Course Type	Course Code	Name of Course	L T P	Credit
DE	NGPD506	**Hydrology**	3 0 0	3

Course Objective

- Students comprehend the hydrologic cycle and related major water quantity and quality challenges and their relevance to human health and well-being, ecosystems, and the food supply.
- Correct solution of three quizzes based on concepts of hydrology and the water cycle. Satisfactory completion of examination questions related to concepts of hydrology and the water cycle on two or three examinations.
- Students understand the essential components and function of the hydrologic cycle including precipitation, evaporation/ evapotranspiration, overland flow and surface storage, groundwater flow and storage, and channel flow, storm water runoff and water quality.

Learning Outcomes

- Students can compute hydrologic mass balance in a closed basin. Students can develop unit hydrographs based on streamflow data, and conduct basic unit hydrograph analysis. Students can conduct frequency analysis on hydrologic data to determine return period or recurrence interval.
- Students can perform hydrologic and hydraulic routing using governing equations for hydraulic river routing. Students understand basic concepts of hydrologic simulation modelling to evaluate potential impacts of management decisions.
- Students can compute critical flow and critical depth in floodplain hydraulics. Students can compute groundwater drawdown based on water well withdrawal. Students can delineate watersheds and stream polylines from digital elevation data.

Unit No.	Description of Lectures	Lecture Hrs.	Learning Outcomes
1.	Hydrologic system and cycle: Hydrologic cycle, types of hydro-meteorological data and their importance, time oriented, space oriented and relational data. Observation of hydro-meteorological data: rainfall, temperature, evaporation, discharge and other parameters. Observational and instrumental errors and quality control.	7	Understanding of hydrological cycle and its interaction with groundwater systems.
2.	Hydrological monitoring and standardization: Guidelines of World Meteorological Organization (WMO), Bureau of Indian Standards (BIS) & International Organization for Standardization (ISO). Storage,	7	Knowledge on WMO,BIS,ISOI MD,CWCandW MO monitoring systems and standardization.

	transmission and retrieval of data, different formats adopted by India Meteorological Department (IMD), Central Water Commission (CWC) and World Meteorological Organization (WMO). Design and optimization of monitoring systems for rainfall, run-off, evaporation, gauge and discharge networks and groundwater data monitoring stations.		
3.	Interpolation methods: Estimation of missing data in rainfall, runoff and other parameters, record extension for rainfall and runoff data. Interpolation and kriging techniques, statistical rainfall-runoff models. Application of auto-regressive (AR), moving -average (MA), auto-regressive moving average (ARMA) and hybrid models for rainfall-runoff modelling.	7	Knowledge on interpolation of hydro-meteorological data.
4.	Graphical and analytical methods and data storage: Development of stage discharge curves using graphical, physical and analytical methods for various types of streams. Automatic weather stations - types, data storage and retrieval; Automatic water level recorders - types, data storage and retrieval.	6	Understanding of discharge curves and water table variability
5.	Random field method for hydro-meteorological data: Analysis of randomness and trends in hydro-meteorological data. Computation of statistical parameters and standards errors, components of time series. Theoretical models for understanding the spatio-temporal variability prediction of hydro-meteorological data. Concepts of short and long term dependence in hydro-meteorological data.	7	Trend and random field method for hydro-meteorological data.
6.	Extreme frequency analysis: Estimation of extremes using frequency analysis. Graphical and analytical methods for normal, lognormal and Gumbel distributions. Case Studies.	**8**	Understanding of distribution curves for frequency analysis
	Total Classes	**42**	

Textbooks

1. Singh V. P., "Elementary Hydrology", Prentice-Hall of India Private -1994.
2. Viessman W. and Lewis G. L., "Introduction to Hydrology", Pearson Education - 2007.

References

1. Chow V. T., Maidment D. R. and Mays L. W., "Applied Hydrology", McGraw-Hill-1988.
2. Hornberger G. M., Raffensperger J. P., Woberg P. L and Eshleman K. N., "Elements of Physical Hydrology", The Johns Hopkins University Press - 1998.
3. Kottegoda N.T., "Stochastic Water Resources Technology", John Wiley & Sons – 1980.
4. Maidment, D.R., "Handbook of Hydrology", McGraw Hill Inc. -1993.
5. S.K. Jain & V.P. Singh, "Water Resources Systems Planning and Management", Elsevier ISBN: 8131205916 (HB)-2006.
6. Singh V. P., "Elementary Hydrology", Prentice-Hall of India Private -1994.
7. Subramanya K., "Engineering Hydrology", Tata McGraw Hill Ltd.- 2008.
8. Viessman W. and Lewis G. L., "Introduction to Hydrology", Pearson Education - 2007.