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| **Semester** | **:** | **IV** | | |
| **Course No.** | **:** | **SWCE-244** | **Credit Hrs.** | **: 3(2+1)** |
| **Course Title** | **:** | **Soil and Water Conservation Engineering** | | |

## SYLLABUS

**Objectives** : i) To enable the students with design of soil and water conservation structures and water harvesting structures,

ii) 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 devisor; 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 watershed.

## TEACHING SCHEDULE

### THEORY [SWCE-244]

| Lecture No. | Topics | Sub-topics/Key points | Weightage (%) |
|---|---|---|---|
| 1 - 2 | **Soil Erosion** | Introduction, Causes and Types - Geological and Accelerated erosion, Agents, Factors affecting and Effects of erosion. | 14 |
| 3 - 4 | | Water erosion: Mechanics and Forms- splash, sheet, rill, gully, ravine and stream bank erosion. | |
| 5 | **Gullies** | Gullies: Classification, Stages of gully development. | |
| 6 - 8 | **Soil Loss Estimation** | Soil Loss Estimation- Universal soil loss equation (USLE) and modified USLE.<br>Rainfall erosivity- Estimation by KE > 25 and $EI_{30}$ methods;<br>Soil Erodibility- Topography, crop management and conservation practice factors. | 18 |
| 9 | | Measurement of Soil Erosion-<br>Runoff plots, Soil samples. | |
| 10 - 11 | **Agronomical & Engineering Measures** | Water erosion control measures: Agronomical measures, contour farming, strip cropping, conservation tillage and mulching; | 18 |
| 12 - 14 | | Engineering measures- Bunds and Terraces;<br>Bunds: Contour and Graded bunds- Design and surplussing arrangements;<br>Terraces: Level and Graded broad base terraces, Bench terraces- Planning, design and layout procedure, Contour stone wall and Trenching. | |
| 15 | **Gully Reclamation** | Gully and Ravine Reclamation-<br>Principles of gully control, Vegetative measures. | 10 |
| 16 | **Diversion Drains** | Temporary structures and Diversion drains. | |
| 17 | **Grassed Waterways** | Grassed waterways and Design. | |

*Continued…*

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| **18 - 19** | **Hydraulic Jump** | Energy and Momentum Principles in Open channels;<br>Specific energy and Specific force hydraulic jump and its application, Types of hydraulic jump, Energy dissipation due to the jump. | 10 |
| **20** | **Permanent Structures** | Soil erosion control structures- Introduction, Classification and Functional requirements. | |
| **21 - 22** | | Design procedures- Hydrologic, Hydraulic and Structural design and Stability analysis. | |
| **23 - 25** | | Permanent structures for Soil conservation and Gully control- Check dams, drop, chute and drop inlet spillways.<br>Design requirements, Planning for design. | |
| **26 - 27** | **Wind Erosion** | Wind Erosion: Factors affecting, Mechanics, Soil loss estimation and Control measures- Vegetative, Mechanical measures, Wind breaks and Shelter belts and Stabilization of sand dunes. | 5 |
| **28** | **Sedimentation** | Land capability classification, Dryland farming; Rate of sedimentation, Silt monitoring and Storage loss in tanks, Control of sedimentation in reservoirs. | 5 |
| **29 - 31** | **Water Harvesting** | Water harvesting techniques: Classification based on source, Storage and use, Runoff harvesting short-term and long-term techniques. | 20 |
| | **Farm Pond** | 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. | |
| | | Farm pond: Cost estimation and construction. | |
| **32** | **Percolation Pond** | Percolation pond - Site selection, design and construction details. | |
| | **Nala Bunds** | Design considerations of *Nala* bunds. | |
| | | **Total =** | **100** |

## TEACHING SCHEDULE

### PRACTICAL [SWCE-244]

| Exercise No. | Exercise Title |
|---|---|
| 1 | Computation of Rainfall erosivity Index. |
| | Computation of Soil erodibility index. |
| | Determination of length of slope (LS) and cropping practices (CP) factors. |
| | Estimation of Soil loss by USLE. |
| 2 | Estimation and Measuring Techniques of soil loss. |
| 3 | Study of rainfall simulator for erosion assessment. |
| 4 | Estimation of sediment rate using Coshocton wheel sampler and Multi-slot devisor. |
| 5 | Determination of sediment concentration through oven drying method. |
| 6 | Calculation of rate of sedimentation and storage loss in tanks. |
| | Study on sedimentation of reservoirs. |
| 7 | Design and layout of contour bunds and graded bunds. |
| 8 | Design and layout of broad base terraces and bench terraces. |
| 9 | Design of vegetative waterways. |
| | Design of shelter belts and wind breaks for wind erosion control. |
| 10 | Design, computation of storage capacity and estimation of farm ponds. |
| 11 | Hydraulic design of drop spillway. |
| | Determination of uplift force and construction of uplift pressure diagram. |
| | Structural design and stability analysis of drop spillway. |
| 12 | Hydraulic and structural design of chute spillway. |
| | Design of chute spillway with SAF energy dissipater. |
| 13 | Design of drop inlet spillway. |
| 14 | Study on components of earth embankments and its design. |
| 15 | Design of water harvesting structures. |
| | Study on prioritization of watershed. |
| 16 | Visit to Soil erosion sites and Watershed project areas for studying erosion control and water conservation measures. |
| | Visit to Watershed. |

**Suggested Readings [SWCE-244]:**


1. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
2. Chow, V. T. 1985. Open-Channel Hydraulics. McGraw-Hill Book Company, Inc.
3. 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.
4. Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service, New Delhi.
5. Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. Kalyani Publishers.
6. Michael, A.M. and Ojha, T.P. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
7. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
8. Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaka, New York, USA.
9. Samra, J.S., Sharda, V.N. and Sikka, A.K. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
10. 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.
11. 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.
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.