Course Code	Course Title			Cr. Hr.
SWM 223	FOREST HYDROLOGY			3 (2+1)
Course Duration: 105 working days of one sem.		Full Marks: 75	Theory: 50	Practical: 25
Level: B.Sc. Forestry	Year: 2 and Semester: IV	Course Mode: Theory & Practical		

OBJECTIVES

After completion of this course, students will be able to understand the hydrologic cycle and forest-water interactions, including precipitation, evapotranspiration, infiltration, and runoff; analyze the impacts of forest management practices like logging and afforestation on water yield, erosion, and quality; evaluate the effects of climate change, fires, and drought on forested watersheds; apply measurement techniques for streamflow, soil moisture, and sediment, and use tools like remote sensing and hydrologic models (e.g., SWAT) for watershed analysis; and integrate ecohydrology principles to develop sustainable forestry practices that support water resource conservation and biodiversity.

SYLLABUS

Introduction to Forest Hydrology, exploring its scope and role in forestry; Hydrologic cycle in forests, detailing precipitation, evapotranspiration, infiltration, and runoff; Precipitation Processes, including canopy interception, throughfall, and stemflow; Snow and evapotranspiration, focusing on snow accumulation, melt, and forest water loss; Soil and water interactions, examining soil water storage, infiltration, and measurement; Runoff and streamflow, addressing surface runoff, baseflow, and streamflow measurement; Watershed fundamentals, covering delineation, forest types, and hydrologic modeling; Forest management impacts, analyzing effects of logging, afforestation, and roads; Erosion and water quality, studying soil erosion, sediment transport, and riparian zones; Climate, disturbance, and applications, evaluating climate change, fires, drought, ecohydrology, remote sensing, and case studies in watershed management.

Practical: Hands-on skills include watershed water balance computation, precipitation analysis and gap estimation, canopy interception and snowmelt assessment, infiltration and streamflow measurement, sediment yield and evapotranspiration estimation, and use of forest hydrology instruments. Field activities cover meteorological station layout, rainfall data analysis, hydrograph preparation, river gauging studies, and infiltration measurement techniques.

COURSE BREAKDOWN

A. Theory Lectures

Units	Lecture Outlines	No. of Lectures
1.	**Foundation of Forest Hydrology**	
	1.1 Introduction to Forest Hydrology (Definition, scope, and importance in forestry; Forests' role in global and local water cycles)	1
	1.2 The Hydrologic Cycle in Forests (Components; Unique influences of forests on hydrologic processes)	1
	1.3 Water Balance in Forested Watersheds (Water balance equation; Factors affecting water balance in forests)	1
2.	**Precipitation Processes**	
	2.1 Precipitation Types and Patterns (Forms and their variability in forested regions; Techniques for measuring precipitation in forests)	1
	2.2 Canopy Interception (Interception loss by forest canopies; influencing factors)	1
	2.3 Throughfall and Stemflow (Mechanisms and measurement of throughfall and stemflow; Hydrologic significance in forest ecosystems)	1
3.	**Snow and Evapotranspiration**	
	3.1 Snow Accumulation in Forests (Snow interception and accumulation under forest cover; Effects of forest structure on snowpack dynamics)	1

	3.2 Snowmelt and Runoff (Snowmelt processes and runoff generation in forests; Forest impacts on snowmelt timing and streamflow)	1
	3.3 Evapotranspiration in Forests (Evaporation vs. transpiration processes; Environmental controls: Climate, vegetation, soil moisture)	1
4.	**Soil and Water Interactions**	
	4.1 Soil Water Storage (Soil properties (texture, porosity) and water retention; Importance for forest health and water availability)	1
	4.2 Infiltration in Forest Soils (Factors affecting infiltration rates (soil type, vegetation); Comparison with non-forested landscapes)	1
	4.3 Soil Moisture Measurement (Techniques: TDR probes, tensiometers, gravimetric methods; Applications in forest management)	1
5.	**Runoff and Streamflow**	
	5.1 Surface Runoff Mechanisms (Hortonian and saturation-excess runoff in forests; Role of forest cover in regulating runoff)	1
	5.2 Baseflow and Groundwater (Groundwater contributions to forest streams; Forest management impacts on baseflow sustainability)	1
	5.3 Streamflow Measurement (Methods: Weirs, flumes, velocity-area techniques; Practical applications in forested watersheds)	1
6.	**Watershed Fundamentals**	
	6.1 Watershed Concepts and Delineation (Defining and mapping forested watersheds; Importance for hydrologic management in forestry)	1
	6.2 Forest Types and Watershed Hydrology (Hydrologic differences in tropical to alpine forests; Examples of forest-watershed interactions)	1
	6.3 Hydrologic Modeling Basics (Introduction to models (e.g., SWAT, HEC-HMS); Applications in forest watershed management)	1
7.	**Forest Management Impacts**	
	7.1 Logging and Hydrologic Changes (Effects of timber harvesting on runoff and erosion; Best management practices to mitigate impacts)	1
	7.2 Afforestation and Water Yield (Hydrologic impacts of forest establishment; Examples from degraded or reforested watersheds)	1
	7.3 Forest Roads and Hydrology (Impacts of roads on runoff and sediment transport; Design strategies to minimize hydrologic disruption)	1
8.	**Erosion and Water Quality**	
	8.1 Soil Erosion in Forests (Types of soil erosion; Role of vegetation in erosion control)	1
	8.2 Sediment Transport in Streams (Sediment dynamics and impacts on water quality; Monitoring sediment in forest streams)	1
	8.3 Riparian Zones and Water Quality (Functions of riparian buffers in pollutant filtration; Management guidelines for riparian zones)	1
9.	**Climate and Disturbance**	
	9.1 Climate Change and Forest Hydrology (Impacts on precipitation and evapotranspiration patterns; Adaptation strategies for forest management)	1
	9.2 Forest Fires and Water Dynamics (Post-fire changes in runoff and erosion; Hydrologic recovery processes after fires)	1
	9.3 Drought Impacts on Forests (Effects on soil moisture and tree water stress; Management strategies for drought resilience)	1
10.	**Applications and Tools**	
	10.1 Eco-hydrology in Forest Management (Linking hydrologic processes with forest ecology; Applications in biodiversity and ecosystem conservation)	1
	10.2 Remote Sensing in Forest Hydrology (Use of GIS and satellite imagery for hydrologic analysis; Mapping soil moisture and vegetation cover)	1

	10.3 Case Studies in Watershed Management (Real-world examples of forest hydrology projects; Integrating hydrology into sustainable forestry practices)	1
	TOTAL	**30**

B. Practical

S.N.	Experiments	No. of Practical
1.	Calculating water balance for a forested watershed	1
2.	Analyzing average precipitation	1
3.	Analyzing missing precipitation	1
4.	Estimating canopy interception loss	1
5.	Quantifying snowmelt runoff	1
6.	Analyzing infiltration rates	1
7.	Estimating streamflow discharge	1
8.	Calculating sediment yield in a forested stream	1
9.	Estimation of evapotranspiration	1
10.	Identification of equipment and their uses related to forest hydrology	1
11.	Field study of the meteorological station layout, equipment and measurement	1
12.	Measurement and analysis of rainfall data	1
13.	Preparation, use and analysis of hydrograph	1
14.	Field study of river gauging station	1
15.	Field exercise on infiltration measurement	1
	TOTAL	**15**

Teaching Learning Strategies	
Theory	***Practical***
• Lectures • Assignments • Quiz	• Performance • Presentations • Group Discussions • Project works • Field visits

Class Work Policies
• Equal opportunity • Intellectual honesty • Regularity and punctuality • Adherence to task deadlines • Fairness • Conformity to discipline

Evaluation and mark weightage:

Evaluation Weightage	Theory (50 marks)				Practical (25 marks)		
	Mid-Term Exam	Final Term Exam	Assignment/ Reports/ Records	Theory Class Attendance	Final Term Exam	Daily Practical Performance Assessment	Practical Class Attendance
Max. Marks	10	30	06	04	15	06	04
Mark %	20%	60%	12%	8%	60%	24%	16%

TEXT BOOKS

1. Brooks, K. N., Ffolliott, P. F., Gregersen, H. M., & DeBano, L. F. (2012). *Hydrology and the Management of watersheds* (4th ed.). Wiley-Blackwell.
2. Chang, M. (2012). *Forest Hydrology: An introduction to water and forests* (3rd ed.). CRC Press.
3. Dingman, S. L. (2015). *Physical Hydrology* (3rd ed.). Waveland Press.

REFERENCES

1. Bonan, G. B. (2016). *Ecological climatology: Concepts and applications* (3rd ed.). Cambridge University Press.

2. DeBano, L. F., Neary, D. G., & Ffolliott, P. F. (1998). *Fire's effects on ecosystems*. Wiley.
3. Eagleson, P. S. (2002). *Ecohydrology: Darwinian expression of vegetation form and function*. Cambridge University Press.
4. Food and Agriculture Organization of the United Nations. (2016). *Forests and water: International momentum and action* (FAO Forestry Paper). FAO.
5. Hewlett, J. D. (1982). *Principles of forest hydrology*. University of Georgia Press.
6. Ice, G. G., & Stednick, J. D. (Eds.). (2004). *A century of forest and wildland watershed lessons*. Society of American Foresters.
7. Neary, D. G., Ice, G. G., & Jackson, C. R. (2009). Linkages between forest soils and water quality and quantity. *Forest Ecology and Management, 258*(10), 2269–2281.
8. Porporato, A., & Rodriguez-Iturbe, I. (2002). Ecohydrology—a challenging multidisciplinary research perspective. *Hydrological Sciences Journal, 47*(5), 811–821.
9. United States Geological Survey. (2025). *USGS water data for the nation*. https://waterdata.usgs.gov/nwis

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