

HWRM-309 DRAINAGE ENGINEERING (THEORY)

(03 Credit hrs)

PRE-REQUISITE: HWRM-102

LEARNING OUTCOMES:

- This course will provide an in depth knowledge of Surface and Subsurface drainage systems.
- This course will introduce the students to the Rainfall process and its Relationship to Drainage.
- The students will learn about the phenomena of Flow of Water through Soil.
- They will have the knowledge about the Surface Drainage Systems.
- The students will get used to Sub-Surface Drainage Systems.
- The students will be equipped with the Vertical Drainage System.

CONTENTS

Unit-1 Introduction

- 1.1. Waterlogging and salinity, their causes and remedial measures
- 1.2. Need for drainage
- 1.3. Purpose of drainage; benefits of drainage
- 1.4. Effect of poor drainage on soil and plant
- 1.5. Drainage problems in Pakistan.
- 1.6. Sources of excess water; relationship of irrigation and drainage.

Unit-II Rainfall and its Relationship to Drainage

- 2.1. Mean rainfall over a basin or watershed
- 2.2. Frequency of rainfall
- 2.3. Characteristics of storm
- 2.4. Time of concentration
- 2.5. The time of overland flow
- 2.6. Different formulas for estimating runoff

Unit-III: Flow of Water through Soil

- 3.1. Occurrence of ground water
- 3.2. Saturated and unsaturated flow
- 3.3. Flow of water through soil
- 3.4. Measurement of hydraulic head
- 3.5. Capillary flow above the water table
- 3.6. Critical water table depth measurement of hydraulic conductivity
- 3.7. Soil salinity control; leaching requirements

Unit-IV: Surface Drainage Systems

- 4.1. Surface drainage methods for flat lands and sloping lands
- 4.2. Surface drain design
- 4.3. Construction of surface drains
- 4.4. Maintenance of surface drains

Unit-V: Subsurface Drainage System

- 5.1. Types of subsurface drainage layouts

- 5.2. Interceptor drain; relief drains; mole drains
- 5.3. Material for subsurface drainage system
- 5.4. Design process for subsurface drainage system
- 5.5. Drainage coefficients; drain spacing formula
- 5.6. Hooghoudt's formula for steady state
- 5.7. Determination of design depth and pipe diameter; layout and patterns
- 5.8. The pipe; and the envelope materials, outlets, installation, maintenance

Unit-VI: Vertical Drainage System

- 6.1. Factors affecting the feasibility of drainage wells
- 6.2. Layout of drainage well systems
- 6.3. Problems associated with vertical drainage
- 6.4. Causes of failure of tubewell drainage in Pakistan
- 6.5. Well configuration, design consideration, maintenance, urban drainage system,
- 6.6. Principle and practices. Drainage, method of drainage, runoff components and soil moisture retardation.
- 6.7. Renovation of drainage system, sub-surface drainage design.
- 6.8. Drain capacity, slope and size. Layout of systems. Interceptor drains, canal design.

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXT BOOKS / SUGGESTED READINGS

1. Smedema, L. K. Vlotman, W. F. Rycroft. D. W. (2020). *Modern Land Drainage: Planning, Design and Management of Agricultural Drainage Systems*. 2nd edition, Taylor & Francis. ISBN 9780367458775
2. Gupta S.A. (2019). *Drainage engineering: principles and practice*, Scientific Publishers ISBN: 9789388172028
3. Micheal, A. M. and Bhattacharya. A. K. (2003). *Land Drainage: Principles Methods and Application*. Konark Publishers Pvt Ltd, India. ISBN: 8122006558
4. Siddiqui, I. H. (2003). *Irrigation and Drainage Engineering*. Oxford University Press, ISBN: 9780195473568
5. Waller P, Yitayew M. (2015) *Irrigation and Drainage Engineering*, Springer ISBN-13: 9783319056982