S.No.	Topic	No. of Lectures
3.	Runoff phenomena, relationship between precipitation and runoff	1
4.	Synthetic unit hydrograph, Unit hydrograph and its derivation including for complex storm,	3
5.	S-hydrograph and derivation, Use of IUH and various methods of estimation.	3
6.	Runoff estimation models: SCS, CN software	3
7.	Flood routing principles	2
8.	Recent advances in analysis of hydrologic data and flow from small watersheds. Methods of runoff estimation from small watersheds.	3
9.	Micro climate, estimation methods of evaporation. Advances and improvements in rational approach. SCS approach criticism and improvements	3
10.	Process of sedimentation of reservoirs	2
11.	Hydrological hazard functions, Methods of estimation of hydrologic parameters, Data transformation,	3
12.	Hydrologic modeling approaches, component conceptualization, types of watershed hydrologic models and choice of model.	3
13.	Calibration and evaluation of hydrologic models. Computer simulation of hydrological process in small watersheds	2
	Total	**32**

VIII. List of Practicals

S.No.	Topic	No. of Practicals
1.	Delineation of watershed and study of watershed characteristics	1
2.	Measurement of rainfall and runoff in a watershed	1
3.	Analysis of hydrologic data and flow from small watersheds	1
4.	Estimation of infiltration and runoff from a watershed	1
5.	Measurement and analysis of stream flow data	1
6.	Analysis of synthetic unit hydrograph for complex storm	1
7.	Analysis of S-hydrograph for complex storm	1
8.	Use of runoff estimation models: SCS, CN software	2
9.	Study of different types of flood routing methods	2
10.	Computer simulation of hydrological process in small watersheds	1
11.	Study of reservoir sedimentation	1
12.	Study of watershed model components	1
13.	Visit to a watershed	1
	Total	**16**

IX. Suggested Reading

- Haan CT. *Hydrologic Modeling of Small Watershed*.
- Singh VP. 2010. *Rainfall-Runoff Modeling* (Vol. I)—Prentice Hall, New York.
- Singh VP. 2010. *Environmental Hydrology*. Springer, New York.

I. Course Title : Soil and Water Conservation Structures

II. Course Code : SWCE 503

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint students with the planning and design of soil and water conservation

structures, their stability checks and mechanized soil conservation techniques.

V. Theory

Unit I

Design, planning and layout of soil and water conservation structures. Criteria of selection of appropriate structures as per soil, land use and climatic conditions.

Unit II

Design and construction of earthen dam, stability analysis of land slopes and soil mass including landslides.

Unit III

Hydrological and structural design including stress analysis. Hydraulic jump and energy dissipaters for soil conservation structures.

Unit IV

Seepage through dams, flow net and determination of uplift pressure in drop structures, design of energy dissipaters.

Unit V

Design of water harvesting structures, construction, maintenance and utilization of stored water. Mechanized construction techniques for soil and water conservation structures.

VI. Practical

Numerical approach on probability distribution functions. Stability analysis and structural design of masonry water harvesting structures. Design of earthen dams and other energy dissipating structures. Cost analysis of water harvesting structures. Field visit to already constructed water harvesting structures in the nearby area/ watershed.

VII. Learning outcome

The student will be able to design the soil and water conservation structures as well as permanent gully control structures and water harvesting structures. They can have understanding of mechanized construction of soil and water conservation structures.

VIII. Lecture Schedule

S.No.	Topic	No. of Lectures
1	Introduction and need of Soil and Water Conservation in agricultural watershed	1
2	Runoff process and factors affecting it and estimation of runoff using various methods	3
3	Analysis of rainfall data, Probability concepts in the design of structures	3
4	Introduction, classification and functional requirement of soil and water conservation structures-Straight Drop spillway, chute spillway and drop inlet spillway	1
5	Specific energy and specific force	2
6	Hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy	2
7	Straight drop spillway- Components and their functions, hydrologic, hydraulic and structural design	4

S.No.	Topic	No. of Lectures
8	Drop inlet spillway- Components and their functions, hydrologic, hydraulic and structural design	2
9	Chute Spillway- Components and their functions, hydrologic, hydraulic and structural design	3
10	Criteria of selection of appropriate structures as per soil, land use and climatic conditions	1
11	Design of energy dissipaters in soil and water conservation structures	1
12	Introduction, types, design, criteria and construction of earthen dam, causes of failure of earthen dam, retaining wall and its design	3
13	Stability analysis of land slopes and soil mass including landslides, seepage control in earthen dams, flow net in earthen dams	2
14	Water harvesting: principles, importance and issues. Water harvesting techniques: classification based on source, storage and use. Runoff harvesting: short-term and long-term harvesting techniques, purpose and design criteria.	3
15	Mechanized construction techniques for soil and water conservation structures	1
	Total	**32**

IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Study of various probability distribution function for rainfall analysis	1
2.	Construction of specific energy and specific force diagram	2
3.	Measurement of hydraulic jump parameters and amount of energy dissipation	1
4.	Hydrologic and hydraulic design of a straight drop spillway	1
5.	Determination of uplift force and construction of uplift pressure diagram	1
6.	Determination of loads on headwall and construction of triangular load diagram	1
7.	Stability analysis of a straight drop spillway	1
8.	Hydraulic design of a chute spillway	1
9.	Design of drop inlet spillway	1
10.	Design of energy dissipating structures	1
11.	Design of earthen dam	1
12.	Seepage analysis in earthen embankment	1
13.	Design of water harvesting structures	1
14.	Economic analysis of water harvesting structures	1
15.	Field visit to already constructed water harvesting structures in the nearby area/watershed.	1
	Total	**16**

X. Suggested Reading

- Mahnot SC, Singh PK and Chaplot PC. 2011. *Soil and Water Conservation and Watershed Management*. Apex Publishing House, Udaipur.
- Murty VVN. 1988. *Land and Water Management Engineering*. Second Edition Kalyani Publishers, New Delhi.
- Singh Gurmel C, Venkataraman G, Sastri and Joshi BP. 1991. *Manual of Soil and Water conservation Practices*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

- Singh PK. 2000. *Watershed Management* (*Design and Practice*). e-media publications, Udaipur.
- Suresh R. 2006. *Soil and Water Conservation Engineering*. Fourth Edition Standard Publishers and Distributors, Delhi.
- Singh Raj Vir. 2003. *Watershed Management*. Second Edition, Yash Publishing, Bikaner.

I. Course Title : Stochastic Hydrology

II. Course Code : SWCE 504

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint students about the stochastic processes in hydrology including statistical characteristics of hydrological time series data, modeling hydrologic uncertainty and analysis of multivariate hydrologic series,

V. Theory

Unit I

Hydrologic cycle, Systems concept, Hydrologic systems model. Classification of hydrologic models, Statistical, stochastic and deterministic approaches. Statistical characteristics of hydrological data, probability distribution of hydrologic variables. Deterministic and stochastic hydrology, Cause and effect analysis. Hydrologic time series analysis – nature, stationarity and ergodicity, components of time series, trend, periodicity and stochastic parts, parameter estimation of probability distributions. Analysis of hydrologic extremes.

Unit II

Multivariate regression analysis, correlation analysis, correlation coefficient and its significance in regional analysis. Developing prediction equation by simple and multiple linear regression. Reliability of the Model.

Unit III

Stochastic Process: Classification, stationary process. Time series: Classification, component of time series. Methods of investigation: Auto correlation coefficient, moving average process, auto regressive process, auto regressive moving average process, auto regressive integrated moving average process. Spectral analysis, analysis of multivariate hydrologic series.

Unit IV

Thomas Fiering model, Box Jenkins model. Model formulation: Parameter estimation, calibration and validation. Application to hydrologic data. Generation and forecasting. Regional flood frequency analysis. Transformations, Hypothesis testing.

Unit V

Modeling hydrologic uncertainty. First order Markov process, Markov chain, Data generation, Hydrologic time series analysis, Modelling of hydrologic time series.

VI. Practical

To estimate various statistical parameters of the hydrologic variables, estimating missing data in historical series, various parameter estimation methods like method of moments, method of maximum likelihood, method of mixed moments, probability of weighted moments fitting discrete and continuous distribution functions to