School of Agriculture, Forestry and Fisheries

Master of Science in Agriculture

(Agronomy)

(M.Sc. (Ag.) Agronomy)

Program Code: .....

CURRICULUM

ACADEMIC YEAR: 2025-2026

Program Span: 2025-2027

JIGYASA UNIVERSITY

Formerly
Himgiri Zee University, Dehradun
(Estd. Under Uttaranchal State Act.No.17, 2003.Approved by UGC Under Sec.2(f))
Post Office Selaqui, Chakrata Road, Dehradun, Uttarakhand,248011

Vision of University

We provide the environment to ignite, nurture, and unleash your potential and talent

Mission Statement

1. Progressive educational proficiencies that stimulate holistic development.
2. Enhancing experiential learning through endorsing an inclusive mindset.
3. Advancing research, nurturing innovations, and catalyzing entrepreneurship.
4. Cultivation of leadership qualities with a strong sense of values and ethics.

Vision of SAFF

To become centre of advanced studies in the field of Agriculture, Forestry & Fisheries Education and Research to cater local, national and global needs.

Mission Statements of SAFF

- To provide quality education and research opportunities in the field of Agriculture and Allied Sciences.
- To engage in extension outreach activities for meeting the farmers and industry needs.
- To inculcate the scientific aptitude through modern techniques and technologies.

About the Program

A. Introduction:

The National Education Policy (NEP) 2020 envisions transforming India's higher education system through holistic, multidisciplinary, and research-driven learning that aligns with the Sustainable Development Goal 4 (SDG-4) – Quality Education. In keeping with this vision, the M.Sc. (Ag.) Agronomy program at the School of Agriculture, Forestry and Fisheries (SAFF), Jigyasa University (Formerly Himgiri Zee University) Dehradun, has been designed to provide advanced academic, technical, and research-oriented training in the field of crop science and sustainable agriculture. The program emphasizes innovation, scientific inquiry, and practical application, integrating traditional agricultural wisdom with modern technological advancements.

The M.Sc. (Ag.) Agronomy is a two-year full-time postgraduate degree program structured ensuring flexibility, academic rigor, and relevance to industry and research needs. The curriculum builds upon the strong foundation of the B.Sc. (Hons.) Agriculture program, advancing knowledge in areas such as crop physiology, soil-water-plant relationships, nutrient management, sustainable cropping systems, and modern agronomic practices. It also emphasizes climate-resilient agriculture, precision farming, resource conservation technologies, and integrated farming systems to promote productivity and sustainability.

Students gain comprehensive exposure through advanced laboratory experiments, field research, seminars, and dissertation work. The program nurtures analytical thinking, problem-solving, and scientific writing skills, encouraging students to undertake independent and collaborative research. It aims to prepare graduates for careers in agricultural research, teaching, agribusiness consultancy, policy formulation, and entrepreneurship.

Through its focus on innovation, sustainability, and practical research, the M.Sc. (Ag.) Agronomy program at SAFF, Jigyasa University (Formerly Himgiri Zee University), truly embodies the vision of NEP 2020. It fosters experiential and interdisciplinary learning, equipping postgraduates to contribute effectively to national food security, environmental stewardship, and the future of sustainable agriculture.

B. National Higher Education Qualifications Framework (NHEQF) levels:

NHEQF Level	NHEQF Level	NHEQF Level	NHEQF Level	NHEQF Level
Level 5	**Undergraduate Certificate**	Completion of 1st year of UG program	**~40 credits**	Foundational knowledge and skills; eligible for vertical mobility
Level 6	**Undergraduate Diploma**	Completion of 2 years of UG program	**~80 credits**	Broader subject understanding; vocational and academic skills
Level 7	**Bachelor's Degree** *(3 years)*	10+2 (Senior Secondary)	**~120 credits**	Core disciplinary knowledge and cognitive skills
Level 7.5	**Bachelor's Degree with Honours** *(4 years)*	Based on strong academic performance	**~160 credits**	Advanced disciplinary depth; research exposure (Capstone)
Level 8	**Bachelor's Degree with Research** *(4 years)*	75%+ in previous semesters; research orientation	**~160 credits + Research Project**	Research, innovation, and preparedness for PG or direct PhD

C. Academic Bank of Credits (ABC):

In alignment with the National Education Policy (NEP) 2020, the Academic Bank of Credits (ABC) facilitates a flexible curriculum framework. It promotes interdisciplinary/multidisciplinary academic mobility among students across various Higher Educational Institutions (HEIs) through an appropriate credit transfer system. Accordingly, the School of Agriculture, Forestry and Fisheries under Jigyasa University, Dehradun, has developed a comprehensive four-year undergraduate program.

As a prerequisite, students/learners are required to register on the Academic Bank of Credits (ABC) portal. The credits earned during the study will be digitally stored in the ABC account. Learners must complete their program as per the guidelines of the UGC's ABC policy. Please note that the validity of earned credits is limited to seven years (or as per the latest advisory from the competent authority). Additionally, each credit earned may only be used once and cannot be reused for multiple programs or purposes.

D. Curriculum Framework:

I. Major Core Courses (MCC):

Major Courses (MCC) in the M.Sc. (Ag.) Agronomy program encompass a comprehensive range of subjects designed to provide students with a strong foundation in core agricultural sciences and allied disciplines. These courses are structured to develop students' analytical abilities, scientific understanding, problem-solving skills, and leadership potential in the field of agriculture. The curriculum integrates key areas such as water management, Soil fertility Management and weed management to produce competent and well-rounded agricultural professionals capable of contributing to sustainable agricultural development.

The MCC includes courses such as Principles and Practices of Water Management, Principles and Practices of Soil Fertility and Nutrient Management, Principles and Practices of Organic Farming, Statistical Methods, Experimental Designs, which provide insights into crop production practices, soil fertility management, climatic influences on crops, and the economics of farming systems. Courses like Modern Concepts in Crop Production, Principles and Practices of Weed Management, Dryland Farming and Watershed Management for enhanced productivity and equip students with practical knowledge of sustainable cultivation techniques, resource utilization, and crop management strategies.

Furthermore, advanced courses such as Agronomy of Major Cereals and Pulses, Agronomy of Oilseeds (Kharif and Rabi), and Agronomy of Fibre Crops enable students to apply scientific research to practical farming for effective technology transfer and rural development. It fosters innovation, self-employment, and sustainable livelihoods. Overall, the Major Core Courses combine theoretical learning with field experience and research, preparing students to excel in government, agribusiness, research, and entrepreneurial sectors, and to contribute to sustainable agricultural advancement.

II. Multidisciplinary Courses (MDC)

In line with the National Education Policy (NEP) 2020, the M.Sc. (Ag.) Agronomy program at the School of Agriculture, Forestry and Fisheries (SAFF), Himgiri Zee University, Dehradun includes Multidisciplinary Courses (MDC) to promote holistic and cross-disciplinary learning. These courses broaden students' perspectives beyond agronomy, linking agriculture with research ethics, technology, environment, and rural development. The MDCs—Disaster Management, Intellectual Property and Its Management in Agriculture, Library and Information Services and Agricultural Research, Research Ethics and Rural Development Programmes equip students with essential knowledge of sustainable development, innovation, and responsible research. Together, they strengthen analytical, ethical, and leadership skills, preparing students to contribute effectively to modern, sustainable, and inclusive agricultural growth.

III. Skill Enhancement Courses (SEC)

Aligned with the vision of the National Education Policy (NEP) 2020, the M.Sc. (Ag.) Agronomy program includes Skill Enhancement Courses (SECs) designed to strengthen students' research aptitude, technical proficiency, and professional competence. These courses emphasize advanced practical learning, scientific experimentation, and data interpretation to prepare students for research and industry-oriented careers. The curriculum focuses on enhancing analytical and laboratory skills through hands-on exposure to modern instruments, experimental protocols, and statistical tools used in agronomic research.

Course like Basic Concepts in Laboratory Techniques provides students with essential knowledge of laboratory procedures, safety protocols, precision in experimental work, and the use of analytical instruments, ensuring accuracy and reliability in agricultural research and data analysis.

IV. Value Added Course (VAC):

In line with the National Education Policy (NEP) 2020, the Value-Added Course (VAC) aims to promote holistic and multidisciplinary learning. It helps students develop essential 21st-century skills such as critical thinking, digital literacy, communication, and leadership. These courses encourage experiential learning and innovation, enabling students to apply classroom knowledge in practical, community, and industry contexts.

Course like Social Engineering (non-credit) course is designed to enhance students' awareness of human-based security threats and the psychological manipulation techniques used by attackers. The course focuses on understanding how trust, curiosity, and social behaviour can be exploited to compromise individuals or organizations. It promotes ethical awareness, digital responsibility, and the development of preventive strategies against manipulation and fraud in both online and offline environments.

V. Research Project (REP):

In accordance with the vision of the National Education Policy (NEP) 2020, the Research Project (REP) in the M.Sc. (Ag.) Agronomy program is designed to promote advanced research aptitude, innovation, and critical thinking among postgraduate students. Conducted under the guidance of faculty supervisors, the project involves independent research on specialized topics such as crop management, soil fertility, water use efficiency, or sustainable farming systems. Students are required to carry out field experiments, data analysis, and prepare a dissertation based on their findings. They are encouraged to present their research in seminars and publish papers in reputed journals. This component strengthens their scientific and analytical capabilities, preparing them for doctoral studies, academic roles, and research-oriented careers in agriculture.

Constitution of Courses in M.Sc. (Ag.) Agronomy Program

Matrix

Course Category Name	Course Category Code	Number of Courses	Total Course Credits
Core Course	COR	13	37
Skill Enhancement Courses	SEC	1	Q/ NQ
Multi- Disciplinary Course	MDC	5	Q/ NQ
Research Project	REP	1	Q/ NQ
Value Added Course	VAC	3	Q/ NQ
TOTAL		23	37

E. PEO's - Program Educational Objectives M.Sc. (Ag.) Agronomy

PEO1. Provide students with a comprehensive understanding of crop production, soil management, skills and modern technologies for sustainable development of agriculture

PEO2. Increase agricultural productivity and address challenges facing the agriculture industry

PEO3. Study tillage management, seed and sowing, plant nutrition and soil health as well as soil fertility and management

PEO4. Ensure food security and improve the living standards of small farmers through increased production and employment generation.

PEO5. Discuss about the fertilizer, organic manures and agricultural economics

F. PO's - Program Outcomes M.Sc. (Ag.) Agronomy

PO	Outcome	BT Level
PO1	**Recall** the crop growth stages, define agronomic terms and concepts	**L1**
PO2	**Understand** modern concept and principle of crop production and soil management	**L2**
PO3	**Understand** the crop-water relationships and soil conservation techniques	**L2**
PO4	**Apply** knowledge of soil science, water management and fertilizer application.	**L3**
PO5	**Execute** the knowledge for becoming Agri entrepreneur and give jobs to others.	**L3**
PO6	**Identify** the factors affecting crop yield and compare different soil management practices.	**L4**
PO7	**Select** the Agro Based Industries and Scientific Institutions for making successful careers in the field of Agronomy.	**L5**
PO8	Know the **significance** of research work in the field of Agronomy.	**L5**
PO9	**Design** a sustainable Farming system model	**L6**

G. Pedagogy, Teaching & Learning:

The M.Sc. (Ag.) Agronomy program at the School of Agriculture, Forestry and Fisheries (SAFF), Himgiri Zee University, Dehradun follows an advanced, research-oriented, and experiential learning approach aligned with the National Education Policy (NEP) 2020. The pedagogy integrates classroom teaching with laboratory experiments, field research, data analysis, seminars, and project-based learning to promote critical thinking, innovation, and practical competence.

I. Experiential and Research-Based Learning:

The program emphasizes hands-on and research-driven learning through field trials, case studies, group discussions, workshops, and dissertation work. Students engage in experimental design, data interpretation, and presentation of research findings, fostering scientific inquiry and analytical skills essential for advanced agricultural research and development.

II. Industry and Research Exposure:

Students gain exposure to agribusiness firms, research institutes, and government organizations through field visits, internships, and collaborative projects. Expert lectures, seminars, and conferences provide insight into current trends and technologies in agronomy, enhancing professional and entrepreneurial readiness.

III. Library and E-Learning Access:

Postgraduate students have full access to the University's well-equipped library and digital databases for academic and research needs. E-learning resources available through the University's ERP system support continuous and self-paced learning, enabling students to deepen their subject expertise and stay updated with emerging advancements in agriculture.

Annexure II

H. Program Structure

Master of Science in Agriculture (Agronomy)

(M.Sc. (Ag.) Agronomy)

S. No.	Course Code	Course Name	Category	Numbers of Hours/Week			C
			Core / Elective / Others	L	T	P	
SEMESTER I							
1	AGA C601	Principles and Practices of Water Management	COR	2	0	2	3
2	AGA C602	Principles and Practices of Soil Fertility and Nutrient Management	COR	2	0	2	3
3	AGA C603	Principles and Practices of Organic Farming	COR	2	0	2	3
4	AGA C604	Statistical Methods	COR	2	0	2	3
5	AGA C 605	Experimental Designs	COR	2	0	2	3
6	-	Multi-Disciplinary Course-I	MDC	-	-	-	Q/ NQ
7	-	Value Added Course-I	VAC	-	-	-	Q/ NQ
Total				**10**	**0**	**10**	**15**
Total contact hours 20							
SEMESTER II							
1	AGA C606	Modern Concepts in Crop Production	COR	2	0	2	3
2	AGA C607	Principles and Practices of Weed Management	COR	2	0	2	3
3	AGA C608	Dryland Farming and Watershed Management	COR	2	0	2	3
4	AGA C609	Cropping Systems and Sustainable Agriculture	COR	2	0	2	3
5	-	Multi-Disciplinary Course-II	MDC	-	-	-	Q/ NQ
6	-	Multi-Disciplinary Course-III	MDC	-	-	-	Q/ NQ
7	-	Multi-Disciplinary Course-IV	AEC	-	-	-	Q/ NQ
8	-	Value Added Course-II	VAC	-	-	-	Q/ NQ
Total				**08**	**0**	**08**	**12**
Total contact hours 16							
Cumulative Total				**18**	**0**	**18**	**27**

SEMESTER III							
1	AGA C701	Agronomy of Major Cereals and Pulses	COR	2	0	2	3
2	AGA C706	Agronomy of Oilseeds Crops	COR	2	0	2	3
3	AGA C703	Agronomy of Fibre Crops	COR	2	0	2	3
4	-	Multi-Disciplinary Course-V	MDC	-	-	-	Q/ NQ
5	-	Skill Enhancement Course-I	SEC	-	-	-	Q/ NQ
6	AGA C707	Master Seminar	COR	0	0	2	1
7	-	Value Added Course-III	VAC	-	-	-	Q/ NQ
Total				**06**	**0**	**08**	**10**
Total contact hours 14							
Cumulative Total				**24**	**0**	**26**	**37**
SEMESTER IV							
1	-	Research Project-I	REP	0	0	20	Q/NQ
Total				**0**	**0**	**20**	**Q/NQ**
Total contact hours 20							
Grand Total				**24**	**0**	**46**	**37**

L – Lecture T- Tutorial P- Practical C-Credits

1L = 1Hr. 1T= 1 Hr. 1P=2 Hr. 1+1C = 1 Hr. of Theory/Tutorial Paper/ week & 2 Hrs. of Practical/ week

Skill Enhancement Courses (SEC): List			
AGA N006	Basic Concepts in Laboratory Techniques		
Multi- Disciplinary Course (MDC) : List			
AGA N001	Disaster Management	AGA N004	Technical Writing And communications skills
AGA N002	Intellectual Property and Its Management In Agriculture	AGA N005	Agricultural Research, Research Ethics And Rural Development Programmes
AGA N003	Library and Information Services		
Research Project (REP): List			
AGA C705	Master's Research		

Value Added Course (VAC): List			
SE 001	Social Engineering I	SE 003	Social Engineering III
SE 002	Social Engineering II		

COURSE DETAILS

SEMESTER I

Course: Principles and Practices Of Water Management

Program	M.Sc. (Ag.) Agronomy	**Semester- I**			
Course Name	Principles and Practices Of Water Management	L	T	P	C
Course Code	AGA C601	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Identify and explain the role of water in plants, major irrigation projects and the extent of irrigated areas in India, with a particular focus on Uttarakhand.
COb2	To Apply knowledge of soil-water-plant relationships, water absorption by plants, and plant responses to water stress to real-world agricultural practices, enhancing productivity and addressing industry challenges.
COb3	To Analyze soil, plant, and meteorological factors that determine crop water needs, and evaluate different irrigation techniques, including scheduling, depth, methods, micro-irrigation systems, and fertigation.
COb4	To Evaluate the quality of irrigation water and the management of saline water for irrigation to improve water use efficiency, ensuring food security and enhancing the living standards of small farmers.
COb5	To Design effective water management strategies for problematic soils, including understanding the drainage requirements of crops and developing appropriate field drainage methods and layouts.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Identify and explain the role of water in plants, major irrigation projects, and the extent of irrigated areas in India, with a particular focus on Uttarakhand.	**L1 and L2**
CO2	Apply knowledge of soil-water-plant relationships, water absorption by plants, and plant responses to water stress to real-world agricultural practices, enhancing productivity and addressing industry challenges.	**L3**
CO3	Analyze soil, plant, and meteorological factors that determine crop water needs, and evaluate different irrigation techniques, including scheduling, depth, methods, micro-irrigation systems, and fertigation.	**L4**
CO4	Evaluate the quality of irrigation water and the management of saline water for irrigation to improve water use efficiency, ensuring food security and enhancing the living standards of small farmers.	**L5**
CO5	Design effective water management strategies for problematic soils, including understanding the drainage requirements of crops and developing appropriate field drainage methods and layouts.	**L6**

Syllabus:

Unit-1	**Water resources**	**Contact Hours: 6**
Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states(especially in context of Uttarakhand).		
Unit-2	**Soil-water-plant relationships**	**Contact Hours:6**
Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.		
Unit-3	**Irrigation systems**	**Contact Hours: 6**
Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; microirrigation system; fertigation; management of water in controlled environments and polyhouses.		
Unit-4	**Water management**	**Contact Hours: 6**
Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.		
Unit-5	**Water management in problem soils**	**Contact Hours: 6**
Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.		

Practical	Suggested list of Exercises
1	Measurement of soil water potential by using tensiometer, and pressure plate and membrane apparatus
2	Soil-moisture characteristics curves
3	Water flow measurements using different devices
4	Determination of irrigation requirements
5	Calculation of irrigation efficiency
6	Determination of infiltration rate
7	Determination of saturated/unsaturated hydraulic conductivity

Suggestive Readings:

Text Books:

T1. Dilip Kumar Majumdar, " Irrigation water Management", Second Edition, PHI Learning Private Limited, 2014.

T2.T. Yellamanda Reddy, G.H. Sankara Reddy, " Principles of Agronomy" Kalyani Publishers, 2019.

Reference Book:

R1. "Handbook of Agriculture", ICAR, New Delhi, Sixteenth Reprint of Sixth Edition, 2021.

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	2	1	2	1	1	1
CO2	2	3	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	2	2	3
CO4	1	2	3	3	3	2	2	3	3
CO5	1	2	2	3	2	2	3	3	3

SEMESTER I

Course: Principles and Practices of Soil Fertility and Nutrient Management

Program	M.Sc. (Ag.) Agronomy	**Semester- I**			
Course Name	Principles and Practices of Soil Fertility and Nutrient Management	L	T	P	C
Course Code	AGA C602	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Understand the difference between soil fertility and soil productivity
COb2	To Understand the criteria of essential plant nutrients and their deficiency symptoms and management
COb3	To Illustrate the time and method of manure and fertilizer application.
COb4	To Identify the nutrients deficiency symptoms on agriculture field based on their special characteristics
COb5	To Apply the concept of integrated nutrient management and to find out best agronomic practices based on observation carried into the field experiment.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Remember the concept of soil fertility and their nutrient management	**L1**
CO2	Understand the function of essential plant nutrients	**L2**
CO3	Apply the knowledge to nutrient management	**L3**
CO4	Analyze the nutrient deficiency symptoms on various crops	**L4**
CO5	Evaluate Integrated Nutrient Management on soil fertility, productivity and design model for Integrated Farming System for Resilient Agriculture	**L5**

Syllabus:

Unit-1	**Soil fertility and productivity**	**Contact Hours: 6**
Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.		
Unit-2	**Essential plant nutrients**	**Contact Hours:6**
Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.		
Unit-3	**Manures and Biofertilizers**	**Contact Hours: 6**
Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management and its importance in Uttarakhand context.		
Unit-4	**Crop response to fertilizers**	**Contact Hours: 6**
Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.		
Unit-5	**Integrated nutrient management**	**Contact Hours: 6**
Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermi compost and residue wastes in crops.		
Practical	**Suggested list of Exercises**	

1	Determination of soil pH
2	Determination of total N and available N in soil, P, K and S in soils
3	Determination of total N, P, K and S in plants
4	Interpretation of interaction effects and computation of economic and yield optima
5	Determination of electrical conductivity of soil
6	Determination of organic carbon in soil
7	Preparation of vermicompost
8	Preparation of organic compost

Suggestive Readings:

Text Books:

T1. Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.

Reference Book:

R1. N.C. Brady, "The Nature and Properties of Soils", 14th Edition, Dorling Kindersley, 2012

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	30 min	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

Outcomes → Course Outcomes ↓									
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	3	2	2	3	2	2	2
CO3	2	3	3	3	2	3	2	2	3
CO4	1	2	3	3	3	3	2	3	3
CO5	1	2	2	2	3	3	3	3	3

SEMESTER I

Course: Principles and Practices of Organic Farming

Program	M.Sc. (Ag.) Agronomy	**Semester- I**			
Course Name	Principles and Practices of Organic Farming	L	T	P	C
Course Code	AGA C603	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Describe the concept and importance of organic farming, its relevance to India and global agriculture, and its significance in the context of Uttarakhand.
COb2	To Apply land and water management practices such as minimum tillage, shelter zones, hedges, pasture management, and agro-forestry in organic farming
COb3	To Analyze the effectiveness of various organic farming techniques in enhancing soil fertility, nutrient recycling, and water use efficiency
COb4	To Evaluate different farming systems, crop rotations, and intercropping practices to maintain soil productivity and improve crop yields
COb5	To Design a layout of integrated pest management strategies using biological agents, pheromones, and bio-pesticides, considering their socio-economic impacts and market potential

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	**Remember** the concept and definition of organic farming and its relevance to India and global agriculture.	**L1**
CO2	**Understand** the land and water management practices such as minimum tillage, shelter zones, and agro-forestry in organic farming	**L2**
CO3	**Apply** the organic farming techniques in enhancing soil fertility, nutrient recycling, and water use efficiency	**L3**
CO4	**Analyze** the socio-economic impacts of organic farming, including its marketing and export potential	**L4**
CO5	Evaluate decomposition of organic residues and vermicomposting to enhance soil health in the field of Agronomy research.	**L5**

Syllabus:

Unit-1	**Organic farming**	**Contact Hours: 6**
Organic farming -concept and definition, its relevance to India and global agriculture and future prospects its importance Uttarakhand context; land and water management -land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.		
Unit-2	**Soil fertility and Water Use Efficiency**	**Contact Hours:6**
Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers		
Unit-3	**Farming systems**	**Contact Hours: 6**
Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.		
Unit-4	**Weed management**	**Contact Hours: 6**
Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.		
Unit-5	**National Economy on Organic Farming**	**Contact Hours: 6**
Socio-economic impacts; marketing and export potential: inspection, certification, labelling and accreditation procedures; organic farming and national economy.		
Practical	**Suggested list of Exercises**	

1	To utilize the organic farm residue for preparation of nutrient rich organic manure through composting.
2	Quality estimation of compost.
3	Determination of soil organic carbon of a soil sample.
4	To utilize the organic farm residue for preparation of nutrient rich organic manure through Vermi-composting.
5	Estimation of cost of organic production system.
6	To determine Quality considerations and certification of organic produce.
7	Post-harvest management of organic produce.
8	Study of different types of organic manures and its application in field.
9	Study of different types of bio fertilizers and its application in field.
10	To study about different types of rhizobium and its seed treatment.
11	To study soil moisture conservation practices for increasing WUE in Organic farm.
12	Visit to a organic farm.

Suggestive Readings:

Text Books:

T1. S.C. Panda "Organic Farming for sustainable Agriculture" Re-Set Edition, Kalyani Publishers, 2019.

Reference Books:

R1. Principles of Organic Farming, S R Reddy, Kalyani Publishers, Ludhiyana.

R2. Organic Farming for Sustainable Agriculture, DilipNandwani Springer Publications

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6

Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	2	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	3	2	2	3
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER I

Course: Statistical Methods

Program	M.Sc. (Ag.) Agronomy	**Semester-I**			
Course Name	Statistical Methods	L	T	P	C
Course Code	AGA C604	2	0	1	3

Course Objectives:

This course ensures that the students understand how:

COb1	To know the principles and methods of statistical calculations used in agriculture.
COb2	To study the statistical methods of analysis of data viz. quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, including skewness, Kurtosis and its measure.
COb3	To understand the statistical methods in collection of any type of data, classification of data, Presentation of data, analysis of data, descriptive statistics, parametric and non-parametric tests,

	etc.
COb4	To Analyze and make statistical hypothesis and design experiment in agriculture.
COb5	Develop the ability to Correlate the results of statistical calculations and their validation with the available agricultural data.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Identify the different types of central tendency.	**L1**
CO2	Classify the data for quantitative and qualitative and its statistical analysis.	**L2**
CO3	Apply the statistical methods in crop production and testing of hypothesis.	**L3**
CO4	Analyze the use of central tendency, correlation and regression analysis in agriculture experiments.	**L4**
CO5	Create solutions through different statistical methods for solving the problems in agriculture in for crop improvements.	**L5 and L6**

Syllabus:

Unit-1	**Data Classification**	**Contact Hours: 06**
Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.		
Unit-2	**Tests of significance**	**Contact Hours: 06**
Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial; Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory.		
Unit-3	**Correlation and regression**	**Contact Hours: 06**
Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting. Profit regression analysis by least		

squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.		
Unit-4	**Non-parametric tests**	**Contact Hours: 06**
Non-parametric tests - sign, Wilcoxon, Mann-Whitney U{test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.		
Unit-5	**Cluster and principal component analysis**	**Contact Hours: 06**
Introduction to multivariate analytical tools- Hotelling's T2 Tests of hypothesis about the mean vector of a multi-normal population. Classificatory problems and discriminant function, D2-statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.		

Practical	**Suggested list of Exercises**
1	Numerical on Fitting of binomial distribution
2	Numerical on Fitting of Poisson distribution
3	Numerical on Fitting of Normal distribution
4	Numerical on Chi- square tests
5	Numerical on t- test, one sample, two sample, paired
6	Numerical on F-test
7	Numerical on Karl Pearson's Correlation
8	Numerical on Spearman's Rank correlation, tied observation
9	Numerical on Non Parametric Tests - one sample tests
10	Numerical on Non Parametric Tests - two sample tests
11	Numerical on Randomized Completely Block Designs
12	Numerical Completely Randomized designs

Suggestive Readings:

Text Books:

T1. Dr. SRS Chandel. Agricultural Statistics Impact Printing Press, Kanpur.

T2. Prof. Abhijit Sharma, Assam Agriculture University: Agricultural Statistics, Kalyani Publishers

Reference Books:

R1. Prof. Rangasawamy: A Text Book of Agricultural Statistics, New Age Publications

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Surprise Quiz	☑	10mins	05			Level 1
Practical Exam	☑	1hr	20			Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER I

Course: Experimental Designs

Program	M.Sc. (Ag.) Agronomy	Semester-I			
Course Name	Experimental Designs	L	T	P	C
Course Code	AGA C605	2	0	1	3

Course Objectives:

This course ensures that the students understand how:

COb1	To know the basic principles of experimental designs used in agriculture
COb2	To study the statistical methods of analysis of data viz. quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, including skewness, Kurtosis and its measure.
COb3	To understand the statistical methods in collection of any type of data, classification of data, Presentation of data, analysis of data, descriptive statistics, parametric and non-parametric tests, etc.
COb4	To Analyze and make statistical hypothesis and design experiment in agriculture.
COb5	To develop the ability to Correlate the results of statistical calculations and their validation with the available agricultural data.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Identify the different types of experimental designs	**L1**
CO2	Understand the data and interpretation for quantitative and qualitative analysis	**L2**
CO3	Apply the importance coefficient of variation and standard deviation in interpretation of results	**L3**
CO4	Analyze the use of Analysis of Variance, correlation and regression analysis in agriculture experiments	**L4**
CO5	Create solutions through different statistical methods for solving the problems in agriculture	**L5 and L6**

Syllabus:

Unit-1	Basic principles of Experimental design	Contact Hours: 06
Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control, Uniformity trials, size and shape of plots and blocks.		

Unit-2	Different types of Experimental designs	Contact Hours: 06
Analysis of variance; Completely randomized design, randomized block design and Latin square design, Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom.		
Unit-3	**Factorial experiments**	**Contact Hours: 06**
Confounding in symmetrical factorial experiments, Factorial experiments with control treatment, Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs.		
Unit-4	**Incomplete block design**	**Contact Hours: 06**
Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.		
Unit-5	**Uniformity trial**	**Contact Hours: 06**
Practical Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces		

Practical	Suggested list of Exercises
1	Numerical on Fitting of binomial distribution
2	Numerical on Fitting of Poisson distribution
3	Numerical on Fitting of Normal distribution
4	Numerical on Chi- square tests
5	Numerical on t- test, one sample, two sample, paired
6	Numerical on F-test
7	Numerical on Karl Pearson's Correlation
8	Numerical on Spearman's Rank correlation, tied observation
9	Numerical on Non Parametric Tests - one sample tests
10	Numerical on Non Parametric Tests - two sample tests
11	Numerical on Randomized Completely Block Designs
12	Numerical Completely Randomized designs

Suggestive Readings:

Text Books:

T1. Dr. SRS Chandel. Agricultural Statistics Impact Printing Press, Kanpur.

T2. Prof. Abhijit Sharma, Assam Agriculture University: Agricultural Statistics, Kalyani Publishers

Reference Books:

R1. Prof. Rangasawamy: A Text Book of Agricultural Statistics, New Age Publications

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Surprise Quiz	☑	10mins	05			Level 1
Practical Exam	☑	1hr	20			Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER I

Multi- Disciplinary Course I: Disaster Management

Program	M.Sc. (Ag.) Agronomy	Semester-I			
Course Name	Disaster Management	L	T	P	C
Course Code	AGA N001	2	0	1	3

Course Objectives:

This course ensures that the students understand how:

COb1	To Identify and describe the different types and effects of natural and man-made disasters, including floods, droughts, cyclones, earthquakes, landslides, nuclear disasters, and chemical disasters with an emphasis on their impact on agricultural productivity.
COb2	To Explain the causes and impacts of climatic changes such as global warming, sea level rise, and ozone depletion on agriculture and food security, especially in the context of Uttarakhand and analyze their contribution to the occurrence and severity of natural disasters
COb3	To Demonstrate knowledge of disaster management strategies by outlining national and global efforts to mitigate natural disasters on agriculture and evaluating the effectiveness of these strategies in various contexts, particularly in Uttarakhand
COb4	To Examine the role and coordination of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response, and assess their impact on disaster management at central, state, district, and local levels and emphasizing the importance of these roles in managing agricultural crises in Uttarakhand.
COb5	To Design the International Strategy for Disaster Reduction and the national disaster management framework, considering financial arrangements, policy implications and propose improvements for effective disaster management and recovery in the agricultural sector, incorporating modern technologies and sustainable practices.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Recall the key terms and concepts related to natural and man-made disasters and their impact on agriculture.	**L1**
CO2	Understand and explain the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security.	**L2**
CO3	Apply principles of soil and water management to develop strategies for mitigating the impacts of natural and man-made disasters on agricultural productivity.	**L3**
CO4	Analyze the role of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response and assess their impact on disaster	**L4**
CO5	Design a comprehensive International Strategy for Disaster Reduction and a national	**L5 and L6**

	disaster management framework, considering financial arrangements and policy implications, for the agricultural sector.	

Syllabus:

Unit-1	**Natural Disaster**	**Contact Hours: 6**
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-2	**Man Made Disasters**	**Contact Hours: 6**
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-3	**Management of Natural Disaster**	**Contact Hours: 6**
Disaster Management- Efforts to mitigate natural disasters at national and global levels.		
Unit-4	**International & National Scheme for Disaster reduction.**	**Contact Hours: 6**
International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements;		
Unit-5	**Roles and Responsibilities in Disaster Management and Response**	**Contact Hours: 6**
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; its importance in Uttarakhand point of view.		

Suggestive Readings:

Text Books:

T1. Vinod K. Sharma, "Disaster Management" Second Edition, Scientific International Pvt. Ltd. (New Delhi).

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels

Test I	☑	1hr	20			Levels 1 to 2
Test II	☑	1hr	20			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Surprise Quiz	☑	10 mins	05			Level 1
Practical Exam	☑	1hr	20			Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER II

Course: Modern Concepts in Crop Production

Program	M.Sc. (Ag.) Agronomy	**Semester- II**			
Course Name	Modern Concepts in Crop Production	L	T	P	C
Course Code	AGA C606	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Recognize and describe the agro-ecological zones of India and their significance in crop production planning.
COb2	To Classify and explain quantitative agro-biological principles, including the inverse yield–nitrogen law and Mitscherlich yield equation, with their interpretation and field applicability.
COb3	To Relate the effects of lodging on cereal physiology and grain yield, and analyze the optimization of plant population, planting geometry, ideal plant type, and crop modeling for achieving desired yield levels.
COb4	To Connect fundamental scientific principles of crop production with strategies for enhancing productivity and yield stability in crop plants.
COb5	To Plan and design integrated farming systems and resource conservation technologies, incorporating modern tillage practices, dry farming concepts, and determination of nutrient requirements for realizing crop yield potential.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Recognize the agro-ecological zones of India.	**L1**
CO2	Classify the quantitative agro-biological principles and inverse yield nitrogen law, Mitscherlich yield equation, its interpretation and applicability.	**L2**
CO3	Relate the Effect of lodging in cereals with physiology of grain yield in cereals and relate the optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.	**L3**
CO4	Connect the scientific principles of crop production for increasing the yield in crop plants.	**L4 & L5**

CO5	Plan and design the Integrated farming systems and resource conservation technology including modern concept of tillage; dry farming and determining the nutrient needs for yield potentiality of crop plants.	**L6**

Syllabus:

Unit-1	**Crop growth analysis**	**Contact Hours: 6**
Crop growth analysis in relation to environment; Agro-ecological zones of India.		
Unit-2	**Quantitative Agro-biological principles**	**Contact Hours:6**
Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.		
Unit-3	**Ideal plant type**	**Contact Hours: 6**
Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modelling for desired crop yield.		
Unit-4	**Soil and plant relations**	**Contact Hours: 6**
Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.		
Unit-5	**Integrated farming systems**	**Contact Hours: 6**
Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture		
Practical	**Suggested list of Exercises**	
1	To determine Leaf Area Index of wheat crop.	
2	To determine Net Assimilation rate of wheat crop.	
3	To determine crop growth rate in wheat crop.	
4	To study lodging characteristics in cereals.	
5	To determine N, P and K content of soil.	
6	To determine the micronutrient content (Zn, Fe and Mn) in soil.	
7	To determine the micronutrients content (B and Mo) in soil.	
8	Case study on Integrated Farming system.	
9	To study about various tillage implements and their uses.	

10	To prepare compost from the various farm and biological waste in the University campus.
11	To study the process of preparation of vermin compost.
12	To study operation of automated drip irrigation in orchards.

Suggestive Readings:

Text Books:

T1. Balasubramaniyan P & Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.

T2. Fageria NK. 1992. Maximizing Crop Yields. Marcel Dekker.

Reference Book:

R1. Reddy SR. 2000. Principles of Crop Production. Kalyani Publishers, New Delhi

R2. Singh SS. 2006. Principles and Practices of Agronomy. Kalyani Publishers, New Delhi

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	30 min	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER II

Course: Principles and Practices of Weed Management

Program	M.Sc. (Ag.) Agronomy	Semester- II			
Course Name	Principles and Practices of Weed Management	L	T	P	C
Course Code	AGA C607	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Identify weed biology and ecology, and classify weeds along with methods of weed control.
COb2	To Classify herbicides and explain their mode and mechanism of action in weed control.
COb3	To Relate factors affecting herbicide efficiency, including formulations and mixtures, and analyze herbicide resistance and its management using bio-herbicides, myco-herbicides, and allelochemicals.
COb4	To Correlate appropriate weed management practices with major crops and different cropping systems.
COb5	To Plan and design integrated weed management strategies by combining cultural, mechanical, chemical, and biological approaches.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Identify the weed biology and ecology and methods of weed control and classification.	**L1**
CO2	Classify the herbicides and relate mode and mechanism of action of herbicides.	**L2**
CO3	Relate the factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelochemicals.	**L3**
CO4	Correlate the weed management practices in major crops and cropping systems.	**L4 & L5**
CO5	Plan and design the Integrated weed management methods.	**L6**

Syllabus:

Unit-1	**Weed biology**	**Contact Hours: 6**
Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices		
Unit-2	**Herbicides and its classification**	**Contact Hours:6**
Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.		
Unit-3	**Efficiency of herbicides**	**Contact Hours: 6**
Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.		
Unit-4	**Weed management**	**Contact Hours: 6**
Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.		
Unit-5	**Integrated weed management**	**Contact Hours: 6**
Integrated weed management; cost : benefit analysis of weed management		

Practical	**Suggested list of Exercises**
1	Identification of important weeds of different crops
2	Preparation of a weed herbarium
3	Weed survey in crops and cropping systems
4	Crop-weed competition studies
5	Preparation of spray solutions of herbicides for high and low-volume sprayers
6	Use of various types of spray pumps and nozzles and calculation of swath width
7	Economics of weed control
8	Herbicide resistance analysis in plant and soil
9	Bioassay of herbicide resistance

10	Calculation of herbicidal requirement

Suggestive Readings:

Text Books:

T1. Gupta OP. 2007. Weed Management – Principles and Practices. Agrobios.

T2. Mandal RC. 1990. Weed, Weedicides and Weed Control - Principles and Practices. Agro Botanical Publ

Reference Book:

R1. Rao VS. 2000. Principles of Weed Science. Oxford & IBH

R2. Subramanian S, Ali AM & Kumar RJ. 1997. All About Weed Control. Kalyani

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2

CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER II

Course: Dryland Farming and Watershed Management

Program	M.Sc. (Ag.) Agronomy	**Semester- II**			
Course Name	Dryland Farming and Watershed Management	L	T	P	C
Course Code	AGA C608	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Define dry land farming and distinguish between dry land and rainfed farming systems.
COb2	**To** Classify soil and climatic parameters of dry land areas, with special emphasis on rainfall characteristics, and relate production constraints limiting crop productivity.

COb3	To Relate stress physiology, drought resistance, and adaptive mechanisms of crop plants to drought conditions, and evaluate drought management strategies.
COb4	To Illustrate concepts of tillage and tilth, including frequency and depth of cultivation, and explain the principles of conservation tillage.
COb5	To Develop an understanding of watershed resource management, emphasizing its importance in India and Uttarakhand, along with associated problems, approaches, and key components.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Define the dry land farming and identify the difference between dry land and rainfed farming.	**L1**
CO2	Classify the soil and climatic parameters with special emphasis on rainfall characteristics and relate constraints limiting crop production in dry land areas.	**L2**
CO3	Relate the stress physiology and resistance to drought and adaptation of crop plants to drought along with drought management strategies.	**L3**
CO4	Illustrate the tillage, tilth, frequency and depth of cultivation and concept of conservation tillage.	**L4**
CO5	Develop the concept of watershed resource management- its importance in India and Uttarakhand, problems, approach and components.	**L5**

Syllabus:

Unit-1	**Dry land farming**	**Contact Hours: 6**
Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in India		
Unit-2	**Climate and rainfall characteristics**	**Contact Hours:6**
Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.		
Unit-3	**Stress physiology**	**Contact Hours: 6**
Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant		

weather.		
Unit-4	**Tillage**	**Contact Hours: 6**
Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use.		
Unit-5	**Watershed resource management**	**Contact Hours: 6**
Concept of watershed resource management- its importance in India and Uttarakhand., problems, approach and components		

Practical	**Suggested list of Exercises**
1	Seed treatment, seed germination and crop establishment in relation to soil moisture contents
2	Moisture stress effects and recovery behaviour of important crops
3	Estimation of moisture index and aridity index
4	Spray of anti-transpirants and their effect on crops
5	Collection and interpretation of data for water balance equations
6	Water use efficiency
7	Preparation of crop plans for different drought conditions
8	Study of field experiments relevant to dryland farming
9	Visit to dryland research stations and watershed projects

Suggestive Readings:

Text Books:

T1. Das NR. 2007. Tillage and Crop Production. Scientific Publishers

T2. Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH

Reference Book:

R1. Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publishers

R2. Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	30 min	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER II

Course: Cropping Systems and Sustainable Agriculture

Program	M.Sc. (Ag.) Agronomy	Semester- II			
Course Name	Cropping Systems and Sustainable Agriculture	L	T	P	C
Course Code	AGA C609	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Define cropping systems and related indices, explain their importance, and recall physical resources, soil and water management practices, and land-use assessment in cropping systems.
COb2	To Compare sustainability concepts in cropping and farming systems, and evaluate production potential under monoculture, multiple cropping, alley cropping, sequential cropping, and intercropping systems.
COb3	To Relate above- and below-ground interactions, including allelopathic effects, with the role of non-monetary inputs and low-cost technologies in sustainable cropping systems.
COb4	To Illustrate the role of crop diversification in sustainability and explain the importance of organic matter in soil fertility maintenance, crop residue management, fertilizer use efficiency, and fertilizer use in intensive cropping systems.
COb5	To Design plant ideotypes suitable for dryland conditions and appraise the role of plant growth regulators in achieving sustainability.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Define the cropping systems, indices and its importance and memorize physical resources, soil and water management in cropping systems and assessment of land use.	**L1**
CO2	Compare the concept of sustainability in cropping systems and farming systems and production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping.	**L2**
CO3	Relate the above and below ground interactions and allelopathic effects and role of non-monetary inputs and low-cost technologies.	**L3**
CO4	Illustrate the crop diversification for sustainability and role of organic matter in maintenance of soil fertility; crop residue management, fertilizer use efficiency and concept of fertilizer use in intensive cropping system.	**L4 & L5**
CO5	Design the Plant ideotypes for drylands and appraise the role of plant growth regulators in sustainability	**L6**

Syllabus:

Unit-1	**Cropping systems**	**Contact Hours: 6**
Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use		
Unit-2	**Sustainability in Crop adaptability**	**Contact Hours:6**
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-3	**Multi-storeyed cropping**	**Contact Hours: 6**
Above and below ground interactions and allelopathic effects; competition relations; multi-storeyed cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.		
Unit-4	**Crop diversification**	**Contact Hours: 6**
Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.		
Unit-5	**Plant ideotypes**	**Contact Hours: 6**
Plant ideotypes for drylands; plant growth regulators and their role in sustainability		

Practical	**Suggested list of Exercises**
1	To visit Himgiri Zee University Agriculture field to observe different cropping system adopted.
2	To study about intercropping system in field.
3	To study about water management in field.
4	To study about soil management in field.
5	To study about Allelopathy effect of Eucalyptus tree.
6	To study about multistoried cropping system in field.
7	To study the role of non-monetary inputs in sustainability.
8	To utilize the organic farm residue for preparation of nutrient rich organic manure through composting.
9	To utilize the organic farm residue for preparation of nutrient rich organic manure through vermi-composting.

10	To study about different types of mulches and its application in field.
11	Calculation of doses of different types of fertilizers.
12	Visit to nearby K.V.K

Suggestive Readings:

Text Books:

T1. Singh SS. 2006. Principles and Practices of Agronomy. Kalyani Publishers, New Delhi.

T2. Palaniappan SP & Sivaraman K. 1996. Cropping Systems in the Tropics; Principles and Management. New Age

Reference Book:

R1. Panda SC. 2003. Cropping and Farming Systems. Agrobios

R2. Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ. Co

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

Outcomes ↓									
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER II

Multi- Disciplinary Course II: Intellectual Property And Its Management In Agriculture

Program	Masters of Science Agriculture (Genetics and Plant Breeding)	Semester-II			
Course Name	Intellectual Property And Its Management In Agriculture	L	T	P	C
Course Code	AGA N002	1	0	0	1

Course Objectives:

This course ensures that the students understand how:

COb1	To Identify and describe the different types and effects of natural and man-made disasters, including floods, droughts, cyclones, earthquakes, landslides, nuclear disasters, and chemical disasters with an emphasis on their impact on agricultural productivity.
COb2	To Explain the causes and impacts of climatic changes such as global warming, sea level rise, and ozone depletion on agriculture and food security, especially in the context of Uttarakhand and analyze their contribution to the occurrence and severity of natural disasters
COb3	To Demonstrate knowledge of disaster management strategies by outlining national and global efforts to mitigate natural disasters on agriculture and evaluating the effectiveness of these strategies in various contexts, particularly in Uttarakhand
COb4	To Examine the role and coordination of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response, and assess their impact on disaster management at central, state, district, and local levels and emphasizing the importance of these roles in managing agricultural crises in Uttarakhand.
COb5	To Design the International Strategy for Disaster Reduction and the national disaster management framework, considering financial arrangements, policy implications and propose improvements for effective disaster management and recovery in the agricultural sector, incorporating modern technologies and sustainable practices.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Recall historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement.	**L1**
CO2	Discuss the Intellectual Property and Intellectual Property Rights (IPR) and its benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties	**L2**
CO3	Apply the fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of	**L3**

	plant varieties and farmers' rights and biodiversity protection.	
CO4	Analyze the National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture	**L4**
CO5	To Evaluate the current regulation and propose recommend technologies of Licensing and summarize Material transfer agreements, Research collaboration Agreement, License Agreement.	**L5**

Syllabus:

Unit-1	**TRIPS**	**Contact Hours: 3**
Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement		
Unit-2	**Indian Patent**	**Contact Hours:3**
Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties		
Unit-3	**PPVFRA**	**Contact Hours: 3**
Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection		
Unit-4	**National biodiversity Board**	**Contact Hours: 3**
National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture		
Unit-5	**Material Transfer Agreement**	**Contact Hours: 3**
Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.		

Reference Books

T1. Erbisch F. H. & Maredia K. Intellectual Property Rights in Agricultural Biotechnology. CABI.

T2. Ganguli P. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw Hill Education, US

T3. Intellectual Property Rights in Animal Breeding and Genetics. CABI. Saha R. (Ed.). Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House., India

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	20			Levels 1 to 2
Test II	☑	1hr	20			Levels 1 to 2
Assignment	☑		10			Levels 1 to 5
Surprise Quiz	☑					Level 1
Practical Exam	☑					Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER II

Multi- Disciplinary Course III: Library And Information Services

Program	Masters of Science Agriculture (Genetics and Plant Breeding)	**Semester-II**			
Course Name	Library And Information Services	L	T	P	C
Course Code	AGA N003	1	0	1	2

Course Objectives:

This course ensures that the students understand how:

COb1	To Recall the library and its services and also identify the role of libraries in education, research and technology transfer.
COb2	To gather review of literature through survey, Online Public Access Catalogue
COb3	To classify the information from primary sources, secondary sources and tertiary sources and also understand their intricacies
COb4	To Analyze the information from Abstracts of Review of literature
COb5	To evaluate the purpose of e-resources access methods for enhancing knowledge and gathering information.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	**Outcome**	**BT Level**
CO1	Recall the library and its services and also identify the role of libraries in education, research and technology transfer along with label of classification systems and organization of library	**L1**
CO2	Explain the literature survey, citation techniques/preparation of bibliography and also CD-ROM Databases, Online Public Access Catalogue and other computerized library services	**L2**
CO3	Apply the sources of information and classify the primary sources, secondary sources and tertiary sources and also understand the intricacies of abstracting and indexing services like Science Citation Index, Biological Abstracts.	**L3**

CO4	To Analyze the information from Abstracts, CABI Abstracts, etc. for tracing information from reference sources	**L4**
CO5	To Evaluate the internet including search engines and its resources and choose e-resources access methods for enhancing knowledge and gathering information.	**L5 and L6**

Syllabus:

Unit-1	**Library and its classification**	**Contact Hours: 3**
Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library		
Unit-2	**Sources of Information**	**Contact Hours:3**
Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts		
Unit-3	**Abstract and Review of Literature**	**Contact Hours: 3**
Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey;		
Unit-4	**Public Access and Bibliography**	**Contact Hours: 3**
Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services		
Unit-5	**E resources**	**Contact Hours: 3**
Use of Internet including search engines and its resources; e-resources access methods.		

Practical	**Suggested List of Exercises**
1	Introduction to library and its services
2	Role of libraries in education, research and technology transfer
3	Citation techniques
4	Preparation of bibliography
5	Use of CD-ROM Databases
6	Online Public Access Catalogue
7	Use of Internet including search engines and its resources; e-resources access

	methods.

Reference Books

T1. Richard E. Bopp R. E. & Smith, L. C. Reference and Information Services: An Introduction, 4th Edition (Library and Information Science Text Series), ABC-CLIO eBook Collection, Santa Barbara, CA

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	20			Levels 1 to 2
Test II	☑	1hr	20			Levels 1 to 2
Assignment	☑		10			Levels 1 to 5
Surprise Quiz	☑					Level 1
Practical Exam	☑					Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

Multi- Disciplinary Course IV: Technical Writing And Communications Skills

Program	Masters of Science Agriculture (Genetics and Plant Breeding)	**Semester-II**			
Course Name	**Technical Writing And Communications Skills**	L	T	P	C
Course Code	AGA N004	1	0	1	2

Course Objectives:

This course ensures that the students understand how:

COb1	To Identify the requirements in technical writing and list various forms of scientific writings like thesis, technical papers, reviews, manuals,
COb2	To Explain the importance of tenses, parts of speech, clauses, punctuation marks intechnical writing.
COb3	To Demonstrate the skills attained in technical writing and presentation of research papers in conferences and seminars
COb4	To Examine the abstracts, summaries, a review article *etc*. in preparation of hypothesis for the research work.
COb5	To Design future research proposals and case studies with the knowledge of technical and soft skills

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	**Outcome**	**BT Level**
CO1	Learn the technical writing of scientific writings like thesis, technical papers, reviews, manuals.	**L1**
CO2	Understand the communication skills like grammar (tenses, parts of speech, clauses, punctuation marks.	**L2**
CO3	Apply the various parts of communication skills in thesis writing and research communications	**L3**

CO4	Analyze the abstracts, summaries, a review article *etc*. in preparation of hypothesis for the research work.	**L4**
CO5	Evaluate the strength and weakness during participation in group discussion, facing an interview and presentation of scientific papers.	**L5 and L6**

Syllabus:

Unit-1	**Technical Writing**	**Contact Hours: 3**
Recall the technical writing and list various forms of scientific writings like thesis, technical papers, reviews, manuals		
Unit-2	**Communication Skills**	**Contact Hours:3**
Explain communication skills like grammar (tenses, parts of speech, clauses, punctuation marks) and also point out error analysis (common errors) and also select concord, collocation, phonetic symbols and transcription.		
Unit-3	**Thesis writing**	**Contact Hours: 3**
Describe about various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion.		
Unit-4	**Research paper writing**	**Contact Hours: 3**
Prepare the abstracts, summaries, a review article *etc*. and apply commonly used abbreviations in the thesis and research communications, illustrations, photographs and drawings with suitable captions, numbering of tables and illustrations and also choose editing and proof-reading		
Unit-5	**Interview and Public presentation**	**Contact Hours: 3**
Reframe accentual pattern like weak forms in connected speech and recommend participation in group discussion, facing an interview and presentation of scientific papers		

Practical	**Suggested lists of practical**
1	Various forms of scientific writings- theses, technical papers, reviews, manuals, etc;

2	Various parts of thesis and research communications
3	Writing of abstracts
4	Writing of summaries
5	Writing of précis
6	Writing of citations
7	Writing of a review article
8	Facing an interview

Text books

1. Chicago Manual of Style. 14th Ed. Prentice Hall of India.New Delhi
2. Collins' Cobuild English Dictionary. Harper Collins.
3. Gordon HM & Walter JA. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
4. Hornby A. S. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press. England
5. James H. S. Handbook for Technical Writing. NTC Business Books.

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		10			Levels 1 to 5
Surprise Quiz	☑					Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER III

Course: Agronomy of Major Cereals and Pulses

Program	M.Sc. (Ag.) Agronomy	Semester- III			
Course Name	Agronomy of Major Cereals and Pulses	L	T	P	C
Course Code	AGA C701	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Describe the origin, history, classification, and varietal improvements of major crops such as rice, maize, millets, wheat, barley, and legumes, along with their production areas, distribution, and agronomic characteristics, especially in the context of Uttarakhand.
COb2	To Explain the climatic, soil, water, and cultural requirements of these crops, including the effects of temperature on growth, fertilizer-soil interactions, and water management practices and discuss the role of green legumes in soil fertility and moisture conservation also address agricultural challenges.
COb3	To Implement integrated weed management, crop protection techniques, and post-harvest technologies in various cropping systems, including problematic soil conditions, to enhance crop yield and quality, with a focus on maximizing production efficiency.
COb4	To Analyze the agronomic investigation data to evaluate the adaptability and nutritional needs of crop plants, assess the yield gaps to improve food security enhance the living standards of small farmers through increased productivity and employment generation
COb5	To Design an agronomy research layout and evaluate the cost of cultivation, industrial uses of byproducts, and the handling and processing techniques of crops, ensure sustainable agricultural practices

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	**Remember** the origin, history, classification, and varietal improvements of major crops such as rice, maize, millets, wheat, barley, and legumes, along with their production areas and distribution.	**L1**
CO2	**Understand** the role of green legumes in building soil fertility and moisture conservation, and discuss the agricultural challenges in crop production, especially in Uttarakhand.	**L2**
CO3	**Apply** the agronomic practices to develop sustainable farming systems and increase productivity, focusing on maximizing production efficiency and quality	**L3**

CO4	**Analyze** the agronomic investigation data to evaluate the adaptability and nutritional needs of crop plants and assess yield gaps to improve food security	**L4**
CO5	Evaluate the effectiveness of integrated weed management, crop protection techniques, and post-harvest technologies, and propose improvements for sustainable agricultural practices.	**L5**

Syllabus:

Unit-1	**Cropping systems**	**Contact Hours: 6**
Origin, antiquity of rice, area and production, distribution, classification, and varietal improvement. Adaptability, Agro-climatic different zones of rice in India, effect of temperature on growth, fertilizer-soil interaction in relation to nutrition and yield of rice, Water & fertilizer management practices, cropping systems cultural practices including integrated weed management for rice. Rice culture in problematic soil conditions (especially in context of Uttarakhand). Yield gap analysis concept and package of practices of hybrid rice. Post harvest Technology, handling and processing of the produce for maximum production of rice.		
Unit-2	**Crop adaptability**	**Contact Hours:6**
Origin & history, area & production, distribution, classification, varietal improvement, adaptability, climate, soil water and cultural requirement, development and nutrition of the crop plant based on agronomic investigation. Crop protection, crop quality, cost of cultivation, Industrial uses of byproducts. Handling and processing of the produce for maximum production of Maize and Millets.		
Unit-3	**Crop protection-weed management**	**Contact Hours: 6**
Origin & history, area & production, distribution, place of wheat and barley crops position in India, description, Varieties and their improvements, adaptability, climatic requirements, growth phases relation with temperature and soil management, tillage and other special cultural practices in respect of rice-wheat cropping sequence (with special reference to Uttarakhand). Agronomic appraisal of varieties, crop quality, handling and processing of the produce, crop protection-weed control, cultivation cost, wheat and barley cultivation (especially in context of Uttarakhand). Industrial uses of byproducts. Handling and processing of the produce for maximum production of Wheat and Barley.		
Unit-4	**Soil fertility and moisture conservation**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification and agronomic appraisal of the varietal improvement. Role of green legumes in building of soil fertility and moisture conservation. Adaptability, climate, soil, water and cultural requirements (with special reference to Uttarakhand), development and nutrition of the crop plant based on agronomic investigation.		
Unit-5	**Crop rotations and cropping systems**	**Contact Hours: 6**

Kharif and Rabi legumes based crop rotations and cropping systems (especially in context of Uttarakhand). Crop protection. Cost of cultivation, industrial uses of bye-products, Crop quality, handling and processing of the produce for maximum production of Kharif and Rabi Pulses..	
Practical	**Suggested list of Exercises**
1	Phenological studies at different growth stages of crop
2	Estimation of crop yield on the basis of yield attributes
3	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
4	Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops
5	Planning and layout of field experiments
6	Judging of physiological maturity in different crops
7	Intercultural operations in different crops
8	Determination of cost of cultivation of different crops
9	Working out harvest index of various crops
10	Study of seed production techniques in various crops
11	Visit of field experiments on cultural, fertilizer, weed control and water management aspects
12	Visit to nearby villages for identification of constraints in crop production (especially in context of Uttarakhand).

Suggestive Readings:

Text Books:

T1. Dr.Rajendra Prasad, Textbook of Field Crops Production Foodgrain Crops, Volume-I, ICAR, New Delhi, Eleventh Reprint of Revised Edition, 2021

T2. Modern techniques of raising field crops by Chhidda Singh and Rajbir Singh, Second Edition, Oxford and IBH Publishing.

Reference Book:

R1. Dr.Rajendra Prasad, "Textbook of Field Crops Production-Commercial Crops", Volume-II, ICAR, New Delhi, Eight Reprint of Revised Edition, 2021.

R2. Principles and practices of rice production by Surajit K. De Datta, wiley-interscience publication.

R3."Handbook of Agriculture", ICAR, New Delhi, Sixteenth Reprint of Sixth Edition, 2021.

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER III

Course: Agronomy of Oilseeds

Program	M.Sc. (Ag.) Agronomy	Semester- III			
Course Name	Agronomy of Oilseeds	L	T	P	C
Course Code	AGA C706	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To recall The importance and potential of oilseed crops in agriculture.
COb2	To understand Principles of oilseed crop nutrition and fertilization.
COb3	To Analyse Soil and climate requirement for oilseed crop production.
COb4	To Identify the major pests and diseases affecting oilseeds crops and their management practices
COb5	To Apply the concept of integrated pest management and sustainable agriculture practices in oilseed crop production.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	**Remember** the importance of oilseeds crop and their production in India	**L1**
CO2	**Understand** the oilseed crop growth and development, including nutrient uptake and water requirement	**L2**
CO3	**Apply** the knowledge of integrated pest and nutrient management to improve the yield and quality of oilseed crop.	**L3**
CO4	**Analyze** the problem associated with oilseeds crop production and management	**L4**
CO5	Evaluate the nutrient management on yield attributing character and yield of oilseed crop.	**L5**

Syllabus:

Unit-1	Ground nut and Soybean Oil seed crop Origin and classification	Contact Hours: 6
Origin & history, area & production, distribution, classification, and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for		

maximum production of Kharif (Ground nut and Soybean with special reference to Uttarakhand		
Unit-2	**Sesame and Castor Oil seed crop Origin and classification**	**Contact Hours:6**
Origin & history, area & production, distribution, classification, and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of Kharif (Sesame and Castor with special reference to Uttarakhand).		
Unit-3	**Rapeseed and Mustard Oil seed crop Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of Oilseeds, Rabi (Rapeseed and Mustard) with special reference to Uttarakhand..		
Unit-4	Linseed **Oil seed crop Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of Rabi (Linseed) Oil Seeds		
Unit-5	**Niger and Taramira Oil seed crop Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, description and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of Rabi (Safflower and Sunflower) Oil Seeds and Rabi (Niger and Taramira) Oil Seeds.		
Practical	**Suggested list of Exercises**	
1	To study about selection of Potato seed and its treatment and method of sowing of Potato.	
2	To study about brief classification of different oil seeds.	
3	To study about selection of sugarcane sets and its treatment.	
4	To study about seed treatment of cotton seed with conc. Sulphuric acid (H2SO4)	

	and cow dung mixture.
5	To calculate fertilizer requirement of N:P:K for Potato crop.
6	To calculate fertilizer requirement of N:P:K for Sugarcane crop.
7	To calculate fertilizer requirement of N:P:K for Groundnut crop.
8	Estimation of Oil Extraction in mustard and groundnut.
9	Estimation of protein in groundnut.
10	Estimation of sugar in sugarcane.
11	Visit nearby K.V.K.

Suggestive Readings:

Text Books:

T1. Rajendra Prasad, "Textbook of Field Crops Production- Commercial Crops", ICAR, New Delhi, Eight reprint of Revised Edition, 2021

T2. P.C. Das, "Oilseed crops of India" Kalyani Publishers, Second Revised Edition, 2014

Reference Books:

R1. "Handbook of Agriculture", ICAR, New Delhi, Sixteenth Reprint of Sixth Edition, 2021

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2
Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

Course Outcomes ↓									
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	1	2	3	3	3	3	2	2	2
CO5	1	2	2	2	3	3	3	3	3

SEMESTER III

Course: Agronomy of Fibre Crops

Program	M.Sc. (Ag.) Agronomy	Semester- III			
Course Name	Agronomy of Fibre Crops	L	T	P	C
Course Code	AGA C703	2	0	1	3

Objectives:

This course ensures that the students understand how:

COb1	To Describe the origin, history, classification, and varietal improvements of fiber crops such as jute, sunhemp, cotton, flax, sisal, and ramie, along with their area of production and distribution, particularly in the context of Uttarakhand.
COb2	To Explain the adaptability, climate, soil, water, and agricultural requirements for the cultivation of these fiber crops, including their development and nutritional needs based on agronomic investigation also address agricultural challenges
COb3	To Apply knowledge of crop quality, handling, and processing techniques to maximize the production of jute, sunhemp, cotton, flax, sisal, and ramie, with special emphasis on sustainable practices and modern technologies.
COb4	To Analyze the agronomic appraisal data to assess the performance of different crop varieties, evaluate the impact of environmental factors on crop growth to improve food security, enhance the living standards of small farmers through increased productivity and employment generation
COb5	To Design an agronomy research layout and evaluate the cost of cultivation, industrial uses of byproducts, and post-harvest handling and processing methods of crops to ensure sustainable agricultural practices

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	**Remember** the origin, history, classification, and varietal improvements of fiber crops such as jute, sunhemp, cotton, flax, sisal, and ramie,along with their areas of production and distribution, particularly in thecontext of Uttarakhand	**L1**
CO2	**Understand** the key agronomic terms and concepts related to the growth stages and cultivation practices of fiber crops	**L2**
CO3	**Apply** the interrelationships between environmental factors and the growth and yield of fiber crops, particularly in the context of Uttarakhand	**L3**
CO4	**Analyze** the adaptability, climate, soil, water, and agricultural requirements for the cultivation of jute, sunhemp, cotton, flax, sisal,and ramie, including their	**L4**

	developmentand nutritional needs based onagronomic investigation	
CO5	Evaluate the effectiveness of current cultivation practices and propose improvements incorporating modern technologies and sustainable practices	**L5**

Syllabus:

Unit-1	**Fiber Crop Jute Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, and agronomic appraisal of the varietal improvement of the crops (Jute). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Jute (especially in context of Uttarakhand).		
Unit-2	**Fiber Crop Sunhemp Origin and classification**	**Contact Hours:6**
Origin & history, area & production, distribution, classification and agronomic appraisal of the varietal improvement of the crops (Sunhemp). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Sunhemp (with special reference to Uttarakhand		
Unit-3	**Fiber Crop Cotton Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, and agronomic appraisal of the varietal improvement of the crops (Cotton). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Cotton (especially in context of Uttarakhand		
Unit-4	**Fiber Crop Flax Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, and agronomic appraisal of the varietal improvement of the crops (Flax). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Flax (especially in context of Uttarakhand		
Unit-5	**Fiber Crop Sisal and Ramie Origin and classification**	**Contact Hours: 6**
Origin & history, area & production, distribution, classification, and agronomic appraisal of the varietal improvement of the crops (Sisal and Ramie). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Sisal and Ramie (with special reference to Uttarakhand		
Practical	**Suggested list of Exercises**	

1	Phenological studies at different growth stages of crop
2	Estimation of crop yield on the basis of yield attributes
3	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
4	Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops
5	Planning and layout of field experiments
6	Judging of physiological maturity in different crops
7	Intercultural operations in different crops
8	Determination of cost of cultivation of different crops
9	Working out harvest index of various crops
10	Study of seed production techniques in various crops
11	Visit of field experiments on cultural, fertilizer, weed control and water management aspects (especially in context of Uttarakhand).
12	Visit to nearby villages for identification of constraints in crop production (especially in context of Uttarakhand).

Suggestive Readings:

Text Books:

T1. Dr.Rajendra Prasad, "Textbook of Field Crops Production-Commercial Crops", Volume-II, ICAR, New Delhi, Eight Reprint of Revised Edition, 2021.

Reference Book:

R1. Principles of Crop production by S R Reddy.

R2. Agronomy of field crops by S R Reddy.

R3."Handbook of Agriculture", ICAR, New Delhi, Sixteenth Reprint of Sixth Edition, 2021

Assessment Scheme

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	10			Levels 1 to 2

Test II	☑	1hr	10			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Quiz	☑	15 min	05			Level 1
Practical Exam	☑	1 hr	20			Levels 3 to 6
Comprehensive Exam	☑	3 hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	1	1	1
CO2	2	3	2	2	2	3	2	2	2
CO3	2	3	3	3	2	2	2	2	2
CO4	2	2	3	3	3	3	2	2	2
CO5	2	2	2	3	3	3	3	3	3

SEMESTER III

Multi- Disciplinary Course 5: Agricultural Research, Research Ethics And Rural

Program	M.Sc. (Ag.) Agronomy	**Semester-III**			
Course Name	Agricultural Research, Research Ethics And Rural Development Programmes	L	T	P	C
Course Code	AGA N005	1	0	0	1

Development Programmes

Course Objectives:

This course ensures that the students understand how:

COb1	To Identify and Recall the State the global agricultural research system: need, scope, opportunities, National agricultural research systems (NARS), Consultative group on international agricultural research (CGIAR), International agricultural research centres (IARC) and partnership with NARS.
COb2	To Explain the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security
COb3	To apply research ethics, standards and problems in research ethics
COb4	To Examine role of policies and strategies, IRDP, Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-governmental organisations, Constraints in implementation of rural policies and programmes.
COb5	To describe the International Strategy Agriculture Research Organization and functioning of agricultural research systems at national and international levels in the various policy implications, for Food security

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Recall the State the global agricultural research system: need, scope, opportunities, National agricultural research systems (NARS), Consultative group on international agricultural research (CGIAR), International agricultural research centres (IARC) and partnership with NARS	**L1**
CO2	Understand the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security.	**L2**
CO3	Apply the research ethics, standards and problems in research ethics.	**L3**
CO4	Analyze the role of policies and strategies, IRDP, Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-governmental organisations, Constraints in implementation of rural policies and programmes	**L4**
CO5	Evaluate the Agriculture Research Organization and functioning of agricultural research systems at national and international levels in the various policy implications, for Food security	**L5**

Syllabus:

Unit-1	History of Agriculture and Role in promoting food security	Contact Hours: 3
History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility		
Unit-2	**Research ethics**	**Contact Hours:3**
Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics		
Unit-3	**Rural development policies and strategies**	**Contact Hours: 3**
Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme		
Unit-4	**Integrated Rural Development Programme**	**Contact Hours: 3**
Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives		
Unit-5	**Non-Governmental Organisations**	**Contact Hours: 3**
Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes		

Text Books

1. **T1.** Bhalla GS & Singh G. Indian Agriculture - Four Decades of Development. Sage Publ. Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
2. Rao B.S.V. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ. New Delhi

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	20			Levels 1 to 2
Test II	☑	1hr	20			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Surprise Quiz	☑	10 mins	05			Level 1
Practical Exam	☑					Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3

SEMESTER III

Program	M.Sc. (Ag.) Agronomy	**Semester-III**			
Course Name	Basic Concepts In Laboratory Techniques (NC)	L	T	P	C
Course Code	AGA N006	1	0	1	2

Skill Enhancement Courses (SEC): Basic Concepts In Laboratory Techniques

Course Objectives:

This course ensures that the students understand how:

COb1	To Define the safety and handling of chemical substances, drying of solvents/chemicals, weighing and preparation of solutions of different strengths and their dilution and handling techniques of solutions
COb2	To Understand the preparation of solutions of acids, buffers of different strengths and pH values, use of laboratory equipment's
COb3	To Apply the experimental protocols in chemical analysis
COb4	To Analyze the experimental results from tissue culture media experiments and testing for seed viability, invitro tissue culture techniques in crop plants
COb5	To evaluate the trouble shooting of the various lab experiments while conduct of experimental results and finding.

Course Outcomes:

Towards the end of the course, the students will be able to:

CO	Outcome	BT Level
CO1	Define the safety and handling of chemical substances, drying of solvents/chemicals, weighing and preparation of solutions of different strengths and their dilution and handling techniques of solutions	**L1**
CO2	Understand the preparation of solutions of acids, buffers of different strengths and pH values, use of laboratory equipment's	**L2**
CO3	Apply the experimental protocols in chemical analysis	**L3**
CO4	Analyze the experimental results from tissue culture media experiments and testing for seed viability, invitro tissue culture techniques in crop plants	**L4**
CO5	Evaluate the trouble shooting of the various lab experiments while conduct of experimental results and finding.	**L5**

Syllabus:

Unit-1	**Safety Regulations in the Laboratory**	**Contact Hours: 3**

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.		
Unit-2	**Preparation of Stock solutions**	**Contact Hours:3**
Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions		
Unit-3	**Preparation of working samples**	**Contact Hours: 3**
Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values		
Unit-4	**Running of Equipment's for experiments**	**Contact Hours: 3**
Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing		
Unit-5	**Experiment protocol execution**	**Contact Hours: 3**
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		

Practical	**Suggested list of Exercises**	
1	Safety measures while in Lab	
2	Use of various glass ware and instruments present in lab	
3	Preparation of different agro-chemical doses in field	
4	Use and handling of microscope	
5	Preparation of media	
6	Seed viability testing	
7	testing of pollen viability	
8	Tissue culture of crop plants;	
9		

Text Books

1. **T1.** Furr A. K. CRC Hand Book of Laboratory Safety. CRC Press. Florida, US.
2. Gabb M. H. & Latchem W. E. A Handbook of Laboratory Solutions. Chemical Publ. Co. Florida, US

Assessment Scheme:

Component	Adopted for this Course	Duration	Weightage	Date & Time	Venue	Levels
Test I	☑	1hr	20			Levels 1 to 2
Test II	☑	1hr	20			Levels 1 to 2
Assignment	☑		05			Levels 1 to 5
Surprise Quiz	☑	10 mins	05			Level 1
Practical Exam	☑	1hr	20			Levels 3 to 6
Comprehensive Exam	☑	3hr	50			Levels 3 to 5

Course Outcomes – Program Outcomes (CO – PO) Mapping

Program Outcomes → Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	3	3	2	3	2	2	2
CO4	2	2	2	3	1	3	2	2	3
CO5	1	2	1	3	1	2	3	2	3