Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Post Graduate Program
w.e.f. 2022-23

M. Sc. (Ag.) Soil Science

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
SOIL 501	**Soil Physics**	**Major**	2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√			√	√
SOIL 502	**Soil Fertility and Fertilizer Use**		2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√		√	√	√
Total																								
SOIL 505	**Soil Erosion and Conservation**	**Optional**	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**																								
AGRON 506	**Agronomy of Major Cereals and Pulses**	**Minor**	2	0	0	20	10	**30**	-	-	-	-	**30**	**70**	**100**	2:0:0	$2^{\$}$	√		√		√	√	√
AGRON 511	**Cropping System and Sustainable Agriculture**		2	0	0	20	10	**30**	-	-	-	-	**30**	**70**	**100**	2:0:0	$2^{\$}$	√	√	√		√		
STAT 511	**Experimental Designs**	**Supporting**	2	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:1	3	√		√		√	√	√
BIOCHEM 505	**Techniques in Biochemistry**		2	0	4	20	10	**30**	-	-	-	20	**50**	**50**	**100**	2:0:2	4	√	√	√				
MCA 512	**Information Technology in Agriculture**		1	0	2	20	10	**30**	-	-	-	20	**50**	**50**	**100**	1:0:1	2	√	√	√				
Total																	**							
PGS503 (e-Course)	**Intellectual Property and Its Management in Agriculture**	**Common**	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	$1^{\#}$	√	√	√				
Grand Total																	***							

*Grand Total (***) = *+**, credit should not exceed more than 22 credit in one semester;* $^{\$}$*Students can opt for any one of the course from Minor.*

M. Sc. (Ag.) Soil Science
SEMESTER-I
Course Title: Soil Physics
Course Code: SOIL 501
w.e.f. Session 2022-23

3(2+1)

Unit-I
Basic principles of physics applied to soils, soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. Alleviation of soil physical constraints for crop production. Soil erosion and edibility.

Unit-II
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 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-III
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-IV
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:
Determination of B.D, P.D and mass volume relationship of soil, Mechanical analysis by hydrometer and international pipette method, 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 (CO):

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-PSO MAPPING

PO	PO										PSO			
CO	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	1	2	2	2	3	3	2	2	2
CO2	3	3	1	1	2	1	1	1	2	3	3	2	2	2
CO3	3	2	2	3	3	2	2	3	2	3	3	3	2	2
CO4	3	3	3	3	3	2	1	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	3	3	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution														

M. Sc. (Ag.) Soil Science
SEMESTER-I
Course Title: Soil Fertility and Fertilizer Use
Course Code: SOIL 502
w.e.f. Session 2022-23

3(2+1)

Unit-I
Soil fertility and soil productivity; fertility status of major soils group of India; nutrient sources – fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients - functions and deficiency symptoms, Nutrient uptake, nutrient interactions in soils and plants; long term effect of manures and fertilizers on soil fertility and crop productivity.

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. Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

Unit-IV
Sulphur - source, forms, fertilizers and their behavior in soils; role in crops and human health; 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; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; speciality fertilizers concept, need and category. Current status of speciality fertilizers use in soils and crops of India;

Unit VI
Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS. Definition and concepts of soil health and soil quality; Long term effects of fertilizers and soil quality.

Practical:
Soil and plant sampling and processing for chemical analysis; Determination of soil pH, total and organic carbon in soil; Chemical analysis of soil for total and available nutrients (major and micro); Analysis of plants for essential elements (major and micro).

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 (CO):

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-PSO MAPPING

PO	PO										PSO			
CO	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	1	1	2	2	3	3	2	2	2
CO2	3	3	2	1	2	1	2	2	2	3	3	2	2	2
CO3	3	2	2	1	2	2	2	3	2	3	3	2	2	2
CO4	3	3	3	2	3	2	2	3	3	3	3	3	3	2
CO5	3	3	3	2	3	2	3	3	3	3	3	3	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution														

M. Sc. (Ag.) Soil Science
SEMESTER-I
Course Title: Soil Erosion and Conservation
Course Code: SOIL 505
w.e.f. Session 2022-23

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

Unit-IV
Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands. 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, 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.

Suggested Readings:

- 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.

COURSE OBJECTIVES:
- To gain the knowledge of soil and its conservation.
- To study about the types of erosion
- To assess the measures to be taken for controlling soil erosion to conserve soil and water
- To study about soil conversation planning methods in different areas.

COURSE OUTCOME (CO):
After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Knowledge of soil and its different types
CO2	Experience on the knowledge of soil conservation
CO3	Utilization of the knowledge in research for solving field problem.

CO-PO-PSO MAPPING

	PO										PSO			
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	2	2	1	1	2	2	3	3	2	2	2
CO2	3	3	2	1	2	1	2	2	2	3	3	2	2	2
CO3	3	2	2	1	2	2	2	3	2	3	3	2	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution														

M. Sc. (Ag.) Agronomy
SEMESTER-I
Course Title: Agronomy of Major Cereals and Pulses
Course Code: AGRON 506
w.e.f. Session 2022-23

2(2+0)

Unit-I
Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Rabi cereals.

Unit-II
Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Kharif cereals.

Unit-III
Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Rabi pulses.

Unit-III
Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Kharif pulses.

Practical:
Phenological studies at different growth stages of crop; 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; 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 and water management aspects; Visit to nearby villages for identification of constraints in crop production.

Suggested Readings:

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Hunsigi G and Krishna KR. 1998. Science of Field Crop Production. Oxford & IBH.
- Jeswani LM and Baldev B. 1997. Advances in Pulse Production Technology. 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 Crop Production. Tata McGraw Hill.
- Prasad Rajendra. 2002. Text Book of Field Crop Production. ICAR.
- Singh C, Singh P and Singh R. 2003. Modern Techniques of Raising FieldCrops. Oxford & IBH.
- Singh SS. 1998. Crop Management. Kalyani.
- Yadav DS. 1992. Pulse Crops. Kalyani.

COURSE OBJECTIVES:
- To impart knowledge of crop husbandry of cereals and pulse crops.

- Processing and handling of Rabi and Kharif cereals.
- Processing and handling of Rabi and Kharif pulses.

COURSE OUTCOMES (CO):

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

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Basic knowledge on cereals and pulse growing in the country
CO2	Estimation of different growth and yield attributes
CO3	Practical knowledge of different indices of crop harvest.

CO-PO-PSO MAPPING

	PO												PSO		
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	3	3	2	2	3	2	2	2	3	3	3	2
CO2	3	3	2	3	2	2	2	1	2	1	3	3	3	3	3
CO3	2	3	3	2	2	1	3	2	3	2	2	3	2	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution															

M. Sc. (Ag.) Agronomy
SEMESTER-I
Course Title: Cropping System and Sustainable Agriculture
Course Code: AGRON 511
w.e.f. Session 2022-23

2(2+0)

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. Artificial Intelligence- Concept and application.

Suggested Readings:

- 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 Hall.

COURSE OBJECTIVES:
- Knowledge and concept of sustainable agriculture
- To acquaint the students about prevailing cropping systems in the country.
- To study of different cropping systems for sustainable agriculture
- To acquaint the students about practices to improve their productivity.

COURSE OUTCOMES (CO):
After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Basic knowledge on cropping system for sustainable agriculture.

CO2	Concept of sustainable agriculture including its relevance to India and global agriculture and future prospects
CO3	Knowledge of intercropping systems
CO4	Crop diversification for sustainability, role of different chemicals in sustainability

CO-PO-PSO MAPPING

	PO												**PSO**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	3	3	2	2	3	2	2	2	3	3	3	2
CO2	3	3	2	3	2	2	2	1	2	1	3	3	3	3	3
CO3	2	3	3	2	2	1	3	2	3	2	2	3	2	3	2
CO4	3	2	2	3	3	3	2	1	2	1	3	3	3	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution															

M. Sc. (Ag.)/M.Sc. (Hort.)
SEMESTER-I
Course Title: Experimental Designs
Course Code: STAT 511
w.e.f. Session 2022-23

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-PSO MAPPING

	PO												PSO		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	2	2	2	1	1	2	2	1	3	2	2	2
CO2	2	3	2	2	2	2	1	1	1	3	1	3	2	2	2
CO3	2	3	2	2	2	2	1	1	2	3	1	3	2	2	2
CO4	2	3	2	2	2	2	1	1	2	3	1	3	3	2	2
CO5	2	3	2	2	2	2	1	1	2	3	1	3	3	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution															

M. Sc. (Ag.)/M.Sc. (Hort.)
SEMESTER-I
Course Title: Techniques in Biochemistry
Course Code: BIOCHEM 505
w.e.f. Session 2022-23

4(2+2)

Unit-I
General scheme for purification of biocomponents. Methods of studying cells and organelles, sub cellular fractionation and marker enzymes. Methods for lysis of plant, animal and microbial cells. Ultra-filtration, sonication, freeze drying and fractional precipitation. Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.

Unit-II
Basic principles, instrumentation, working and applications of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC.

Unit-III
Electrophoretic techniques - slab, capillary, 2-D, pulse field, polyacrylamide/agarose gel electrophoresis. Blotting techniques: Western, Southern and Northern blotting- principle and methodology.

Unit-IV
Fundamental principles of flourescene & phosphorescence, absorption, transmission of light, Beer – Lamberts law, Colorimeter, flame photometry. Principle, instrumentation, working and application of – UV, visible and IR spectroscopy, atomic absorption spectrometry, Nuclear Magnetic Resonance (NMR), Mass spectroscopy - GC-MS, HPLC-MS and LC-MS/MS, Matrix-assisted laser desorption/ionization- Time-of-Flight Mass spectroscopy (MALDI-TOF MS), X-ray crystallography.

Unit-IV
Basic principles, instrumentation and applications of microscopy. Bright field, phase contrast, fluorescence and confocal microscopy. Electron microscope – scanning and transmission electron microscopy. Nature of radioactivity, decay and types of radiation. Radiation hazards and precautions taken while handling radioisotopes. Radiation detection and measurements: Geiger Muller counter, scintillation counter and pulse height analyzer. Application of radioisotopes in biological science-autoradiography.

Practical:
Methods for lysis of plant and microbial cells; Centrifugation; Verification of Beer-Lambert's law and determination of absorption coefficients; Paper chromatography – Separation of amino acids and carbohydrates in a mixture; Thin layer chromatography of fatty acids; Column chromatography – Separation of a mixture of proteins and salt using Sephadex column; Electrophoresis. Staining of bacteria – Simple staining, differential staining, staining of spores.

Suggested Readings:

- Principles and Techniques of Practical Biochemistry by Keith Wilson, John Walker (eds), Cambridge University Press; 5th edition.
- Principles and Techniques of Practical Biochemistry by Wilson, K., Walker, J. (eds.), Cambridge University Press, Cambridge, 2000, 5th edition.
- Lehninger Principles Of Biochemistry by David L. Nelson, Michael M. Cox, W. H. Freeman, 6th edition.

COURSE OBJECTIVES:

- Knowledge and concept of Biomolecules.
- Basic concepts and principles of different biochemical techniques.
- Applications of different bioanalytical techniques.

COURSE OUTCOMES (CO):

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

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Understand about the cells and apply the concept of centrifugation.
CO2	Explain classification, principle and application of chromatography.
CO3	Discuss principle and application of electrophoresis and blotting techniques
CO4	Understand working principle of spectrophotometer and able to handle different spectrophotometric techniques
CO5	Understand the concept of microscopy and radiations.

CO-PO-PSO MAPPING

	PO												PSO		
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	2	1	2	1	2	1	2	2	3	3	3	2
CO2	3	2	1	1	2	2	1	1	1	1	3	3	3	3	3
CO3	3	3	2	1	2	1	1	2	2	1	2	3	2	3	2
CO4	3	2	1	2	1	1	2	1	1	1	3	3	3	3	2
CO5	3	3	1	1	1	1	1	2	1	1	2	3	2	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution															

M. Sc. (Ag.)/M.Sc. (Hort.)
SEMESTER-I
Course Title: Information Technology in Agriculture
Course Code: MCA 512
w.e.f. Session 2022-23

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
Smartphone Apps in Agriculture for farm advisory, Weather forecasting, types, methods, tools & techniques, Use of ICT in Agriculture, Computer Models for understanding plant processes.

Unit-III
Crop models, concepts & techniques, types of crop models, spatial data and their management in GIS; Remote sensing concepts and application in agriculture, Global positioning system (GPS), components and its functions.

Unit-IV
Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Kisan call centers, e-chaupal, RRA, PRA tools and techniques KVK, Adopter categories, MANAGE, EEI: extension education institute.

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:

- 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.
- Yadav, D S, Foundations of IT, New Age, Delhi.
- 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:
- To gain basic knowledge of information technology in agriculture
- The aim of improving communication and learning processes between various sectors in agriculture locally, regionally and worldwide
- They gain knowledge of weather forecasting to increase the production and productivity of Agriculture
- Type of education and Agricultural Journalism
- 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 crop models concepts & techniques
CO3	Know about computer models for understanding plant processes.
CO4	Knowledge of education and their Characteristics and Agricultural Journalism
CO5	Knowledge of contact methods, Kissan Call center and e-Chaupal.

CO-PO-PSO MAPPING

	PO												PSO		
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	3	3	1	1	2	3	3	3	3	2	2
CO2	3	3	3	2	1	3	2	1	3	2	3	3	2	3	2
CO3	3	3	1	2	2	2	3	1	2	3	3	3	2	3	3
CO4	3	3	3	2	3	3	2	1	3	2	3	3	3	1	2
CO5	3	3	2	3	1	3	1	1	2	2	3	3	3	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution															

M. Sc. (Ag.)/M.Sc. (Hort.)/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 and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.

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-PSO MAPPING:

	PO												PSO			
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3	3	3	1	1	1	3	3	2	3	3	3	2	2	2
CO2	2	3	2	2	1	1	1	1	2	3	1	3	2	2	2	2
CO3	3	3	3	3	1	1	2	2	3	3	2	3	2	2	2	2
CO4	3	3	2	2	1	1	1	1	2	3	3	3	3	2	2	2
CO5	3	3	2	3	1	1	1	3	3	3	3	1	3	3	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution																

M. Sc. (Ag.)/M.Sc. (Hort.)
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-PSO MAPPING:

	PO												PSO			
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	2	2	2	1	2	1	2	2	2	1	3	2	2	2	2
CO2	2	2	2	2	1	2	1	2	1	2	1	3	2	2	2	2
CO3	3	3	3	2	1	2	1	2	2	2	1	3	2	2	2	2

CO4	3	3	3	2	1	2	1	2	2	2	1	3	2	2	2	2
CO5	3	3	3	2	2	2	1	2	2	2	1	3	2	2	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution																