Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

PG Degree Programme Syllabus as per ICAR

M.Sc. (Ag.) Agronomy

Department of Agronomy

Session: 2023-2024 onwards

- **Programme Structure**
- **Programme Outcomes (POs)**
- **Course Outcomes (COs)**
- **Detailed Syllabus (Course Contents)**

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Contents

Framework of the courses

The following nomenclature and Credit Hrs. need to be followed while providing the syllabus for all the disciplines

Courses	Credits
Major courses	20
Minor courses	08
Supporting courses	06
Common courses	05
Seminar	01
Thesis	30
Total	70

M.Sc. (Ag.) Agronomy Semester wise

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Semester I

					EVALUATION (MM-100)		
					INTERNAL	EXTERNAL	
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
AGRON-501	Modern Concepts in Crop Production	Major	3(2+1)	**T/P**	30	20	50
AGRON-502	Principles and Practices of Soil Fertility and Nutrient management	Major	3(2+1)	**T/P**	30	20	50
AGRON - 506	Agronomy of Major Cereals, Millets and Pulses	Major	2(1+1)	**T/P**	30	20	50
AGRON - 511	Cropping System and Sustainable Agriculture						
PGS-501	Technical Writing and Communication Skills	Common	1(0+1)	**P**	40+10*	50	00
PGS-502	Library and Information services	Common	1(0+1)	**P**	40+10*	50	00
SOIL-505	Soil Erosion and Conservation	Minor	3(2+1)	**T/P**	30	20	50

1. Select any one from AGRON-506 & 511.
2. Minor course is taken from allied programme

Semester II

					EVALUATION (MM-100)		
					INTERNAL	EXTERNAL	
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
AGRON - 504	Principles and Practices of Water Management	Major	3(2+1)	**T/P**	30	20	50
AGRON - 508	Agronomy of Medicinal, Aromatic & Underutilized Crops	Major	3(2+1)	**T/P**	30	20	50
AGRON - 513	Principles and Practices of Organic Farming						
STAT-511	Experimental Designs	Supporting	3(2+1)	**T/P**	30	20	50
STAT-502	Statistical Method for Applied Science						
PGS-503	Intellectual Property and its Management in Agriculture	Common	1(1+0)	**T**	40+10*	00	50

PGS-504	Basic concepts in Laboratory Techniques	Common	1(0+1)	**P**	40+10*	50	00
AGM-502	Fundaments of Agricultural Meteorology	Minor	2(1+1)	**T/P**	30	20	50

1. Select any one from AGRON-508 & 513.
2. Select any one from STAT-511 & 502.
3. Minor course is taken from allied programme

Semester III

					EVALUATION (MM-100)		
					INTERNAL	**EXTERNAL**	
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
AGRON - 503	Principles and Practices of Weed Management	Major	3(2+1)	**T/P**	30	20	50
AGRON - 509	Agronomy of Fodder and Forage Crops	Major	3(2+1)	**T/P**	30	20	50
AGRON - 507	Agronomy of Oilseed, Fibre and Sugar Crops						
MCA-501	Computer Fundamentals and Programming	Supporting	3(2+1)	**T/P**	30	20	50
PGS-505	Agriculture Research, Research Ethics and Rural Development	Common	1(1+0)	**T**	40+10*	00	50
GPB-510	Seed Production and Seed Certification	Minor	3(2+1)	**T/P**	30	20	50

1. Select any one from AGRON-507 & 509.
2. Minor course is taken from allied programme

Semester IV

Course Code	**Title of the Course**	**Type**	**Credits**	**Internal**	**External**
AGRON -550	Seminar	Compulsory	1(0+1)	100	-
AGRON -560	Thesis	Compulsory	30(0+30)	-	100

Thesis Guidelines:

1st Semester- a Supervisor/Advisor and a Topic/title allotment for his/her thesis.

2nd & 3rd Sem.-Synopsis presentation, Research field allotment, experimentation data collection etc.

4th Sem.- Seminar, Data Analysis, Thesis writing, Pre-submission, and Thesis Evaluation.

Criteria for Thesis Evaluation

1. Synopsis: There will be a research advisory committee also called (SAC) student advisory committee, at institutions level
2. Synopsis presentation will be conducted in presence of SAC members sixty percent of members will form the quorum SAC members.
3. The research advisor of Student shall be convenor of this committee. This committee will have following responsibilities:

i) To review the research title and finalize the topic of research.
ii) To guide the student to build up the study design and research methodology of research
iii) To periodically review and guide in the progress of research work of the students

4. There will be pre- submission presentation by the student before SAC at institution level
5. After incorporation of suggestion final thesis will be submitted to the university for evaluation.
6. Pannal of external & internal examiner will be appointed by the university.
7. The place of final presentation/ viva voice examination will be decided by the university.

Note:

- Total credits to be earned by a student for completion of the PG program: 40 +30 (Thesis) =70

Common Courses

PGS-501- TECHNICAL WRITING AND COMMUNICATIONS SKILLS (0+1)

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc.

To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications; • Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed. 5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. Speaking English Effectively. MacMillan India.

9. Richard WS. 1969. Technical Writing.

10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.

PGS-502 LIBRARY AND INFORMATION SERVICES (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

PGS-503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge- based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.

2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.

3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.

4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol.V. Technology Generation and IPR Issues. Academic Foundation.

5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.

PGS-504 BASIC CONCEPTS IN LABORATORY TECHNIQUES (0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory. **Practical**

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy. **Suggested Readings**

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.

2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

PGS-505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and
Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ. 4. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

SUPPORTING COURSES

I. Course Title : Computer Fundamentals and Programming
II. Course Code : MCA 501
III. Credit Hours : 3(2+1)
IV. Aim of the course
This is a course on Computer Fundamentals and Programming that aims at exposing the students to understand how computer works, analytical skills to solve problems using computers. andto write computer programs using C.

V. Theory
Unit I
Functional units of computer, I/O devices, primary and secondary memories. Number systems: decimal, octal, binary and hexadecimal; Representation of integers, fixed and floating point numbers, Operator precedence, character representation; ASCII, Unicode.
Unit II
Programming Fundamentals with C - Algorithm, techniques of problem solving, flowcharting, stepwise refinement; Constants and variables; Data types: integer, character, real, data types; Arithmetic expressions, assignment statements, logical expressions. Control flow
Unit III
Arrays and structures. Pointers, dynamic memory allocations
Unit IV
Program Structures – functions, subroutines
Unit V
I/O operations, Program correctness; Debugging and testing of programs.

VI. Practical

- Conversion of different number types;
- Creation of flow chart, conversion of algorithm/flowchart to program;
- Mathematical operators, operator precedence;

•**Prof.** Sequence, control and iteration;
• Arrays and string processing;
• Matrix operations, Sorting, Pointers and File processing – Reading and writing text files.

VII. Suggested Reading
• Balaguruswamy E. 2019. Programming with ANSI C. Tata McGraw Hill.
• Gottfried B. 2017. Programming with C, Schaum Outline Series. Tata McGraw Hill.
• Kanetkar Y. 1999. Let Us C. BPB Publ.
Statistical Sciences: Computer Application
763
• Malvino A.P. and Brown J.A.. 2017. Digital Computer Electronics. Tata McGrawHill.
• Mano M.M. 1999. Digital Logic and Computer Design. Prentice Hall of India.

I. Course Title : Experimental Designs
II. Course Code : STAT 511
III. Credit Hours : 2+1
IV. Aim of the course
This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

V. Theory
Unit I
Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.
Unit II
Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design. **Unit III**
Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.
Unit IV
Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

VI. 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,
• Analysis with missing data, • Split plot and strip plot designs.

VII. Suggested Reading

• Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
• Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
• Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
• Federer WT. 1985. *Experimental Designs*. MacMillan.
• Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
• Nigam AK and 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.
• www.drs.icar.gov.in.

Course Contents M.Sc. (Ag.) Agronomy

I. Course Title : Modern Concepts in Crop Production
II. Course Code : Agron 501
III. Credit Hours : 3(2+1)

Theory Unit I

Crop growth analysis in relation to environment; geo-ecological zones of India.**Unit II**

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation, and applicability; Baule unit.**Unit III**

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

Unit IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition.

Unit V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needsfor yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture. Modern crop production concepts: soil less cultivation, Aeroponic, Hydroponic, Robotic and terrace farming. use of GIS, GPS andremote sensing in modern agriculture, precision farming and protected agriculture.

VI Practical

- Estimation of crop yield.
- Calculation of plant population
- Evaluation of manures and fertilizers
- Visit to organic farms

II. Suggested Reading

- Balasubramaniyan P and Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
- Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers.* 7th Ed. Prentice Hall.
- Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.

I. Course Title : Principal and Practices of Soil Fertility and Nutrient Management

II. Course Code : Agron 502

III. Credit Hours : 3(2+1)

Theory Unit I

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

Unit II

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

Unit III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability, and crop responses; recycling of organic wastes and residue management. Soil less cultivation.

Unit IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects, and fertilizer use efficiency; agronomic, chemical, and physiological, fertilizer mixtures, and grades; methods of increasing fertilizer use efficiency; nutrient interactions.

Unit V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic nutrients; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

Practical

- Determination of soil pH and soil EC
- Determination of soil organic C
- Determination of available N, P, K and S of soil
- Determination of total N, P, K and S of soil
- Determination of total N, P, K, S in plant
- Computation of optimum and economic yield

IV. Suggested Reading

- Brady NC and Weil RR. 2002. *The Nature and Properties of Soils.* 13th Ed.Pearson Edu.
- Fageria NK, Baligar VC and Jones CA. 1991. *Growth and Mine*

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I. Course Title : Agronomy of Major Cereals, Millets and Pulses

II. Course Code : Agron 506

III. Credit Hours : 2(1+1)

IV. Aim of the course

To impart knowledge of crop husbandry of cereals and pulse crops.

V. Theory

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:

Unit I:

Rabi cereals.

Unit II: *Kharif* cereals.

Unit III: *Rabi* pulses

.**Unit IV:** *Kharif* pulses

Practical

- Phenological studies at different growth stages of crop
- Formulation of cropping schemes for various farm sizes and calculationof cropping and rotational intensities
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR,LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity IndeX, Sustainable Yield IndeX Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- Estimation of protein content in pulses
- Planning and layout of field eXperiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops • Working out harvest index of various crops
- Study of seed production techniques in selected crops
- Visit of field experiments on cultural, fertilizer, weed control andwater management aspects
- Visit to nearby villages for identification of constraints in crop production

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VIII. Learning outcome

Basic knowledge on cereals and pulse growing in the country.

IX. Resources

- Kushwaha, K. P. and Vishwakarma, S. P. 2021, *Numerical of Agronomy*. Kushal Publications and Distributors, Varanasi.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Hunsigi G and Krishna KR. 1998. *Science of Field Crop Production*.OXford & IBH.
- Jeswani LM and Baldev B. 1997. *Advances in Pulse ProductionTechnology*.ICAR.
- Khare D and Bhale MS. 2000. *Seed Technology*. Scientific Publ.
- Kumar Ranjeet and Singh NP. 2003. *Maize Production in India:Golden Grain in Transition*. IARI, New Delhi.
- Pal M, Deka J and Rai RK. 1996. *Fundamentals of Cereal CropProduction*.Tata McGraw

Hill.
- Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- Singh C, Singh P and Singh R. 2003. *Modern Techniques of RaisingFieldCrops*. OXford & IBH

Course Title : Cropping Systems and Sustainable Agriculture

II. Course Code : Agron 511 III. Credit Hours : 2(1+1) IV. Aim of the course

To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity.

V. 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; multi-storied 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. Advanced nutritional tools for big data analysis and interpretation.

Unit V

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

Unit VI

Artificial Intelligence- Concept and application.

VII. Teaching methods/ activities

Classroom teaching with AV aids, group discussion, assignment.

VIII. Learning outcome

Basic knowledge on cropping system for sustainable agriculture.

IX. Suggested Reading

- Panda SC. 2017. *Cropping Systems and Sustainable Agriculture*. Agrobios (India)
- Panda SC. 2018. *Cropping and Farming Systems*. Agrobios.
- Palaniappan SP and 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 and Mudaliar TVS. 1997. *Principles of Agronomy.* The Bangalore Printing & Publ. Co.
- Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

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

I. Course Title : Principles and Practices of Water Management II. Course Code : Agron 504

III. Credit Hours : 3(2+1)

IV. Aim of the course

To teach the principles of water management and practices to enhance the water productivity

V. Theory

Unit I

Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in of India and concerned state, major irrigation projects, eXtent of areaand crops irrigated in India and in different states.

Unit II

Field water cycle, water movement in soil and plants; transpiration; soil-water- plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and loses.

Unit III

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.

Unit IV

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement-estimation of ET and effective rainfall; Water management of the major crops and cropping systems. Automated irrigation system.

Unit V

EXcess of soil water and plant growth; water management in problem soils, drainage requirement of crops and methods of field drainage, their layout and spacing; rain water management and its utilization for crop production.

Unit VI

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

Unit VII

Soil moisture conservation, water harvesting, rain water management and its utilization for crop production.

Unit VIII Hydroponics, Unit IX

Water management of crops under climate change scenario.

VI. Practical

- Determination of Field capacity by field method
- Determination of Permanent Wilting Point by sunflower pot culture technique
- Determination of Field capacity and Permanent Wilting Point byPressure PlateApparatus
- Determination of Hygroscopic Coefficient
- Determination of maXimum water holding capacity of soil
- Measurement of matric potential using gauge and mercury type tensiometer
- Determination of soil-moisture characteristics curves
- Determination of saturated hydraulic conductivity by constant andfalling headmethod
- Determination of hydraulic conductivity of saturated soil below the watertable byauger hole method
- Measurement of soil water diffusivity
- Estimation of unsaturated hydraulic conductivity

Estimation of upward fluX of water using tensiometer and from depthground watertable

- Determination of irrigation requirement of crops (calculations)
- Determination of effective rainfall (calculations)
- Determination of ET of crops by soil moisture depletion method16.Determinationof water requirements of crops
- Measurement of irrigation water by volume and velocity-area method
- Measurement of irrigation water by measuring devices and calculation ofirrigationefficiency
- Determination of infiltration rate by double ring infiltrometer

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

VIII. Learning outcome

Basic knowledge on water management for optimization of crop yield

IX. Suggested Reading

- Majumdar DK. 2014. *Irrigation Water Management: Principles andPractice*. PHL Learning private publishers
- Mukund Joshi. 2013. *A Text Book of Irrigation and Water ManagementHardcover*, Kalyani publishers
- Lenka D. 1999. *Irrigation and Drainage*. Kalyani.

I. Course Title : Agronomy of Medicinal, Aromatic and Under Utilized Crops II. Course Code : Agron 508

III. Credit Hours : 2(1+1)

IV. Aim of the course

To acquaint students about different medicinal, aromatic and underutilizedfieldcrops, their package of practices and processing.

V. Theory

Unit I

Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according tobotanical characteristics and their uses, export potential and indigenous technical knowledge.

Unit II

Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Mulhati, Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, *Stevia*, Safed Musli, Kalmegh, Asaphoetida, *Nuxvomica*, etc). **Unit III**

Climate and soil requirements; cultural practices; yield and important constituentsof aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose).

Unit IV

Climate and soil requirements; cultural practices; yield of under-utilized crops (Sesbania, Clusterbean, French bean, Fenugreek Coffee, Tea and Tobacco).

Unit V

Post harvest handling –drawing, processing, grading, packing and storage, valueaddition and quality standards in herbal products.

VI. Practical

- Identification of crops based on morphological and seed characteristics
- Raising of herbarium of medicinal, aromatic and under-utilized plants
- Quality characters in medicinal and aromatic plants
- Methods of analysis of essential oil and other chemicals of importancein medicinaland aromatic plants.

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

VIII. Learning outcome

Acquainted with various MAP and their commercial base for developing entrepreneurship.

Suggested Readings

- Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants.* OXford & IBH.
- Prajapati ND, Purohit SS, Sharma AK and Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book*. Agrobios.

I. Course Title : Principles and Practices of Organic Farming II. Course Code : Agron 513

III. Credit Hours :3(2+1)

IV. Aim of the course

To study the principles and practices of organic farming for sustainable cropproduction.

V. Theory

Unit I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversionof land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

Unit II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organicresidues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, bio-fertilizers and biogastechnology.

Unit III

Farming systems, selection of crops andcrop 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.

VI. Practical

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making vermicompost
- Identification and nursery raising of important agro-forestry tressand tress forshelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field
- Visit to a biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment. eXposure visit

VIII. Learning outcome

Basic knowledge on organic farming for sustainable agriculture and developmentof entrepreneurship on organic inputs.

I. Suggested Reading

- Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in BiologicalControl of Phytophagous Insects*. OXford & IBH.
- Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDPRegional Project Document, FAO.
- Joshi M. 2016. *New Vistas of Organic Farming*. Scientific Publishers
- Lampin N. 1990. *Organic Farming*. Press Books, lpswitch, UK.

I. Course Title : Principles and Practices of Weed Management II. Course Code : Agron 503

III. Credit Hours : 3 (2+1)

IV. Aim of the course

To familiarize the students about the weeds, herbicides and methods of weed control.

V. Theory

Unit I

Weed biology, and ecology and classification, crop-weed competition including allelopathy; principles and methods of weed control and classification management;weedindices, weed shift in different eco-systems

Unit II

Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

Unit III

Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide miXtures, sequential application of herbicides, rotation; weed control through use of nano-herbicides and bio-herbicides, myco- herbicides bio-agents, and allelochemicals; movement of herbicides in soil and plant, Degradation of herbicides in soil and plants; herbicide resistance, residue, persistence and management; development of herbicide resistance in weeds and crops and their management, herbicide combinationand rotation.

Unit IV

Weed management in major crops and cropping systems; alien, invasive and parasiticweeds and their management; weed shifts in cropping systems; aquatic and perennialweed control; weed control in non-crop area.

Unit V

Integrated weed management; recent development in weed management- robotics, use of drones and aeroplanes, organic etc., cost: benefit analysis of weed management.

VI. Practical

- Identification of important weeds of different crops, Preparation of a weed herbarium, Weed survey in crops and cropping systems, Crop-weed competition studies, Weed indices calculation and interpretation with data, 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 residues,
- Calculation of herbicidal herbicide requirement

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, field visit to identify weeds.

VIII. Learning outcome

Basic knowledge on weed identification and control for crop production **IX.** Suggested Reading

- Das TK. 2008. *Weed Science: Basics and Applications*, Jain Brothers (NewDelhi). • Fennimore, Steven A and Bell, Carl. 2014. *Principles of Weed ontrol*, 4th Ed, California Weed Sci. Soc.
- Gupta OP. 2007. *Weed Management*: *Principles and Practices*, 2nd Ed.

I. Course Title : Agronomy of Fodder and Forage Crops II. Course Code : Agron 509

III. Credit Hours : 2(1+1)

IV. Aim of the course

To teach the crop husbandry of different forage and fodder crops along with theirprocessing.

V. Theory

Unit I

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne, etc.

Unit II

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasseslime, Napier grass, *Panicum,* etc.

Unit III

Year-round fodder production and management, preservation and utilization of forage and pasture crops.

Unit IV

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poorquality fodder.

Unit V

Economics of forage cultivation uses and seed production techniques of important fodder crops.

VI. Practical

- Practical training of farm operations in raising fodder crops;

Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, and cellulose, etc. of various fodder andforage crops

- Anti-quality components like HCN in sorghum and such factors in other crops • Hay and silage making and economics of their preparation.

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

VIII. Learning outcome

Acquainted with various fodder and forage crops and their commercial base fordeveloping entrepreneurship.

IX. Suggested Reading

- Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*.OXford & IBH.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Narayanan TR and Dabadghao PM. 1972. *Forage Crops of India*. ICAR.

I. Course Title : Agronomy of Oilseed, Fibre and Sugar Crops II. Course Code : Agron 507

III. Credit Hours : 3(2+1)

IV. **Aim of the course**

To teach the crop husbandry of oilseed, fiber and sugar crops

V. Theory

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:

Unit I

Rabi oilseeds – Rapeseed and mustard, Linseed and NigerUnit II

Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and SafflowerUnit III

Fiber crops - Cotton, Jute, Ramie and Mesta.Unit IV Sugar crops – Sugar-beet and Sugarcane.

VI. Practical

- Planning and layout of field ex periments
- Cutting of sugarcane setts, its treatment and methods of sowing, tyingandpropping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity

IndeX, ~~Sustainable Yield IndeX Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative~~ Crowding Coefficient, Competition Ratio and ATER etc)

- Judging of physiological maturity in different crops and working out harvestindeX
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities.

- Determination of oil content in oilseeds and computation of oil yield.
- Estimation of quality of fibre of different fibre crops.
- Study of seed production techniques in various crops.
- Visit of field experiments on cultural, fertilizer, weed control andwater management aspects.
- Visit to nearby villages for identification of constraints in crop production

VIII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and classdiscussion

IX. Learning outcome

Basic knowledge on production of oil seed, sugar and fibre crops.

X. Suggested Reading

- Kushwaha, K. P. and Vishwakarma, S. P. 2021, *Numerical of Agronomy*. Kushal Publications and Distributors, Varanasi.

 Das NR. 2007. *Introduction to Crops of India*. Scientific Publ. Das PC. 1997. *Oilseed Crops of India*. Kalyani.

 Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2nd Ed.OXford & IBH. • Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

MINOR COURSES

Course Title : Soil Erosion and Conservation
Course Code : Soil 505
Credit Hours : 2+1
Aim of the course

To enable students to understand various types of soil erosion and measures to betaken for controlling soil erosion to conserve soil and water.

Theory

Unit I Unit II

History, distribution, identification and description of soil erosion problems in India. Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.

Unit III

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

Unit IV

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.

Unit V

Soil conservation planning; land capability classification; soil conservation in special

problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

Unit VI

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and

Physical Sciences: Soil Science 89 evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement

Practical

Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index

Computation of kinetic energy of falling rain drops

Computation of rainfall erosivity index (EI30) using rain gauge data

Land capability classification of a watershed

Visits to a watersheds

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil conservation and their utility in research for solving field problem.

Suggested Reading

Biswas TD and Narayanasamy G. (Eds.) 1996. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Society of Soil Science No. 17.

Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.

Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH.

Hudson N. 1995. Soil Conservation. Iowa State University Press.

Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi. Oswal MC. 1994. Soil Physics. Oxford & IBH.

I. Course Title : Fundamentals of Agricultural Meteorology II. Course Code : AGM 502 III. Credit Hours : 2(1+1) IV. Aim of the course

To impart the theoretical and practical knowledge of physical processes occurring in relation to plant and atmosphere with advanced techniques.

V. Theory

Unit I

Meaning and scope of agricultural meteorology; components of agricultural meteorology; role and responsibilities of agricultural meteorologists.

Unit II

Importance of meteorological parameters in agriculture; efficiency of solar energy conversion into dry matter production; meteorological factors in photosynthesis, respiration and net assimilation; basic principles of water balance in ecosystems; soil-water balance models and water production functions. **Unit III**

Crop weather calendars; weather forecasts for agriculture at short, medium and long range levels; agromet advisories, preparation, dissemination and economic

impact analysis; use of satellite imageries in weather forecasting; synoptic charts and synoptic approach to weather forecasting.

Unit IV

Concept, definition, types of drought and their causes; prediction of drought; crop water stress index, crop stress detection; air pollution and its influence on vegetation, meteorological aspects of forest fires and their control.

Unit V

Climatic change, green house effect, CO2 increase, global warming and their impact on agriculture; climate classification, agro-climatic zones and agro-ecological regions of India. **VI. Practical**

- Preparation of crop weather calendars
- Development of simple regression models for weather, pest and disease relation in different crops.
- Preparation of weather based agro-advisories
- Use of automated weather station (AWS)

VII. Teaching methods/activities

Classroom teaching and practical-classes, visit to Agromet Observatory

VIII. Learning outcome

Overall and basic knowledge on Agrometeorology

IX. Suggested Reading

- Bishnoi OP. 2007. *Principles of Agricultural Meteorology*. Oxford Book Co.
- Kakde JR. 1985. *Agricultural Climatology.* Metropolitan Book Co.
- Mahi and Kingra. 2014. *Fundamentals of agrometeorology*. Kalyani publishers.
- Mavi HS and Tupper. 2004. *Principles and applications of climate studies in agriculture*. CRC Press
- Varshneya MC and Pillai PB. 2003. *Text Book of Agricultural Meteorology*. ICAR.

Journals

- *Journal of Agrometeorology*
- *Italian Journal of Agrometeorology*
- *Agricultural and Forest Meteorology*
- *Current Science* **Websites**
- http://www.imd.gov.in/pages/main.php
- http://www.fao.org/home/en/
- www.wmo.org
- www.ipcc.org

Course Title : Seed Production and Certification

II. Course Code : GPB 510

III. Credit Hours : 3(2+1) IV.

Why this course?

Seed is the essence of life. Its improvement, production and maintenance is an essential feature of any variety. Seed chain concept is highly relevant in commercial promotion of new varieties whereas process of certification is mandatory for quality assurance of seed. **V. Aim of the course**

To impart knowledge on principles of seed production and certification. This will help the students to understand seed production practices and seed certification procedures in different crops.

VI. Theory

Unit I

Importance of seed as basic input in agriculture; Seed quality concept and importance; Generation system of seed multiplication -Varietal replacement rate, Seed multiplication ratios, Seed replacement rate, Seed renewal period and seed demand and supply; Various factors influencing seed production –Physical and Genetic purity in seed production; Factors responsible for varietal and genetic deterioration.

Unit II

Nucleus seed production and its maintenance - Maintenance of parental lines of hybrids, Production of breeder, foundation and certified seed and their quality maintenance; Principles of seed production in self- and cross-pollinated crops; Hybrid seed production - system and techniques involved in Seed village concept; Organic seed production and certification.

Unit III

Principles of seed production in field crops; Floral structure, pollination mechanism and seed production techniques in self- and cross-pollinated cereals and millets.

Unit IV

Floral structure, pollination mechanism and methods and techniques of seed production in major pulses and oilseed crops; Varietal and hybrid seed production techniques in Pigeon pea, Mustard, Castor and Sunflower.

Unit V

Floral structure, pollination mechanism and methods and techniques of seed production in major commercial fibres. Hybrid-seed production techniques in major vegetatively propagated crops.

Unit VI

Seed certification - history, concept, objectives;Central seed certification board Seed certification agency/ organization and staff requirement; Legal status - Phases of seed certification, formulation, revision and publication of seed certification standards; Minimum Seed Certification Standards (MSCS) for different crops - General and specific crop standards, Field and seed standards; Planning and management of seed certification programs; Eligibility of a variety for certification, area assessment, cropping history of the seed field.

VII. Practical

- Planting design for variety- hybrid seed production techniques, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony;
- Identification of rogues and pollen shedders, supplementary pollination, detasseling, hand emasculation and pollination;
- Pollen collection and storage methods, pollen viability and stigma receptivity;
- Pre-harvest sanitation, maturity symptoms, harvesting techniques;
- Visits to seed production plots - visit to seed industries;

- Planning for seed production: cost benefit ratio, seed multiplication ratio and seed replacement rate;
- General procedure of seed certification, identification of weed and other crop seeds as per specific crops, field inspection at different stages of a crop and observations recorded on contaminants and reporting of results, inspection and sampling, harvesting/ threshing, processing and after processing for seed law enforcement; • Specifications for tags and labels to be used for certification purpose.

VIII. Teaching methods

- Power point presentation Chalk and Board
- Smart board
- Lectures
- Assignments, quiz
- Group tasks, student's presentations

IX. Learning outcome

After completing this course the student will be able to know about seed production of different crop varieties and hybrids, their processing, marketing and seed laws.

X. Suggested Reading

Agrawal PK and Dadlani M. 1987. *Techniques in Seed Science and Technology*, South Asian Publishers, Delhi.

Agrawal RL. 1997. *Seed Technology,* Oxford & IBH Publishing.

Anon, 1965. *Field Inspection Manual and Minimum Seed Certification Standards*, NSC Publication, New Delhi.

Anon. 1999*. Manual of Seed Certification procedures.* Directorate of Seed Certification, Coimbatore, Tamil Nadu.

Joshi AK and Singh BD. 2004. *Seed Science and Technology*, Kalyani Publishers, New Delhi. Kelly AF. 1988. *Seed Production of Agricultural Crops*. John Wiley, New York.

Mc Donald MB and Copeland LO. 1997. *Seed Science and Technology*, Scientific Publisher, Jodhpur.

Ramamoorthy K, Sivasubramaniam K and Kannan M. 2006. *Seed Legislation in India*. Agrobios (India), Jodhpur, Rajasthan.

Singhal NC. 2003. *Hybrid Seed Production in Field Crops*, Kalyani Publications, New Delhi Tunwar NS and Singh SV. 1988. *Indian Minimum Seed Certification Standards*. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

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www.agricoop.nic.in
www.agri.nic.in www.fao.org
www.seednet.gov.in