

M.Sc. Agronomy

Semester- wise distribution of courses

First Semester

A. Major Courses			
S. No.	Course code	Title of course	Credit hours
1.	Agron -501	Concepts in crop production	3(3+0)
2.	Agron-502	Principles of soil fertility and nutrient management	3(2+1)
3.	Agron-503	Principles of weed management	3 (2+1)
B. Minor courses			
1.	SST-501	Principles of seed production	3(2+1)

Second Semester

A. Major Courses			
S. No.	Course code	Title of course	Credit hours
1.	Agron-504	Dry land farming and watershed management	3(2+1)
2.	Agron-505	Agronomy of tuber and fibre crops	3(2+1)
3.	Agron-506	Principles of organic farming	3(2+1)
B. Minor courses			
1.	SST-502	Seed processing and storage	3(2+1)
C. Supporting courses			
1.	AST-501	Experimental design	3(2+1)

Third Semester

A. Major Courses			
S. No.	Course code	Title of course	Credit hours
1.	Agron-507	Principles of cropping system and sustainability	2(2+0)
2.	Agron-601	Agroforestry & agrostology	3(2+1)
B. Minor courses			
2.	SST-503	Seed quality testing	3(2+1)
C. Supporting courses			
1.	FOR-501	Research methodology	2(1+1)

Fourth semester

S. No.	Course code	Title of course	Credit hours
1.	Agron-590	Master's Seminar	1(1+0)
2.	Agron-591	Master's Research	20

PGS Courses

S. No.	Course code	Title of course	Credit hours
1.	PGS-501	Library and information Services	1(0+1)
2.	PGS-502	Technical Writing and Communication Skills	1(0+1)
3.	PGS-503	Intellectual Property and its Management in Agriculture	1(1+0)
4.	PGS-504	Basic concepts in Laboratory Techniques	1(0+1)
5.	PGS-505	Agricultural Research, Research ethics and rural development programme	1(1+0)
6.	PGS-506	Disaster management	1(1+0)

COURSE CONTENT

Theory

1. Concepts in crop production

Crop growth in relation to environment, agroecological zones of India; concept of potential yield and its realization; modern concepts in tillage: zero or minimum, conservation tillage etc. optimization of plant population and planting geometry in relation to soil fertility, solar radiation and available moisture regimes; Mitscherlich, Baule and Inverse- yield- nitrogen laws, biotic and abiotic stresses; concept of soil plant relation, concept of ideal plant type; crop modelling for maximizing crop yield: crop response production functions; cropping and farming systems for sustainable agriculture: organic farming crop residue recycling and management; crop production under protective agriculture: precision agriculture, Remote sensing for yield forecasting, Nano technology in agriculture.

Suggested Readings

Balasubramaniyan P & Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.
Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.
Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

2. Principles of soil fertility and nutrient management

Theory

Soil fertility and productivity ; soil composition in relation to crop production, organic and inorganic constituents: essential plant nutrients; deficiency and toxicity symptoms of major and micronutrients and remedial measures ; transformation and dynamics of major plant nutrients; kinds of fertilizers, straight, complex and bulk blended ; methods of fertilizer application; crop response to nutrients ; fertilizer use efficiency, agronomic, chemical and physiological; methods of increasing fertilizer use efficiency : nutrient interactions; fertilizer application in cropping systems direct, residual and cumulative effects; integrated plant nutrient supply systems, organic manures, compost, green, manures, vermi-compost, bio- fertilizers, crop residue and inorganic fertilizers; sustainable agriculture and soil fertility, fertilizers and environment ; fertilizer use in problem soils ; soil moisture-nutrients interactions, long term effect of fertilizer use on crop yield and productivity, integrated nutrient management, site specific nutrient management.

Practical

- Determination of soil pH, EC_e, organic C, total N, available N, P, K and S in soils
- Determination of total N, P, K and S in plants
- Interpretation of interaction effects and computation of economic and yield optima

Suggested Readings

Brady NC & Weil R.R 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
Yawalkar KS, Agrawal JP & Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

3. Principles of weed management

Theory

Classification and characteristics of weeds; special weed problems including aquatic and parasitic weeds. Ecology and physiology of major weeds; ecophysiology of crop weed competition including allelopathy; weed indices; principles and methods of weed control, concept of integrated weed management; weed control through bioherbicides, mycoherbicides and allelochemicals; herbicides history, development and their classification; mode and mechanism of action of herbicides; herbicide selectivity, herbicide mixtures, adjuvants and safeners ; degradation of herbicides in soil and plants; effect of herbicides in relation to environment; herbicide resistance in weeds and crops ; weed management in major crops and cropping systems ; weed shifts in cropping systems; control of weeds in non cropped situations.

Practical

- Identification of important weeds of different crops
- Preparation of a weed herbarium
- Weed survey in crops and cropping systems
- Crop-weed competition studies
- Preparation of spray solutions of herbicides for high and low-volume sprayers
- Use of various types of spray pumps and nozzles and calculation of swath width
- Economics of weed control
- Herbicide resistance analysis in plant and soil
- Bioassay of herbicide resistance
- Calculation of herbicidal requirement

Suggested Readings

- Aldrich RJ & Kramer RJ. 1997. *Principles in Weed Management*. Panima Publ.
- Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley Inter-Science.
- Gupta OP. 2007. *Weed Management – Principles and Practices*. Agrobios.
- 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 Control*. Kalyani.
- Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

4. Dry land farming and watershed management

Theory

Unit I

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.

Unit II

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

Unit III

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

Unit IV

Tillage, tith, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use.

Unit V

Concept of watershed resource management, problems, approach and components.

Unit VI

Soil erosion -definition, nature and extent of erosion ; types of erosion, factors affecting erosion; soil conservation- definition, methods of soil conservation - agronomic measures, contour cultivation, strip cropping, cover, crops, vegetative barrier; improved dry farming practices ; mechanical measures - bunding .gully control, bench terracing ; role of grasses and pastures in soil conservations ; wind breaks and shelter belts

Practical

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- Moisture stress effects and recovery behaviour of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations
- Water use efficiency
- Preparation of crop plans for different drought conditions

5. Principles of organic farming

Theory

UNIT I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

UNIT III

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

UNIT IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

UNIT V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

- Aerobic and anaerobic methods of making compost
- Making of vermicompost
- Identification and nursery raising of important agro-forestry trees and trees for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

Suggested Readings

Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.

Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.

6. Principles of cropping system and sustainability

Theory

UNIT I

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

UNIT II

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

UNIT III

Above and below ground interactions and allelopathic effects; competition relations; multistoried cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

UNIT IV

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.

UNIT V

Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

Suggested Readings

Palaniappan SP & Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management*. New Age.

Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.

Reddy SR. 2000. *Principles of Crop Production*. Kalyani.

Sankaran S & Mudaliar TV. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ. Co.

Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice

7. Agroforestry & Agroecology

Theory

Definition, concept, scope; historical perspective, agroforestry systems; agri-silvi-culture, silvipasture. agri-silvipasture. agri-horticulture, aqua -silviculture ; alley cropping and energy

plantation: agro forestry systems for forage and fuel wood production, resource conservation; improvement of degraded lands: biological diversity and sustainable agriculture and environmental protection; associative influence in relation to above ground and underground interferences: allelopathy in various agro forestry designs/models for different agro climatic conditions : tree crop animal relationship ; food -fodder-fuel systems ; productivity and sustainability: alternate land use systems through agro forestry; social acceptability and economic viability : agro forestry interventions with multipurpose tree species; nutritive value of tree leaf, economics of AF systems. Grass covers of India, Rangeland management

8. Experimental Designs

Theory

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control. Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT II

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

UNIT III

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT IV

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

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.

Suggested readings

Cochran WG & Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley. - Dean AM & Voss D. 1999.

Design and Analysis of Experiments. Springer. - Federer WT. 1985.

Experimental Designs. MacMillan. Fisher RA. 1953.

Design and Analysis of Experiments. Oliver & Boyd. - Nigam AK & Gupta VK. 1979.

Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983.

The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.

9. Agronomy of tuber and fibre Crops

Theory

Origin & history, area & production, distribution, botany, classification, description and agronomic appraisal of the varietal improvement of the crop, adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of by products, individual crop-based cropping system. Crop quality, handling and processing of the produce for maximum production of Tuber crops: potato and other tuber crops sweet potato, cassava, Jute, Sunhemp, Hemp and Flax.

Practical

- Planning and layout of field experiments
- Intercultural operations in different crops
- Working out growth indices (LER, CGR, RGR, NAR, LAD) aggressivity, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of quality for different tuber crops
- Estimation of quality of fibre of different fibre crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

Suggested Readings

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

10. Principles of Seed Production

Theory

UNIT I

Introduction : Seed as basic input in agriculture; seed development in cultivated plants; seed quality concept and importance of genetic purity in seed production; types of cultivars, their maintenance and factors responsible for deterioration; seed production in self and cross pollinated crops.

UNIT II

Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, roguing etc. male sterility and incompatibility system in hybrid seed production, role of pollinators and their management.

UNIT III

Seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production – agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of Nucleus seed, production of Breeder, Foundation and Certified seed– criteria involved; life span of a variety and causes for its deterioration; certification standards for self and cross pollinated and vegetatively propagated crops.

UNIT IV

Hybrid Seed - Methods of development of hybrids; use of male sterility and self-incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops and vegetables.

UNIT V

Planning of seed production for different classes of seeds for self and cross-pollinated crops, Seed quality control system and organization, seed village concept; Seed production agencies, seed industry and custom seed production in India.

PRACTICALS

- To study about the germination test
- Study about the different classes of seed
- To study about the emasculation and pollination methods
- Seed production in rice
- Seed production in maize
- Visit to seed production field,
- Visit to seed processing units.

Suggested Readings

- Agarwal, R.L. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
- Desai, B.B. 2004. *Seeds Handbook*. Marcel Dekker
- Singh, B.D. 2005. *Plant Breeding: Principles and Methods*. Kalyani Publishers.
- Chhabra AK. 2006. *Practical Manual of Floral Biology of Crop Plants*. Dept. of Plant Breeding CCS HAU, Hisar.
- Singhal NC. 2003. *Hybrid Seed Production in Field Crops*. Kalyani.

11. Seed Processing and Storage

Theory

UNIT I

Introduction: Principles of seed processing; methods of seed drying including dehumidification and its impact on seed quality. Relative humidity and equilibrium moisture content of seed; humb rules of seed storage; loss of viability in important agricultural and horticultural crops, viability equations and application of nomograph.

UNIT II

Seed cleaning equipment and their functions: Preparing seed for processing; functions of scalper debearder, scarifier, huller, seed cleaner and grader. Screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines; seed blending.

UNIT III

Assembly line of processing and storage, receiving, elevating and conveying equipments, plant design and layout, requirements and economic feasibility of seed processing plant.

UNIT IV

Seed treatments-methods of seed treatment, seed treating formulations and equipments, seed disinfestations, identification of treated seeds; Packaging: principles, practices and materials; bagging and labeling.

UNIT V

Seed storage: Seed drying and storage; drying methods-importance and factors affecting it, changes during storage, concepts and significance of moisture equilibrium, methods of maintaining safe seed moisture content. Methods to minimize the loss of seed vigour and viability; factors influencing storage losses. Storage methods and godown sanitation. Storage structures. Storage problems of recalcitrant seeds and their conservation.

PRACTICAL

- Seed processing equipments
- Operation and handling of mechanical drying equipments
- Seed processing and testing equipments
- Seed quality upgradation

- Seed blending and bag closures
- Study of orthodox, intermediary and recalcitrant seeds
- Evaluating seed viability at different RH and temperature levels and packaging materials
- Prediction of storability by accelerated ageing controlled deterioration tests
- Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores

Suggested Readings

- Agrawal RL. 1996. *Seed Technology*. Oxford Publ.
- Barton LV. 1985. *Seed Preservation and Longevity*. International Books and Periodicals Supply Service, New Delhi.
- Justice OL & Bass LN. 1978. *Principles and Practices of Seed Storage*. Castle House Publ. Ltd.
- Mathews RK, Welch GB, Delouche JC & Dougherty GM. 1969. *Drying, Processing and Storage of Corn seed in Tropical and Subtropical Regions*. Proc. Am. Agric. Eng. St. Joseph, Mich. Paper No. 69-67.
- Sahay KM & Singh K K. 1991. *Unit Operations in Food Engineering*. Vikas Publ.
- Viridi SS & Gregg BG. 1970. *Principles of Seed Processing*. National Seed Corp., New Delhi.\

12. Seed Quality Testing

Theory

UNIT I

Introduction: Structure of monocot and dicot seeds; seed quality: objectives, concept and components and their role in seed quality control; instruments, devices and tools used in seed testing. ISTA and its role in seed testing.

UNIT II

Seed Sampling: definition, objectives, seed-lot and its size; types of samples; sampling devices; procedure of seed sampling; sampling intensity; methods of preparing composite and submitted samples; sub-sampling techniques, dispatch, receipt and registration of submitted sample in the laboratory, sampling in the seed testing laboratory.

UNIT III

Physical Purity: definition, objective and procedure, weight of working samples for physical purity analysis; components of purity analysis and their definitions and criteria; pure seed definitions applicable to specific genera and families; multiple seed units; general procedure of purity analysis; calculation and reporting of results, prescribed seed purity standards; determination of huskless seeds; determination of weed seed and other seed by number per kilogram; determination of other distinguishable varieties (ODV); determination of test weight and application of heterogeneity test.

UNIT IV

Seed moisture content: importance of moisture content; equilibrium moisture content; principles and methods of moisture estimation - types, instruments and devices used; pre-drying and grinding requirements, procedural steps in moisture estimation; calculation and reporting of results.

UNIT V

Germination: importance; definitions; requirements for germination, instrument and substrata required; principle and methods of seed germination testing; working sample and choice of method; general procedure for each type of method; duration of test; seedling evaluation; calculation and reporting of results; dormancy: definition, importance, causal mechanisms, types and methods for breaking dormancy.

UNIT VI

Viability and Vigour Testing: definition and importance of viability tests; different viability tests; quick viability test (TZ- test) - advantages, principle, preparation of seeds and solutions, procedure, evaluation and calculation of test results. Vigour testing: concept, historical development, definitions, principles and procedures of different methods used for testing vigour.

UNIT VII

Genetic purity testing : objective and criteria for genetic purity testing; types of test; laboratory, Growth Chamber and field testing based on seed , seedling and mature plant morphology; principles and procedures of chemical, biochemical and molecular tests.

UNIT VIII

Seed health Testing: field and seed standards ; designated diseases, objectionable weeds - significance of seed borne disease vis-a-vis seed quality - seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes.

UNIT IX

Testing of GM seeds and trait purity, load of detection (LOD).

UNIT X

Preparation and dispatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances.

Practical

- Structure of monocot and dicot seeds
- Identification and handling of instruments used in seed testing laboratory
- Physical purity analysis of samples of different crops
- Estimation of seed moisture content (oven method)
- Seed dormancy breaking methods
- Specifications and proper use of different substrata for germination
- Seed viability test (tetrazolium test)
- Seedling vigour test
- Genetic purity testing by chemical, biochemical and molecular methods

- Seed health testing for designated diseases, blotter methods, agar method and embryo count methods

Suggested Readings

- Agarwal RL. 1997. *Seed Technology*. Oxford & IBH.
- Agrawal PK & Dadlani M. 1992. *Techniques in Seed Science and Technology*. 2nd Ed. South Asian Publ.
- Agrawal PK. (Ed.). 1993. *Handbook of Seed Testing*. Ministry of Agriculture, GOI, New Delhi.
- Copland LO & McDonald MB. 1996. *Principles of Seed Science and Technology*. Kluwer.
- ISTA 2006. *Seed Testing Manual*. ISTA, Switzerland.
- Martin C & Barkley D. 1961. *Seed Identification Manual*. Oxford & IBH.
- Tunwar NS & Singh SV. 1988. *Indian Minimum Seed Certification Standards*. Central Seed Certification Board, Ministry of Agriculture, New Delhi.