

curve; Analysis of rainfall data and estimation of mean rainfall by different methods; Analysis of frequency of hydrologic data and estimation of missing data, test for consistency of rainfall records; Computation of infiltration indices; Computation of peak runoff and runoff volume by Cook's method and rational formula; Computation of runoff volume by SCS curve number method; Study of stream gauging instruments- current meter and stage level recorder; Study and determination of geomorphic parameters of watersheds; Study of runoff hydrograph and separation of base flow and surface flow ; Study of unit hydrograph; Study of synthetic hydrograph; Study of flood routing; Study of various discharge measuring devices.

### Suggested Readings

1. Chow, V. T., Maidment, D. R. and Mays, L. W. 2010. *Applied Hydrology*. McGraw Hill, New York.
2. Das, G. 2000. *Hydrology and Soil Conservation Engineering*. PHI, New Delhi.
3. Garg, S. K. 1998. *Hydrology and Water Resources Engineering*. Khanna Publishers, Delhi.
4. Jaya Rami Reddy, P. 2011. *A Text Book of Hydrology*. University Science Press, New Delhi.
5. Linsley, R. K., Kohler, M. A., and Paulhus, J. L. H. 1984. *Hydrology for Engineers*. McGraw-Hill Publishing Co., Japan.
6. Mutreja, K. N. 1990. *Applied Hydrology*. Tata McGraw-Hill Publishing Co., New Delhi.
7. Panigrahi, B. and Panigrahi, K. 2016. *Engineering Hydrology*. New India Publishing Agency, New Delhi.
8. Raghunath, H. M. 2006. *Hydrology: Principles Analysis and Design*. 2nd Edition, New Age International (P) Limited Publishers, New Delhi.
9. Subramanya, K. 2008. *Engineering Hydrology*. 3rd Edition, Tata McGraw-Hill, New Delhi.
10. Suresh, R. 2005. *Watershed Hydrology*. Standard Publishers and Distributors, Delhi.
11. Varshney, R. S. 1986. *Engineering Hydrology*. Nem Chand and Brothers, Roorkee, U.P.

### Soil and Water Conservation Engineering

3 (2+1)

#### Objective

To make the students acquainted with the different causes of soil erosion and water loss and the different measures for soil and water conservation

#### Theory

Soil erosion: Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion.

Water erosion: Mechanics and forms- splash, sheet, rill, gully, ravine and stream bank erosion; Gullies: classification, stages of development; Soil loss estimation- Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity- estimation by  $KE > 25$  and  $EI_{30}$  methods; Soil erodibility- topography, crop management and conservation practice factors; Measurement of soil erosion- Runoff plots, soil samples.

Water erosion control measures: Agronomical measures, contour farming, strip cropping, conservation tillage and mulching; Engineering measures- bunds and terraces, bunds: contour and

graded bunds- design and surplussing arrangements; terraces: level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stone wall and trenching; Gully and ravine reclamation- principles of gully control, vegetative measures, temporary structures and diversion drains. Grassed waterways and design.

Energy and momentum principles in open channels; specific energy and specific force, hydraulic jump and its application, types of hydraulic jump, energy dissipation due to the jump.

Soil erosion control structures- Introduction, classification and functional requirements. Permanent structures for soil conservation and gully control- check dams, drop, chute and drop inlet spillways- design requirements, planning for design, design procedures- hydrologic, hydraulic and structural design and stability analysis.

Wind erosion: Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes.

Land capability classification, dryland farming; Rate of sedimentation, silt monitoring and storage loss in tanks, control of sedimentation in reservoirs.

Water harvesting techniques: Classification based on source, storage and use, runoff harvesting- short-term and long-term techniques; Structures- farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes; Farm pond- components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction; Percolation pond - site selection, design and construction details. Design considerations of *nala* bunds.

## Practical

Estimation of soil loss by USLE, computation of rainfall erosivity index, computation of soil erodibility index in soil loss estimation; Determination of length of slope (LS) and cropping practice (CP) factors; Estimation/measuring techniques of soil loss; Study of rainfall simulator for erosion assessment, estimation of sediment rate using Coshocton wheel sampler and multi-slot device; Determination of sediment concentration through oven drying method. Calculation of rate of sedimentation and storage loss in tanks; Study on sedimentation of reservoirs; Design and layout of contour bunds and graded bunds; Design and layout of broad base terraces and bench terraces; Design of vegetative waterways; Design of shelter belts and wind breaks for wind erosion control; Farm pond- design, capacity and estimation; Hydraulic design of drop spillway; Determination of uplift force and construction of uplift pressure diagram, structural design and stability analysis of drop spillway; Hydraulic and structural design of chute spillway, design of SAF energy dissipater; Design of drop inlet spillway; Study on components of earth embankments and its design; Design of water harvesting structures; Study on prioritization of watershed; Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures; Visit to a watershed.

## Suggested Readings

1. Chow, V. T. 1985. *Open-Channel Hydraulics*. McGraw- Hill Book Company, Inc.
2. Frevert, R. K., Schwab, G. O., Edminster, T. W. and Barnes, K. K. 2009. *Soil and Water Conservation Engineering*. 4th Edition, John Wiley and Sons, New York.
3. Mahnot, S. C. 2014. *Soil and Water Conservation and Watershed Management*. International Books and Periodicals Supply Service, New Delhi.

4. Mal, B. C. 2014. *Introduction to Soil and Water Conservation Engineering*. 2014. Kalyani Publishers.
5. Michael, A. M. and Ojha, T. P. 2003. *Principles of Agricultural Engineering*. Volume II. 4th Edition, Jain Brothers, New Delhi.
6. Murthy, V. V. N. 2002. *Land and Water Management Engineering*. 4th Edition, Kalyani Publishers, New Delhi.
7. Norman Hudson. 1985. *Soil Conservation*. Cornell University Press, Ithaca, New York, USA.
8. Samra, J. S., Sharda, V. N. and Sikka, A. K. 2002. *Water Harvesting and Recycling: Indian Experiences*. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
9. Sharda, V. N., Juyal, G. P., Prakash, C. and Joshi, B. P. 2007. *Training Manual: Soil Conservation and Watershed Management (Vol.-II)* – CSWCRTI Publication, Dehradun.
10. Singh, G., Venkataraman, C., Sastry, G. and Joshi, B. P. 1996. *Manual of Soil and Water Conservation Practices*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
11. Suresh, R. 2014. *Soil and Water Conservation Engineering*. Standard Publisher Distributors, New Delhi.
12. Das, G. 2000. *Hydrology and Soil Conservation Engineering*. Prentice Hall of India Pvt. Ltd, New Delhi.
13. USDA. 1964. *Engineering Hand Book on Drop Spillways (Section-11)*. USDA, Soil Conservation Service.

## Farm Machinery and Equipment II

3 (2+1)

### Objective

To make the students acquainted with the basic construction and operational features, and economics of operation of different farm machineries used in operations such as weeding, harvesting, etc., including operations done by combines, etc.

### Theory

Plant protection equipment: Different types of sprayers and dusters; Classification of sprayers and sprays; Types of nozzles; Calculations for calibration of sprayers and chemical application rates; Introduction to interculture equipment; Weeders- different types of manual and powered weeders; Functional requirements of weeders and main components; Different types of fertilizer application methods and equipment.

Harvesting of crops: Harvesting methods, harvesting terminology; Mowers– types, constructional details, working and adjustments; Shear type harvesting devices- cutter bar, inertia forces, counter balancing, terminology, cutting pattern; Reapers, binders and windrowers- principle of operation and constructional details; Hay conditioning, importance, methods of hay conditioning, and calculation of moisture content of hay.

Threshing: manual and mechanical systems; Types of threshing drums and their applications; Types of threshers- tangential and axial, constructional details and cleaning systems; Factors affecting thresher performance; Grain combines- combine terminology and features, classification of grain combines, study of material flow in combines; Computation of combine losses; Combine