GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Subject Code: ME02033081

Subject Name: Stochastic Model In Water Resources

w. e. f. Academic Year:	2024-2025
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Basics of hydrology
Rationale:	Hydrological processes such as rainfall, river flow, evaporation, and groundwater recharge are inherently variable and uncertain. Stochastic models help account for this randomness, making them essential tools for realistic representation and prediction. Stochastic models are widely used in forecasting hydrological events (e.g., floods, droughts) and simulating long-term resource behavior. Knowledge of stochastic models equips students with essential tools to analyze, predict, and manage complex and uncertain water systems, preparing them for both professional challenges and advanced research opportunities.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Analyse hydrologic data	R, U
02	Perform frequency analysis of hydrologic extremes	R, U, A
03	Apply multivariate analysis in hydrologic systems	R, U
04	Analyse hydrologic time series	A, N, E
05	Develop models for synthesis of hydrologic variables	A, N, C

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	**150**

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Deterministic and Stochastic Hydrology, review of concepts of probability, probability axioms, Random variables and their properties, probability distribution and probability density function. Discrete and continuous probability distributions used in hydrology, moments and expectations of distributions, Parameter estimation, method of moments, maximum likelihood method and method of probability weighted moments. Hypothesis testing, goodness test of fit tests, Chi Square test and KS test.	8	20
2.	Frequency analysis of hydroclimatic extremes, extreme value distributions, analysis of floods, droughts and other natural hazards, Regional flood frequency analysis, Risk and reliability in hydrologic design, Analysis and measures of hydrologic uncertainty. Correlation analysis and correlation coefficient, Simple linear regression, Multivariate regression analysis. Correlation coefficient and its significance in regional analysis, analysis of variance, applications – rainfall-runoff analysis, rating curves, water quality modelling, Multivariate analysis, principal component analysis, cluster analysis.	8	20
3.	Hydrologic Time Series Analysis, Hydrologic time series, stationary and non-stationary time series, Ensemble and realisation, trend analysis, trend removal, analysis of periodicity, Fourier transformation and harmonic analysis, autocorrelation function, spectral density function, Wavelet analysis.	11	20
4.	Modelling of Hydrologic Time Series, Time series models, autoregressive and moving average models, periodic models, Calibration and validation of hydrologic time series models, data generation techniques, simulation of hydrologic time series, streamflow forecasting.	8	20
5.	First order Markov process, Markov chain, Multi-site time series model, cross-correlation, spatial and temporal disaggregation models. Theory of copula and its use in hydrology, commonly used copula functions, selection of best fit copula, uses of copula.	10	20
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**15**	**20**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Applied Hydrology, Chow, V.T., Maidment, D.R., and Mays, L.W., Tata McGraw Hill Edition, 2017 2nd Edition
2. Statistical Methods in Hydrology, Haan T. C., East West Publishers, 2002
3. Statistics, Probability and Reliability for Civil and Environmental Engineers, Kotteguda, N.T., and Resso, R., Blackwell Publishing, UK, 2008.
4. Stochastic Water Resources Technology, Kotteguda, N.T., The Macmillan Press, New York, 1982.
5. Statistical Methods in Hydrology and Hydroclimatology, Rajib Maity, Springer Nature Singapore Pte Ltd., 2018

(b) Open source software and website:

1. https://nptel.ac.in/courses/105/108/105108079/

SList of Laboratory/Learning Resources Required:

Suggested Project List:

1. Project on Frequency analysis of hydroclimatic extremes such as Flood, drought, etc.
2. Project on Analyze and model time series of rainfall or streamflow.
3. Project on Modeling of Hydrologic Time Series.
4. Project on Rainfall-runoff analysis.
5. Project on Principal component analysis of rainfall data.
6. Analyze extreme events like floods and droughts using hydrological data.

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