Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Post Graduate Program
M. Sc. (Ag.) Soil Science
w.e.f. 2021-22

Semester-I

Course Code	Course Title	Type of Course	Periods/ Per week			Evaluation Scheme Theory Mid Sem			Evaluation Scheme Practical Mid Sem			Practical End Sem Exam	Sub Total (Theory + Practical Mid Sem Exam)	End Sem Theory Exam	Subject Total	Credit	Total Credit Points	Attributes						
			L	T	P	CT	TA	Total	CT	TA	Total							Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
AS501	**Soil Physics**	**Core courses (Compulsory)**	2	0	1	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√			√	√
AS502	**Soil Fertility and Fertilizer Use**		2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√		√	√	√
Total																								
AS507	**Fertilizer Technology**	**Optional Courses**	1	0	0	20	10	**30**	-	-	-	-	**30**	**70**	**100**	1:0:0	1	√	√	√		√		
AS508	**Land Degradation and Restoration**		1	0	0	20	10	**30**	-	-	-	-	**30**	**70**	**100**	1:0:0	1	√	√	√		√		
Total																	*							
***Major Course (Core course + Optional course) should not exceed more than 9 credit**																								
AA503	**Organic Farming**	**Minor/ Related/ Supporting courses**	2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√		√	√	√
MT519	**Experimental Designs**		2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√				
Total																	**							
PGS503 (e-Course)	**Intellectual Property and Its Management in Agriculture**	**Non Credit Course (Compulsory)**	1	0	0	20	10	**30**	-	-	-	-	**30**	**70**	**100**	1:0:0	1#	√	√	√				√
PGS504	**Basic Concepts in Laboratory Techniques**		0	0	2	0	0	**0**	-	25	25	75	**25**	-	**100**	0:0:1	1#	√	√	√				
PGS507	**e-Agriculture**		1	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	1:0:1	2#			√				
Grand Total																	***							

+**=**Total credit should not exceed more than 18 credit in one semester***

M. Sc. (Ag.) Soil Science

SEMESTER-I

Syllabus: Soil Physics

Paper Code: AS501

w.e.f. Session 2021-22

3(2+1)

Unit-I

Scope of soil physics and its relation with other branches of soil science; soil as a three phase system.

Unit-II

Soil texture, textural classes, mechanical analysis, specific surface, Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation, Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts.

Unit-III

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

Unit-IV

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils, Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

Unit-V

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

Practical: Mechanical analysis by pipette and international methods, Measurement of Atterberg limits, Aggregate analysis - dry and wet, Measurement of soil-water content by different methods, Measurement of soil-water potential by using tensiometer and gypsum blocks, Determination of soil-moisture characteristics curve and computation of pore-size distribution, Determination of hydraulic conductivity under saturated and unsaturated conditions, Determination of infiltration rate of soil, Determination of aeration porosity and oxygen diffusion rate, Soil temperature measurements by different methods, Estimation of water balance components in bare and cropped fields

Suggested Readings:

- Ghildyal BP & Tripathi RP. 2001, Soil Physics, New Age International.
- Hanks JR & Ashcroft GL. 1980, Applied Soil Physics. Springer Verlag.
- Hillel D. 1972, Optimizing the Soil Physical Environment toward Greater Crop Yields, Academic Press.
- Applications of Soil Physics- Hillel D. 1980, Academic Press.
- Environmental Soil Physics- Hillel D. 1998, Academic Press.
- Introduction to Environmental Soil Physics- Hillel D. 2003, Academic Press.

- Fundamentals of Soil Science- Indian Society of Soil Science. 2002, ISSS, New Delhi.
- Text Book of Soil Physics- Saha AK. 2004, Kalyani.
- Soil Physics- Jury WA. 2012, Wiley India Pvt Ltd.

COURSE OBJECTIVES:

- To gain the knowledge of soil physical properties
- To study about the soil formation factors and processes
- To assess the importance of soil water for plant growth
- To study in detail about soil components
- To study about management of soil physical properties for better crop yield

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To gain the knowledge of soil physical properties
CO2	To study about the soil formation factors and processes
CO3	To assess the importance of soil water for plant growth
CO4	To study in detail about soil components
CO5	To study about management of soil physical properties for better crop yield

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	To gain the knowledge of soil physical properties	3	2	2	3	3	1	2	2	2	3
CO2	To study about the soil formation factors and processes	3	3	1	1	2	1	1	1	2	3
CO3	To assess the importance of soil water for plant growth	3	2	2	3	3	2	2	3	2	3
CO4	To study in detail about soil components	3	3	3	3	3	2	1	3	3	3

CO5	To study about management of soil physical properties for better crop yield	3	3	3	3	3	2	2	3	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.) Soil Science

SEMESTER-I

Syllabus: Soil Fertility and Fertilizer Use

Paper Code: AS502

w.e.f. Session 2021-22

4(3+1)

Unit-I

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms.

Unit-II

Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

Unit-III

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions.

Unit-IV

Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions. Sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers, Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

Unit-V

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions, Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site -specific nutrient management; plant need based nutrient management; integrated nutrient management, Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Practical: Principles of colorimetry, Flame-photometry and atomic absorption spectroscopy, Chemical analysis of soil for total and available nutrients, Analysis of plants for essential elements.

Suggested Readings:

- The Nature and Properties of Soils13th Ed. - Brady NC & Weil RR. 2002, Pearson Edu.
- Trace Elements in Soils and Plants- Kabata-Pendias A & Pendias H 1992, CRC Press.
- Biofertilizers Technology- Kannaiyan S, Kumar K & Govindarajan K 2004, Scientific Publ.
- Nitrogen Fixation at the Millennium- Leigh JG. 2002, Elsevier.
- Principles of Plant Nutrition- Mengel K & Kirkby EA. 1982, International Potash Institute, Switzerland.
- Micronutrients in Agriculture. 2nd Ed.- Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991, SSSA, Madison.
- Soils and Environmental Quality. 2nd Ed.- Pierzinsky GM, Sims TJ & Vance JF. 2002, CRC Press.
- Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients- Stevenson FJ & Cole MA. 1999, John Wiley & Sons.
- Soil Fertility and Fertilizers. 5th Ed.- Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999, Prentice Hall of India.
- Soils and Soil Fertility- Troeh FR & Thompson LM. 2005, Blackwell.
- Soil Fertility- Issaka R. 2014, Intech.
- Soil Fertility Fertilizer and Integrated Nutrient Management- Tolanur S. 2018.

COURSE OBJECTIVES:

- To gain the knowledge of nutrient availability
- To study about the nutrient mobility
- To assess the importance of nutrient use efficiency
- To study about soil fertility and productivity
- To study about fertilizer and manure use

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To gain the knowledge of nutrient availability
CO2	To study about the nutrient mobility
CO3	To assess the importance of nutrient use efficiency
CO4	To study about soil fertility and productivity
CO5	To study about fertilizer and manure use

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	To gain the knowledge of nutrient availability	3	2	2	2	2	1	1	2	2	3
CO2	To study about the nutrient mobility	3	3	2	1	2	1	2	2	2	3
CO3	To assess the importance of nutrient use efficiency	3	2	2	1	2	2	2	3	2	3
CO4	To study about soil fertility and productivity	3	3	3	2	3	2	2	3	3	3

CO5	To study about fertilizer and manure use	3	3	3	2	3	2	3	3	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.) Soil Science

SEMESTER-I
Syllabus: Fertilizer Technology
Paper Code: AS507
w.e.f. Session 2021-22

1(1+0)

Unit-I
Fertilizers – production, consumption and future projections with regard to nutrient use in the country and respective states; fertilizer control order.

Unit-II
Manufacturing processes for different fertilizers using various raw materials, characteristics and nutrient contents.

Unit-III
Recent developments in secondary and micronutrient fertilizers and their quality control as per fertilizer control order.

Unit-IV
New and emerging issues in fertilizer technology – production and use of slow and controlled release fertilizers, supergranules fertilizers and fertilizers for specific crops/situations.

Suggested Readings:

- The Nature and Properties of Soils- Brady NC & Weil RR. 2002, Pearson Edu.
- Fertilizer (Control) Order, 1985 and the Essential Commodities Act. FAI New Delhi.
- Soil Fertility: Theory and Practice (Ed.).- Kanwar JS. 1976, ICAR.
- Fertilizer Technology and Use. 2nd Ed.- Olson RA, Army TS, Hanway JJ & Kilmer VJ. 1971. Soil Sci. Soc. Am. Madison.
- Soil Fertility Management for Sustainable Agriculture- Prasad R & Power JF.. CRC Press.
- Soil Fertility and Fertilizers- Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999, McMillan Publ.
- Textbook of Quantitative Inorganic Analysis- Vogel AI. 1979, ELBS.
- Fertilizer Technology and Management- Mishra B. 2012.

COURSE OBJECTIVES:

- To gain the knowledge of fertilizer production, consumption and future projections
- To study about manufacturing process of different fertilizers
- To assess the importance of Fertilizer control order
- To study about secondary and micronutrient fertilizer
- To study about emerging issues in fertilizer technology

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To gain the knowledge of fertilizer production, consumption and future projections
CO2	To study about manufacturing process of different fertilizers
CO3	To assess the importance of Fertilizer control order
CO4	To study about secondary and micronutrient fertilizer
CO5	To study about emerging issues in fertilizer technology

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	To gain the knowledge of fertilizer production, consumption and future projections	3	2	1	2	2	2	2	2	2	3
CO2	To study about manufacturing process of different fertilizers	3	3	1	1	1	1	2	2	2	3
CO3	To assess the importance of Fertilizer control order	3	2	1	1	1	2	2	2	2	3
CO4	To study about secondary and micronutrient fertilizer	3	3	1	2	2	1	2	2	2	3

CO5	To study about emerging issues in fertilizer technology	3	3	1	3	3	1	2	2	2	3
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.) Soil Science

SEMESTER-I

Syllabus: Land Degradation and Restoration

Paper Code: AS508

w.e.f. Session 2021-22

1(1+0)

Unit-I

Type, factors and processes of soil/land degradation and its impact on soil productivity, including soil fauna, biodegradation and environment.

Unit-II

Land restoration and conservation techniques - erosion control, reclamation of salt-affected soils; mine land reclamation, afforestation, organic products.

Unit-III

Extent, diagnosis and mapping of land degradation by conventional and modern RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

Suggested Readings:

- Soil Management in Relation to Land Degradation and Environment- Biswas TD & Narayanasamy G. (Eds.). 1996, Bull. Indian Soc. Soil Sci. 17, New Delhi.
- Methods of Assessing Soil Quality- Doran JW & Jones AJ. 1996, Soil Science Society of America, Madison.
- Soil Resilience and Sustainable Land Use- Greenland DJ & Szabolcs I. 1994, CABI.
- Methods for Assessment of Soil Degradation- Lal R, Blum WEH, Vailentine C & Stewart BA. 1997, CRC Press.
- Soil Degradation in India: Status and Impact- Sehgal J & Abrol IP 1994, Oxford & IBH.
- Soil Erosion and Conservation- Morgan RPC. 2012.

M.Sc. (Ag.) Agronomy

SEMESTER-I

Course Title: Organic Farming

Course Code: AA503

w.e.f. Session 2020-21

3(2+1)

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 ,water use efficiency.

Unit-II

Soil fertility-nutrient recyline, organic residues, organic manures, composition, soil biota and decomposition of organic residues, earthworms and vermin-compost, green manures , bio-fertilizers, farming systems crop rotations multiples and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit-III

Control of weeds, diseases and insects pests; animals husbandry, dairy farming, sheep and goat and piggery etc. Integrated pest management biological agents and pheromones, bio-pesticides.

Unit-IV

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 vermin compost; Identification and nursery raising of important agro-forestry tress and tress for shelter belts, Efficient use of bio-fertilizers technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum* and PSB cultures in field; Visit to a organic farm; Quality standard, inspection, certification and labeling and accreditation procedures for farm produce form organic farms.

Suggested Readings:

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Hunsigi G & Krishna KR. 1998. Science of Field Crop Production. Oxford & IBH.
- Khare D & Bhale MS. 2000. Seed Technology. Scientific Publ.
- Kumar Ranjeet & Singh NP. 2003. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.
- Pal M, Deka J & Rai RK. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill.
- Prasad, Rajendra. 2002. Text Book of Field Crop Production. ICAR.
- Reena (2018) A Colour Handbook on Rainfed Kharif Crops: Protection, Constraints and Mitigation Strategies. New India Publishing Agency.

- E. Somasundaram (2018) Agronomy: Principles and Practices. New India Publishing Agency.

COURSE OBJECTIVES:

- Knowledge and concept of organic farming
- Basics of soil fertility, nutrient cycle manures and soil biota
- Knowledge of weeds and their control in agricultural crops
- Basic concepts of marketing and export potential, certification and labeling
- Study of Cropping and farming systems for sustainable agriculture

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Concept of organic farming including its relevance to India and global agriculture and future prospects
CO2	Knowledge of soil fertility, nutrient cycle manures and soil biota (earthworms and vermicompost)
CO3	Concepts of marketing and export potential, certification and labeling
CO4	Knowledge of cropping and farming systems for sustainable agriculture
CO5	Knowledge of Socio-economic impact, Organic farming and national economy

CO-PO MAPPING:

	CO	PO 1. Basic Agronomy knowledge	PO 2. Research	PO 3. Field Experiments	PO 4. Modern implementation usage	PO 5. Modern concepts of crop production	PO 6. Modern farming system	PO 7. Soil-water-plant relationship	PO 8. Environment and sustainability	PO 9. Ethics	PO 10. Individual and team work	PO 11. Communication	PO 12. Life-long learning
CO1	Concept of organic farming including its relevance to India and global agriculture and future prospects	3	3	3	3	3	3	3	3	3	2	2	3
CO2	Knowledge of soil fertility, nutrient cycle manures and soil biota (earthworms and vermicompost)	3	2	2	2	2	2	3	1	2	2	2	3
CO3	Concepts of marketing and export potential, certification and labeling	3	2	3	3	3	3	2	2	3	2	2	3

CO4	Knowledge of cropping and farming systems for sustainable agriculture	3	3	2	2	2	2	1	1	2	2	3	3
CO5	Knowledge of Socio-economic impact, Organic farming and national economy	3	2	3	3	2	2	3	3	3	2	3	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

M. Sc. (Ag.)
SEMESTER-I
Course Title: Experimental Designs
Course Code: MT519
w.e.f. Session 2018-19

3(2+1)

Unit-I

Experiments: Absolute Experiments, Comparative experiments, need for designing of experiments, characteristics of a good design. Treatment, experimental unit, blocks, yield, uniformity trials, size and shape of plots and blocks. Principles of design of experiment: randomization, replication and local control.

Unit-II

Designs of experiments: Completely Randomized Design, Randomized Block Design and Latin square design and their analysis of variance. factorial design; symmetrical and asymmetrical. Confounding in symmetrical factorial experiments, factorial experiments with control treatment, advantages and disadvantages of confounding.

Unit-III

Analysis of covariance for two-way classification (Randomized Block Design). Split plot design: comparison between split-plot design and factorial design, advantages and disadvantages of split plot design. Missing Plot techniques: Analysis of missing plot design (Fisher's Rule),analysis of Randomized Block Design with one missing observation, analysis of Latin Square Design with one missing observation

Unit-IV

Balanced Incomplete Block Design (BIBD), parameters of BIBD, Incidence matrix, Symmetric BIBD, Analysis of BIBD, efficiency of BIBD relative to Randomized Block Design, Response Surfaces.

Practical

Uniformity trial data analysis, formation of plots and blocks, Analysis of data obtained from Completely Randomized Design, Randomized Block Design, Latin Square Design; Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot designs; Transformation of data; Fitting of response surfaces.

Suggested Readings:

- Cochran, W.G. and Cox, G.M. Experimental Design. Asia Publishing House.
- Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
- Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.
- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata.
- Casella, G, (2008). Statistical Design. Springer.
- Gupta, S.C. and Kapoor, V.K. Latest Revised Edition 2015. Fundamentals of Applied Statistics.

COURSE OBJECTIVES:

- Basic concepts of Experiments, designs and analysis of covariance
- Comparative experiments, need for designing of experiments
- In depth knowledge of principles of design of experiment: randomization, replication and local control
- Knowledge of completely randomized design, Randomized Block Design and Latin square design and their analysis of variance
- Balanced Incomplete Block Design (BIBD) and its parameters
- Analysis of missing plot design (Fisher's Rule),analysis of Randomized Block Design with one missing observation

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will have basic knowledge of Experiments, designs and analysis of covariance
CO2	Students will have knowledge of Comparative experiments
CO3	The students will be able to prepare their experimental fields on the basis of designs
CO4	Students can have the knowledge of completely Randomized Design, Randomized Block Design and Latin square design and their analysis of variance
CO5	Students can analyze their results according to the designs

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	Students will have basic knowledge of Experiments, designs and analysis of covariance	2	3	2	2	2	2	1	1	2	2
CO2	Students will have knowledge of Comparative experiments	2	3	2	2	2	2	1	1	1	3
CO3	The students will be able to prepare their experimental fields on the basis of designs	2	3	2	2	2	2	1	1	2	3

CO4	Students can have the knowledge of completely Randomized Design, Randomized Block Design and Latin square design and their analysis of variance	2	3	2	2	2	2	1	1	2	3
CO5	Students can analyze their results according to the designs	2	3	2	2	2	2	1	1	2	3
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.)/MBA Agribusiness Management

SEMESTER-I

Course Title: Intellectual Property and Its Management in Agriculture

Course Code: PGS503

w.e.f. Session 2018-19

1(1+0)

Unit-I

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;

Unit-II

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,

Unit-III

Protection of plant varieties and farmers' rights and bio-diversity 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

Unit-IV

Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Download e-course free from: http://hau.ac.in/HRM/pdf/ecourse503.pdf
- Chandan Roi (2018). The Role of Intellectual Property Rights in Agriculture and Allied Sciences CRC Press.
- Neeraj Pandey and Kushdeep Dharni. Intellectual Property Rights PHI Learning Pvt. Limited.

COURSE OBJECTIVES:

- Knowledge, concept and introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement
- Basics of Legislations for the protection of various types of Intellectual Properties
- Fundamentals of patents, copyrights, geographical indications, designs and layout
- Basic concepts of Protection of plant varieties and farmers' rights and bio-diversity protection, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
- Study of Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Concept of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement
CO2	Knowledge of Legislations for the protection of various types of Intellectual Properties
CO3	Concepts of Protection of plant varieties and farmers' rights and bio-diversity protection, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
CO4	Knowledge of Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
CO5	Knowledge of Socio-economic impact, Research collaboration Agreement, License Agreement

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	Concept of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement	2	3	3	3	1	1	3	2	3	3
CO2	Knowledge of Legislations for the protection of various types of Intellectual Properties	2	3	2	2	1	1	2	3	1	3
CO3	Concepts of Protection of plant varieties and farmers' rights and bio-diversity protection, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture	3	3	3	3	1	1	3	3	2	3

CO4	Knowledge of Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture	3	3	2	2	1	1	2	3	3	3
CO5	Knowledge of Socio-economic impact, Research collaboration Agreement, License Agreement	3	3	2	3	1	1	3	3	3	1
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.)/MBA Agribusiness Management

SEMESTER-I

Course Title: Basic Concepts in Laboratory Techniques

Course Code: PGS504

w.e.f. Session 2018-19

1(0+1)

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; Neutralization 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

- Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

COURSE OBJECTIVES:

- Basic concepts of Safety measures while handling instruments, chemicals, glasswares, etc. in lab
- Use of different instruments, chemicals, glasswares, etc. of lab
- Preparation of different agrochemical doses in field and pot applications
- Preparation of buffers of different strengths and pH values
- Preparation of media and methods of sterilization
- Seed viability testing, testing of pollen viability

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will have basic knowledge of handling and safety measures of instruments, chemicals, glasswares, etc. in lab before and after use
CO2	Students will have knowledge of usage of different type of lab equipments, instruments, glasswares, plasticwares, etc.
CO3	The students will be able to prepare different agrochemical doses in field and pot applications
CO4	Students can have the knowledge to prepare media, acid and bases of different strengths and buffer solutions
CO5	Students can also perform seed and pollen viability testing

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	Students will have basic knowledge of handling and safety measures of instruments, chemicals, glasswares, etc. in lab before and after use	2	2	2	2	1	2	2	2	1	3
CO2	Students will have knowledge of usage of different type of lab equipments, instruments, glasswares, plasticwares, etc.	2	2	2	2	1	2	1	2	1	3
CO3	The students will be able to prepare different agrochemical doses in field and pot applications	3	3	3	2	1	2	2	2	1	3

CO4	Students can have the knowledge to prepare media, acid and bases of different strengths and buffer solutions	3	3	3	2	1	2	2	2	1	3
CO5	Students can also perform seed and pollen viability testing	3	3	3	2	2	2	2	2	1	3
3: Strong contribution, 2: average contribution, 1: Low contribution											

M. Sc. (Ag.)
SEMESTER-I
Course Title: e-Agriculture
Course Code: PGS507
w.e.f. Session 2018-19

2(1+1)

UNIT-I

Introduction and Applications of e-Agriculture, Introduction to Online Agricultural resources: Consortium for e-resources in Agriculture (CeRA), e-agriculture community, Agriculture: National Portal of India. Agricultural Datasets and Databases: Agricola, Agris. Need of Biological databases in Agricultural Sciences

UNIT-II

ICAR- Centre for Agricultural Bioinformatics (CABin): Mandates and Thrust areas; National Agricultural Bioinformatics Grid (NABG): ASHOKA - Advanced Supercomputing Hub for OMICS Knowledge in Agriculture: features and applications; National Bio-Computing Portal: objectives, facilities provided at NBCP.

UNIT-III

Education – Meaning, Definition, Types – Formal Informal and Non-formal education and their Characteristics. Individual contact methods – Meaning, Objectives, Steps. Group contact methods, Mass contact Methods and Innovative Information sources, Method of training.

UNIT-IV

Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Types of training, RRA, PRA tools and techniques KVK, Adopter categories, MANAGE, EEI: extension education institute.

Practicals: Usage of Biological database and tools, Briefing about retrieval of scientific articles from PubMed database and NAL Online Catalog – AGRICOLA, PRA tools and techniques, Introduction of Geospatial Technology for generating valuable information for Agriculture, Research priorities at NABG, Softwares and Tools available at NABG, Link to available Database resources at NABG and its implications.

Suggested Readings:

- Agri Informatics: An Introduction (Industry Series), by R Chakravarthy, ICFAI University Press
- E-Agriculture: Concepts and Applications (Agriculture Series), Rahul Gupta (Author), ICFA University Press
- Introduction to Bioinformatics by Teresa Attwood, David Parry-Smith 1st edition; Prentice Hall Publications
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette (Eds), 2nd Edition; Willey & Sons Publications.
- Bioinformatics: Sequence, Structure, and Databanks: A Practical Approach by Des Higgins, Willie Taylor; OUP.

- BIOS Instant Notes in Bioinformatics by Charlie Hodgman, Andrew French, David Westhead, Taylor & Francis publishing; 2 edition.

COURSE OBJECTIVES:

1.To gain basic knowledge of e-Agriculture
2. The aim of improving communication and learning processes between various sectors in agriculture locally, regionally and worldwide
3. They gain knowledge to increase the production and productivity of Agriculture
4. Type of education and Agricultural Journalism
5. Knowledge of Innovative Information sources

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Use of Information and Communication Technology in Agriculture
CO2	Know about Online Agricultural resources, e-agriculture community
CO3	Know about Centre for Agricultural Bioinformatics, national Agricultural Bioinformatics Grid.
CO4	Knowledge of education and their Characteristics and Agricultural Journalism
CO5	Knowledge of contact methods, Kissan Call center and e-Chaupal.

CO-PO MAPPING:

	CO	**PO1** Basic knowledge of Soil Science	**PO2** Problem Solving	**PO3** Identification and Designing of research problems	**PO4** Scientific skills	**PO5** Integrated Sustainable Soil Management	**PO6** Environment and sustainability	**PO7** Ethics	**PO8** Individual and team work	**PO9** Communication	**PO10** Lifelong learning
CO1	Use of Information and Communication Technology in Agriculture	3	3	2	1	1	3	1	3	3	3
CO2	Know about Online Agricultural resources, e-agriculture community	3	3	2	2	1	1	2	2	3	2
CO3	Know about Centre for Agricultural Bioinformatics, national Agricultural Bioinformatics Grid.	3	3	1	1	2	2	2	3	3	3
CO4	Knowledge of education and their Characteristics and Agricultural Journalism	3	3	1	2	3	1	1	2	3	2

CO5	Knowledge of contact methods, Kissan Call center and e-Chaupal.	3	3	1	1	1	1	1	2	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution											

Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Post Graduate Program
w.e.f. Session 2020-21

M. Sc. (Ag.) Soil Science

Semester-II

Course Code	Course Title	Type of Course	Periods/ Per week			Evaluation Scheme Theory Mid Sem			Evaluation Scheme Practical Mid Sem			Practical End Sem Exam	Sub Total (Mid Sem Theory + Practical End Sem Exam)	End Sem Theory Exam	Subject Total	Credit	Total Credit Points	Attributes						
			L	T	P	CT	TA	Total	CT	TA	Total							Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
AS503	Soil Chemistry	Core courses (Compulsory)	2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3	√		√				
AS504	Soil Biology and Biochemistry		2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3	√		√		√	√	√
Total																								
AS506	Soil Erosion and Conservation	Optional Courses	2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3	√	√	√		√	√	√
Total																	*							
*Major Course (Core course + Optional course) should not exceed more than 9 credit																								
AA509	Agronomy of Major Field Crop (Rabi)	Minor/ Related/ Supporting courses	3	0	0	20	10	30	-	-	-	-	30	70	100	3:0:0	3	√		√				
Total																	**							
PGS502	Technical Writing and Communications Skills	Non Credit Course (Compulsory)	0	0	2	0	0	-	-	-	-	25	75	0	100	0:0:1	1#	√		√				√
PGS505 (e-Course)	Agricultural Research, Research Ethics and Rural		1	0	0	20	10	30	-	-	-	0	0	70	100	1:0:0	1#	√		√			√	√

	Development Programmes																							
PGS506 (e-Course)	**Disaster Management**		1	0	0	20	10	**30**	-	-	-	0	**0**	**70**	**100**	1:0:0	1[#]	√		√				
AS510	**M. Sc. (Ag.) Seminar**		-	-	-	-	-	-	-	-	-	-	-	-	**100**	0:0:1	1			√				
AS520	**M. Sc. (Ag.) Research**		-	-	-	-	-	-	-	-	-	-	-	-	S/US	0:0:3	3[$]	√		√			√	√
Grand Total																	***							

Grand Total (***) = *+**, Total credit should not exceed more than 18 credit in one semester; [#]Non-Gradial Course; [$]M.Sc. (Ag.) Research credit to be counted in Final Semester examinations; S/US=Satisfactory/Unsatisfactory

M.Sc. (Ag.) Soil Science
SEMESTER-II
Course Title: Soil Chemistry
Paper Code: AS503
w.e.f. Session 2021-22

3(2+1)

Unit I

Chemical (elemental) composition of the earth's crust and soils. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics.

Unit II

Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.

Unit III

Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand exchange - inner-sphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

Unit IV

Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects. Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity, Chemistry of salt-affected soils and amendments; soil pH, EC_e, ESP, SAR and important relations; soil management and amendments, Chemistry and electrochemistry of submerged soils.

Practical: Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, E_h by the use of E_h-pH meter and conductivity meter, Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method, Potentiometric and conductometric titration of soil humic and fulvic acids, (E_4/E_6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the (E_4/E_6) values at two pH values, Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm, Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved, Determination of titratable acidity of an acid soil by $BaCl_2$-TEA method, Determination of lime requirement of an acid soil by buffer method, Determination of gypsum requirement of an alkali soil.

Suggested Readings:

1. Chemistry of the Soil- Bear RE. 1964, Oxford and IBH.
2. Soil Chemistry- Bolt GH & Bruggenwert MGM 1978, Elsevier.
3. Chemistry of Soil Processes- Greenland DJ & Hayes MHB 1981, John Wiley & Sons.
4. Environmental Chemistry of Soils- McBride MB. 1994, Oxford Univ. Press.
5. Humus Chemistry. 2nd Ed.- Stevenson FJ. 1994, John Wiley & Sons.
6. Fundamentals of Soil Science- Indian Society of Soil Science (ISSS) 2012, 2nd edition.
7. Basic Concepts of Soil Science- Kolay AK. 2017, New Age International Publishers.

COURSE OBJECTIVES:

- To study earth's elemental composition and basics of physical chemistry
- To learn properties of soil colloids
- Knowledge of soil organic matter
- To study ion exchange processes in soil
- To know chemistry of NPK in soil
- To know chemistry of problematic soils

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Knowledge about earth's elemental composition and physical chemistry
CO2	Understand the properties of inorganic and organic soil colloids
CO3	Understand the ion exchange processes in soil
CO4	Knowledge of sorption-desorption mechanisms and NPK chemistry in soil
CO5	Understand the chemistry of problematic soils

CO-PO MAPPING:

	CO	PO 1. Basic Agriculture knowledge	PO 2. Problem Solving	PO 3. Field Experimentations	PO 4. Modern implementation usage	PO 5. Modern Horticultural implements	PO 6. Modern Plant Protection implements	PO 7. Extension Program	PO 8. Environment and sustainability	PO 9. Ethics	PO 10. Individual and team work	PO 11. Communication	PO 12. Life-long learning
CO1	Knowledge about earth's elemental composition and physical chemistry	1	2	1	2	1	1	2	2	1	1	1	2
CO2	Understand the properties of inorganic and organic soil colloids	2	2	1	2	1	1	2	2	1	1	1	2
CO3	Understand the ion exchange processes in soil	2	2	1	1	1	2	1	2	1	1	1	2
CO4	Knowledge of sorption-desorption mechanisms and NPK chemistry in soil	2	2	1	1	1	2	2	3	1	2	1	2
CO5	Understand the chemistry of problematic soils	2	3	1	1	1	2	2	3	1	2	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

M.Sc. (Ag.) Soil Science
SEMESTER-II
Course Title: Soil Biology and Biochemistry
Paper Code: AS504
w.e.f. Session 2021-22

3(2+1)

Unit I

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota. Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora.

Unit II

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients.

Unit III

Biodegradation of pesticides, organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.

Unit IV

Biofertilizers – definition, classification, specifications, method of production and role in crop production.

Practical: Determination of soil microbial population, Soil microbial biomass, Elemental composition, fractionation of organic matter and functional groups, Decomposition of organic matter in soil, Soil enzymes, Measurement of important soil microbial processes such as ammonification, nitrification, N_2 fixation, S oxidation, P solubilization and mineralization of other micro nutrients, Study of rhizosphere effect.

Suggested Readings:

1. Introduction to Soil Microbiology- Alexander M. 1977, John Wiley & Sons.
2. Soil Biology- Burges A & Raw F. 1967, Academic Press.
3. Soil Biochemistry. Vol. XI- McLaren AD & Peterson GH. 1967, Marcel Dekker.
4. Soil Microbial Ecology – Applications in Agricultural and Environmental Management- Metting FB. 1993, Marcel Dekker.
5. Soil Biochemistry- Paul EA & Ladd JN. 1981, Marcel Dekker.
6. Soil Organisms and Litter in the Tropics- Reddy MV. (Ed.), Oxford & IBH.
7. Plant Root System: Their Functions and Interaction with the Soil - Russel RS. 1977, ELBS & McGraw Hill.
8. Soil Biochemistry. Vol. VIII - Stotzky G & Bollag JM. 1993, Marcel Dekker.
9. Principles and Applications of Soil Microbiology- Sylvia DN 2005, Pearson Edu.
10. Soil and the Environment - An Introduction- Wild A. 1993, Cambridge Univ. Press.
11. Fundamentals of Soil Science- Indian Society of Soil Science (ISSS) 2012, 2nd edition.
12. Fundamentals of Soil Science- Rathinasamy A. 2014.

COURSE OBJECTIVES:

- To learn about the soil biology
- To provide knowledge various methods of enzymatic activities in soil
- To know the essential micro nutrients
- To learn about soil biochemistry
- To study about biofertilizers

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To learn about the soil biology
CO2	To provide knowledge various methods of enzymatic activities in soil
CO3	To know the essential micro nutrients
CO4	To learn about soil biochemistry
CO5	To study about bio fertilizers

CO-PO MAPPING:

	CO	PO 1. Basic Agriculture knowledge	PO 2. Problem Solving	PO 3. Field Experimentations	PO 4. Modern implementation usage	PO 5. Modern Horticultural implements	PO 6. Modern Plant Protection implements	PO 7. Extension Program	PO 8. Environment and sustainability	PO 9. Ethics	PO 10. Individual and team work	PO 11. Communication	PO 12. Life-long learning
CO1	To learn about the soil biology	3	2	2	2	1	1	2	3	1	2	2	3
CO2	To provide knowledge various methods of enzymatic activities in soil	3	1	3	2	1	1	2	3	1	2	2	3
CO3	To know the essential micro nutrients	3	1	3	3	1	1	2	3	1	2	2	2
CO4	To learn about soil biochemistry	3	1	3	2	1	1	2	3	1	1	2	2
CO5	To study about bio fertilizers	3	2	3	3	1	1	2	3	1	2	2	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

M.Sc. (Ag.) Soil Science
SEMESTER-II
Course Title: Soil Erosion and Conservation
Paper Code: AS506
w.e.f. Session 2021-22

3(2+1)

Unit I
History, distribution, identification and description of soil erosion problems in India.

Unit II
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 EI_{30} 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. Wind erosion - types, mechanism and factors affecting wind erosion; extent of problem in the country.

Unit III
Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout. 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 IV
Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socio-economic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds.

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 (EI_{30}) using rain gauge data, Visits to a watersheds.

Suggested Readings:

1. Soil Management in Relation to Land Degradation and Environment- Biswas TD & Narayanasamy G. (Eds.) 1996, Bull. Indian Society of Soil Science No. 17.
2. Methods of Assessing Soil Quality, Doran JW & Jones AJ. 1996, Soil Science Society of America, Spl Publ. No. 49, Madison, USA.
3. Manual of Soil and Water Conservation Practices- Gurmal Singh, Venkataramanan C, Sastry G & Joshi BP. 1990, Oxford & IBH.
4. Soil Conservation- Hudson N. 1995, Iowa State Univ. Press.
5. Fundamentals of Soil Science- Indian Society of Soil Science 2002, ISSS, New Delhi.
6. Oswal MC. 1994. Soil Physics. Oxford & IBH.
7. Soil Erosion and Conservation- Morgan RPC. 2012.
8. Introductory Soil Science- Das DK. 2015, Kalyani Publication.

COURSE OBJECTIVES:

- To learn about the soil erosion
- To provide knowledge various methods of erosion control
- To know the soil erosion problems of India
- To learn about soil conservation in problematic soil areas
- To study about watershed management
- Remote sensing in assessment and planning of watershed

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To learn about soil erosion problems of India
CO2	To learn about different types of soil erosion
CO3	To learn about the soil conservation in special problem areas
CO4	To learn about watershed management
CO5	To learn about the methods of remote sensing application for watershed management

CO-PO MAPPING:

	CO	PO 1. Basic Agriculture knowledge	PO 2. Problem Solving	PO 3. Field Experimentations	PO 4. Modern implementation usage	PO 5. Modern Horticultural implements	PO 6. Modern Plant Protection implements	PO 7. Extension Program	PO 8. Environment and sustainability	PO 9. Ethics	PO 10. Individual and team work	PO 11. Communication	PO 12. Life-long learning
CO1	To learn about soil erosion problems of India	3	2	2	2	1	1	2	3	1	2	2	3
CO2	To learn about different types of soil erosion	3	2	3	2	1	1	2	3	1	2	2	3
CO3	To learn about the soil conservation in special problem areas	3	2	3	3	1	1	2	3	1	2	2	3
CO4	To learn about watershed management	3	2	3	2	1	1	2	3	1	1	2	3
CO5	To learn about the methods of remote sensing application for watershed management	3	2	3	3	1	1	2	3	1	2	2	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

M.Sc. (Ag.) Agronomy
SEMESTER-II
Course Title: Agronomy of Major Field Crops (Rabi)
Paper Code: AA509
w.e.f. Session 2018-19

3(3+0)

Unit I

Origin, history, distribution, adaptation, classification, morphology, phenology, physiology, Varietal improvement and production technology of Wheat, Barley, Chickpea, Peas, Lentil, Rajma

Unit II

Origin, history, distribution, adaptation, classification, morphology, phenology, physiology, Varietal improvement and production technology of Rapeseed and Mustard, Linseed, Safflower, Tara mira, Potato, Tabacco and Sugar Beet

Unit III

Quality components and industrial uses of the main and by- products and their post harvest handling for marketing

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. Kumar Ranjeet & Singh NP. 2003. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.
5. Pal M, Deka J & Rai RK. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill.
6. Prasad, Rajendra. 2002. Text Book of Field Crop Production. ICAR.

Course objective:

- To study about the origin, history, distribution, adaptation, classification, morphology, physiology of major field crops
- To study about the adaptation, classification, morphology, physiology of major field crops
- To study about the phenology, varietal improvement and production technology of major field crops
- To know about the quality components and industrial use of the main and by products
- To know about the post-harvest handling of main and by products for marketing

Course Outcome
After completion of course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learn study about the origin, history, distribution, adaptation, classification, morphology, physiology of major field crops
CO2	Learn about the adaptation, classification, morphology, physiology of major field crops
CO3	Understand the phenology, varietal improvement and production technology of major field crops
CO4	Know the quality components and industrial use of the main and by products
CO5	Understand the post-harvest handling of main and by products for marketing**.**

CO PO Mapping:

	CO	**PO 1. Basic Agronomy knowledge**	**PO 2. Research**	**PO 3. Field Experiments**	**PO 4. Modern implementation usage**	**PO 5. Modern concepts of crop production**	**PO 6. Modern farming system**	**PO 7. Soil-water-plant relationship**	**PO 8. Environment and sustainability**	**PO 9. Ethics**	**PO 10. Individual and team work**	**PO 11. Communication**	**PO 12. Life-long learning**
CO1	Learn study about the origin, history, distribution, adaptation, classification, morphology, physiology of major field crops	2	2	3	3	3	3	3	3	3	2	2	2
CO2	Learn about the adaptation, classification, morphology, physiology of major field crops	3	2	1	2	2	2	3	2	2	3	2	2
CO3	Understand the phenology, varietal improvement and production technology of major field crops.	2	2	3	3	3	3	2	3	3	3	2	3
CO4	Know the quality components and industrial use of the main and by products	3	3	2	2	2	2	1	3	2	2	3	3
CO5	Understand the post-harvest handling of main and by products for marketing	3	2	3	2	2	1	1	3	2	2	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

M.Sc. (Ag.)/MBA Agribusiness Management
SEMESTER-II
Course Title: Technical Writing and Communications Skills
Paper Code: PGS502
w.e.f. Session 2018-19

1(0+1)

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. Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.
2. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
3. Mohan K. 2005. Speaking English Effectively. MacMillan India.
4. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
5. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
7. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
8. Collins' Cobuild English Dictionary. 1995. Harper Collins.
9. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
10. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
11. Richard WS. 1969. Technical Writing. Barnes & Noble.

Course objective

1. To give knowledge about the various forms of scientific writings
2. To give knowledge about the various parts of thesis, research communications
3. To give knowledge about writing of abstracts, summaries, citations etc
4. To give knowledge about research communications, illustrations, photograph, drawings
5. To give knowledge about pagination, scientific write ups, editing and proof reading, and writing of review article

Course Outcome

After completion of course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learn that what are the various forms of scientific writings
CO2	Learn how to write the various parts of thesis, research communications
CO3	Learn how to do writing of abstracts, summaries and what are citations etc
CO4	Learn research communications, illustrations, photograph, drawings
CO5	Learn pagination, scientific write ups, editing and proof reading, and writing of review article

CO-PO MAPPING:

	CO	**PO1** Basic Agricultural knowledge	**PO2** Problem Solving	**PO3** Lab/Field Experimentations	**PO4** Modern implements usage	**PO5** Modern Horticultural/ Agricultural implements	**PO6** Modern plant protection implements	**PO7** Extension Programme	**PO8** Ethics	**PO9** Individual and team work	**PO10** Communication	**PO11**Lifelong learning
CO1	Learn that what are the various forms of scientific writings	3	3	1	2	0	0	2	0	1	1	3
CO2	Learn how to write the various parts of thesis, research communications	3	3	1	2	0	3	2	0	0	0	2
CO3	Learn how to do writing of abstracts, summaries and what are citations etc	3	3	1	0	0	1	2	0	0	0	3
CO4	Learn research communications, illustrations, photograph, drawings	3	3	2	3	0	2	2	0	0	0	3
CO5	Learn pagination, scientific write ups, editing and proof reading, and writing of review article	3	3	2	3	0	3	2	1	0	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution												

M.Sc. (Ag.)/MBA Agribusiness Management
SEMESTER-II
Course Title: Agricultural Research, Research Ethics and Rural Development
Programmes (e-Course)
Paper Code: PGS505
w.e.f. Session 2018-19

1(1+0)

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 Centers (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 Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings:

1. Bhalla GS & 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.

Course Objectives:

- To know the objective and principle of extension education
- To obtain idea on various development programmes in agriculture and allied area to help farmers.
- 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.

Course Outcomes: ***After completion of the course, a student will be able to***

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students capable, efficient and self-reliant in character. .
CO2	They gain knowledge to help rural families in better appreciation of SWOT in the village.
CO3	They know about to open new opportunities for developing talents and leadership of rural people.
CO4	To provide knowledge and help for better management of farms and increase incomes.
CO5	To promote better social, natural recreational intellectual and spiritual file among the people.

CO-PO MAPPING:

	CO	**PO1** Basic Agriculture knowledge	**PO2** Problem Solving	**PO3** Field Experimentations	**PO4** Modern implementation usage	**PO5** Modern Agricultural/Horticultural implements	**PO6** Modern plant protection implements	**PO7** Extension Programme	**PO8** Environment and sustainability	**PO9** Ethics	**PO10** Individual and team work	**PO11** Communication	**PO12** Lifelong learning
CO1	Students capable, efficient and self-reliant in character.	3	1	2	1	1	3	3	3	2	3	1	3
CO2	They gain knowledge to help rural families in better appreciation of SWOT in the village.	3	3	3	1	1	3	3	3	2	3	3	2
CO3	They know about to open new opportunities for developing talents and leadership of rural people.	3	2	1	1	1	2	3	3	2	1	2	3
CO4	To provide knowledge and help for better management of farms and increase incomes.	3	2	2	2	1	3	3	3	2	2	3	3
CO5	To promote better social, natural recreational intellectual and spiritual file among the people.	3	1	1	1	1	2	3	3	2	2	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

M.Sc. (Ag.)/MBA Agribusiness Management
SEMESTER-II
Course Title: Disaster Management (e-Course)
Paper Code: PGS506
w.e.f. Session 2018-19

1(1+0)

Unit I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.

Unit II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

Unit III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings:

1. Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
2. Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management. Routledge.
3. Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

Course objective

1. To give knowledge prompt assistance to victims
2. To give knowledge about the different techniques and to achieve rapid and effective recovery.
3. To give knowledge about how to reduce, or avoid, the potential losses from hazards,
4. To give knowledge about assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery

Course Outcome
After completion of course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Able to know what are the basic criteria for disaster management
CO2	Can use the basic knowledge regarding prompt assistance to victims
CO3	Students are able to know about to reduce, or avoid, the potential losses from hazards
CO4	Study to assure prompt and appropriate assistance to victims of disaster and pollution
CO5	By the end of course students will be able to know the knowledge regarding different methods to control and to avoid disaster.

CO-PO MAPPING

	CO	**PO1** Basic Agricultural knowledge	**PO2** Problem Solving	**PO3** Lab/Field Experimentations	**PO4** Modern implements usage	**PO5** Modern Horticultural/ Agricultural implements	**PO6** Modern plant protection implements	**PO7** Extension Programme	**PO8** Ethics	**PO9** Individual and team work	**PO10** Communication	**PO11**Lifelong learning
CO1	Able to know what are the basic criteria for disaster management	3	3	1	2	0	0	2	0	1	1	3
CO2	Can use the basic knowledge regarding prompt assistance to victims	3	3	1	2	0	3	2	0	0	0	2
CO3	Students are able to know about to reduce, or avoid, the potential losses from hazards	3	3	1	0	0	1	2	0	0	0	3
CO4	Study to assure prompt and appropriate assistance to victims of disaster and pollution	3	3	2	3	0	2	2	0	0	0	3
CO5	By the end of course students will be able to know the knowledge regarding different methods to control and to avoid disaster.	3	3	2	3	0	3	2	1	0	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution												