IFET COLLEGE OF ENGINEERING
DEPARTMENT OF AI&DS, AI&ML, CIVIL, CSE & IT

SUBJECT CODE: 23CH6603 **YEAR/SEMESTER: III/VI**
SUBJECT NAME: WATER AND SOIL CONSERVATION

UNIT- II - WIND EROSION AND DEPOSITION

FUNDAMENTALS

SYLLABUS:

Wind erosion - Types of soil movement - Erosion damage by wind erosion - Estimation of wind erosion - wind erodibility index, roughness factor, climate factor, unsheltered distance and vegetative cover factor - Detaching capacity of wind - transport capacity of wind - Factors affecting wind erosion.

Wind erosion is the natural process where wind detaches, transports, and deposits soil particles, common in dry, bare areas, causing land degradation, dust storms, and economic damage through processes like surface creep, saltation, and suspension.

Soil movement occurs primarily through erosion, mass wasting, or anthropogenic activity, categorized by the force and mechanism involved. Key types include wind-driven transport are suspension, saltation, and surface creep.

Saltation: Particles (0.1 to 0.5 mm) lift and bounce, dislodging other particles upon impact.

Suspension: Very fine particles (<0.1 mm) are lifted high into the atmosphere and carried long distances.

Surface Creep: Larger particles (0.5 to 2 mm) roll or slide along the surface, pushed by wind or saltating particles.

Wind-erosion damage includes loss of soil depth, textural change, nutrient and productivity losses, abrasion, air pollution, and sedimentation.

Wind erosion estimation involves calculating soil loss (E) based on factors like wind erodibility index (I), roughness factor (K), climate factor (C), unsheltered distance (or) field length (L), and vegetation cover factor (V), commonly expressed as $E=f(IKCLV)$.

The wind erodibility index (I) is a numerical value used to quantify a soil's susceptibility to wind erosion based on its texture, surface aggregates (>0.84mm), and stability.

The soil roughness factor (Kor K') in wind erosion models (WEQ/RWEQ) quantifies how surface irregularities-specifically tillage ridges (oriented) and soil aggregates (random)-reduce soil loss by trapping particles and reducing wind velocity. A higher, rougher surface (higher K) generally reduces erosion, with the factor influenced by ridge height, spacing, and orientation relative to the wind.

The climate factor (C) in soil erosion by wind is a key component of the Wind Erosion Equation (E=($IKCLV$)) representing a region's erosivity based on wind speed and surface soil moisture. It calculates the potential erosion by quantifying the average annual or monthly wind velocity and the Thornthwaite "effective precipitation" index (soil moisture).

In soil erosion by wind, **field length (L) represents the unsheltered distance** of an open, erodible area along the direction of the prevailing wind. It is a critical, variable component in the Wind Erosion Equation (WEQ) (E=(I,K,C,L,V)) that determines how wind velocity accelerates and increases soil transport capacity.

The vegetation factor (V) in wind erosion models (like the Wind Erosion Equation, E=f($IKCLV$)) quantifies the protection provided by crop residue or standing plants, reducing soil loss by covering the surface and absorbing wind energy. It is expressed as the equivalent quantity of small-grain residue (in pounds per acre) that reduces soil transport.

The detaching capacity of wind is related to its friction velocity, or shear stress, and to the sizeof the erodible grains.

$$D = f(u)^2$$

Where, D = detaching capacity, g/cm^2, u = friction velocity over an eroding surface, cm/s

Transport capacity of wind is related to wind velocity, but not to soil-grain size. The rate of dune sand and soil movement by wind (weight of material moving past a unit width, normal to the direction of movement, per unit time) was related to the third power of the friction velocity:

$$q = \frac{\rho}{g} * u^3$$

where, q = rate of soil movement, g/(cm width)-s

ρ = air density, g/cm^3

g = gravitational constant, 980 cm/s^2

u = friction velocity over an eroding surface, cm/s^2

Factors that influence the amount of erosion that wind will cause are the soil's resistance to erosion, surface roughness, rainfall, land slope (hummocks), length of exposed area, and vegetative cover.