

SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC
u/s (2f) of UGC Act 1956]



SYLLABUS

FOR

M.SC. (AGRICULTURE) AGRONOMY

School of Agricultural Sciences

(w.e.f. 2021-22)

SHRI GURU RAM RAI UNIVERSITY

(Estd. By Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act No. 03 of 2017 Act No. 03 of July 2017)

Pathribagh, Dehradun-248001, Uttarakhand**M.SC. (AGRICULTURE) AGRONOMY****OUTCOME BASED EDUCATION****Programme outcome (POs)****Students will be able to:**

PO 1.	Quality education in Agriculture with special reference to Agronomy, Soil Science, Horticulture, Entomology, Plant Pathology, Seed Science & Technology and crop improvement to the solution of Agriculture related issues.
PO 2.	Understand and analyze the current events and issues that are occurring in agriculture and how they affect futuristic agriculture.
PO 3.	Skills to select and apply natural resources, modern techniques and IT tools for weather forecasting, soil analysis, pest management and quality seed production of food crops.
PO 4.	Research oriented innovative ideas should be recognized and examine the relationship between inputs and outputs in their agricultural field to make profitable decisions.
PO 5.	Research based knowledge of the environment and recognizes the importance of crop biodiversity in the field to preserve agro-ecosystem
PO 6.	Moral, ethical, and legal perspectives of Agricultural activities and their importance in local, regional, national and global societies.
PO 7.	Demonstrate the impact of globalization and diversification of agriculture. extension programmes to disseminate modern technologies for farmer's welfare
PO 8.	To engage in critical thinking by analyzing situations and constructing viable solutions with ability to work effectively with each.
PO 9.	.The programme will enhance job opportunities and entrepreneurship development
PO 10.	Self-critical opinion to solve the on farm problems on sustainable basis.
PO 11.	Know the recent development, future possibilities in agriculture sector. Provide comprehensive knowledge of agriculture production.
PO 12.	The students will generate a culture of lifelong learning in an inclined environment to get personal achievement and professional ethics.

Programme specific outcome (PSOs)

PSO 1.	To develop the skills of modern concepts in crop production
PSO 2.	To educate the various management strategies developed for the losses by various biotic and abiotic factors
PSO 3.	To disseminate modern agriculture knowledge as basic objective of education
PSO 4.	Develop skills in practical work experiments, equipments and laboratory use along with data collection and their interpretation.

School of Agricultural Sciences

'ACADEMIC RULES AND REGULATIONS'

(Effective from 2021-22)

01. Regulations

The Regulations provided herein shall apply to M.Sc. (Ag.) Agronomy Degree Programme offered by the Shri Guru Ram Rai University.

02. Short Title and Commencement

These regulations shall be called "M.Sc. (Ag.) Agronomy Degree Programme Academic Rules and Regulations 2020". They shall come into force from the academic year 2020-21.

03. Definitions & Abbreviations

3.1 'University' means the Shri Guru Ram Rai University, Dehradun.

3.2 'Curriculum' is a group of courses and other specified requirements for the fulfillment of the Degree Programme.

3.3 'Curricula and syllabi' It includes a list of approved courses for the Degree Programme wherein each course is identified by course code, outline of syllabus, credit assigned and semester wise distribution.

3.4 'Semester' means a period consisting of 90 working days inclusive of the mid-semester and practical examinations but excluding the study holidays and final theory examinations in each semester.

3.5 'Academic Year' means a period consisting of two consecutive semesters including the inter-semester break as announced by the University. The first year of study shall be the first and second semesters following student's admission. The second year of study shall be the third and fourth semesters.

3.6 'Course' is a teaching unit of a discipline to be covered within a semester as detailed in the Curricula and Syllabi issued by the University.

3.7 Core Course: Core course means the list of courses specified by the University in the curricula and syllabi to be registered compulsorily by the students of M.Sc. (Ag.) Agronomy Degree Programme.

3.8 Other Course: Other courses include Master's seminar & Thesis Research to be registered compulsorily by the students of M.Sc. (Ag.) Agronomy Degree Programme.

3.9 'A credit' in theory means one hour of class room lecture and a credit in practical means two and half hour of laboratory or field work per week.

Explanation:

A 1+1 course (2 credits) means 1 hour theory and two and half hour practical per week.

A 0+1 course (1 credit) means two and half hour practical per week.

A 1+0 course (1 credit) means 1 hour theory per week.

3.10 'C' is abbreviated for Credit

'L' for lecture

'T' for Tutorial

'P' for Practical or Lab work or Field work

04. Eligibility for admission to M.Sc. (Ag.) Agronomy Degree Programme:

A candidate passes in the B.Sc.Agriculture / or equivalent degree programme from a recognized college/Institute/University.

05. Admission Procedure: As per the University Norms.

06. System of Education

6.1 The system of education for M.Sc. (Ag.) Agronomy Degree programme is Semester System with duration of two academic years (4 Semesters). The maximum duration permissible for a student shall be 06 consecutive semesters (3 years). If a student at any stage of his/her course is found unable to complete it within the said time, he/she shall not be allowed to continue the studies further.

6.2 The date of commencement and closure of semesters as well as inter-semester break and schedule of final theory examinations shall be announced by the University.

6.3 Credits are assigned to each course in M.Sc. (Ag.) Agronomy on the basis of the number of theory classes or lectures and Practical classes or laboratory work or field work as well as other form of learning required to complete course content in a scheduled period as decided by the University.

6.4 An academic calendar shall be prepared by the University for every semester indicating the date of commencement and closure of semesters, date of mid semester examinations, final practical and theory examinations, inter semester break and holidays.

6.5 Summary of Credits in M.Sc. (Ag.) Agronomy (All Semesters)

Semester	Core course	Elective course	Supporting courses	Total credits
I	10	-	04	14
II	13	03	-	16
III	09	03	-	12
IV	21		-	21
Grand Total				63

6.6 A student must successfully complete a total of 63 credits which include 53 credits for core courses, 06 credits elective courses, 04 credits basic supporting course as per the Curriculum requirement of M.Sc. (Ag.) Agronomy Degree Programme.

6.7 A course shall be offered only once in an academic year during the semester as listed in the course curricula and syllabi.

07. The Medium of Instruction: The medium of instruction will be in English.

08. Reservation: The reservation will be as per the State Government rules / University Norms and Policies.

09. Total Seats: The total seats in M.Sc. (Ag.) Agronomy degree programme will be as per the guidelines of the University.

10. Fee structure: As decided by the University.

11. Attendance: As per University Norms.

12. Examination and Evaluation: As per University Norms with following guidelines:

12.1 The medium of Examination:

The medium of Examination will be English.

12.2 Duration of examinations: The examinations shall be conducted according to the description given below:

Examination	Courses with theory and practical	Courses with only theory	Courses with only practical
Mid-semester Examination (internal)	1.0 hour	1.0 hour	--
Final Theory Examination	3.0 hours	3.0 hours	--
Final Practical Examination	3.0 hours	--	3.0 hours

12.3 Distribution of marks in External and Internal Exams:

(a) Courses with Theory and Practical both (Maximum Marks 100):

- External Theory Examination (50% or 50 marks) in each paper
- Internal Mid-term theory Examinations (30% or 30 marks) in each paper
- Internal Practical Examination (20% or 20 marks) in each paper

(b) Courses with only Theory (Maximum Marks 100):

- External Theory Examination (50% or 50 marks) in each paper
- Internal Mid-term theory Exams (40% or 40 marks) + Assignment (10% or 10 marks) in each paper

(c) Courses with only Practical (Maximum Marks 100):

- Internal Practical Examination (100% or 100 marks) in each paper

12.4 Assessment Norms: As per University Norms

12.5 Question paper pattern:

(a) External theory Examinations for courses with theory and practical:

The question paper pattern for External theory Examination (Maximum Marks: 50) for courses with theory and practical is given below:

SECTION	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total Marks
A	Objectives	10	10	01	10
B	Short answer type	08	04	05	20
C	Long answers type	04	02	10	20
Total					50

(b) External theory Examinations for courses with theory only:

The question paper pattern for External theory Examinations (Maximum marks: 50) for courses with only theory shall be as per given in section 12.5 (a).

(c) Mid-term Exam:

Courses with theory and practical both shall contain two Mid-term Exams of 15 marks each. Courses with only theory shall contain two mid-term Exams of 20 marks each plus an assignment of 10 marks. Question paper for Mid-term Exams can be designed by Examiner as per the requirement of course content including objective and short answer type questions.

(d) Practical Exam:

Courses with theory and practical shall contain one practical Exam of 20 marks including Written (5 marks) + Spotting (2.5 marks) + Viva (5 marks) + Lab record (2.5 marks) + assignment (5 marks).

(e) Practical Examinations for courses with practical only:

Courses with practical only shall contain one practical Exam of 100 marks including Written (30 marks) + Spotting (10 marks) + Viva (15 marks) + Lab record (15 marks) + Attendance (15 marks) + Assignment (15 marks).

13. Submission of Master's Thesis: As per University Norms.

14. Promotion of students to next semester: Cases of students' promotion to next semester such as Back papers, Carry over system, Ex – Studentship, Special examination, Grace Marks, Candidate leaving the semester will be as per the University Norms and policies.

15. Approval of Final Results, Award of Degree and Issue of Provisional Certificates

And Transcripts or Mark sheet: As per University Norms

16. Removal of Difficulties:

16.1 If any difficulty arises in giving effect to the Provisions of these regulations, the University may issue necessary orders which appear to be necessary or expedient for removing the difficulty.

16.2 Every order issued by the University under this provision shall be laid before the Academic Council of the University immediately after the issuance.

16.3 Notwithstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary

COURSE CURRICULUM
M. Sc. (Ag.) Agronomy

A. Core Courses			
S. No.	Course Number	Name of the Courses	Credit Hours
1.	MSAC-101	Advances in Soil fertility and Nutrient Management	3 (2-0-1)
2.	MSAC-102	Agronomy of Major Cereals and Pulses	4 (3-0-1)
3.	MSAC-103	Dry land Farming and watershed Management	3 (3-0-0)
3.	MSAC-201	Agro meteorology and crop Weather Forecast	3 (2-0-1)
4.	MSAC-202	Cropping System and Sustainable Agriculture	3 (2-0-1)
5.	MSAC-203	Agronomy of Oil Seed, Fibre & Sugar Crops	4 (3-0-1)
6.	MSAC-204	Principles and practices of water management	3 (2-0-1)
7.	MSAC-301	Principles and Practices of Organic Farming	3 (2-0-1)
8.	MSAC-302	Modern concept in Crop Production	3 (2-0-1)
9.	MSAC-303	Principles and Practices of Weed Management	3 (2-0-1)
10	MSAC-401	Master's Seminar	01
Total			33
B. Basic Supporting Courses			
11.	MSAS-104	Statistical Methods and Experimental Designs	3 (3-0-1)
Total			03
C. Research			
9.	MSAC-402	Master's Thesis Research	20
D. Elective Courses			
10.	-	From the list of elective courses	06 (Minimum)

List of Elective Courses:

S.No.	Course No.	Course Title	Credit hours
1.	MSAE-205	Management of Problematic Soils	3 (2-0-1)
2.	MSAE-206	Stress Physiology	3 (2-0-1)
3	MSAE-207	Agronomy of Fodder and Forage crops	3 (2-0-1)
4	MSAE-304	Agrostology and Agroforestry	3 (2-0-1)
5	MSAE-305	Crop Ecology	3 (2-0-1)
6.	MSAE-306	Agronomy of Medicinal, Aromatic and Under-Utilized Crops	3 (2-0-1)

SEMESTER WISE DISTRIBUTION OF COURSES**M.Sc. (Agriculture) Agronomy****First Semester**

S. No.	Course Code	Course Title	Periods			Credit Hours	M M
			L	T	P		
Core Courses							
1.	MSAC-101	Advances in Soil fertility and Nutrient Management	2	0	1	3	100
2.	MSAC-102	Agronomy of Major Cereals and Pulses	3	0	1	4	100
3.	MSAC-103	Dry land Farming and watershed management	3	0	0	3	100
Basic Supporting Courses							
4.	MSAS-104	Statistical Methods and Experimental Designs	3	0	1	4	100
Total			10	0	4	14	400

Semester-II

S. No.	Course Code	Course Title	Periods			Credit Hours	MM
			L	T	P		
Core Courses							
1.	MSAC-201	Agro meteorology and crop Weather Forecast	2	0	1	3	100
2.	MSAC-202	Cropping System and Sustainable Agriculture	3	0	0	3	100
3.	MSAC-203	Agronomy of Oil Seed, Fibre & Sugar Crops	3	0	1	4	100
4.	MSAC-204	Principles and practices of water management	2	0	1	3	100
5.	Elective Course-1 (from the list of elective courses)		2	0	1	3	100
Total			12	0	4	16	500

Semester-III

S. No.	Course Code	Course Title	Periods			Credit Hours	MM
			L	T	P		
Core Courses							
1.	MSAC-301	Principles and practices of organic farming	2	0	1	3	100
2.	MSAC-302	Modern concept in Crop Production	2	0	1	3	100
3.	MSAC-303	Principles and practices of weed management	2	0	1	3	100
4.	Elective Course-2 (from the list of elective courses)		2	0	1	3	100
Total			09	0	4	12	400

Semester-IV

S. No.	Course Code	Course Title	Periods			Credit Hours	MM
			L	T	P		
1.	MSAC-401	Master's Seminar	0	0	1	1	100

MSAC-402 Master's Thesis Research:

Students may register up to 20 credits from first to fourth Semester during M. Sc. (Ag.) Agronomy program

DESCRIPTION OF COURSES

M.Sc. (Ag.) Agronomy

Programme Name	M.Sc. (Ag.) Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-101	Credit	3(2+1)
Year/Sem	1/I	L-T-P	2-0-1
Course Name	Advances in soil fertility and nutrient management		
<p>Course Objectives: The objectives of this course are</p> <ol style="list-style-type: none"> 1. To impart the knowledge about the basic concept of soil fertility, plant nutrients and Maintenance of soil resources on sustainable basis. 2. To develop understanding of the integrated approach of nutrient management. 3. To develop the skills of soil and plant analysis. 4. To develop the ability to identify nutrients related problems and their solution. 			
<p>UNIT- I (Total Topics-3 and Hrs-3) 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</p>			
<p>UNIT- II (Total Topics-3 and Hrs-3) Criteria of essentiality of nutrients; Essential plant nutrients - their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients</p>			
<p>UNIT- III (Total Topics-5 and Hrs-7) Preparation and use of farmyard manure, compost, green manures, vermicompost, bio fertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.</p>			
<p>UNIT- IV (Total Topics-5 and Hrs-7) 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</p>			
<p>UNIT-V (Total Topics-5 and Hrs-10) 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</p>			
<p>Practical (Experiments-6 and Hrs-30)</p> <ul style="list-style-type: none"> • Determination of soil pH and soil EC • Determination of soil organic C • Determination of available N, P, K and S of soil • Determination of total N, P, K and S of soil • Determination of total N, P, K, S in plant 			

- Computation of optimum and economic yield

Upon successful completion of the course a student will be able to:

CO.1	Memorize basic concept of soil fertility, plant nutrients and maintenance of soil resources on sustainable basis.
CO.2	Outline and summarize the integrated approach of nutrient management.
CO.3	skilled for soil and plant analysis
CO.4	Analyze nutrients related problems and their solution
CO .5	Assesses the soil fertility and methods of fertilizer application
CO .6	Execute and manage the experimental protocol regarding nutrient budgeting for crop production
Suggested Readings	
<ul style="list-style-type: none"> • Brady NC & Weil R.R 2002. <i>The Nature and Properties of Soils</i>. 13th Ed. Pearson Edu. • Fageria NK, Baligar VC & Jones CA. 1991. <i>Growth and Mineral Nutrition of Field Crops</i>. • Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. <i>Soil Fertility and Fertilizers</i>. 7th Ed. Prentice Hall. • Prasad R & Power JF. 1997. <i>Soil Fertility Management for Sustainable Agriculture</i>. CRC Press. • Yawalkar KS, Agrawal JP & Bokde S. 2000. <i>Manures and Fertilizers</i>. Agri-Horti Publ. 	

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	-	-	2	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	2	1	2	-	-	-	1	-	-	-	-	-	2	-	2	2
CO4	1	1	2	1	-	-	-	-	-	2	1	-	-	-	-	-
CO5	-	-	1	2	2	1	2	2	1	1	2	2	-	-	2	-
CO6	-	-	-	1	2	1	1	1	1	1	3	3	2	3	2	2
Average	1.6	1.5	1.4	1.5	2	1.3	1.5	1.5	1	1.3	2	2.5	2	2	2	2

Programme Name	M.Sc.(Ag.) Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-102	Credit	4(3+)
Year/Sem	1/I	L-T-P	2-0-1
Course Name	Agronomy of Major Cereals and Pulses		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To acquaint with the Cereals and Pulses, their distribution in India and Worldwide. 2. To develop understanding of the production technology, economic value, centre of Origin, soil and climatic requirement of cereals and pulse crops. 3. To develop the skills of cropping scheme and growth indices. 4. To develop the ability to identify problems identification and their management during Cultivation. 			
<p>UNIT-I (Total topics-5 and Hrs. 8) Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of <i>Kharif</i> cereals.- Paddy, Maize, Sorghum, Bajra & Smaller Millets</p>			
<p>UNIT- II (Total topics-5 and Hrs. 8) Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of <i>Rabi</i> cereals. - Wheat and Barley, winter Maize</p>			
<p>UNIT- III (Total topics-3 and Hrs. 6) Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of <i>Kharif</i> pulses- Arhar, Mungbean and Urdbean.</p>			
<p>UNIT- IV (Total topics-5 and Hrs. 8) Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of <i>Rabi</i> pulses- Gram, Lentil, French bean and Field Pea.</p>			
<p>Practical (Experiments-10 and Hrs-25)</p> <ul style="list-style-type: none"> • Phenological studies at different growth stages of crop • Estimation of crop yield on the basis of yield attributes • Formulation of cropping schemes for various farm sizes and calculation of cropping and rotation intensities • Working out growth indices (LAI, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and LER of prominent intercropping systems of different crops • Estimation of protein content in pulses 			

- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops
- Working out harvest index of various crops
- Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

Upon successful completion of the course a student will be able to:

CO 1	Gather information regarding cereal and pulse crops in India and worldwide
CO 2	Outline and summarize cropping system and cropping pattern
CO 3	Analyze the problems and their management during crop cultivation
CO 4	Manage cultivation of crops
CO 5	Evaluate the physiological condition of crops
CO 6	Create crop experimental design

Suggested Readings

- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
- Jeswani LM & Baldev B. 1997. *Advances in Pulse Production Technology*. CAR.
- Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.
- Kumar Ranjeet & Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, NewDelhi.
- Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*. *Tata McGraw Hill*.
- Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Singh SS. 1998. *Crop Management*. Kalyani.
- Yadav DS. 1992. *Pulse Crops*. Kalyani

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	-	-	2	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	2	1	2	-	-	-	1	-	-	-	-	-	2	-	2	2
CO4	1	1	2	1	-	-	-	-	-	2	1	-	-	-	-	-
CO5	-	-	1	2	2	1	2	2	1	1	2	2	-	-	2	-
CO6	-	-	-	1	2	1	1	1	1	1	3	3	2	3	2	2
Average	1.6	1.5	1.4	1.5	2	1.3	1.5	1.5	1	1.3	2	2.5	2	2	2	2

Programme Name	M.Sc.Ag. Agronomy	Program Code	MSCAG1095
Course Code	MSAC-103	Credit	3(3+0)
Year/Sem	1/I	L-T-P	3-0-0
Course Name	Dry land farming and watershed management		
Course Objectives: The objectives of this course are: 1. To acquaint with the basic concept of dry land farming in India. 2. To develop understanding of the water harvesting and watershed management. 3. To develop the skills of soil water conservation, crop management under stress conditions. 4. To develop the ability of planning cropping system and cropping schemes for dry land areas			
UNIT-I (Total topics-5 and Hrs. 8) Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture			
UNIT-II (Total topics-6 and Hrs. 7) Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.			
UNIT- III (Total Topics-5 and Hrs-7) Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.			
UNIT –IV (Total Topics-8 and Hrs-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); anti- transparent; soil and crop management techniques, seeding and efficient fertilizer use.			
UNIT –V (Total Topics-8 and Hrs-8) Concept of watershed resource management, problems, approach and components. planning and operation of projects for watershed management. Development of cropping system for watershed areas			

Upon successful completion of the course a student will be able to:

CO 1	Memorize dimensions of dry land in India and their classification
CO 2	Acquaint with classification of dry climate and agro climatic zones of India and their characteristics in relation to productivity
CO 3	Examine constraints for crop production in dry farming areas
CO 4	Estimating drought and Strategies for its management
CO 5	Evaluate soil and moisture conservation approaches
CO 6	Formulate IFS models for dry farming areas

Suggested Readings

- Das NR. 2007. Tillage and Crop Production. Scientific Publishers.
- Dhopte AM. 2002. Agro technology for Dryland Farming. Scientific Publ.
- Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR.
- Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH.
- Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
- Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publishers.
- Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
- Singh RP. 1988. Improved Agronomic Practices for Dryland Crops. CRIDA.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	-	-	2	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	2	1	2	-	-	-	1	-	-	-	-	-	2	-	2	2
CO4	1	1	2	1	-	-	-	-	-	2	1	-	-	-	-	-
CO5	-	-	1	2	2	1	2	2	1	1	2	2	-	-	2	-
CO6	-	-	-	1	2	1	1	1	1	1	3	3	2	3	2	2
Average	1.6	1.5	1.4	1.5	2	1.3	1.5	1.5	1	1.3	2	2.5	2	2	2	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1 095
Course Code	MSAS-104	Credit	4(3+1)
Year/Sem	1/I	L-T-P	3-0-1
Course Name	Statistical Methods and Experimental Designs		
Course Objectives: The objectives of this course are:			
<ol style="list-style-type: none"> 1. To acquaint with the basic concept of statistics, experimental designs, analysis of variance, hypothesis. 2. To develop understanding of growth and yield parameters of crops and collection of data. 3. To develop the ability to select problem and layout field experiments. 4. To develop the skills to conduct experiments and their statistical analysis 			
UNIT-I (Total Topics-8 and Hrs-5)			
Processing of data: Classification and tabulation of statistical data by categories and measurements, graphical and diagrammatic representation-histogram. Frequency polygon, frequency curve and cumulative frequency curves.			
UNIT- II (Total Topics-7 and Hrs-4)			
Measure of location and dispersion: Mean, median, mode, partition values (quartiles, deciles and percentiles). Range, quartile deviation, mean deviation about mean and median, standard deviation coefficient of variation, moment kurtosis			
UNIT –III (Total Topics-6 and Hrs-5)			
Probability & distribution: Random experiment, sample space (discrete case only), events mathematical and statistical definition of probability, random variable (discrete and continuous), bermoulli trials, binomial distribution. poisson distn. Poisson distn as a limiting case of the binominal distn, normal sistn, properties of the above distributions and fitting with available date, Test for their goodness of fit			
UNIT- IV (Total Topics-8 and Hrs-6)			
Correlation and regression : Bivariate dats, bivariate frequency distribution, correlation coefficient, rank correlation, Regression lines, regression coefficients and their relation with correlation coefficient, Multiple regression, multiple and partial correlation coefficients			
UNIT –V (Total Topics-7 and Hrs-5)			
Estimation: Concept of population and sample; parameters and statistics: criteria for a good estimate or unbiasedness, consistency of population mean and its confidence internal in the normal case.			
UNIT- VI (Total Topics-8 and Hrs-6)			
Testing of hypothesis: Null and alternative hypotheses, two type of errors, level of significance			
UNIT- VII (Total Topics-8 and Hrs-6)			
Tests of significance: (a) large sample tests for mean & equality of means of two populations (2 tests). Student's statistic and its use of testing the mean equality of means of two populations (with independent and paired observations) correlation coefficient and regression coefficients. Chi-Square statistics and its use as a test of goodness of fit, independence of attributes (contingency table) with Yates correction, and testing for the variance of a population. (c) Fishers statistic and its use in testing the equality of two variances and homogeneity of means (analysis of variance).			
UNIT- VIII (Total Topics-8 and Hrs-6)			
Analysis of variance and covariance (ANOVA and ANCOVA): Analysis of variance and covariance with			

one way and two-way classifications (one observation per cell). Bartlett's test for testing the homogeneity of variances.

UNIT –IX (Total Topics-8 and Hrs-6)

Design of experiments: Need: uniformity trials, Principles of experimental design replication, randomization and local control, (a) Completely Randomized Design, Randomized Block Design and Latin Square Designs and their analysis, missing plot technique in RBD. (b) Simple factorial experiments of the type 2², 3³, 2⁴, 3², confounding in factorial experiments. (c) Split-plot experiments

Practical Experiments-(8 and Hrs-16)

- Presentation of data-tabulation, histograms and frequency polygons
- Calculation of mean, mode, standard deviation, skewness and kurtosis
- Calculation of expected frequencies in binomial, poisson and normal distributions testing the observed results against expected frequencies
- Tests of significance as prescribed in theory
- Regression and correlation coefficients and their significance
- Analysis of variance for different designs prescribed
- Analysis of covariance

Upon successful completion of the course a student will be able to:

CO 1	Define the basic concept of statistics, t-test, f-test, hypothesis, and sampling.
CO 2	Understand the role of statistics in research experiments.
CO 3	Choose and prepare experimental designs.
CO 4	Analyze the results of statistical calculations and their validation
CO 5	Evaluate the properties of estimators
CO 6	Plan and Manage field experimental designs

Suggested Readings

- Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
- Federer WT. 1985. *Experimental Designs*. MacMillan.
- Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
- Pearce SC. 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	-	-	2	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	2	1	2	-	-	-	1	-	-	-	-	-	2	-	2	2
CO4	1	1	2	1	-	-	-	-	-	2	1	-	-	-	-	-
CO5	-	-	1	2	2	1	2	2	1	1	2	2	-	-	2	-
CO6	-	-	-	1	2	1	1	1	1	1	3	3	2	3	2	2
Average	1.6	1.5	1.4	1.5	2	1.3	1.5	1.5	1	1.3	2	2.5	2	2	2	2

Programme Name	M.S.Ag. Agronomy	Programe Code	MSCAG10 95
Course Code	MSAC-201	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Agro Meteorology and Crop Weather Forecasting		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To acquaint with the basic terms, concept, principles and objectives of Agro Meteorology and Crop Weather Forecasting variance, hypothesis. 2. To develop understanding of Indian monsoons, their types, distribution and constrains of erratic, uneven distribution of rainfall. 3. To develop the skills for safe handling of instruments in automated weather station and recording of data. 4. To develop the ability to use principles and data related to weather forecasting and utilization of agro-advisory released by Indian and State meterological department. 			
<p>UNIT- I (Total Topics-8 and Hrs-6) Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind</p>			
<p>UNIT- II (Total Topics-8 and Hrs-6) Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature</p>			
<p>UNIT- III (Total Topics-8 and Hrs-6) Temperature profile in air, soil, crop canopies soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapo-transpiration and meteorological factors</p>			
<p>UNIT –IV (Total Topics-8 and Hrs-6) Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation. Determining evapo-transpiration</p>			
<p>UNIT –V (Total Topics-8 and Hrs-6) Weather forecasting in India - short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.</p>			
<p>Practical (Experiments-10 and Hrs-30)</p> <ul style="list-style-type: none"> • Visit to agro-meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure. • Measurement of solar radiation outside and within plant canopy. • Measurement/estimation of evapo-transpiration by various methods. • Measurement/estimation of soil water balance. • Rainfall variability analysis. • Determination of heat-unit requirement for different crops. • Measurement of crop canopy temperature. • Measurement of soil temperatures at different depths. • Remote sensing and familiarization with agro-advisory service bulletins. 			

Upon successful completion of the course a student will be able to:

CO 1	Memorize roles of agro meteorology.
CO 2	Classify meteorological and hydrological factors in relation to agriculture..
CO 3	Solve the problems based on climatic factors.
CO 4	Categories of Weather and climate.
CO 5	Assesss the effect of precipitation on crop production
CO 6	Design crop weather calendar for various agroclimatic zones

Suggested Readings

- Chang Jan Hu 1968. Climate and Agriculture on Ecological Survey. AldinePubl.
- Critch field HJ.1995. *General Climatology*. Prentice Hall ofIndia.
- Das PK.1968. *The Monsoons*. National Book TrustPubl.
- Lal DS.1998. *Climatology*. Sharda Pustak Bhawan.
- Lenka D.1998. Climate, Weather and Crops in India.Kalyani.
- Mavi H.S.1994. Introduction to Agro-meteorology. Oxford &IBH.
- Mavi HS & Tupper GJ. 2004. Agrometeorology: Principles and Application of Climate Studies in Agriculture. Haworth Press.
- Menon PA.1991. Our Weather. National Book Trust Publ.Sahu DD. Agrometeorology and Remote Sensing: Principles and Practices.Agrobios.
- Variraju R & Krishnamurty 1995. Practical Manual onAgricultural Meteorology.Kalyani.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	1	1	2	-	-	1	-	-	-	-	-	-	2	-	-	2
CO4	1	1	1	1	2	1	-	-	-	-	1	3	-	-	-	-
CO5					2		2		3	1	2	-				
CO6							2		2	2	2	2				
Average	1.3	1.25	1.5	1	2	1.3	2	-	1.5	1.5	1.6	2.5	2	1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-202	Credit	3(3+0)
Year/Sem	1/II	L-T-P	3-0-0
Course Name	Cropping Systems and Sustainable Agriculture		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To Acquaint with the basics of cropping systems 2. To develop understanding of cropping scheme. 3. To develop the skills for cropping intensity and rotation intensity 4. To develop the skills for site specific problems and their solutions. 			
<p>UNIT –I (Total Topics-8 and Hrs-6) Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.</p>			
<p>UNIT II (Total Topics-8 and Hrs-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.</p>			
<p>UNIT III (Total Topics-8 and Hrs-6) Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture</p>			
<p>UNIT IV (Total Topics-8 and Hrs-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.</p>			
<p>UNIT V (Total Topics-8 and Hrs-6) Plant Ideotypes for dry lands; plant growth regulators and their role in sustainability.</p>			

Upon successful completion of the course a student will be able to:

CO 1	Acquainted with the basics of cropping systems
CO 2	Build and manage cropping scheme
CO 3	Calculate cropping intensity, rotation intensity etc
CO 4	Analyze site specific problems and their solutions.
CO 5	Evaluate the factors affecting crop growth analysis.
CO 6	Formulate advanced concept of crop growth productivity

Suggested Readings:

- Palaniappan SP & Sivaraman K. 1996. Cropping Systems in the Tropics; Principles and Management. New Age.
- Panda SC. 2017. *Cropping Systems and Sustainable Agriculture*. Agrobios (India)
- Panda SC. 2018. *Cropping and Farming Systems*. Agrobios.
- Reddy SR. 2000. Principles of Crop Production.

- Kalyani.Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ.Co.
- Singh SS. 2006. Principles and Practices of Agronomy.Kalyani.
- Menon PA.1991. Our Weather. National Book Trust Publ.Sahu DD. Agro meteorology and Remote Sensing: Principles and Practices.Agrobios.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	1	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	1	1	2	-	-	1	-	-	-	-	-	-	2	-	-	2
CO4	2	1	1	1	2	1	-	2	2	2	2	-	-	-	-	-
CO5				2	2		2			1	2	2				
CO6							2					1				
Average	1.5	1.25	1.5	1.5	2	1.3	2	2	2	1.5	2	1.5	2	1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG195
Course Code	MSAC-203	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Agronomy of Oilseed, Fibre and Sugar Crops		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To acquaint with the basics of oilseed, fibre and sugar crops production. 2. To develop understanding of cropping system. 3. To develop the skills for cropping intensity and rotation intensity 4. To develop the of skills Planning and layout of field experiments 			
<p>Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of :</p>			
<p>UNIT I (Total Topics-8 and Hrs-6) <i>Kharif</i> oilseeds - Groundnut, sesame, castor, soybean etc.</p>			
<p>UNIT II (Total Topics-8 and Hrs-6) <i>Rabi</i> oilseeds - Rapeseed and mustard, linseed, sunflower, safflower oil seed.</p>			
<p>UNIT III (Total Topics-8 and Hrs-6) Fiber crops - Cotton, jute, sun hemp etc.</p>			
<p>UNIT IV (Total Topics-8 and Hrs-6) Sugar crops - Sugar-beet and sugarcane.</p>			
<p>Practical (Total Topics-8 and Hrs-6)</p> <ul style="list-style-type: none"> • Planning and layout of field experiments • Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane • Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop • Intercultural operations in different crops • Cotton seed treatment • Working out growth indices (LAI, CGR, RGR, NAR, LAD) aggressively, relative crowding coefficient, monetary yield advantage and LER of prominent intercropping systems • Judging of physiological maturity in different crops and working out harvest index • Working out cost of cultivation of different crops • Estimation of crop yield on the basis of yield attributes • Formulation of cropping schemes for various farm sizes and calculation of cropping and rotation intensities • Determination of oil content in oilseeds and computation of oil yield • Estimation of quality of fibre of different fibre crops • Study of seed production techniques in various crops 			

CO 1	Identify and recognize the seeds of oilseed, fibre and sugar crops.
CO 2	Classify crops according to economic importance
CO 3	Prepare cropping scheme.
CO 4	Practical knowledge for the Planning and layout of field experiments
CO 5	Assess a nature of farm site and develop a new crooping system with available resources
CO 6	Construct postharvest management practices and value addition

Suggested Readings

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Das PC. 1997. Oilseed Crops of India. Kalyani.
- Lakshmikantam N. 1983. Technology in Sugarcane Growing. 2nd Ed. Oxford &IBH.
- Prasad, Rajendra. 2002. Text Book of Field Crop Production. ICAR.
- Singh C, Singh P & Singh R. 2003. Modern Techniques of Raising Field Crops.Oxford &IBH.
- Singh SS. 1998. Crop Management.Kalyani.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	1	-		2	1	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-		-		1	-	-
CO3	1	1	2	-	-	1	-	-	-	-		2		-	1	2
CO4	1	1	1	1	-	1	1	-	1	-	2	-	2	-	1	-
CO5	-	-	-	-	-	-	2	-	2	2	3	-	2	-	2	
CO6	-	-	-	-	-	-	-	-	3	2	2	-	-	-	-	
Average	1.3-	1.25	1.5	1	-	1.3	-	-	1	-		2		1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-204	Credit	3(2+1)
Year/Sem	1/II	L-T-P	3-0-1
Course Name	Principles and Practices of Water Management		

Course Objectives: The objectives of this course are:

1. To develop understanding of water management.
2. To develop the skills of water resources of India.
3. To develop the skills of soil-water-plant relationships.
4. To develop the ability to manage moisture stress conditions.

UNIT- I (Total Topics-8 and Hrs-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.

UNIT II (Total Topics-8 and Hrs-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- III (Total Topics-8 and Hrs-6)

Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and poly houses.

UNIT -IV(Total Topics-8 and Hrs-6)

Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.

UNIT -V(Total Topics-8 and Hrs-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 (Total Topics-8 and Hrs-30)

- Measurement of soil water potential by using tensiometer, and pressure plate and membrane apparatus.
- Soil-moisture characteristics curves
- Water flow measurements using different devices
- Determination of irrigation requirements (Calculations)
- Calculation of irrigation efficiency
- Determination of infiltration rate
- Determination of saturated/unsaturated hydraulic conductivity
- Measurement of irrigation water by measuring devices and calculation of irrigation efficiency

Upon successful completion of the course a student will be able to:

CO1	Memorize basic concept of water management.
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CO2	Outline and summarize the water resources of India.
CO3	Display and execute the principles of soil-water-plant relationships.
CO4	Manage moisture stress conditions.
CO5	Assess the suitable method of irrigation according to crops.
CO6	Construct ideologies pertaining to water management in problematic soils
<p>Suggested Readings</p> <ul style="list-style-type: none"> • Lenka D. 1999. Irrigation and Drainage.Kalyani • Majumdar DK. 2014. <i>Irrigation Water Management: Principles and Practice</i>. PHL Learning private publishers • Michael AM. 1978. Irrigation: Theory and Practice. Vikas Publ. • Paliwal KV. 1972. <i>Irrigation with Saline Water</i>. IARI Monograph, New Delhi. • PandaSC. 2003. Principles and Practices of Water Management.Agrobios. • Prihar SS & Sandhu BS. 1987. Irrigation of Food Crops - Principles and Practices.ICAR • Reddy SR. 2000. Principles of Crop Production.Kalyani. • Singh Pratap & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ. 	

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	-	-		1	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-		-	-	1	-	-
CO3	1	1	2	-	-	1	-	-	-	-		-	2	-	-	2
CO4	1	1	1	1	-	1	-	2	-	1		1	-	-	-	-
CO5							2			2	3	2				
CO6									1		2	2				
Average	1.3	1.25	1.5	1	-	1.3	-	-	-	1			2	1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-205	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Management of Problematic Soils		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding of problematic soils. 2. To develop skills to understand salt-affected soils and their management. 3. Basic nature, sources, effect and management of acid soils 4. To develop the ability to assess quality of irrigation water 			
<p>UNIT-I (Total Topics-8 and Hrs-6) Problem soils classification and distribution. Nature and properties of saline, alkali and acidic soils.</p>			
<p>UNIT –II (Topics-8 and Hrs-6) Plant responses to soil reaction, extent of damage to crops, salt tolerance of the crops. Management and improvement of saline, alkali and acidic soils.</p>			
<p>UNIT –III (Total Topics-8 and Hrs-6) Excess soil water conditions – sources and occurrences. Rainfall analysis and water balance. Effect of excess soil water on crop growth.</p>			
<p>UNIT- IV(Total Topics-8 and Hrs-6) Management of excess soil water, water fluctuation and side movements, lowering of water table for successful crop production. Degraded soils and their rehabilitation</p>			
<p>Practical (Total Topics-8 and Hrs-30)</p> <ul style="list-style-type: none"> • Determination of pH, E.C., gypsum requirement for sodic soils and lime requirement for acidic soils. • Determination of specific gravity, bulk density, porosity and soil texture. • Analysis of irrigation water. • Visit to areas of problem soils. 			

Upon successful completion of the course a student will be able to:

CO1	Memorize basic concept of problematic soils.
CO2	Outline and summarize salt-affected soils and their management.
CO3	Basic nature, sources, effect and management of acid soils.
CO4	Estimate the quantity of water required by crop.
CO5	Assess and collaborate quality of irrigation water
CO6	Solve the problems of acidic soils.
Suggested Readings	

- Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. 1982. Saline and Alkali Soils of India. ICAR, New Delhi
- Bolt, G.H. and Bruggenwert, M.G.M. 1978. Soil Chemistry. Elsevier, Amsterdam, The Netherlands.
- Goswami, N.N., Rattan, R.K., Dev, G., Narayanasamy, G., Das, D.K., Sanyal, S.K., Pal, D.K. and Rao, D.L.N. 2009. Fundamentals of Soil Science. Second Edition. Indian Society of Soil Science, New Delhi.
- Havlin, J. L., Beaton, J. D., Tisdale, S. L. and Nelson W. L. 2006. Soil Fertility and Fertilizers (7th Edn.) Prentice Hall, New Delhi.
- Jurinak, J.J. 1978. Salt-affected Soils. Department of Soil Science and Biometeorology, Utah State Univ, Ames, USA.
- Mahapatra, I.C., Mandal, S.C., Mishra, C., Mitra, G.N. and Panda, N. (Eds). Acid Soils of India. ICAR, New Delhi

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-		-	-	-	-		-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-		-	-	1	-	-
CO3	1	1	2	-	1	1	-	1	-	1		1	2	-	-	2
CO4	1	1	1	1	-	1	-	2	-	2	2	-	-	-	-	-
CO5							2		2	-	-	1				
CO6											3	2				
Average	1.3	1.25	1.5	1	-	1.3	-	1.5	-	1.5			2	1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programe Code	MSCG1095
Course Code	MSAC-206	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Stress Physiology		
Course Objectives: The objectives of this course are:			
<ol style="list-style-type: none"> 1. To develop understanding of stress physiology. 2. To develop knowledge of biotic and abiotic factors responsible for plant stress. 3. To develop skills of stress management strategies. 4. To develop understanding of management of salt affected soil. 			
UNIT- I (Total Topics-8 and Hrs-6)			
Response of plants to abiotic stresses: Abiotic stresses affecting plant productivity. Basic principles of a crop improvement programme under stress. Interactions between biotic and abiotic stresses			
UNIT –II (Total Topics-8 and Hrs-6)			
Drought stress: Physiological, biochemical and molecular mechanism, strategies to alleviate drought stress, signal transduction mechanism, Drought in relation to MAS and QTL, Role of ROS/ antioxidants, ABA, Cytokinin and other hormones			
UNIT –III (Total Topics-8 and Hrs-6)			
Temperature stress (high and low): Tolerance mechanisms-role of membrane lipids in temperature tolerance. Functions of regulatory proteins			
UNIT- IV(Total Topics-8 and Hrs-6)			
Salinity stress: Species variation in salt tolerance. Salinity effects at – Cellular and whole plant level, tolerance mechanisms. Salt tolerance in – Glycophytes and halophytes, breeding for salt resistance.			
UNIT V(Total Topics-8 and Hrs-6)			
Heavy metal stress: Aluminium and cadmium toxicity in acid soils. Role of phytochelatins (heavy metal binding proteins).			
Practical (Total Topics-8 and Hrs-30)			
<ul style="list-style-type: none"> • Determination of electrical conductivity of plant cell sap. • Determination of osmotic potential and tissue water potential. • Measurement of transpiration rate. • Measurement of stomatal frequency. • Measurement of Relative water Content of Leaf. • Growing of plant in sand culture under salt stress for biochemical and physiological studies. • Measurement of low temperature injury under field condition. • Studies on plant responses to excess water. 			

Upon successful completion of the course a student will be able to:

CO1	Retrieve and recall the basics of stress physiology.
CO2	Infer and implement the various biotic and abiotic factors responsible for plant stress
CO3	Device and review the techniques to manage stress.
CO4	Integrate management of crop under stress condition
CO5	Assess cause of stress in crops.
CO6	Manage salt affected soil.

Suggested Readings

- Andrew, M.A. and Wood, J. Eds Jenks 2010. *Genes for plant abiotic stress*. Wiley-BlackwellPublication.
- Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. *Biochemistry and Molecular Biology of Plants*. Am, Soc. Plant Physiologists, Rockville, Maryland.
- Hirt, H., Shinozaki, K. Hirt, Heribert 2004. *Plant responses to abiotic stress*. Springer Berlin HeidelbergPublication.
- Hopkins, W.G. and Huner, N.P.A. 2004. *Introduction to Plant Physiology*. John Wiley & Sons.
- Khan, N.A. and Singh, Sarvajeet 2008. *Abiotic stress and plant responses*. I.K. Publication.
- Parikh, A., Sopory, S.K. and Bohnert, H.J. 2010. *Abiotic stress adaptation in plants: Physiological, molecular and genomic foundation*. SpringerPublication.
- Taize, L. and Zeiger, E. 2006. *Plant Physiology*. Sinauer Associates, Inc, Publishers, Sunderland, Massachusetts, USA

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	3	-	-
CO3	1	1	2	2	2	1	-	1	-	1	-	-	2	-	-	2
CO4	1	1	1	1	-	1	2	-	3	2	-	-	-	-	-	-
CO5							2	2	2		2	1				
CO6											1	2				
Average	1.3	1.25	1.5	1.5	2	1.3	2	1.5	2.5	1.5	1.5	1.5	2	2.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-207	Credit	3(2+1)
Year/Sem	I/II	L-T-P	2-0-1
Course Name	Agronomy of Fodder and Forage Crops		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding basics of fodder production. 2. To develop knowledge of cultivation practices of forage crops. 3. To develop skills of fodder preservation 4. To develop knowledge of fodder availability during drought period 			
<p>UNIT-I (Total Topics-8 and Hrs-6) Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti- quality factors of important fodder crops like maize, <i>bajra</i>, <i>guar</i>, cowpea,oats,barley,berseem,<i>senji</i>,Lucerne</p>			
<p>UNIT- II (Total Topics-8 and Hrs-6) Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses- lime, Napier grass, <i>Panicum</i>, <i>Lasiurus</i>, <i>Cenchrus</i> etc.</p>			
<p>UNIT- III (Total Topics-8 and Hrs-7) Year-round fodder production and management, preservation and utilization of forage and pasture crops.</p>			
<p>UNIT- IV (Total Topics-8 and Hrs-6) Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder.</p>			
<p>UNIT –V (Total Topics-8 and Hrs-6) Economics of forage cultivation, uses and seed production techniques.</p>			
<p>Practical (Total Topics-8 and Hrs-30)</p> <ul style="list-style-type: none"> • Practical Training of farm operations in raising fodder crops; • Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF,lignin, silica, cellulose etc. of various fodder and forage crops • Anti-quality components like HCN in sorghum and such factors in other crops • Hay and silage making and economics of their preparation 			

Upon successful completion of the course a student will be able to:

CO1	Retrieve and recall the basics of fodder production
CO2	Summarize the cultivation practices of forage crops.
CO3	Devise and review different techniques of fodder preservation.
CO4	Categorize the fodder crops on the basis of nutritive value.
CO5	Grade the forage according to availability and quality
CO6	Manage fodder availability during drought period

Suggested Readings

- Chatterjee BN. 1989. Forage Crop Production - Principles and Practices. Oxford & IBH. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Narayanan TR & Dabadghao PM. 1972. *Forage Crops of India*. ICAR.
- Singh P & Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
- Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	1	1	2	-	-	1	-	-	-	-	-	2	2	-	-	2
CO4	1	1	1	1	2	1	3	1	-	-	2	-	-	-	-	-
CO5							1		2	2	3	1			2	
CO6								2	1		1					
Average	1.3	1.25	1.5	1	2	1.3	2	1.5	1.5	2	2	1.5	2	1.5	2	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-301	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Principles and Practices of Organic Farming		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding basics of organic farming. 2. To develop knowledge of various source of organic manures. 3. To develop skills of organic certification process and standards of organic products set by various agencies 4. To develop knowledge of organic mode of farming 			
<p>UNIT-I (Total Topics-8 and Hrs-7) Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry</p>			
<p>UNIT –II (Total Topics-8 and Hrs-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 vermin compost, green manures and bio-fertilizers</p>			
<p>UNIT –III (Total Topics-8 and Hrs-5) Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.</p>			
<p>UNIT –IV(Total Topics-8 and Hrs-6) Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.</p>			
<p>UNIT- V(Total Topics-8 and Hrs-6) Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy</p>			
<p>Practical (Total Topics-8 and Hrs-32)</p> <ul style="list-style-type: none"> • Aerobic and anaerobic methods of making compost • Making of vermicompost • Identification and nursery rising of important agro-forestry tress and tress for shelterbelts. • Efficient use of bio-fertilizers, technique of treating legume seeds with <i>Rhizobium</i> cultures, use of <i>Azotobacter</i>, <i>Azospirillum</i>, and PSB cultures in field • Visit to an organic farm • Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms 			

Upon successful completion of the course a student will be able to:

CO1	Recognize basic concepts of principles and practices of organic farming
CO2	Learn about efficient nutrient use through various source of organic manures, insect,

	pest, disease and weed management under organic mode of production
CO3	Associate with the harmony within an agro ecosystem by organic mode of farming
CO4	Familiarize with organic certification process and standards of organic products by various agencies
CO5	Assesses different sources of organic manure
CO6	Solve the problems associated with organic farming

Suggested Readings

- Ananthkrishnan TN. (Ed.). 1992. Emerging Trends in Biological Control of Phytophagous Insects. Oxford &IBH.
- Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document,FAO.
- Lampin N. 1990. *Organic Farming*. Press Books, Ipswitch,UK.
- Palaniappan SP & Anandurai K. 1999. *Organic Farming - Theory andPractice*. Scientific Publ.
- Rao BV Venkata. 1995. Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective: Publ.3, Parisaraprajna Parishtana, and Bangalore.
- Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford &IBH.
- Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
- Singh SP. (Ed.) 1994. Technology for Production of Natural Enemies. *PDBC,Bangalore*.
- Subba Rao NS. 2002. *Soil Microbiology*. Oxford &IBH.
- Trivedi RN.1993. *A Text Book of Environmental Sciences*, AnmolPubl.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	-	-		-	-	-	-	1		2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO3	1	1	2	-	-	1	2	-	-	-	2	-	2	-	-	2
CO4	1	1	1	1	2	1	-	2	-	2		1	-	-	-	-
CO5									1			-				
CO6									2	2		2				
	1.3	1.25	1.5	1	2	1.3	2	2	1.5	2	1.5	1.5	2	1.5	-	2

Programme Name	M.Sc. Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAC-302	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Modern Concept in Crop Production		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding of modern concept of crop production. 2. To develop knowledge of various plant growth indices 3. To develop understanding of agro-climatic zones of India 4. To develop knowledge of crop modeling. 			
<p>UNIT-I (Total Topics-8 and Hrs-5) Crop growth analysis in relation to environment; Agro-ecological zones of India.</p>			
<p>UNIT-II I (Total Topics-8 and Hrs-8) Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit</p>			
<p>UNIT-III I (Total Topics-8 and Hrs-8) Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield</p>			
<p>UNIT-IV (Total Topics-8 and Hrs-6) Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.</p>			
<p>UNIT-V I (Total Topics-8 and Hrs-5) 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.</p>			
<p>Practical (Total Topics-8 and Hrs-28)</p> <ul style="list-style-type: none"> • Technique of rapid soil and plant tissue test. • Technique of rapid field test for conductance. • Determination of soil moisture. • Finding out leaf area and calculation of LAI, NAR, and CGR. 			

Upon successful completion of the course a student will be able to:

CO1	Recognize agro climatic zones of India
CO2	Categorize plant growth indices
CO3	Device and review modern concept in crop production
CO4	Analyze crop modeling in agronomic system.
CO5	Assess the yield loss during crop lodging
CO6	Solve the on farm problems associated with crops and soil.
<p>Suggested Readings</p> <ul style="list-style-type: none"> Balasubramanian P & Palaniappan SP. 2001. <i>Principles and Practices of Agronomy</i>. Agrobios. Fageria NK. 1992. <i>Maximizing Crop Yields</i>. Marcel Dekker Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. <i>Soil Fertility and Fertilizers</i>. 7thEd. Prentice Hall.Paroda R.S. 2003. <i>Sustaining our Food Security</i>. Konark Publ. ReddySR. 2000. <i>Principles of Crop Production</i>. Kalyani Publ. Reddy SR. 2000. <i>Principles of Crop Production</i>. Kalyani Publ 	

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-		-	-	-	-			2	2	-	-
CO2	-	2	1	1	-	2	-	-	-	-		-	-	1	-	-
CO3	1	1	2	-	-	1	2	-	-	-		-	2	-	1	2
CO4	1	1	1	1	-	1	-	1	-	1			-	-	-	-
CO5								2	3		2	2				
CO6									1							
Average	1.3	1.25	1.5	1	-	1.3	2	1.5	2	1	2	2	2	1.5	1	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG10 95
Course Code	MSAC-303	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Principles and Practices of Weed Management		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding of weeds. 2. To develop knowledge of various weed management practices 3. To develop understanding of herbicides. 4. To develop knowledge of integrated weed management. 			
<p>UNIT-I (Total Topics-8 and Hrs-8)</p> <p>Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices</p>			
<p>UNIT-II (Total Topics-6 and Hrs-8)</p> <p>Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.</p>			
<p>UNIT-III (Total Topics-8 and Hrs-7)</p> <p>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</p>			
<p>UNIT-IV (Total Topics-5 and Hrs-8)</p> <p>Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.</p>			
<p>UNIT-V (Total Topics-3 and Hrs-2)</p> <p>Integrated weed management; cost: benefit analysis of weed management.</p>			
<p>Practical (Total Topics-8 and Hrs-32)</p> <ul style="list-style-type: none"> • Identification of important weeds of different crops • Preparation of a weed herbarium • Weed survey in crops and cropping systems • Crop-weed competition studies • Preparation of spray solutions of herbicides for high and low-volume sprayers • Use of various types of spray pumps and nozzles and calculation of swath width • Economics of weed control • Herbicide resistance analysis in plant and soil 			

Upon successful completion of the course a student will be able to:

CO1	Identify and recognize the weeds of all season.
CO2	Associate with identification, life cycle & nature and type of damage done by weed.
CO3	Analyze the negative and positive consequences of weeds in agriculture, human life.
CO4	Judge and categorize weed management practices
CO5	Evaluate different methods of weed control
CO6	Formulate integrated weed management practices for different ecosystem

Suggested Readings

- Aldrich RJ & Kramer RJ. 1997. *Principles in Weed Management*. Panima Publ.
- Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley Inter-Science.
- Gupta OP. 2007. *Weed Management - Principles and Practices*. Agrobios.
- Mandal RC. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ.
- Rao VS. 2000. *Principles of Weed Science*. Oxford & IBH.
- Subramanian S, Ali AM & Kumar RJ. 1997. *All About Weed Control*. Kalyani.
- Zimdahl RL. (ed). 2018. *Integrated Weed Management for Sustainable Agriculture, B. D. Sci. Pub.*

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO2	-	2	1	-	1	2	-	-	-	-	-	-	-	1	-	-
CO3	1	1	2	-	-	1	2	3	-	-	2	1	2	-	-	2
CO4	1	1	1	1	-	1	-	-	2	1		2	-	-	-	-
CO5				2	2					2						
CO6								2								
Average	1.3	1.25	1.5	1.5	1.5	1.3	2	2.5	2	1.5	1.5	1.5	2	1.5	-	2

Programme Name	M.S.Ag. Agronomy	Programme Code	MSCAG1095
Course Code	MSAE-304	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	AGROSTOLOGY AND AGRO-FORESTRY		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. To develop understanding of agro forestry and agrostology. 2. To develop knowledge of various agroforestry systems of India. 3. To develop understanding of suitable tree species for agroforestry. 			
<p>UNIT-I(Total Topics-7 and Hrs-7) Agrostology: definition and importance; principles of grassland ecology: grassland ecology - community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands</p>			
<p>UNIT-II(Total Topics-8 and Hrs-7) Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.</p>			
<p>UNIT-III (Total Topics-3 and Hrs-8) Agro forestry: definition and importance; agro forestry systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aqua- silviculture, alley cropping and energy plantation</p>			
<p>UNIT-IV(Total Topics-10 and Hrs-10) Crop production technology in agro-forestry and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and underground interferences; lopping and coppicing in agro-forestry systems..</p>			
<p>UNIT-V(Total Topics-3 and Hrs-3) social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics</p>			
<p>Practical</p> <ul style="list-style-type: none"> • Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry. • Seed treatment for better germination of farm vegetation. • Methods of propagation/planting of grasses and trees in silvipastoral system. • Fertilizer application in strip and silvipastoral systems. • After-care of plantation. • Estimation of protein content in lopping's of important fodder trees. • Estimation of calorie value of wood of important fuel trees.. 			

Upon successful completion of the course a student will be able to:

CO1	Memorize the basic terms of agrostology and agroforestry
CO2	Classify agroforestry system in India
CO3	Estimate protein content, calorific value, total biomass
CO4	Able to select suitable multipurpose tree species for agroforestry systems
CO5	Manage pastures and increase production.
CO6	Formulate the designs for agroforestry system

Suggested Readings

- Chatterjee BN & Das PK. 1989. Forage Crop Production. Principles and Practices. Oxford & IBH.
- Dabadghao PM & Shankaranarayan KA. 1973. *The Grass Cover in India*. ICAR.
- Dwivedi AP. 1992. Agroforestry- Principles and Practices. Oxford & IBH. Indian Society of Agronomy. 1989. Agroforestry System in India. Research and Development, New Delhi.
- Narayan TR & Dabadghao PM. 1972. *Forage Crop of India*. ICAR, New Delhi.
- Pathak PS & Roy MM. 1994. Agroforestry System for Degraded Lands. Oxford & IBH. SenNL,
- Dadheech RC, Dashora LK & Rawat TS. 2004. *Manual of Agroforestry and Social Forestry*. Agrotech Publ.
- Shah SA. 1988. *Forestry for People*. ICAR.
- Singh Panjab, Pathak PS & Roy MM. 1994. *Agroforestry System for Sustainable Use*. Oxford & IBH.
- Singh SP. 1994. *Handbook of Agroforestry*. Agrotech Publ.
- Solanki KR. 2000. Multipurpose Tree Species: Research, Retrospect and Prospects. Agrobios.

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	1	-	1	-	-
CO3	1	1	2	2	-	1	-	-	-	-	-	-	2	-	-	2
CO4	1	1	1	1	2	1	-	2	-	2	2	2	-	-	-	-
CO5	-	-	-	-	-	-	2	2	2	2	-	1	-	-	-	-
CO6	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Average	1.3	1.25	1.5	1.5	2	1.3	2	2	1.5	2	2	1.3	2	1.5	-	2

Programme Name	M.Sc. Agronomy	Programe Code	MSCAG1095
Course Code	MSAE-305	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	CROP ECOLOGY		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1.To develop understanding of crop ecology 2. To develop knowledge of various biodiversity. 3. To develop understanding of ecosystem. 			
<p>UNIT-I (Total Topics-5 and Hrs-8) Concept of crop ecology, agricultural systems, ecology of cropping systems, principles of plant distribution and adaptation, crop and world food supply.</p>			
<p>UNIT-II (Total Topics-7 and Hrs-10) Ecosystem characteristics, types and functions, terrestrial ecology, flow of energy in ecosystem, ecosystem productivity, biomass, succession and climax concept</p>			
<p>UNIT-III (Total Topics-6 and Hrs-8) Physiological response of crop plants to light, temperature, CO₂, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production.</p>			
<p>UNIT-IV(Total Topics-3 and Hrs-3) Exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production.</p>			
<p>UNIT-V(Total Topics-5 and Hrs-4) Competition in crop plants; environmental pollution, ecological basis of environmental management and environment manipulation through agronomic practices; improvement of unproductive lands through crop selection and management.</p>			
<p>Practical</p> <ul style="list-style-type: none"> • Study of the climatic logical data of the state and their relationship with the growth and yield of the crops. • Effect of solar light on photosynthesis rate of plants. • Nitrogen cycle and Nitrogen fixation. • Food Chain. • Determination of areas in India with the help of data of crop yield. • Study the micro- climate in crops. • Visit to important agro-forestry research stations. 			

Upon successful completion of the course a student will be able to:

CO1	Memorize basic concept of crop ecology
CO2	Develop understanding of geographical distribution of crops
CO3	Apply the principles of natural resource management
CO4	Analyze the biotic and abiotic factors affecting crop growth
CO5	Evaluate the cropping system according to climatic condition.
CO6	Solve the problems associated with crop competition

Suggested Readings

- Ambasht RS. 1986. *A Text Book of Plant Ecology*. 9th Ed. Students' Friends & Co.
- Chadha KL & Swaminathan MS. 2006. *Environment and Agriculture*. Malhotra Publ. House.
- Dwivedi P, Dwivedi SK & Kalita MC. 2007. *Biodiversity and Environmental Biotechnology*. Scientific Publ.
- Hemantarajan A. 2007. *Environmental Physiology*. Scientific Publ.
- Kumar HD. 1992. *Modern Concepts of Ecology*. 7th Ed. Vikas. Publ.
- Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani.
- Misra KC. 1989. *Manual of Plant Ecology*. 3rd Ed. Oxford & IBH.
- Pandey SN & Sinha BK. 1995. *Plant Physiology*. Vikas Publ.
- Singh J & Dhillon SS. 1984. *Agricultural Geography*. Tata McGraw Hill. Taiz L & Zeiger E. 1992. *Plant Physiology*. Benjamin/Cummings Publ.

CO-PO/PSO Mapping

COs POs/ PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-	-	-	-	-	-	-	2	-	-	2	-	-
CO2	1	2	1	-	-	2	-	-	-	-	-	2	-	1	-	-
CO3	1	1	2	-	-	1	2	-	-	-	2	-	2	3	-	2
CO4	1	1	1	1	-	1	-	2	2	-	-	2	-	-	-	-
CO5	-	-	-	2	2	-	2	2		2	-	-	-	-	2	
CO6	-	-	-	-	1	-	-	-	3		-	-	2	-	-	
Average	1.25	1.5	1.5	1.5	1.5	1.3	2	2	2.5	2	2	2	2	2	2	2

Programme Name	M.Sc. Ag. (Agronomy)	Programme Code	MSCAG1095
Course Code	MSAE-306	Credit	3(2+1)
Year/Sem	1/2; I/II/III	L-T-P	2-1-1
Course Name	Agronomy of Medicinal, Aromatic and Under-Utilized Crops		
Course Objectives: The objectives of this course are:			
<ol style="list-style-type: none"> 1. To educate about the importance of medicinal and aromatic plants in human health, national economy and related industries. 2. To develop the understanding of climate and soil requirement; cultural practices; yield and important constituents of medicinal and aromatic crops; and the nutritional importance, production practices of important under-utilizes crops. 3. To develop the skills in classifying medicinal and aromatic crops according to botanical characteristics and uses. 4. To develop ability to analyze the essential oil and other chemical constituents in medicinal and aromatic plants. 			
UNIT- I (Total Topics - 5 and Hrs -8)			
Importance of medicinal and aromatic plants in human health, national economy and related industries; classification of medicinal and aromatic plants according to botanical characteristics and uses.			
UNIT-II (Total Topics - 6 and Hrs -9)			
Climate and soil requirement; cultural practices; yield and important constituents of medicinal plants (Isabgol, Rauwolfia, Poppy, Aloe vera, Satavar, Stevia, Safed Musli, Kalmegh, Asaphoetida, Nux vomica, Rosadleetc).			
UNIT- III (Total Topics - 6 and Hrs - 8)			
Climate and soil requirement; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium, etc.).			
UNIT-IV (Total Topics - 3 and Hrs - 5)			
Climate and soil requirement; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, <i>Sesbania</i>).			
Practical (Experiments- 11 and Hrs -22)			
Identification of crops based on morphological and seed characteristics; Preparation of herbarium of medicinal, aromatic and under-utilized plants; Quality characters in medicinal and aromatic plants; Methods of analysis of essential oil and other chemical constituents in medicinal and aromatic plants.			
Upon successful completion of the course a student will be able to:			
CO.1.	Recognize and identify medicinal and aromatic plants		
CO.2.	Summarize climate and soil requirement; cultural practices; yield and important constituents of medicinal and aromatic crops; and the nutritional importance, production practices of important under-utilizes crops.		
CO.3.	Classify medicinal and aromatic crops according to botanical characteristics and uses.		
CO.4.	analyze the essential oil and other chemical constituents in medicinal and aromatic plants		
CO.5.	Evaluate Quality characters in medicinal and aromatic plants		
CO.6.	Manage the aromatic crop at farm		
Suggested readings:			
<ul style="list-style-type: none"> • Farooqi, A.A., Khan, M.M. and Vasundhara, M. 2001 Production technology of medicinal and aromatic crops. Natural remedies Pvt. Ltd. • Jain, S.K. 2000. Medicinal plants. National Book Trust, India. 			

- Prajapati, N.D., Pacro Hit S.S., Sharma, A.K., Kumar T. 2006. A Hand book of medicinal plants Agrobios (India).
- Farooqi, A.A. and Sriramu B.S. 2000. Cultivation practices for medicinal and aromatic crops, University Press, Hyderabad.
- Kumaran, A. and Ashe M. 2007. Medicinal plants Horticulture science series, New India Publ., New Delhi.
- Panda, H. 2002. Medicinal plants cultivation and their uses, Asia Pacific Business Press, New Delhi.

CO-PO/PSO Mapping

COs POs/PS Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-								2	2	-	-
CO2	-	2	1	-	-	2	2					2	-	1	-	-
CO3	1	1	2	-	2	1	2	2		2			2	-	-	2
CO4	1	1	1	1	-	2	-			-	3	3	-	-	-	-
CO5				2	3			-			-	-			2	
CO6									2		2	-				
Average	1.3	1.25	1.5	1.5	2.5	1.5	2	2	2	2	2.5	2.5	2	1.5	2	2

Programme Name	M.Sc. Ag. (Agronomy)	Programme Code	MSCAG1095
Course Code	MSAC-401	Credit	1(0+1)
Year/Sem	2/IV	L-T-P	0-0-1
Course Name	Master's Seminar		
Course Objectives: The objectives of this course are:			
<ol style="list-style-type: none"> 1. To acquaint with scientific terms, concepts and content preparation, etc. 2. To develop the ability to make power point and presentation. 3. To develop the ideas for using photographs and sketches in power point to give valuable information. 4. To develop the skills of preparation of research proposal or synopsis, report, manuscripts/article and publications and use of computer programs etc. 			
Practical (Hrs- 15)			
A power point presentation on any topic chosen from the courses studied to be prepared and delivered to the group of faculty members/staff and students of department.			
Essential components of Presentation are:			
Organization of topic, Presentation of data. Oral presentation, Delivery, language, explanation of figures, Ability to grasp and understand the subject, Depth of understanding the topic.			
Upon successful completion of the course a student will be able to:			
CO1: Acquaint with scientific terms, concepts and content preparation, etc.			
CO2: Outline and summarize presentation.			
CO3: Present and implement photographs and sketches in power point to give valuable information.			
CO4: correlate research proposal or synopsis, report, manuscripts/article and publications.			
CO5: Debate on the concern topic			
CO6: Prepare research paper, articles and newsletters			
Suggested readings:			
Grover, S. and Ameen, S. 2018. A Primer of Research, Publication and Presentation. Jaypee Publisher, New Delhi.			

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	1	-	-	2	-	-	-	-	-	2	-	-	-	-
CO3	1	1	2	-	-	1	-	-	2	-	2	1	-	-	-	-
CO4	1	1	1	1	-	1	-	-	1	-	1	1	-	2	-	-
CO5					1		2	2	1	3	1		3	1	2	
CO6				3	2		2			2			2			
Average	1.3	1.25	1.5	2	1.5	1.3	2	2	1.3	2.5	1.3	1.3	2.5	1.5	2	-

Programme Name	M.Sc. Ag. (Agronomy)	Programme Code	MSCAG1095
Course Code	MSAC-402	Credit	20(0+20)
Year/Sem	2/IV	L-T-P	0-0-20
Course Name	Master's Thesis Research		
<p>Course Objectives: The objectives of this course are:</p> <p>1. Aim of introducing thesis in M.Sc. (Ag.) Agronomy is to give the students preliminary exposure for conducting the research and presenting its findings systematically and scientifically in a manuscript shape.</p> <p>2. To fulfill this goal, a specific topic for thesis research shall be assigned to M.Sc. student by the teacher(s)/supervisor(s) of the department, in the first semester</p> <p>3. The student will carry out the research for thesis under the respective supervisor(s) and finally present it in a book shape called thesis</p>			
<p>Practical</p> <p>Synopsis, Research Work & Thesis work provides the students an excellent opportunity to develop analytical research and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and investigate the things.</p>			
<p>Upon successful completion of the course a student will be able to:</p> <p>CO.1: Remember scientific terms of research designing, citation and bibliography.</p> <p>CO.2: summarize ethical dimensions of research work and knowledge to obtain appropriate approval.</p> <p>CO.3: correlate scientific measurements, statistical calculations and analysis of data.</p> <p>CO.4: Explain research works, collection, classification, presentation and analysis of data.</p> <p>CO.5: Evaluate the treatments in experiments.</p> <p>CO.6: Prepare and Manage experimental fields.</p>			
<p>Suggested readings:</p> <ul style="list-style-type: none"> • Kumar, R. 2014. Research Methodology: A Step-by-Step Guide for Beginners. 4th Edition. SAGE Publications Ltd. • Parikh, M.N, Gogtay, N. 2009. ABC of Research Methodology and Applied Biostatistics. Jaypee Publishers, New Delhi. 			

CO-PO/PSO Mapping

COs POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	1	2	-	-		-	-	-	-			2	2	-	-
CO2	-	2	1	-	-	2	-	-	-	-			-	1	-	-
CO3	1	1	2	-	-	1	-	-	-	-		2	2	-	-	2
CO4	1	1	1	1	-	1	-	-	-	-	2	1	-	-	-	-
CO5					2		2	3	2	2		2			2	
CO6								2	1		2	1			2	
Average	1.3	1.25	1.5	1	2	1.3	2	2.5	1.5	2	2	1.5	2	1.5	2	2