

COURSE CATALOGUE & SYLLABUS

M.Sc. (Agrometeorology)

**Annexure-V**

**Revised Course code (2013) Department of Environmental Science**

**M.Sc. Agrometeorology**

Courses	Course Code	Course Title	Credits			
			L	T	P	Credit
<b>Major Courses</b>	ENVS-751	General Meteorology-I	3	0	0	3
	ENVS-752	Agrometeorology-I	2	0	1	3
	ENVS-753	Meteorological Instruments	2	0	1	3
	ENVS-754	General Meteorology-II	3	0	0	3
	ENVS-850	Applied Agro-Climatology	2	0	1	3
	ENVS-851	Micrometeorology	2	0	1	3
	ENVS-763	Climatology	2	0	0	2
	ENVS-766	Agrometeorology-II	2	0	1	3
	ENVS-768	Air Pollution Meteorology	2	0	1	3
	ENVS-769	Hydrometeorology	2	0	1	3
	ENVS-862	Farm House Meteorology	1	0	0	1
	ENVS-865	Agroclimatology	3	0	0	3
	ENVS-864	Environmental Physics	3	0	0	3
<b>Minor Courses</b>	AP-818	Animal Climatology - 2010	2	0	0	2
	SS-733	Watershed Hydrology and Resource Conservation	2	0	1	3
	SS-732	Watershed Survey, Mapping and Structural Engineering Design	1	0	1	2
	SWLE-725	Fundamentals of Remote Sensing, Image Interpretation and Advances in Remote Sensing	2	0	1	3
<b>Supporting Courses</b>	MAS-815	Experimental Design	2	0	1	3
	CSIT-701	Computer Orientation	2	0	1	3
	MAS-511	Statistical Methods(Deficiency)	2	0	1	3
<b>Seminar and Research</b>	ENVS-781	Seminar -I	0	0	1	1
	ENVS-881	Seminar -II	0	0	1	1
	ENVS-898	Thesis	0	0	30	30
<b>Non -Credit</b>	MLI-501	Library and information Services	0	0	1	1
	LNG-502	Technical Writing and Communication skills	0	0	1	1

	AEAB-503	Intellectual Property & its management in Agriculture	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
--	----------	---	----------	----------	----------	----------

	AEAB-504	Agricultural Research, Research Ethics and Rural Development programme	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
	ENVS-504	Basic Concept in Laboratory Technique	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
	ENVS-506	Disaster Management	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

# AGROMETEOROLOGY

**ENVS 751**

**General Meteorology-I**

**3(3+0)**

Earth and its atmosphere in relation to sun. Radiation in the atmosphere; physical and physiological processes important to radiation. Laws of radiation and greenhouse effect. Heat balance of the atmosphere. Terrestrial radiation absorption by ozone, carbon dioxide, water vapour and clouds. Heat transfer processes.

Temperature in the atmosphere; Distribution of temperature in time and space, subdivisions of the atmosphere-troposphere, stratosphere, thermosphere. Thermodynamics in the atmosphere; Adiabatic process, relation between temperature and pressure in dry air-hydrostatic equation atmospheric stability and stability criteria for the atmosphere. Meteorological temperatures, thermodynamic diagrams and their uses.

Dynamics of the atmosphere and general circulation. Influence of land masses and oceans on the circulation pattern.

**ENVS 752**

**Agrometeorology-I**

**3(2+ 1)**

Important meteorological processes to agriculture; Importance of various microenvironment on plant growth and development; Meaning and scope of agrometeorology. Radiation balance as applied to agriculture; Energy balance over agriculturally important surfaces. Evaluation of energy balance components; Radiation instruments, empirical methods for estimation of short-wave, long-wave and net radiation; Radiation charts-Moller, Elsassasser, Kew and Yamamoto charts. Net radiation profiles and light distribution within the plant communities. Radiation utilisation during successive stages of plant development and its efficiency.

Thermal effects of environment on growth and development of plants; Cardinal temperatures; Thermoperiodism; Phenology and tolerance; Heat unit concept; Photoperiodism; Leaf temperatures. Transfer process between leaf surface and adjoining air. Latent heat and sensible heat transfer in air; various approaches to evaluate evaporation and sensible heat fluxes; Principle of similarity and Bowen Ratio concept. Conduction of heat in soil, heat capacity and thermal conductivity of soil-their dependence on texture, structure and moisture content of soil. Fourier heat conduction equation. Diurnal and annual variation of soil temperature. Computation of heat flux from soil temperature profiles; Instruments for direct measurement of soil heat flux and thermal properties of soil.

**ENVS 763****Climatology****2(2+ 0)**

Statistical methods in climatological studies. Uses of measures of central tendency, measures of dispersion statistical distributions commonly occurring in climatology-Normal, Gamma, Exponential, Logarithmic, Lognormal, Binomial, Poisson and  $X^2$  distributions. Graphs and maps for representing agro-meteorological data. Special statistical methods of importance in climatology. Orthogonal polynomials; Time series; extreme value theory; Harmonic analysis, Statistical processes; Power spectrum analysis; Game theory; theory of decision making.

Persistence-its measurement, and evaluation model, Conditional probabilities; Random and Markov model, Application of Random and Markov model for various agrometeorological phenomena. Climatic indices. Graphical methods of objective forecasting

**ENVS 753 Meteorological Instruments.****3(2+ 1)**

Theory of measurement of meteorological parameters. Elementary principles (theory) behind measurement of radiation, temperature, pressure, humidity, wind, evaporation, condensation and precipitation. Meteorological instruments for agrometeorological observatories. Self recording&nonrecording instruments.

Meteorological instruments used for routine observation at agrometeorological observatories-their description, care, maintenance, calibration, detection of faults and repairs. Special meteorological instruments for micrometeorological work. Theory behind the design of these instruments their characteristics and limitations.

Lysimeters. Infrared thermometer. Multichannel potentiometric recorder.

**ENVS 754****General Meteorology-II****3(3+0)**

Air masses and their structure; properties of air masses, classification of air masses. Important air masses of India. Models of secondary circulation in the atmosphere. Fronts; Cyclones and anticyclones, troughs and ridges in upper air, tropical cyclones; monsoon circulation, mountain and valley breezes, land and dust whirls due to thermal circulation. Various humidity parameters and their inter-relationships; psychrometry-theory of dry and wet bulb psychrometry (Norman's Theorem).

Condensation and precipitation in the atmosphere; condensation forms clouds and cloud classification,Elementary aspects of weather Forecasting. Observational network; preparation of surface and upper air synoptic chart and their analysis; Techniques for short range, medium range and long range forecasting.

Climatic classification; various criteria for classification of climate. Geographic distribution of various climatic types. Principal weather phenomena occurring in four main seasons in India. Mechanism of Indian monsoon and general distribution of precipitation during South-West and North-East monsoon; Spatial interrelationships between synoptic features and precipitation distribution during monsoon.

**ENVS 766**

**Agrometeorology-II**

**3(2+ 1)**

Evaporation and evapotranspiration; Theory of evaporation; Individual and combined influences of soil, plant and meteorological factors on evapotranspiration, methods of measuring evapotranspiration, pan evaporimeter, atmometer, drainage and weighing type lysimeters, hydraulic type lysimeter with a manometer. Estimation of evapotranspiration. Concepts of potential and actual evapotranspiration. Aerodynamic approaches such as Dalton's equation, Thornthwaite-Holtzman equation, Pasquill's approach; eddy correlation method.

Energy balance methods-Bowen Ratio approach, combination approaches of Penman, Slatyer and Malory, van Bavel, Monteith and Tanner. Empirical formulae of Thornthwaite, Balaney-Criddle, Makkink, Turc, Budyko, Papadakis etc. Water balance and physical factors concerning water movement in soil.

Evaluation and insitu measurements of various components of hydrologic cycle. Soil moisture measurements by gravimetric sampling, conductivity units, tensiometers and neutron dispersion technique. Concept of hydraulic conductivity in saturated and unsaturated soils, evaluation of soil moisture fluxes and drainage components; water extraction pattern by plant roots. Climatic water budgeting approach.

Soil moisture budget models of Thornthwaite and Mather, Shaw, Robertson and Baier. Linear model, log and exponential models of soil moisture decay curves. Water and yield relationships, Consumptive use; water use efficiency, relationship between water use and dry matter production.

**ENVS 768**

**Air Pollution Meteorology**

**3(2+ 1)**

Nature of air pollutants; various types of air pollutants in the atmosphere; their effects on plants and animals. Detection and measurement of contaminants of the atmosphere. Principles of diffusion of particulate matter in the atmosphere.

Meteorological factors in the dispersion of air pollutants. topographical, geographical and large scale meteorological factors affecting air pollution. Meteorological conditions and typical plume forms. Air pollution forecasting and climatology.

**ENVS 769****Hydrometeorology****3(2+ 1)**

Hydrological cycles and its modifications. Rainfall and its interception by plants and crops. Measurement of runoff, infiltration, moisture retention of soil, percolation, evaporation, evapotranspiration and its importance to agriculturists, irrigation engineers and flood forecasting personnel. Water holding capacity of soils, plant available water, cultural practices on soil moisture in relation to different phases of crop growth. Evaporation from snow, lakes, reservoirs and crops. Drought and its effect on water balance. Climatic water budgeting and its applications.

**ENVS 850****Applied Agro-Climatology****3(2+1)**

Phenology and seasonal changes of weather conditions. Crop Climatology. Thermoperiodism; Photoperiodism; Heat Unit concept and its applications; climatic water budgeting technique and its application in evaluation of moisture availability periods with in crop growing season; planning of multiple cropping pattern for different soil-climatic zones of India based on above techniques.

Influence of agro-meteorological factors on incidence of pests and diseases. Effect of timing and effectiveness of control measures.

Weather forecasting for agriculture; General forecasting-medium range, short range and seasonal forecasting for agriculture purpose. Special weather forecasts for frost, insects, pests and diseases, drought, high winds, heat waves etc. Protection against frost, forest fire, drought and floods. Wind breaks and shelter belts. Principles of cloud seeding.

**ENVS 851****Micrometeorology****3(2+ 1)**

Meaning and scope of micrometeorology. Divisions of the atmosphere. Importance of the lower region of the atmosphere. Distinctive features of micrometeorology compared with macro and mesometeorology. Distribution of important meteorological parameters in the boundary layer. Profiles of temperature, humidity and wind under different stability conditions. Laminar and turbulent conditions; Reynold and Richardson number. Turbulent transfer of mass, momentum and energy. Concepts of exchange coefficient, exchange coefficient relationships. Application of turbulent transfer processes to agricultural phenomena such as photosynthesis under field conditions.

Microclimatology and Topoclimatology. Microclimates in low plant cover, microclimates of meadows and grain fields, microclimates within forests and climatic influences of forests. Influence of kind, colour and condition of soil on microclimates. Influences of slopes and topography on insolation, temperature and winds. Atmospheric diffusion.

**ENVS 862                      Farm House Meteorology                      1(1 +0)**

Meteorological conditions prevailing in glass-house, green house, animal house, poultry house and grain storage barns.

Heating, cooling and ventilation of these structures as governed by meteorological factors.

**AP- 818                      Animal climatology.                      2(2+0)**

Thermal balance in animals. Energy exchange processes at the skin of the animals and the need for the maintenance of thermal balance in the animals. Direct and indirect effects of weather on animals.

The effect of weather conditions on animal production, loss of water from the body, growth rate and body weight, reproduction, grazing habits and food intake, milk production, sun burn and photosensitive disorders.

**ENVS 864                      Environmental Physics.                      3(3+0)**

Thermodynamics of the atmosphere. Physics of radiation-origin and nature of radiation, radiation laws and their application in agricultural meteorology; radiation geometry in cartesian, spherical and cylindrical coordinate systems, conservation principle for radiant energy.

Physics of transport phenomena-heat transport in soil, liquid and gas, 'thermal conduction, soil temperature and ground heat flux, diffusion and thermal conductivity. Fluid motion, laminar and turbulent transfer, fluctuation theory for turbulent transfer of momentum, heat and water vapour. Physics of condensation and precipitation. Physics of evaporation-aerodynamic approach, energy balance approach and combination approach for evaporation estimates.

Physics of soil water system-the concept of potential as applied to soil water system, total potential and components. Movement of water in soil, fundamental equation, hydraulic conductivity, infiltration, field drainage and water vapour movement in soil. Physics of crop water use - A physical introduction to plant-water system and relationships, water transport through soil-plant atmosphere system, measurement of crops water use in terms of water conservation equation.

Micrometeorology of crops-measurment and interpretation of fluxes above crop canopy, microclimate of crops, a measurement of canopy fluxes and application.

**ENVS 865                      Agroclimatology                      3(3+0)**

Microclimate as an aspect of general plant environment. Heat economy of plants and plant temperatures, radiation and temperature and humidity and wind relationship in a

differential plant cover, causes of temperature inversion and its effects. Temperature, wind and humidity inter relationships, crop adaptation and microclimate, weather and diseases of crops, weather and crop pests. Microclimate and phenology, importance of microclimate studies in ecological research. Crop weather observation and their importance in predicting epidemics of adverse weather. Organisation of meteorological observatories of the world in general and of India in particular and weather forecasting. Understanding of crop weather relationship and control of plant climate.



**CSIT 701 COMPUTER ORIENTATION****Cr. 3(2+1)****Theory**

Introduction to multi programming and time sharing computers - Login and creation of files - Introduction to structured programming with reference to BASIC - Variables and constants, complex, double precision, logical, character - Arithmetic expressions, arrays, control statements (DO, IF, Computed GOTO) - Functions and subroutines - I/O statements - Elementary programming of algorithms.

**Practical**

Loading Windows and other features in Windows. MS Word - creation, editing of a document. Using features like underlining, bold, italics, spell check etc. and printing. Creation of excel sheet and processing for statistical analysis. Creation of a database in access - Mstat - creation of a data file. Internet - getting connected and email Internet - retrieval of information.

**Theory**

<b>Content</b>	<b>Lecture</b>
• Introduction to multi programming and time sharing computers	3
• Login and creation of files	3
• Introduction to structured programming with reference to BASIC	4
• Variables and constants	3
• Complex, double precision	3
• Logical, character	3
• Arithmetic expressions	3
• Arrays, control statements (DO, IF, Computed GOTO)	4
• Functions and subroutines - I/O statements	4

- Elementary programming of algorithms 4

### Practical

Content	Lect
• Loading Windows and other features in Windows	3
• MS Word - creation, editing of a document	2
• Using features like underlining, bold, italics, spell check etc. and printing	3
• Creation of excel sheet and processing for statistical analysis	2
• Creation of a database in access - Mstat - creation of a data file	3
• Internet - getting connected and email Internet - retrieval of information	3

### References

1. Chris Lewis, Essential Tips: Using the Internet
2. Gene Weisskopf, ABCs of Excel 97
3. Kenneth N. Berk, Introductory Statistics with Systat
4. Kris N, Advanced Data Analysis with Systat
5. Mark Wallace, Things to do on the Internet
6. Ron Mansfield, The Compact Guide to Microsoft Office

### MAS-815

### EXPERIMENTAL DESIGNS

3(2+1)

Analysis of variance: Definition and assumptions, one way classification, two way classification. Sampling Techniques: Simple random sampling, stratified random sampling, systematic sampling. Design Experiments: Randomized Block design, Latin Square design, Factorial design ( $2^2$ ,  $2^3$ ,  $3^2$ ,  $3^3$  factorials), Some P x Q experiments, Split Plot Experiments. Balanced Incomplete Block design

### Practical

Analysis of variance, Randomized Block Design.

### Theory

Content	Lect
• Analysis of variance	2
• Definition and assumptions,	2
• one way classification,	2
• two way classification.	2
• Sampling Techniques	2
• Simple random sampling	2
• stratified random sampling	2
• systematic sampling.	2
• Design Experiments	2
• Randomized Block design	2
• Latin Square design	2
• Factorial design ( $2^2$ , $2^3$ , $3^2$ , $3^3$ factorials)	3

- Some P x Q experiments 3
- Split Plot Experiments 3
- Balanced Incomplete Block design 3

**Practical**

**ContentLecture**

- Analysis of variance 6
- Randomized Block Design 11

**Suggested Readings:**

1. Bernard Ostle and R.W.Mensing, Statistics in Research.
2. C.H. Goulden, Method of Statistical Analysis.
3. G.W. Snedecor and W.G. Cochran, Statistical Methods.
4. R.G. Steel and J.H. Torrie, Principles and Procedures of Statistics (with special reference to Biological Sciences)
5. R.Rangaswamy, A Text Book of Agricultural Statistics.
6. Chandel S.R.S, A Text Book of Agricultural Statistics.
7. W.G. Cochran and G.M.Cox, Experimental Designs.

**MAS-511**

**STATISTICAL METHODS**

**3(2+1)**

Statistical Methods: Measures of Skewness and Kurtosis, standard error of mean, Coefficient of variation. Theory of Probability : Definitions, Additions and Multiplication rules of Probability, Conditional Probability. Probability distributions: Normal, Binomial and Poisson distributions. Correlation and Regression: Simple correlation, Rank correlation, Regression Coefficient, Multiple and Partial Correlation, Regression lines between two variables, Multiple Regression. Tests of Significance:  $X^2$  - test, t - test one sample, two sample t - tests, paired t-test, F - test, Fisher's 2 - transformation

**Practical**

Coefficient of variation, SE of mean, Skewness and Kurtosis. Fitting of Normal, Binomial and Poisson distribution. Simple Correlation, Multiple and Partial Correlation with three variables only. Regression lines between two variables.  $X^2$ , t and F - tests

**Theory**

**Content Lecture**

- Statistical Methods: Measures of Skewness and Kurtosis 2
- standard error of mean 2
- Coefficient of variation 2
- Theory of Probability : Definitions 2
- Additions and Multiplication rules of Probability 2

• Conditional Probability	2
• Probability distributions: Normal, Binomial and Poisson distributions	2
• Correlation and Regression : Simple correlation	2
• Rank correlation	2
• Regression Coefficient	2
• Multiple and Partial Correlation	3
• Regression lines between two variables	3
• Multiple Regression	3
• Tests of Significance: $\chi^2$ - test	3
• t - test one sample	2
• two sample t - tests	2
• paired t-test, F - test	2
• Fisher's 2 - transformation	2

### **Practical**

#### **ContentLecture**

• Coefficient of variation	2
• SE of mean	1
• Skewness and Kurtosis	2
• Fitting of Normal	2
• Binomial and Poisson distribution	2
• Simple Correlation	2
• Multiple and Partial Correlation with three variables only	2
• Regression lines between two variables	2
• $\chi^2$ , t and F - tests	2

#### **Suggested Readings:**

1. C.H. Goulden, Method of Statistical Analysis.
2. Bernard Ostle and R.W. Mensing, Statistics in Research.
3. R. Rangaswamy, A Text Book of Agricultural Statistics.
4. Chandel S.R.S, A Text Book of Agricultural Statistics.
5. W.G. Cochran and G.M. Cox, Experimental Designs.

### **SS-733 WATERSHED HYDROLOGY AND RESOURCE CONSERVATION**

#### **3(2+1)**

Hydrological cycle and characteristics of small and medium watersheds- precipitation, infiltration, run-off (run-off hydrographs) total and peak, soil moisture, hydrograph, ground water and evapo-transpiration. Resources inventory- soil, land, water and Niota. JSoil survey and land use planning -soil types, fertility, productivity, erosion and conservation practices. Water resource development, water availability, pressurized irrigation crop water requirements and water use efficiency. Biota- vegetation types, distribution and utilization. Wildlife -role and conservation.

**Practical:** Rain water budgeting - run off and soil loss, infiltration, soil moisture, deep

percolation and ground water change, rainfall measurements hydrograph.

## Lecture Schedule

### Theory

•	Content	Lecture
•	Hydrological cycle and characteristics of small and medium watersheds-pretipitation	6
•	infiltration, run-off (run-off hydrographs) total and peak.	4
•	soil moisture, hydrograph, ground water and evapo-transpiration.	4
•	Resources inventory- soil, land, water and Niota.	2
•	Soil survey and land use planning -soil types, fertility, productivity, erosion and conservation practices.	5
•	Water resource development, water availability, pressurized irrigation crop water requirements and water use efficiency.	6
•	Biota- vegetation types, distribution and utilization.	5
•	Wildlife -role and conservation.	3

### Practical

•	Content	Lecture
•	Rain water budgeting - run off and soil loss	5
•	Infiltration, soil moisture	3
•	Deep percolation and ground water change	5
•	rainfall measurements hydrograph.	4

### Suggested Readings:

- 1.Datta, S.K. 1986. Soil Conservation and Land Management, International Book Distributors, Dehra Dun.
- 2.Hamilton, I.S. 1987. Forest and Watershed Development and Conservation in Asia and the Pacific, International Book Distributors, Dehra Dun.
- 3.Hamilton, I.S. 1988. Tropical Forest Watersheds. Hydrologic and Soil Response to Major Uses of Conservation, International Book Distributors Dehra Dun.
- 4.Moorthy, V.V.N. 1990, Land and Water Management, Kalyani Publishers, New Delhi.
- 5.Oswal, M.C., 1999. Watershed Management (For Dry land Agriculture), Associated Publishing Company, New Delhi.
- 6.RajeshRajora, 1998. Integrated watershed Management, Ravat Publication, New Delhi.
- 7.Rama Rao. 1980. Soil Conservation. Standard Book Depot, Bangalore.
- 8.Richard, Lee. 1980. Forest Hydrology, Columbia University Press, New York.
- 9.Tideman, E.M. 1996. Watershed Management for Indian Conditions, Omega Scientific Publishers, New Delhi.