

Unit 1: Basic Physics

Conservation of mass, energy and momentum; Forces in nature; Measurement of heat, specific heat, transfer of heat; Huygen's principle, reflection, refraction, diffraction, polarization, interference and scattering of light waves; Optics theory, principles of optical instruments; Change of phase and polarization, equation of state, Laws of thermodynamics; Free energy, Entropy and concept of negative entropy; Vont Hoff's law; Cathode rays; Radio activity, alpha-, beta-, and gamma- rays, detection and measurement of radiation; Properties of X-rays; Bragg's law; Nuclear fission, fusion, nuclear reactions, neutron moderation, nuclear energy, atomic power; Radioactivity and its applications in agriculture.

Unit 2: Soil Physics

Factors and processes of soil formation; Physical, physicochemical and biological properties of soils; Soil water retention and movement under saturated and unsaturated conditions; Infiltration, redistribution and evaporation of soil water; Field water balance and water use efficiency; Soil aeration; Thermal properties of soil and heat transport; Influence of soil water, temperature and aeration on crop growth and their management; Soil erosion and control; Soil physical constraints and their management..

Unit 3: Radiation Physics

Basics of Electromagnetic spectrum and its interaction with matter; Laws of radiation, scattering, reflection, transmission, absorption, emission, diffuse and specular radiations; Radiation units, flux, intensity, emittance, inter conversion of radiometric units; Energy balance of land surfaces.

Unit 4: Plant Biophysics and Nano Technology

Introduction and scope of biophysics; Structure and properties of water; Experimental techniques used for separation and characterization of biomolecules sedimentation, ultra-centrifugation, diffusion, osmosis, viscosity, polarization and electrophoresis, chromatography; Fibre physics; Basic Spectroscopic techniques, UV-Visible, IR, NMR, EPR spectroscopy, X-ray diffraction; Chlorophyll fluorescence; Nanostructures, Properties and characterization of nanomaterials; Nano-biology, hazards of nanomaterial; Applications of nanotechnology in agriculture.

Unit 5: Remote sensing

Electromagnetic radiation, and interactions with the matter, remote sensing system – active and passive, sensor and platform; Radiometric quantities; Spectral signatures of natural targets and its physical basis, spectral indices; Satellite characteristics, spatial, spectral, radiometric and temporal resolutions; Air borne remote sensing; Imaging and non-imaging systems; Multispectral, hyperspectral, thermal and microwave remote sensing; Digital image processing;

National and International satellite systems for land, weather, ocean and other observations; Applications of remote sensing in agriculture.

Unit 6: Geoinformatics

Basic concepts and principles: Hardware and software requirements; Common terminologies of geographic information system (GIS); Maps and projections, principles of cartography; Basic geodesy: Geoid /Datum/Ellipsoid; Cartographic projections, coordinate systems, types and scales; Accuracy of maps; Raster and Vector data model; DBMS; Geostatistical analyses; Spatial interpolation - Thiessen polygon; Inverse square distance; Digital Elevation Model; Principles of GPS; DGPS; Errors in GPS data and correction; GPS constellations; Geoinformatics application in agriculture and natural resource management.

Unit 7: Atmospheric physics

Weather and climate: Atmosphere and its constituents; Meteorological elements and their measurements; Heat balance of the earth and atmosphere; Climatic classification systems; climatology of India, agro- ecological regions; Monsoon, western disturbances, cyclones, droughts; Wind system, precipitation, cloud, pressure pattern. Atmospheric stability; Weather forecasting: numerical weather prediction; El Nino, La Nina and ENSO; Climate change, global warming, impacts of climate change on agro-ecosystems; Physiological response of crop plants to weather (light, temperature, CO₂, moisture and solar radiation); Heat units, thermal time and thermal use-efficiency and their applications; Micro-, meso- and macro-climates; Exchange of mass, momentum and energy between surface and atmosphere, exchange coefficients; Richardson number & Reynold's analogy; Boundary layer; Eddy covariance techniques; Wind profile; Modification of microclimate; Radiation distribution within the plant canopy; Concept of evapotranspiration: potential, reference and actual evapotranspiration, crop coefficient; Measurement of evapotranspiration.

Unit 8: Mathematical Modelling of soil-plant-atmosphere system

Applications of matrices: Differentiation and integration; Numerical modelling: finite difference and finite element; Spatial statistics: Variogram and interpolation techniques; Surface modelling; Root water uptake models; Simulation models for water, heat, and solute movement in two- and three dimensional porous media; Fundamentals of dynamic simulation, systems, models and simulation; Mechanistic, stochastic and deterministic models; Model calibration, validation and sensitivity analysis; Crop weather models and its use in crop yield estimation; Advantage and limitations of modelling.