



VIVEKANANDA GLOBAL UNIVERSITY

(Established by Rajasthan State Legislature and covered u/s 2(f) of the UGC Act, 1956)

FACULTY OF AGRICULTURE (Department of Agriculture) EVALUATION SCHEME & SYLLABUS FOR

M.Sc. (Ag.) Agronomy I, II, III, IV Semester (Implemented from Academic Session 2019-20)

Sem	I	II	III	IV	TOTAL
Credits	15	15	12	18	60

SESSION: 2019-20

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M.Sc. (Ag.) Agronomy

SEMESTER I

AGN 501 Agrometeorology and Crop Weather Forecasting

3(2+1)

Objective

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

MODULE I

Agro meteorology: aim, scope and development in relation to crop environment, composition of atmosphere, distribution of atmospheric pressure, Solar radiation : characteristics, energy balance of atmosphere system, radiation distribution in plant canopies, radiation utilization by field crops, photosynthesis and efficiency of radiation utilization by crops, energy budget of plant canopies.

MODULE II

Environmental temperature, soil, air, canopy temperature, temperature profile in air, soil and crop canopies, soil and air temperature effects on plant processes, regulation of air, soil temperature for protection against frost and hot winds, Environmental moisture and evaporation ,measures of atmospheric moisture, temperature, relative humidity, vapor pressure and their relationship, evapotranspiration and meteorological factors determining evapotranspiration,.

MODULE III

Modification of plant environment , artificial rain making, controlling heat load, heat trapping and shedding, protection from cold, reduction in sensible and latent heat flux, Monsoon: monsoon and their origin, characteristics of monsoon, onset and progress of monsoon, withdrawal of monsoon.

MODULE IV

Weather forecasting in India: short, medium and long range forecasting, benefits of weather service to agriculture, forecasting of destructive frost, soil moisture forecast, phenological forecast, crop yield forecast.

MODULE V

Aero-space science and remote sensing, application in agriculture, present status of remote sensing in India, Atmospheric pollution and its effect on climate and crop production

Lecture schedule-Theory

S. No.	Topic	No. of Lectures
1	Agrometeorology - aim, scope and development in relation to crop	2
2	Composition of atmosphere, distribution of atm. pressure	1
3	Solar radiation – characteristics	1
4	Energy balance of atmosphere system	1
5	Radiation distribution in plant canopies, radiation utilization by field crops	2
6	Photosynthesis and efficiency of radiation utilization by crops	2
7	Energy budget of plant canopies	1
8	Environmental temperature - soil, air, canopy temperature, temperature	2
	Crop canopies	
9	Soil and air temperature effects on plant processes	2
10	Regulation of air, soil temperature for protection against frost and hot	2
11	Environmental moisture and evaporation- measures of atmospheric	2
12	moisture, transpiration and relative humidity, vapor pressure and	2
13	Modification of plant environment, artificial rain making, controlling heat	2
14	Reduction from cold, reduction in sensible and latent heat flux	1
15	Monsoon and their origin, characteristics of monsoon	1
16	Onset and progress of monsoon withdrawal of monsoon	1
17	Weather forecasting in India: short, medium and long range forecasting	2
18	Benefits of weather service to agriculture, forecasting of destructive frost,	2
18	soil moisture.	

19	Aero- space science and remote sensing-application in agriculture. present	2
20	atmospheric pollution and its effect on climate and crop production.	1

List of Practical's -

S. No.	Topic	No. of lectures
1	Agro meteorological observatory – classes, site selection, layout and installation	1
2	Installation for meteorological instruments	1
3	Measurement of weather parameters	1
4	Measurement of weather parameters	1
5	Working out agro climatic indices	1
6	Maintenance of records	2
7	Calculation of daily, weekly and monthly means	1
8	Visit to state Remote Sensing Centre, Jodhpur/Jaipur	1
9	Measurement of soil temperature in different soil conditions/depths	1
10	Interpretation and use of weather data	2
11	Rainfall analysis for variability 2	1
12	Moisture availability indices for an arid district 1	1
13	Moisture availability indices for a humid district 1	1
14	Length for growing season, fitting cropping systems 1	1
15	Preparation of weather maps, synoptic charts & weather reports 1	1
16	Preparation of crop weather calendar 1	1

Suggested Readings:

- S. Mavi (1994). Introduction to Agrometeorology. Oxford & IBH Publishing Co. New Delhi.
- P. A. Menon (1989). Our weather. National Book Trust, New Delhi.
- A. A. Rama Sastu (1984). Weather and Weather forecasting Publication Division, GOI.
- P. K. Das (1992). The Monsoon. National Book Trust, New Delhi.
- S. Venkateraman and A. Krishnan. Crops and Weather. Indian Council of Agricultural Research, New Delhi.
- Critchfield, H.J. 1995. General Climatology, Prentice Hall of India Pvt. Ltd., New Delhi
- R.S. Gena And S.P. Seetharaman (1991). Natural Resource Management: The Role of Remotesensing in decision making. Oxford & IBH Publishing Co. New Delhi.

AGN502 Principles and Practices of Water Management
MODULE I

3(2+1)

Water, its properties and role in plants; Water resources of India, Major irrigation projects and extent of age and crops irrigated in India; Water potential concept, components and relationship between different components

MODULE II

Water movement in plant and soils; Absorption and transpiration of water in plants; Scheduling and methods of irrigation including micro irrigation system; Fertigation, Water use efficiency

MODULE III

Water management of crops and cropping systems; Soil, plant and meteorological factors determining water needs of crops; Water deficit stress in plants and its effect on growth.

MODULE IV

Quality of irrigation water – effect of saline water and soil salinity on plants and its management, Excess soil water and plant growth.

MODULE V

Water management in problem soils, Drainage requirement of crops and methods of drainage, their layout and spacing.

Lecture schedule Theory

S. No.	Topic	No. of lectures
1	Water, its properties and role in plants.	2
2	Water resources of India, major irrigation projects, and extent of area and Crops irrigated.	3
3	Water potential- concept, components and relationship between different components.	2
4	Water movement in plants and soils.	2
5	Absorption- types and relative importance.	2
6	Transpiration– types and methods to reduce transpiration	2
7	Scheduling of irrigation and methods of irrigation including micro Irrigation system.	2
8	Water use efficiency and factors affecting it.	2
9	Water management of crops and cropping systems.	2
10	Soil, plant and meteorological factors determining water needs of crops	2
11	Water deficit stress in plants and its effect on growth.	2
12	Quality of irrigation water- criteria used, effect of poor quality water on Plant growth and management of saline water for irrigation.	3
13	Excess soil water and plant growth.	2
14	Water management in problem soils.	2
15	Drainage requirement of crops and methods of drainage, their layout and spacing.	2

List of Practical's -

S. No.	Topic	No. of lectures
1	Determination of soluble salts and Ca+ Mg in irrigation water.	1
2	Determination of CO ₃ = and HCO ₃ - and Na in irrigation water.	1
3	Determination of FC and PWP.	2
4	Determination of soilmoisture by tensiometer and pressure plate apparatus	2
5	Water flow measurement using different devices.	2
6	Determining soil profile moisture deficit.	1
7	Determination of irrigation requirement of crops.	2
8	Calculations on irrigation efficiencies.	2
9	Computation of water requirement of crops using modified Penman formula.	1
10	Determination of infiltration rate of soil.	1
11	Determination of hydraulic conductivity of soil.	1

Suggested readings

A.M. Michael, 1987. Irrigation – Theory and Practice, Vikas Publishing House Pvt. Ltd., New Delhi

S.S. Parihar and B.S. Sandhu, 1978. Irrigation of field crops – Principles and Practices, ICAR, New Delhi

D. Lenka, 1999. Irrigation and Drainage. Kalyani Publishers, New Delhi.

R.D. Mishra and M. Ahmed. 1987. Manual on Irrigation Agronomy, Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi

G.H. Sankara Reddy and T. Yellamanda Reddy. 1995. Efficient use of irrigation water. Kalyani Publishers, New Delhi

AGN 503 Principles and Practices of Soil Fertility and Nutrient Management 3(2+1)

MODULE I

Problems and management relating to mechanical impedance and soil submergence; Salt affected soils - problems and remedial measures; Soil acidity and remedial measures; Soil fertility and productivity concept and differences: Criteria of essentiality and forms in which nutrients are absorbed by plants; Physiological methods of increasing FUE.

MODULE II

Nitrogen: Functions, deficiency and toxicity symptoms, forms of nitrogen, nitrogen transformation in soil, organic and mineral N balance in soil, mineralization of N compounds, losses of N from soil, nitrogenous fertilizer materials. Methods to increase N use efficiency and slow release fertilizers; Biological N fixation, symbiotic and free living N fixers.

MODULE III

Phosphorus: Functions and deficiency symptoms, forms of P in soil, their availability and P fixation, various phosphatic fertilizers; Practices of increasing the effectiveness of applied and native phosphorus (PSB).

MODULE IV

Potassium: Functions and deficiency symptoms, forms of K in soil, fixation and release of potassium in soil; Potassic fertilizers and their application. Sulphur and micronutrients (Fe, Zn) functions, deficiency symptoms and application;

MODULE V

Inter relationship of nutrient availability and soil pH. Important nutrient interactions and their effect on nutrient availability, cation exchange capacity and availability of plant nutrients.

Lecture schedule-Theory

S. No.	Topic	No. of lectures
1	Soil problems relating to mechanical impedance and their Management / remedial measures.	1
2	Soil submergence - problems and remedial measures/ Occurring (oxidized-	2
3	Salt affected soils- characteristics, classification and their remedial.	2
4	Soil acidity- characteristics, reasons of soils acidity and remedial measures.	2
5	Soil fertility and productivity concept and differences.	1
6	Criteria of essentiality and forms in which nutrients are absorbed by plant.	6
7	Physiological methods of increasing FUE.	7
8	Nitrogen:	
	Functions, deficiency and toxicity symptoms, forms of nitrogen- N transformation in soil, organic and mineral nitrogen balance in soil, mineralization of N	4
	N-fertilizers, slow release fertilizers and methods t increase nitrogen use.	1
	Biological nitrogen fixation, symbiotic and free living N fixers.	2

9	Phosphors	
	Availability in relation top H,P-fixation.	
	Various P fertilizers and practices of increasing the effectiveness of applied and native phosphorus (PSB).	2
10	Potassium:	
	Functions and deficiency symptoms, forms of K in soil, fixation and release of K in Potassium fertilizer and their application.	3
11	Sulphur and micronutrients (Fe & Zn) – functions, deficiency symptoms.	2
12	Interrelationship of nutrient availability and soil pH.	1
13	Important nutrient interactions and their effect on nutrient availability, cation exchange.	2
14	Integrated nutrient management concepts, Functions and deficiency.	1
15	Symptoms, forms of P in soil and their application.	2

List of Practical's -

S. No.	Topic	No. of lectures
1	Procedure of plant and soil sampling	1
2	Determination of soil pH, ECe and organic carbon	3
3	Determination of total N and available N,P and K in soil	4
4	Determination of total N,P,K and S in plant samples	4
5	Determination of Ca, Mg and Na in soil	2
6	Determination of gypsum requirement of alkali soils	2

Suggested Readings:

- 1.S.L. Tisdale, W.L. Nelson, J.D. Beaton and J.L. Havlin. 1997. Soil Fertility and Fertilizers. Prentice Hall of India, Pvt. Ltd., New Delhi.
2. T.R. Reddy an G.H.S. Reddi 1992. Principles of Agronomy, Kalyani Publishers, New Delhi.
3. L.A. Richards, 1968. Diagnosis and Improvement of Saline and Alkali Soils. Oxford and IBH Publishing Company, New Delhi.
4. Tamhaney, Motiramani, Bali and Donahu, 1970. Soils Their Chemistry and Fertility in Tropical Asia, Prentice Hall of India, New Delhi.
5. R.R. Agarwal, J.S. P. Yadav and S.N. Gupta, 1982. Saline and Alkalai soils of India. ICAR Publication, New Delhi.

AGN 504 Analytical techniques and instrumental methods in soil and plant analysis 3(1+2)

MODULE I

Principles of visible, ultraviolet and infra-red spectro-photometry.

MODULE II

Atomic absorption, flame- photometry.

MODULE III

Inductively coupled plasma spectrometry.

MODULE IV

Chromatographic techniques, mass spectrometry and X-ray diffractometry.

MODULE V

Identification of minerals by Xray by different methods.

Lecture schedule Theory

S.No	Topic	No. of Lecture
1.	Principles of visible, ultraviolet and infrared spectrophotometer	2
2.	Principle and instrumentation of atomic absorption spectrophotometer	2
3.	Principles of flame-photometry	1
4.	Principles and instrumentation of inductively coupled plasma spectrometry	2
5.	Principles and instrumentation of chromatographic techniques	4
6.	Principles of mass spectrometry and X-ray diffractometry	2

List of Practical's –

S. No.	Topic	No. of lecture
1.	Analytical chemistry – Basic concepts, techniques and calculations.	3
2.	Principle of analytical instruments and their calibration for soil and plant analysis.	2
3.	Determination of available nitrogen in soil.	1
4.	Determination of available phosphorus in soil.	1
5.	Determination of available potassium in soil.	1
6.	Determination of available sulphur in soil.	1
7.	Determination of available Boron in soil.	1
8.	Determination of available molybdenum in soil.	1
9.	Determination of iron, copper, manganese and zinc in soil.	1
10.	Determination of potential buffering capacity of phosphorus.	1
11.	Determination of potential buffering capacity of potassium.	1
12.	Determination of ammonium fixation capacity of soil.	1
13.	Determination of potassium fixation capacity of soil.	1
14.	Determination the cation exchange capacity of soil.	1
15.	Determination the anion exchange capacity of soil.	1
16.	Determination of calcium and magnesium in soil.	1
17.	Determination of Sodium in soil.	1
18.	Estimation of root cation exchange capacity.	1
19.	Determination of nitrogen in plant.	1
20.	Determination of phosphorus in plant.	1

Suggested Readings:

- Hesse P. 1971. *Textbook of Soil Chemical Analysis*.
William Clowes & Sons. Jackson ML. 1967. *Soil Chemical Analysis*. Prentice Hall of India.
Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.
Kenneth Helrich 1990. *Official Methods of Analysis* Association of Official
Analytical Chemists. Page AL, Miller RH & Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.

MAT 206 Statistical Methods in Agricultural Research 3(2+1)

MODULE I

Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics.
Exploratory data analysis.

MODULE II

Theory of probability. Random variable and mathematical expectation, Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications.

MODULE III

Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory, Introduction to theory of estimation and confidence-intervals.

MODULE IV

Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination,

MODULE V

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

Lecture schedule: Theory

S. No.	Topics	No.of Lectures
1.	Classification, tabulation	2
2.	Exploratory data analysis	1
3.	Theory of probability	2
4.	Random variable and mathematical expectation	1
5.	Binomial, Poisson, Negative Binomial, Normal distribution	4
6.	Beta and Gamma distributions and their applications	2
7.	Tests of significance for large samples	2
8.	Tests of significance for small samples	3
9.	theory of estimation and confidence-intervals	2
10	Simple partial and multiple correlation	3
11	Simple and partial regression	1
12	Non parametric tests	1
13	One sample non parametric tests	2
14	Two sample non parametric tests	2
15	k sample non parametric tests	2

List of Practical -

S.N.	Topics	No.of Lectures
1.	Box-Cox plots	1
2.	Fitting of Binomial distribution	1
3.	Fitting of Poisson distribution	1
4.	Fitting of Negative binomial distribution	1
5.	Fitting of Normal distribution	1
6.	Large Sample tests	1
7.	Chi Square test	1
8.	One sample, two sample and paired t test	1
9.	F- test	1
10	Computation of Simple correlation	1
11	Computation of partial and multiple correlation	1
12	Computation of Simple and partial regression	1
13	Computation of Run test	1
14	Sign and sign wilcoxon test	1
15	Mann-whitney U test	1

Referenes

1. Anderson TW. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.
2. Dillon WR & Goldstein M. 1984. *Multivariate Analysis - Methods and Applications*. John Wiley.
3. Goon AM, Gupta MK & Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
4. Goon AM, Gupta MK & Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I. The World Press.
5. Hoel PG. 1971. *Introduction to Mathematical Statistics*. John Wiley.

**M.Sc. (Ag.) Agronomy
SEMESTER II**

AGN 601 Modern Concepts in Crop Production

3(3+0)

Module I

AGNomic aspects in food security; Crop growth and production in relation to climate change; Agro ecological and agroclimatic zones of India.

Module II

Concept of potential yield; Modern concepts in tillage - zero, minimum and conservation tillage; Optimization of plant population and planting geometry in relation to soil fertility, solar radiation and available moisture regimes.

Module III

Mitscherlich, Baule and Inverse yield : nitrogen laws; Biotic and abiotic stresses; Concept of ideal plant type; Organic farming, Physiology of grain yield in cereals; Crop growth analysis;

Module IV

Crop modelling in AGNomic systems; Precision agriculture; Growth regulators and their role in agriculture; Designer crops; Vermi-technology;

Module V

Agro biodiversity; Seed priming; Indigenous technological knowledge; Herbicide resistance in weeds; Allelopathy in agriculture ; Plant nutrition and disease tolerance in field crops.

Suggested Readings:

1. Gardner, F.P.; Pearce, G.R. and Michell, R.I. Physiology of Crop Plants, Scientific Pub., Jodhpur.
2. S.P. Palaniappan and Shivarama, K. 1996. Cropping Systems in the Tropics - Principles and Management. New Age International Pub.
3. Fageria, N.K. 1992. Maximising crop yields. Marcel Dekker, New York.
4. Reddy, S.R. 2000. Principles of AGNomy. Kalyani Pub. New Delhi.
5. Sankaran, S. and Mudaliar, T.V.S. 1997. Principles of AGNomy. The Bangalore Printing and Pub. Bangalore.
6. Redford, J. 1967. Growth Analysis formulae: Their use and abuse. Crop Science. 76:171 - 175.
7. Singh, G.; Kolar, J.S. and Sekhon, H.S. 2002 Recent Advances in AGNomy (Ed). ISA, Publication, New-Delhi.
8. Paroda, R.S. 2003. Sustaining Our Food Security. Konark Publishers Pvt. Ltd., Delhi.

Module I

Weed–biology, ecology and classification; history, development and classification of herbicides, their properties, mode of action and uses, basis of selectivity of herbicides; herbicide mixtures, adjuvants and safeners.

Module II

Weed control principles and management practices in important grain crops, oilseeds, pulses, sugar, fibre crops, tuber crops and forage crops; vegetables and orchards.

Module III

weed control under specific situations viz. intercropping systems, non cropped areas and drylands; noxious farm weeds and parasitic weeds and their control.

Module IV

Fate of herbicides in soil; herbicide - pesticides and fertilizer interactions; allelopathic effect.

Module V

Integrated weed management; problem of aquatic weeds particularly water hyacinth, hydrilla and typha grass in Rajasthan and their possible control measures; weed control through bio herbicides and myco-herbicides; herbicide resistance in weeds and crops.

Practical:

Identification of common *kharij*, *rabi* and perennial weeds of crop fields, road sides, waste lands and irrigation channels; familiarization with trade names, common names, uses, cost and source of availability of herbicides; calibration of sprayer and maintenance (before and after use); study of different herbicidal formulations; calculation on herbicidal requirement for field crops and aquatic situation; application of herbicides in field crops; control of some noxious weeds by cultural and chemical means; study on weed control efficiency and calculation on weed infestation and weed index; preparation of weed herbarium, methodology for weed control research and precautions in handling or storage of herbicides.

Suggested Readings :

1. Aldrich RJ & Kramer RJ. 1997. *Principles in Weed Management*. Panima Publ.
2. Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley Inter-Science. Gupta OP. 2007. *Weed Management – Principles and Practices*. Agrobios.
3. Mandal RC. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ. Rao VS. 2000. *Principles of Weed Science*. Oxford & IBH. Subramanian S, Ali AM & Kumar RJ. 1997. *All About Weed*
4. *Control*. Kalyani. Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic. Press.

Module I

Definition, concept, significance and dimensions of dryland farming in Indian agriculture, characteristics of dryland farming and dryland versus rainfed farming: constraints limiting crop production in dry land areas.

Module II

Characterisation of environment for water availability; delineation of dry farming areas on the basis of moisture deficit index and their characteristics, use of mulches, kinds, effectiveness and economics; antitranspirants- their types, mechanism and role in dry farming.

Module III

Water harvesting- its concepts, techniques and practices; soil and crop management techniques- tillage, seeding, fertilizer use, crop and varietal choice, cropping system,

Module IV

Weed control and other management practices; plant ideotypes for drylands, drought management strategies; preparation of appropriate crop plans for dryland areas; mid season corrections for aberrant weather conditions.

Module V

Watershed management- definition, objectives, concepts, problems, approach components, development of cropping systems for watershed areas; alternate land use systems; planning and operation of project for watershed management.

Suggested Readings:

1. R.P. Singh, Srinivas Sharma, M.V. Padmanabhan, S.K. Das and P.K. Mishra, 1990. A Field Manual on Watershed Management, ICAR (CRIDA) Publication, Hyderabad.
2. S.C. Verma and M.P. Singh. 1984. AGNomy of New Plant Types. Tara Book Agency, Varanasi.
3. S. Palaniappan. 1985. Cropping Systems in Tropics: Principles and Management, Wiley Eastern Ltd., New Delhi & TNAU, Coimbatore.
4. Mahendra Pal, K.A. Singh and I.P.S. Ahlawat. 1985. Cropping System Research I & II. In processing of the National Symposium on Cropping Systems Published by ISA, New Delhi.

AGN 604 Cropping Systems and Sustainable Agriculture

3(3+0)

Module I

Cropping systems- intercropping and multiple cropping, concepts, needs, indices and assessment; existing cropping systems under irrigated and rainfed situations.

Module II

Cropping system indices viz., relative spread index and relative yield index. Farming system: integrated farming system, alternate farming system - meaning and scope including specific examples.

Module III

Recycling and crop residue management. Natural farming - concept and components; Organic farming; Crop diversification - principles, types and needs.

Module IV

Sustainable agriculture - definition, scope and objectives, Natural resources, their characterization and management.

Module V

Sustainable cropping and farming systems in agriculture in relation to environmental degradation; Research needs on sustainable agriculture.

Suggested Readings:

1. K.N. Singh and R.P. Singh (Eds), 1990. AGNomic Research Towards Sustainable Agriculture, Indian Society of AGNomy, New Delhi
2. R.P. Singh, 1990. Sustainable Agriculture: Issues, Perspectives and Prospects in Semi Arid Tropics. Vol. I & II Indian Society of AGNomy, New Delhi.
3. Proceedings of the National Symposium on Cropping Systems 1985. Indian Society of AGNomy, New Delhi
4. R.M. Devlin and E.H. Watham. 1986. Plant Physiology. CBS Publishers and Distributors, New Delhi.
5. L.L.Somani, K.L. Totawat and B.L. Baser. 1992 (Ed.) Proceedings of National Seminar on Natural Farming, NSMP Publication, Rajasthan College of Agriculture, Udaipur
6. K. Balakrishnan Nair, U.N. Goswami and K. Kunhkrishnan 1972 (Ed.) Proceedings of the Symposium on Cropping Patterns in India. ICAR Publication, New Delhi.
7. R.W. Willey 1979. Intercropping: Its Importance and Research Needs, Field Crop Abstracts 332:1-10 & 73- 81
8. S.C. Panda. 2004. Cropping Systems and Farming Systems. Agrobios (India) Jodhpur
9. Guriqbal Singh, J.S. Kolar and H.S. Sekhon 2002. Recent Advances in AGNomy, Indian Society of AGNomy, IARI, New Delhi
10. Singh, S.S. 2006. *Principles and Practices of AGNomy*. Kalyani Publishers, Ludhiana.

MAT 207 Experimental Designs 3(2+1)

Module I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

Module II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

Module III

Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments.

Module IV

Factorial experiments with control treatment, Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs.

Module V

Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

Practical:

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD; Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces.

References:

1. Cochran WG & Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
2. Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
3. Federer WT. 1985. *Experimental Designs*. MacMillan.
4. Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
5. Nigam AK & Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
6. Pearce SC. 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley.

SEMESTER III
AGN 701 Agronomy of Major Cereals and Pulses

3(2+1)

Module I

Origin and history, area and production. Classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, Handling and processing of the produce for maximum production of wheat & Barley

Module II

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, Handling and processing of the produce for maximum production of rice

Module III

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, Handling and processing of the produce for maximum production of pearl millet.

Module IV

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, Handling and processing of the produce for maximum production of sorghum.

Module IV

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, Handling and processing of the produce for maximum production of chickpea & pigeon pea.

Practical:

Phenological studies at different growth stages of crops, different methods of raising nursery including dapog in rice; estimation of crop yields on the basis of yield attributes; calculation of fertilizer requirements and their application at different stages of growth on the basis of soil test values; computation of cost of cultivation of various crops, planning and layout of field experiments, formulation of cropping scheme for various farm sizes, calculation of cropping and rotation intensities, visit of field experiments for cultural, fertilizer, weed control and water management aspects; working out indices of intercropping systems – L.E.R. aggressivity, relative crowding coefficient and monetary yield advantage, ATER; determination of physiological maturity in different crops; working out of harvest index in various crops; computation of growth analysis indices. Study of root nodules and seed treatment with bio- fertilizers in pulses, Estimation of protein in pulses.

Suggested Readings :

1. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
2. Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
3. Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.
4. Pal M, Deha J & Rai RK. 1996. *Fundamentals of Cereal Crop*
5. *Production*. Tata Mc GrawHill. Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Module I

Origin and history, area and production ,classification, improved varieties, adaptability, climate, soil, water and cultural requirements, Nutrition quality component, handling and processing of the produce for maximum production of oilseeds, Handling and processing of the produce for maximum production of ground nut and soybean

Module II

Origin and history, area and production ,classification, improved varieties, adaptability, climate, soil, water and cultural requirements, Nutrition quality component, handling and processing of the produce for maximum production of oilseeds, Handling and processing of the produce for maximum production of – rapeseed and mustard

Module III

. Origin and history, area and production ,classification, improved varieties, adaptability, climate, soil, water and cultural requirements, Nutrition quality component, handling and processing of the produce for maximum production of oilseeds, Handling and processing of the produce for maximum production of – sugarcane

Module IV

Origin and history, area and production ,classification, improved varieties, adaptability, climate, soil, water and cultural requirements, Nutrition quality component, handling and processing of the produce for maximum production of oilseeds, Handling and processing of the produce for maximum production of- cotton and jute

Module IV

Origin and history, area and production ,classification, improved varieties, adaptability, climate, soil, water and cultural requirements, Nutrition quality component, handling and processing of the produce for maximum production of oilseeds, Handling and processing of the produce for maximum production of- potato

Practical

Phenological studies at different growth stages of crops, study of yield attributing characters

of oilseeds and cotton; computation of yield on the basis of yield attributing characters; determination of protein and oil content in oilseeds, Seed treatment of cotton seed with sulphuric acid and cow dung; computation of cost of cultivation of various crops; determination of quality of cotton including ginning per cent and lint index; calculation of fertilizer requirements and their application at different growth stages in various crops on the basis of soil test values. cutting of cane setts, its treatment and method of sowing, tying and propping of sugarcane; determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in juice; preparation of blue print for sugarcane, calculation of seed rate and fertilizer requirement for sugarcane; to work out the cost of cultivation of sugarcane; selection of potato seed, its treatment and method of sowing; calculation of seed rate and fertilizer requirement for potato; preparation of blue print for potato.

Suggested Readings:

1. Das, N.R. 2007. Introduction to crops of India. Scientific Publisher, Jodhpur.
2. H.C. Srivastava, S. Bhaskaran, B. Vatsyas and K.K.G. Menon 1985. Oilseed Production: Constraints and Opportunities, Oxford & IBH Company, New Delhi.
3. J.S. Grewal & V.P. Jaiswal. 1990. AGNomical studies in potato under all India co-ordinated Potato Improvement Project, CPRI Pub. Shimla.

Module I

Area and distribution of problem soils – acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible,

Module II

Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties.

Module III

Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

Module IV

Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management,

Module V

Quality of irrigation water; management of brackish water for irrigation; salt balance under irrigation; characterization of brackish waters, area and extent; relationship in water use and quality, agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

Practical

Characterization of acid, acid sulfate, salt-affected and calcareous soils, determination of cations (Na^+ , K^+ , Ca^{++} and Mg^{++}) in ground water and soil, samples, determination of anions (Cl^- , SO_4^{--} , CO_3^{--} and HCO_3^-) in ground waters and soil samples, lime requirements of acid soil and gypsum requirements of sodic soil.

Suggested Readings

- 1 Bear FE. 1964. *Chemistry of the Soil*. Oxford & IBH.
- 2 Jurinak JJ. 1978. *Salt-affected Soils*. Department of Soil Science & Biometeorology. Utah State Univ.
- 3 USDA Handbook No. 60. 1954. *Diagnosis and improvement of Saline and Alkali Soils*. Oxford & IBH.

Module I

Definition and classification of plant growth regulators- Hormones, endogenous growth substances and synthetic chemicals, Endogenous growth regulating substances other than hormones. triconanol, Phenols – polyamines, jasmonates, concept of death hormone.

Module II

Site of synthesis, biosynthetic pathways and metabolism and the influence on plant growth development of individual group of hormones- Auxins, Gibberellins, cytokinins, Abscisic acid and Ethylene Brassinosteroids.

Module III

Signal perception, transduction, and effect at functional gene level of different hormones - Auxins- cell elongation, Gibberellins -, germination of dormant seeds, cytokinins- cell division.

Module IV

Retardation of senescence of plant parts, Abscisic acid - Stomatal closure and induction of drought resistance, Ethylene- fruit ripening. Interaction of hormones in regulation of plant growth and development processes. Rooting of cuttings - Flowering. Apical dominance, molecular aspects of control of reproductive growth and development.

Module V

Synthetic growth regulators - Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture.

Practical:

Extraction of hormones from plant tissue. Auxins- bioassays- auxins effect on rooting of cuttings, abscission, apical dominance, Gibberellins- bioassays-GA effect on germination of dormant seeds, cytokinin- bioassays- cytokinin effect on apical dominance and senescence, ABA bioassay estimation. ABA effect on stomatal movement, Ethylene bioassays, estimation using physico chemical techniques (with the condition that GLC/ HPLC is provided) - effect of hormones on breaking dormancy.

Suggested Readings

1. Hopkins WG & Huner NPA. 2004. *Introduction to Plant Physiology*. John Wiley & Sons.
2. Salisbury FB & Ross C. 1992. *Plant Physiology*. 4th Ed. Wadsworth Publ.