K.,(2006), Irrigation Engineering and Hydraulic Structures, Khanna Publishers, Naisarak, New Delhi				
Suggested readings				
Majumdar D. K. (2004). Irrigation Water Management Principles and Practice. Prentice-Hall of India Pct. Limited. New Delhi.				
S. S. Singh (1995) Crop Management (5th Edition). Kalyani Publishers, New Delhi.				
Case studies				
Any one major or medium irrigation project in India				
Websites				
1) http://www.fao.org/home/en/				

- 2) <http://www.iwmi.cgiar.org/>
- 3) <http://agricoop.nic.in/>

Journals

- The Indian Journal of Agricultural Sciences
- Indian Journal of Soil and Water Conservation
- Water Resources Research
- Agricultural Systems
- Journal of Irrigation and Drainage Engineering

Additional information (if any)

This course contains basics as well as advanced knowledge of agricultural and other related engineering in practise. It offers opportunity by combining interesting theory, practise and field visits. Guest Lecturer : Once At least

Practical's:

- 1) Measurement of soil moisture by gravimetric method
- 2) Irrigation scheduling by tensiometer/ gypsum block
- 3) Measurement of infiltration using double ring infiltrometer
- 4) Estimation of evapotranspiration based on climatological data

Field Visits

- 1) Identification of crops, cropping systems and crop cultural operations
- 2) Visit to automatic weather station, lysimeter and green house
- 3) Visit to Irrigation Project to understand canal system, water distribution system and irrigation project management (At the end of course, Optional)

Student responsibilities

Attendance (Minimum 75%). Practical cannot be repeated.

Course reviewers:

1. Prof Ram Karan Singh, Department of Civil Engineering, King Khalid University, Saudi Arabia.
2. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.