Gopal Narayan Singh University,

Jamuhar, Sasaram, Rohtas (Bihar) 821305

NARAYAN INSTITUTE OF AGRICULTURAL SCIENCES

APPROVED BY	DATE
BOS	29/09/24
Academic Council	11/11/2024
Board of Management	11/11/2024
Governing Body	15/11/2024

BoS Committee			
1	Prof. (Dr.) H. K. Singh	Director, NIAS, GNSU	Chairman
2	Prof. (Dr.) Manoj Kumar Singh	Professor, Department of Agronomy, Institute of Agricultural Sciences, BHU, Varanasi	Member
3	Prof. (Dr.) Mukesh Kumar	Professor, Department of Agronomy, RPCAU, Samastipur, Bihar	Member
4	Prof. (Dr.) Ashok Kumar	Professor, NIAS, GNSU	Member
5	Prof. (Dr.) D.R. Singh	Professor, NIAS, GNSU	Member
6	Dr. Shashank Shakhar Singh	Assistant Professor, NIAS, GNSU	Member
7	Dr. S.K. Yadav	Assistant Professor, NIAS, GNSU	Member Secretaray

2024

DEPARTMENT OF AGRONOMY

ORDINANCES AND SYLLABUS GOVERNING TO COURSES OF M.Sc. (Ag.) Agronomy & Ph.D. Agronomy

As per recommendation of ICAR's BSMA Committee, 2021

ORDINANCES GOVERNING ADMISSION TO M.Sc. (Ag.) Agronomy

1.	**ADMISSION**
1.1	**MODE OF ADMISSION**
	Admission to the M.Sc. (Ag.) in Agronomy courses shall be made on merit computed on the basis of marks obtained by candidates in a competitive examination called Post Graduate Entrance Test for Agriculture, herein-after abbreviated 'PGET-Ag' to be conducted by the Controller of Examinations, Gopal Narayan Singh University or CUET/ICAR-AIEEA-PG, on a date and centers to be announced from time to time by conducting by concern instiute.
1.2	**ELIGIBILITY**
	I. Candidates with four years B.Sc. (Ag.) Degree with credit-based course programme under the guidelines of ICAR or an equivalent qualification. II. 6.00/10 or 2.5/4, 3.5/5, 4.0/6 OGPA for general candidates. For SC/ST/OBC candidates OGPA of 5.5/10, 2.0/4, 3.0/5, and 3.5/6 as per university guidelines. III. Has not secured more than one III division or equivalent O.G.P.A. in his/her academic career.
1.2.1	Candidates appearing at the respective qualifying examinations shall be eligible to appear at the entrance examination but shall have to provide the proof of their passing the said examination by the date as decided by theuniversity.
1.3	**NUMBER OF SEATS**
	Total number of seats available is 15. Reservation as per Bihar Government rules.
1.4	**SUPERNUMERARY ADMISSION/WEIGHTAGES**
1.4.1	**ADMISSION OF FOREIGN NATIONALS** As per University rules existing at the time of admission
1.4.2	**ADMISSION OF UNIVERSITY EMPLOYEES**
	As per University rules existing at the time of admission
1.4.3	**ADMISSION OF SONS / DAUGHTERS OF PERMANENT EMPLOYEES OF THE UNIVERSITY** As per University rules existing at the time of admission
1.5	**ACADEMIC RECORD RATING**
	Not applicable in the light of entrance examination
1.6	**SCHEME OF ENTRANCE EXAMINATION (PGET-Ag.)** The examination shall comprise one paper of 480 marks of two-hour duration consisting of 120 MULTIPLE CHOICE questions.
1.6.1	**SYLLABUS FOR THE ENTRANCE EXAMINATION** The question paper shall be based on B.Sc. (Ag.) courses generally taught at graduation level as approved by ICAR.
1.7	**MERIT LIST FOR ADMISSION**
1.7.1	**EVALUATION** Four marks shall be awarded for each correct answer whereas one mark shall be deducted for each incorrect answer
1.7.2	Candidates shall be selected in order of merit on the basis of the aggregate marks

1.7.1	**EVALUATION** Four marks shall be awarded for each correct answer whereas one mark shall be deducted for each incorrect answer
1.7.2	Candidates shall be selected in order of merit on the basis of the aggregate marks securedat the PGET-Ag. of that academic session.
1.7.3	In case of equal marks at the PGET-Ag the *inter-se* ranking of the candidates shall be decided in the following order. i. The OGPA obtained by the candidates at the qualifying examination recognized for the purpose of appearing in thePGET-Ag. ii. If the OGPA at the above [vide 1.7.3 (i) examination happens to be the same, the date of birth would be the basis, i.e., the candidate senior in the age would rank higher.
1.7.4	In all matters relating to M.Sc. (Ag.) in Agronomy admission decisions of a Committee comprising the Admission Committee of Institute and the Admission Committee of the respective Department shall be final.
1.7.5	Scrutiny/re-evaluation of the answer books of the PGET-Ag shall be done as per university rules.
1.7.6	The candidates shortlisted for counseling will be informed individually by registered post/ speed post/ e-mail / university webpage.
1.7.7	A candidate / candidates selected for admission may be referred to a Medical Board for Medical Examination for fitness by the Admission Committee.
1.8	**ALLOCATION OF DISCIPLINE**
	The successful candidates on merit basis will be called on a specific date(s) for verification of certificates. Those found eligible shall appear, in order of merit, on the given date and time before the Admission Committee for counseling, where they shall be asked to exercise their choice of the subject. The choice once exercised shall be final and no change shall be allowed even if vacancies arise in any discipline at a later stage.
1.8.1	**INSTITUTIONAL PREFERENCE**
	As per University rules.
1.9	Not with standing anything contained in these ordinances, the Entrance Test Notification approved by the Academic Council for the concerned academic year shall be final.

ORDINANCES GOVERNING ADMISSION TO Ph.D. in Agronomy

2.0	**ADMISSION**
	Admissions shall be made in the disciplines where M.Sc. (Ag.) Agronomy cou are being offered.
2.1	**MODE OF ADMISSION**
	The admission to the Ph.D. programme shall be through the Agriculture Res Entrance Test (ARET) conducted along with PGET-Ag. Ordinance o University. In the event of seats remaining vacant after the closer of admiss the first semester candidates may also be admitted in the second semester

			academic year from among the successful candidates of the ARET including those who could not turn up in the firstsemester.	
		2.2	**ELIGIBILITY**	
			A candidate seeking admission to the Ph.D. programme in the department of Agronomy, shall be required to have passed the qualifying examination in concerned main discipline with credit based course programme securing the minimum 6.5/10 or 2.5/4 or 3.5/5 or 4.0/6 OGPA for general candidates. For SC/ST/OBC candidates OGPA of 6.0/10, 2.0/4, 3.0/5, 3.5/6 as per university guidelines. A candidate must not have more than one III division or equivalent grade point average in his/her academic career.	
		2.3	**NUMBER OF SEATS**	
			The number of students shall be as per university guidelines.	
		2.3.1	**RESERVATIONS**	
			Reservation as per Bihar Government rules.	
		2.4	**SCHEME OF ENTRANCE TEST**	
			(a) Written Test: (b) A candidate possessing the minimum qualifications with the requisite percentage of marks and academic record as prescribed in Clauses 2.2 supra and Annexure-I shall be eligible to appear in the writtentest. (c) The written test shall be conducted by the Controller of Examinations normally in the month of May every academic year, the results of which shall be declared ordinarily by the end of June. The test shall be of 2 hour duration, carrying 300 marks, consisting of 100 multiple-choice questions out of which there would be 40 multiple choice questions (Section 'A') of general nature to test the knowledge of the candidates in fundamentals and also to test their logical and analytical thinking, quantitative ability, language skills, computer awareness, general knowledge, etc. These questions shall be common to all the candidates appearing for the test in all the disciplines and shall be based on the subjects taught at the intermediate/higher secondary and graduate levels. The remainder of 60 multiple choice questions (Section 'B') shall be of specialized nature and discipline specific for each discipline of the Faculty. The candidate shall be required to answer only one such set of 60 questions corresponding tothesubjectofhis/herqualifyingdegree.These questions shall be of post-graduate level in the concerned subject.	
			MERIT LIST FOR INTERVIEW / EVALUATION	
			Three marks shall be awarded for each correct answer whereas one mark shall be deducted for each incorrect answer.	

Candidates shall be selected for interview in order of merit on the basis of aggregate marks obtained at the ARET.

ACADEMIC RECORD

Formula for calculating academic index

= 45 (X_1 + 0.6 X_2 + 0.25 X_3 + 0.15 X_4)/100, where postgraduate degree is considered as the qualifying examination and

= 90 (X_2 + 0.4 X_3 + 0.3 X_4)/100, where undergraduate degree is considered as the qualifying examination, where,

M = Marks for the academic record, which shall be an integer. Any fraction in 'M' shall be rounded off to the nearest integer.

X_1 = Percentage of marks obtained at the post-graduate examination, X_2 =Percentage of marks obtained at the under-graduate examination,

X_3 =Percentage of marks obtained at the intermediate/higher secondary examination, and

X_4 = Percentage of marks obtained at the high school examination.

In case of equal marks at the ARET the inter-se ranking of the candidates shall be decided in the following order.

i. The OGPA obtained by the candidates at the qualifying examination recognized for the purpose of appearing in the ARET.

ii. If the OGPA at the above, (i) examination happens to be the same, the date of birth would be the basis, i.e., the candidate senior in the age would rank higher.

INTERVIEW

Personal Interview

(a) The Controller of Examinations shall send an alphabetical list of short-listed candidates along with their application forms, to the academic section of the Institute.

(b) The academic section of the Institute shall coordinate with each department and after scrutinizing the application forms thoroughly, shall send letters to short-listed candidates to appear in a personal interview, which shall be conducted prior to commencement of a semester.

(c) The personal interview shall be conducted by a committee consisting of the following members:

i) Dean of the Faculty or his/her nominee of the Faculty Chairman

ii) Director of the Institute (in the case where the Faculty is associated with an Institute or his/her nominee of the Institute) ---------- Member

(d) Two senior Professors of the Institute/Faculty Member(s)

iv) Concerned Head ofthe Department --Member

v) Concerned coordinator of Centre---------- Member

vi) Two senior most members of the concerned DRC excluding the Head/Coordinator

----------Member(s)

vii) One SC teacher ---------- Member

viii) One ST teacher ---------- Member

(e) The personal interview shall carry a maximum of 40 marks.

- The marks of "Personal Interview" along with marks of "Academic Record" shall be sent by the concerned department/centre to the Controller of Examinations in duplicate. Thereafter the marks obtained by the candidates in ARET would be added by the office of the Controller of Examinations for final computation of the Merit List and a copy would be provided to the concerned department/centre for declaration of final merit list discipline-wise by the Faculty.
- Separate merit lists shall be prepared for the ARET qualified candidates.
- The said committee shall recommend to each department the names of selected candidates who are by habit, character and qualifications, fit and proper to be admitted to the Ph. D. Programme, from ARET qualified (depending on the number of total available seats in the department/school).
- The Department shall notify the merit list of the selected candidates and shall issue the letter of admission to the candidates.
- On receipt of the letter of admission, each candidate shall pay the fees and complete other official formalities pertaining to admission within three days.
- The DRC shall assign a supervisor to supervise the research work.
- If required, on the request of the supervisor, the DRC shall assign a co-supervisor/external supervisor.
- The Head of the Department/Coordinator shall send a complete list of the admitted candidates along with the necessary details to the Registrar (Academic) with a copy to the Dean of the Faculty within a week from the date of admission.
- The records of the merit list of both the ARET qualified candidates along with their application forms shall be maintained in the Department.
- If some vacancies arise in a Department for the even semester, the short-listed candidates who could not be admitted in the immediately preceding odd semester may be called for counseling afresh for admission as per procedure laid above.
- Every candidate shall be registered only at the beginning of

	counseling afresh for admission as per procedure laid above. • Every candidate shall be registered only at the beginning of each semester.
	No full-time Ph. D. Scholar shall accept during the period of research any paid assignment apart from Research Fellowships, Research Assistantships, externally funded research project assignments etc provided it is not detrimental to his/her research programme as determined by the DRC. A Ph. D. Scholar shall not be permitted to join any other degree course. However, he/she may be permitted to join part-time Diploma or Certificate Course(s) by the DRC on the recommendation of the RPC provided it is not detrimental to his/her research programme.
2.5	**REGISTRATION** Ordinarily the successful candidates shall be registered in the first semester of the Academic year, in order of merit. However, in the event of seats remaining vacant after the close of registration in the first semester candidates may also be registered in the second semester of the academic year from among the successful candidates of the ARET as per Ph.D. Ordinance of theUniversity.
2.6	Notwithstanding anything contained in these ordinances, the Entrance Test Notification approved by the Academic Council for the concerned academic year shall be final.

ANNEXURE-I

Equivalent M. Sc./M. Sc.(Ag.) in Agronomy degrees or allied subjects for ARET

Sr.No.	Disciplines of Ph.D.	Proposed
1.	Agronomy	M.Sc. (Ag.) in Agronomy

ORDINANCES GOVERNING CREDIT AND COURSE REQUIREMENTS OF M. Sc.(Ag.)Agronomy

(Separate Ordinances for Special Courses will be framed)

3.0	**RESIDENTIAL REQUIREMENT**
	Minimum residential requirement for Master of Science (Ag.) Agronomy degree shall be four (4) semesters, extendable to a maximum of Ten (10) semesters in total.
3.1	**CREDIT AND COURSE REQUIREMENT**
3.1.1	**i. Minimum CreditRequirements** **Course work** — **Credits** Major discipline — 20 Minor disciplines — 08 Supporting subject — 06 Common courses — 05

	Master Seminar 01 Master Research 30 **Total** 70 **ii. STAT- 502 shall be one of the supporting courses compulsory for all M.Sc. (Ag.) Agronomy students. This course will be pre-requisite for other statistics courses.**
3.2	A student shall opt Minor courses from two disciplines excluding the supporting Statistics course (STAT-502).
3.3	**SEMINAR**
	Seminar is compulsory for all the post graduate students and should register and present one seminar. Registration of credit seminar is not allowed in the first two semesters. The seminar topics are to be assigned to the students related to the major fields by seminar In-charge in the beginning of the semester and progress made by the students should be monitored. The circular on the presentation of the seminar by post graduate students may be sent to other departments to enable those interested to attend the same. The performance of the students in credit seminar is evaluated by Head of the department, seminar In-charge and the faculty members present during seminar. Grade point may be given based on the following norms: **Coverage of literature: 40** **Presentation: 30** **Use of audio-visual aids: 10** **Capacity to participate in discussion and answering questions: 20**
3.4	**CREDIT LOAD PER SEMESTER**
3.4.1	Credits offered by a student shall be decided by the Chairman of the AdvisoryCommittee.
3.4.2	A student shall offer a minimum of 8 credits and a maximum of 18 credits in each semester including thesis credits.
3.4.3	A student shall offer core course in first two semesters.
3.4.4	The minimum prescribed load shall not be mandatory beyond the first four semesters of study.

ORDINANCES GOVERNING CREDIT AND COURSE REQUIREMENTS OF Ph.D. Agronomy

4.0	**RESIDENTIAL REQUIREMENT**
4.1	Minimum residential requirement shall be six (6) semesters, extendable to a maximum of fourteen (14) semesters. Under extraordinary circumstances, the Post Graduate Research Committee (PGRC) may grant a further extension of two years for the submission of the thesis, for which the candidates shall apply giving the reasons due to which he/she was not able to submit thesis and his/her application is duly forwarded and recommended by the concerned RPC and the DRC. No further

	extension shall be given under any circumstances.
4.2	**COURSE REQUIREMENT**
	CREDIT REQUIREMENT FOR COURSE AND THESIS The Ph.D. programme shall consist of the course work and the research work. Minimum credit requirement for Ph.D. degree shall be 100 credits as prescribed below:- (i) Major discipline: 12 credits • 500/600 series courses in the discipline where registered. At least 50% of these courses shall be of 600 series (ii) Minor disciplines: 6 credits • 500/600 series courses, from any two disciplines. (iii) Supporting subjects: 05 Credits (iv) Non-Credit compulsory courses (05) (If a candidate has not offered them at PG Level) (v) Research Plan Proposal Seminar: 0 Credit (vi) Doctoral Seminar: 02 Credit (vii) Pre Submission Thesis Seminar: 0 Credit (viii) Doctoral Research: 75 Credit **Total : 100 Credits** Minimum one course from major discipline in each semester, including core courses, must be offered during the first four semesters.
4.2.1	Courses below 500 and of PG series shall not be counted towards the minimum credit requirement of major and minor disciplines and shall, also not be considered for computing OGPA. They may be offered as remedial courses. To qualify, a candidate shall be required to secure a GPA of 6.0 in the course (Detail of the courses as per approved syllabus).
4.3	**CREDIT LOAD PER SEMESTER**
	RPC of a student shall decide the credit load of each semester subject to a maximum of 18 credits and a minimum of 8 credits including research credits. A candidate will be required to offer at least one core/major course in each of the first four semesters.
4.4	**SEMINAR**
	Seminars is compulsory for all Ph.D. students and should register and present two seminars each in two semesters. Registration of credit seminars is not allowed in the first two semesters. The seminar topics are to be assigned to the students related to the major fields by the seminar In-charge in the beginning of the semester and progress made by the students should be monitored. The credit seminars presented by the Ph.D. scholars should submit an abstract (hard copy) to the concerned chairman and present faculty members before presentation, or else the seminar will not be evaluated. The circular on the presentation of the seminar by doctoral students may be sent

	to other departments to enable those interested to attend the same. The performance of the students in credit seminar is evaluated by Head of the department, seminar In-charge and the faculty members present during seminar. Grade points may be given based on the following norms: **Coverage of literature : 40** **Presentation : 30** **Use of audio-visual aids : 10** **Capacity to participate in discussion and answering questions : 20**
4.4.1	**COURSE SEMINAR**
	A student shall be required to deliver a course seminar before the end of the fourth semester. The seminar shall be awarded grades by the Members of DRC and seminar in charge. In case the grades awarded are below the minimum GP prescribed for passing the course, the student will deliver the seminar again in the same semester.
4.4.2	**Research Plan Proposal Seminar** (a) By the end of the second semester the candidate shall submit to the RPC, a research plan proposal generally consisting of a preamble, the definition of the problem , approaches, results anticipated and references, in about 8 to 10 pages. (b) The RPC and the DRC shall examine the research plan proposal of the candidate and the candidate shall deliver a detailed seminar called "Research Plan Proposal Seminar" before the RPC and the DRC by the end of the second semester. All other teachers and students will be invited to the seminar. (c) The RPC and the DRC, if satisfied with the research proposal and the seminar, shall approve the proposal and the topic of research, and shall forward its recommendation along with the second relevant progress repot of the candidate to the Registrar (Academic)with a copy to the Dean. (d) If the RPC and the DRC are not satisfied with quality of the research plan proposal, the candidate shall submit a fresh proposal and deliver the seminar within a time limit specified by the SRC (not exceeding three months in any case), and a fresh evaluation shall be done. But,if only this minar is unsatisfactory, the candidate shall deliver only the seminar again within one month. (e) If the candidate fails to submit the research plan proposal by the end of the second semester or the research plan proposal and/or the research plan proposal seminar of the candidate is/are not approved by the DRC, the candidate's admission shall stand cancelled. (f) The minimum time between Research Plan Proposal Seminar and thesis submission will be of three semesters to be counted after completion of the semester in which seminar is given. (g) If a candidate offers thesis credit in the very first semester of his/her admission, he/she will have to deliver/submit his/her Research Plan Proposal Seminar in that very semester.

ORDINANCES GOVERNING EVALUATION OF COURSE WORK

5.0 EXAMINATIONS

The student's achievements shall be evaluated on the basis of their performance in different tests in the form of written and practical examinations, and thesis and viva-voce examination where applicable. The various tests, their number and relative weightage in each semester shall be as follows:

	Name of Test	No.	Relative Weightage
(i)	**Theory and Practical Course**		
	(a) Mid-semester Examination	One	**30%**
	(b) End-semester Examination		
	(i) Theory	One	**40%**
	(ii) Practical	One	**30%**
(ii)	**Theory Courses only**		
	(a) Mid-semester examination	One	**40%**
	(b) End-Semester Examination	One	**60%**
(iii)	**Practical Courses only**		
	End-Semester Practical Examination	One	**100%**

5.1 MID-SEMESTER EXAMINATION

The mid-semester examination shall be of two hour's duration and shall generally cover 50 percent of the total course.

5.2 END-SEMESTER EXAMINATION

This examination covering the entire subject matter of a course shall be held at the end of each semester. The duration of the examination shall be of 2 or 3 hrs.

5.2.1 The End Term Examination shall be confidential and may be internally examined.

5.2.2 PROJECT REPORT

A project report (about 10-15 pages) comprising work on some assignment, visit to centers of research, extension or demonstration work will be submitted by each of the students.

5.2.3 Wherever a study tour has been prescribed in a course, it shall be compulsory and the students(s) will submit a tour report which will form a part of the practical examination comprising of 10 marks.

5.3 SUBMISSION OF GRADE

The Grades shall be sent within 10 days of the conduct of the examinations, and the answer books of all the examinations shall be returned to the Controller of Examinations.

5.3.1 SIGNIFICANCE OF GRADES

The examinations conducted throughout the semester shall be evaluated in numeral assigning 100 markstoeachcourse. The numerical rating shall be converted to ten point system by placing adecimal before the last digit called

	here-in-after "grade"	

GRADE For M.Sc.(Ag.) Agronomy /Ph.D. Agronomy	EXPRESSION
8.00 and above	Excellent
7.00-7.99	Good
6.00-6.99	Fair
Below 6.0	FAIL

5.3.2 EQUIVALENCE OF GRADES IN PERCENT AND AS DIVISION

M.Sc. (Ag.) Agronomy / Ph.D. Agronomy

Grade x 10.0 = % marks

70% and above = First Division

Above 65% but below 70% = Second Division Below 60% = Fail

5.4 CALCULATION OF GP, GPA, and OGPA

Grade point and overall grade point average shall be calculated as illustrated hereunder

Credits	Marks				Grade	OGPA
(Theory + practical)	Mid-term	End-term	Practical	Total	Grade Point (GP)	**53.6 ÷ 7 = 7.657**
3 (2+1)	25	33	22	80	24.0	
2 (2+0)	28	50	-	78	15.6	
2(0+2)	18	-	52	70	14.0	
7 (4+3)					53.6	

Note :-

GradePoint(GP) : Grade xCredit

GradePointAverage :GP/Credit

Over All Grade Point Average (OGPA) : Total GP/Total Credits

Grade : Total Marks in a Course /10

5.5 MINIMUM GRADE POINT REQUIREMENT FOR PASSING A COURSE /SEMESTER /DEGREE PROGRAMME

Minimum grade points required are given below :

Passing requirement of	M.Sc. (Ag.) Agronomy /Ph.D. Agronomy
A course	6.0
A semester	6.5
An academic year	6.5
Degree Programme	6.5

5.5.1 Significance of OGPA

M.Sc.(Ag.) Agronomy /Ph.D. Agronomy	EXPRESSION

	8.00 and above	Excellent	
	7.00-7.99	Good	
	6.50-6.99	Fair	
	Below 6.50	FAIL	

5.6 PROMOTION FROM FIRST SEMESTER TO SECOND SEMESTER/CURRENT ACADEMIC YEAR TO THE NEXT ACADEMIC YEAR

5.6.1 A student who maintains or fails to maintain the minimum prescribed GPA/OPGA (clause 5.5) at the end of first semester of an Academic year shall be promoted to the II semester of that Academic year.

5.6.2 A student who maintains the minimum prescribed GPA/OGPA (clause 5.5) for each of the semesters at the end of 2nd Semester of an academic year and does not carry a grade of less than 6.0 [for M.Sc. (Ag.) Agronomy and Ph.D. Agronomy] in any course shall be declared to have passed that Academic year and shall be promoted to the next Academic year.

5.6.3 Ph.D. students(s) admitted in the second semester shall be promoted to the next semester on the basis of his / her performance (clause 5.5) in the Semester of admission.

5.7 REPEAT EXAMINATION

5.7.1 A repeat examination shall be held for both the odd and even semesters at the end of the concerned academic year for those students who have failed in any of the courses taught during one or both of the semesters or have failed to appear in any of the examinations, if otherwise, eligible. Students who could not appear in the examinations shall be required to produce valid reasons for the absence.

5.7.2 The weightage of the Repeat examination shall be as under:

PARTICULARS OF COURSE	**EXAMINATION**	
	THEORY	PRACTICAL
Theory + Practical course	70%	30%
Theory only	100%	--
Practical course only	.....	100%

5.7.3 The better of the two grades shall be used in the computation of GP/OGPA, with remark "R"(repeat) on the transcript.

5.7.4 Only one chance shall be given to a candidate to improve his/her GP in a course.

5.7.5 In case a student appearing in the repeat examination vice clause 5.7 supra fails to obtain the minimum prescribed GP/GPA/OGPA he/she shall be declared to have failed in the class where studying.

5.7.6 The repeat examination shall also be evaluated as provided under clause 5.0.

5.8 TRANSCRIPT AND GRADESHEET OF A STUDENT

The transcript of a student shall indicate:

(i) Course number, course title, credit value, grade, GPA/OGPA and comprehensive, seminar, viva-voce and thesis examination reports and the title of the thesis wherever applicable.

(ii) A transcript shall be issued for each of the semesters.

(iii) Successive transcripts shall carry forward the GPA/OGPA unto the last semester. A combined transcript shall be issued after the completion of the degree programme.

(iv) The status of a re-admitted student shall be indicated on the transcript as Re-admitted in the semester wherere-admitted.

(v) The result shall be indicated as: PASSED /FAILED / PROMOTED as maybe

	applicable. (vi) Course/courses repeated by candidates shall be indicated by a suffix"(R)". (vii) The transcripts will carry the following formula for the conversion of OGPA into percent marks: % Marks = OGPA X 10
5.9	**MERIT OF A STUDENT**
5.9.1	The merit shall be decided on the basis of OGPA obtained.
5.9.2	Students having the same OGPA shall be bracketed together.
5.9.3	A student who has improved his/her OGPA by repeating course/courses or by readmission or by studying extra semester, over and above the minimum prescribed, shall not be eligible for merit.
5.9.4	A student who has dropped a semester shall also not be eligible for merit.

ORDINANCES GOVERNING SPECIAL EXAMINATIONS AND THESIS WORK OF M. Sc. (Ag.) Agronomy

6.0	**ADVISORY COMMITTEE FOR M.Sc. (Ag.) AGRONOMY STUDENTS**
6.1	A student enrolled in Master's degree programme shall be guided by an Advisory Committee comprising three members, two representing the major discipline and one representing the minor discipline.
6.1.1	The Supervisor of the candidate thesis, appointed by the Admission Committee of the Department concerned, shall be the Advisor - Chairman. The Chairman will nominate the other members specified above in consultation with the Head of the Department concerned. However, the member from the minor discipline shall be nominated from such a discipline where the student is going to offer maximum credits.
6.1.2	**FUNCTION OF THE ADVISORY COMMITTEE**
	The Advisory Committee shall guide the student in the choice of courses in the major, minor disciplines, supporting courses and selection of suitable research problems for thesis and in all other matters relating to his/her academic activities.
6.1.3	The details of the programme of work prepared by the Advisory Committee shall be submitted to the Head of the Department for onward transmission to the Controller Examinations before the end of each Semester.
6.2	**COMPREHENSIVE EXAMINATION**
	A student shall be eligible to appear in the comprehensive examination as soon as he/she successfully completes at least 75% of his/her course requirement. The examination shall be oral and shall be conducted by the Advisory Committee vide a notification of the Head of the Department. No grades shall be awarded in this examination. The performance will be judged as Satisfactory/Unsatisfactory.
6.2.1	In case the performance of a student is judged unsatisfactory he/she shall be required to appear again after a lapse of at least 8 weeks from the last oral

	The Advisory Committee shall guide the student in the choice of courses in the major, minor disciplines, supporting courses and selection of suitable research problems for thesis and in all other matters relating to his/her academic activities.
6.1.3	The details of the programme of work prepared by the Advisory Committee shall be submitted to the Head of the Department for onward transmission to the Controller Examinations before the end of each Semester.
6.2	**COMPREHENSIVE EXAMINATION**
	A student shall be eligible to appear in the comprehensive examination as soon as he/she successfully completes at least 75% of his/her course requirement. The examination shall be oral and shall be conducted by the Advisory Committee vide a notification of the Head of the Department. No grades shall be awarded in this examination. The performance will be judged as Satisfactory/Unsatisfactory.
6.2.1	In case the performance of a student is judged unsatisfactory he/she shall be required to appear again after a lapse of at least 8 weeks from the last oralexamination.
6.3	**THESIS SUPPLICATION**
6.3.1	A M.Sc. (Ag.) Agronomy student shall submit his/her thesis during the fourth semester but on or before 30th June.
6.3.2	A student submitting his/her thesis after the stipulated date shall be required to register in the current semester with ZERO credits and pay full semester fees.
6.3.3	A student who submits his/her thesis after 30th June (vice clause 6.3.1 supra) shall be awarded the degree of the academic session in which he/she submitted the thesis.
6.3.4	Loose bound thesis, in the standard format as prescribed by the University for M.Sc.Programme, along with soft in a CD copy shall be accepted in the office of the Head of the Department for onward transmission of loose bound thesis only to the Controller of Examinations, after the production of an up-to-date "No dues" certificate by the student.
6.3.5	The thesis shall be submitted loose-bound initially which shall be hard-bound after the viva-voce examination.
6.4	**THESIS EVALUATION**
6.4.1	**APPOINTMENT OF EXAMINER** (S)
	The M.Sc. (Ag.) Agronomy thesis shall be evaluated by the Chairman of the Advisory Committee and One External Examiner. The name of the External Examiner shall be decided by the Board of Examiners of the Department from a panel of three eminent persons in the subject area proposed by the Chairman, Advisory Committee.
6.4.2	The examiners will give a detailed report on the thesis making a clear recommendation whether "Accepted / Rejected / To be Revised".
6.4.3	In case one of the examiners rejects the thesis it will be sent to a third examiner, whose report will be final.

6.4.4	In case the examiner recommends revision, the revised thesis shall be sent to t same examiner for final recommendation.
6.4.5	Re submission will be permitted once only.
6.5	In case the thesis reports are "Satisfactory", viva-voce examination shall be conducted only when he / she has successfully completed all the examinations as per clause 5.5 as well as written and/or oral comprehensive examination (s). The viva-voce examination shall be conducted by the members of the Advisory Committee and the External Examiner who has evaluated the thesis. The examiners shall submit a comprehensive viva-voce report making clear recommendation whether "Satisfactory/Unsatisfactory".
6.5.1	In case the External Examiner who has evaluated the thesis declines to conduct the viva-voce examination, it shall be conducted by the members of the Advisory Committee and another external examiner appointed by the Board of Examiners of the Department.
6.5.2	In case the viva-voce report is "Unsatisfactory" the repeat viva-voce examination shall be conducted vice 6.5 after a lapse of at least 8 (eight) weeks from the last viva-voce examination.
6.5.3	In case the student fails again (6.5.2) he/she shall be declared "Failed" and removed from the rolls of the Institute.
6.6	**DECLARATION OF RESULT**
	The final result of an M.Sc. (Ag.) Agronomy student shall only be declared when he/she has successfully completed all the requirements (clauses 5.5, 6.2 and 6.4 *supra*)

Internship during Masters programme

Internship for Development of Entrepreneurship in Agriculture (IDEA)

Currently, a provision of 30 credits for dissertation work in M.Sc. (Ag.) Agronomy programme helps practically only those students who aspire to pursue their career in academic/ research. There is hardly any opportunity/ provision under this system to enhance the entrepreneurship skills of those students who could start their own enterprise or have adequate skills to join the industry. Therefore, in order to overcome this gap, an optional internship/ in-plant training (called as IDEA) in lieu of thesis/ research work is recommended which will give the students an opportunity to have a real-time hands-on experience in the industry.

It is envisaged that the internship/ in-plant training would enhance the interactions between academic organizations and the relevant industry. It would not only enable the development of highly learned and skilled manpower to start their-own enterprises but also the industry would also be benefitted through this process.

This pragmatic approach would definitely result in enhanced partnerships between academia and industry.

The main objectives of the programme:

1. To promote the linkages between academia and industry.

2. To establish newer University – Cooperative R&D together with industry for

knowledge creation, research and commercialization.

3. Collaboration between Universities and industries through pilot projects.

4. To develop methods for knowledge transfer, innovation and networking potential.

5. To enhance skill, career development and employability.

Following criteria for IDEA will be taken into consideration.

- At any point of time there will not be more than 50% of students who can opt under IDEA
- Major Advisor will be from Academia and Co-advisor (or Advisory Committee member) from industry.
- Total credits (30) will be divided into 20 for internship/ in-plant training and10 for writing the report followed by viva-voce similar to dissertation.
- Work place will be industry; however, academic/ research support would be provided by the University or both. MoU may be developed accordingly.
- The IPR, if any, would be as per the University policy.

Note : All courses will be completed in three semester if student opted Internship during Masters programme.And if stusdentwant to develop himself as entrepreneur and does not want to go research work under this condition he/ shecan opt. idea of 30 credit.

ORDINANCES GOVERNING SPECIAL EXAMI

NATIONS AND RESEARCH WORK OF Ph. D. AGRONOMY

7.0	RESEARCH COMMITTEE
7.1	Subject to the general superintendence of the Academic Council, the following Committees shall deal with all matters connected with the Ph.D. programme of the University in accordance with these ordinances: a) Post graduate Research Committee (PGRC) b) the Departmental Research Committee (DRC) c) The Research Programme Committee (RPC)

		7.2	The RDCU shall consist of the following; i) The Vice-Chancellor — Chairman ii) The Rector(if any) — Member iii) The Director of the Institute (in case where the faculty is associated with an institute) — Member iv) Dean of the faculty — Member v) Heads of the Departments vi) Members of the concerned DRC — Member vii) Supervisor and Co-Spervisor (if any) of the concerned Ph.D. scholar — Member viii) Emeritus Scientists/Emeritus Professors/ Visiting Professors/ Honorary Professors/Adjunct Faculty (if any) in the concerned Faculty. — Special Invitees ix) Registrar — Secretary In the case of Faculties consisting of a single department, at least two Heads of the Departments from sister Faculties, as recommended by the Dean of the concerned Faculty, shall also be members of the PGRC. As the Secretary, the Registrar shall convene all the meetings of the PGRC.
		7.3	The DRC shall consist of the following: i) Head of the Department — Chairman ii) All Professors & Research Scientists "C" Member of the Department/All Professors of the concerned discipline. iii) Associate professor + Assistant professor of the Member Department, according to seniority, by rotation every two years and senior most Research Scientists "B and A" of the Department + the senior most Faculty member (Associate + Assistant) of the concerned discipline. iv) Supervisor and Co-Supervisor (if any) Member of the concerned Ph.D. scholar v) Emeritus Scientists/Emeritus Special Invitees Professors Member /Visiting Professor vi) Honorary Professors/ Adjunct Faculty (if any) in the concerned Department. vii) Where there are three or less than three teachers in the Department, the DRC shall consist of the following: viii) The Dean of the concerned Faculty. — Chairman ix) All teachers of the Department. — Member

			x) A Senior teacher of a sister Department (Nominated by the Dean in consultation with the concerned Head of the Department): Member xi) In case the Centre does not conduct any teaching program at PG level, the Dean of the concerned Faculty shall nominate 04 senior teachers of departments having expertise in to the research areas of the Centre. xii) The DRC shall appoint one of its members as Secretary and Convener. xiii) The DRC shall have powers to co-opt such members of the teaching staff of the concerned/sister Department as may be helpful to them in their deliberations. xiv) In the case of Faculties consisting of a single department, a senior teacher of sister Faculty recommended by the Dean of the concerned Faculty shall also be a member of the DRC.	
		7.4	The RPC shall consist of the following. i) Supervisor of the concerned Ph.D. Scholar Chairman ii) Co-supervisor (if any) of the concerned Ph.D. Scholar Member iii) A nominee of the Chairman of DRC Member iv) One expert in the field from the Department Member v) One or two experts from outside Department Member (s) • Experts mentioned in **Clauses 7.4 (iv)** and **(v)** above shall be nominated by the supervisor of the candidate and approved by the DRC. • In the case of Faculties consisting of a single department, **Clause 7.4 (v)** shall not be applicable. • A teacher who is not eligible to guide a Ph.D. scholar as per **Clause 8.1.1 (l)** or due to not satisfying the conditions laid down in **Clause 8.1.1 (d)** read with **Clause 8.1.1(k)** or the one referred under **Clause 8.1.3(c)** of these ordinances cannot become a member of any of the research committees mentioned above. • The DRC and RPC shall not make any recommendation that is not in conformity with these ordinances and/or such other directives as may be issued by the PGRC and/or the Academic Council in regard to the Ph.D. programme from time to time.	
		8.1	**GUIDELINES FOR APPOINTMENT OF SUPERVISOR / CO-SUPERVISOR**	

		8.1.1	**Appointment of Supervisors and Co-Supervisors:** (a) Every candidate, prior to admission to the Ph. D. programme (payment of Fee) shall be assigned a Research Supervisor, by the DRC of the concerned Department. on the mutual consent of the student and faculty members. The DRC may assign a Co-Supervisor (if necessary) on the request of the Supervisor. (b) The external part-time research scholar shall normally have one supervisor from the University (Internal) and another from the parent organization (External), where the candidate will be carrying out the research work (such candidate will submit a certificate from the External Supervisor to the effect that the candidate did work under the external supervisor during the period). If there is a need, there can be an internal co-supervisor and an external co-supervisor, from the university and the sponsoring organization respectively. The internal and external supervisors/co-supervisors shall consult each other in all matters pertaining to the progress of the work of the candidate. (c) In case a candidate is permitted to do a part of his/her research work at a place outside the University for a period of one semester or more but not exceeding three semesters in continuation or in parts, the person who will be looking after the research work of the candidate at the outside organization shall be appointed as an external supervisor by the concerned DRC. (d) The permanent Professor/Associate/Assistant Professor of the University with at least two research publications in refereed journals (more than 5.0 NAAS rating) may be recognized as Research Supervisor. (e) Provided that in areas/discipline where there is no or only a limited number of refereed journals, the University may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing. A full time regular teacher has been permitted to act as a supervisor. (f) Scientists/Scientific Officers/Research Officers who are appointed for a period of not less than 5 years under research projects in the University and who hold Ph.D. degree with at least 2 publications shall also be eligible to guide Ph.D. scholars. The teachers of the University, who are appointed against the above posts are also eligible to guide Ph.D. scholars provided they hold lien on their substantive posts and are otherwise qualified to guide Ph.D. scholars. (g) If a teacher working in a department different from his/her specialization wishes to guide a candidate in the subject in which the teacher holds the Ph.D. degree, he/she may be appointed as the supervisor/co-supervisor of the candidate. However, the candidate shall be admitted only in the main department corresponding to the subject of the research of the candidate, in accordance with the normal procedures laid down for admission. (h) Professors Emeritus/ Distinguished Professor/ UGC Scientists/Fellows appointed by the University or any national organization, shall be eligible to guide Ph. D. scholars, provided their

			(k) A faculty member who has three years of services before the retirement can be allowed to enrol/supervise a research scholar and can continue to be the supervisor of already registered candidates even after his/her retirement provided the DRC are convinced of his/her availability for continued guidance to the candidate. (l) A teacher who has retired/resigned from the University service may continue to be the supervisor, if the research scholar has fulfilled the minimum period requirement for the submission of the thesis. (m) Notwithstanding **Clause 8.1.1 (d)**, a permanent/retired faculty member or an Emeritus Professor/Scientist/Fellow employed in a department who does not possess a Ph.D. degree may be allowed to become a supervisor/co-supervisor on the recommendation of the DRC and approval by the Vice-Chancellor, provided he/she is engaged in research for at least five years as evidenced by publications in peer reviewed/reputed journals or he/she has supervised at least two dissertations at the Master's degree level. (n) The teachers of the University, who are enrolled as Ph.D. scholars in the University or in any other Institute/University, shall not be entitled to guide a Ph.D. scholar. Those, appointed as supervisors, would cease to be supervisors if they get enrolled for Ph.D. (c) In case where the supervisor of the candidate is appointed in a sister department of the University, provision for transfer of candidates pursuing research under his/her supervision in the earlier department shall be available provided the candidate opts for it and the DRC's of the concerned department agree to the proposed transfer. However, the research scholar, subsequent upon transfer, shall be governed by the ordinances of the faculty / department to which he/she is transferred.	
		8.1.2	**Quota of Ph.D. Scholars** (a) The maximum number of full time candidates who can be supervised by a faculty member at any time shall be as follows: **by a Professor – 8,** **by an Associate Professor – 6,** **by an Assistant Professor – 4,** (b) In case a co-supervisor is also appointed, a full time candidate shall be counted towards the quota of both the supervisor and the co-supervisor. (c) All full time research scholars registered for Ph.D. shall be counted within the quota till they submit their theses. (d) A faculty member can supervise a maximum number of two external/internal part time candidates at any time and it shall not be counted towards the quota provided at (a) above. (e) An Internal Adjunct Faculty can enrol a maximum number of two candidates in the host department of the University (where he/she is appointed as internal adjunct faculty) at any time and such enrolment	

			shall not be counted towards the quota provided at (a) above. (f) The quota prescribed to Professor Emeritus and Distinguished Professor for the registration of Ph.D. students shall be same as that allotted to a Professor. (g) The teachers of the University shall also be permitted to guide Ph.D. Scholars admitted in other Universities of national importance, provided that (i) there is a vacancy with the guide under whom the candidate intends to work (ii) the sponsoring university seeks prior permission in the matter and (i) the concerned DRC approves it.	
		8.1.3	**Appointment of a New Supervisor:** (a) If the supervisor of a candidate proceeds on leave/lien/deputation for a period of more than 12 months, or he/she proceeds on leave for a period of less than 12 months, but later extends his/her leave beyond 12 months, then a co-supervisor shall be appointed. However, if the candidate submits the abstract of the thesis or the thesis itself before the supervisor proceeds on leave, then no co-supervisor shall be required. Further provided that if the Supervisor of a candidate proceeds on lien/deputation to another institution for a period of more than 12 months, the DRC may permit a candidate to complete his/her research work under the same supervisor in that institution provided consents of the supervisor, candidate and the host institution is available and the DRC is convinced that the facilities available in the host institution are adequate for successful completion of research work. (b) If the supervisor of a candidate expires or is terminated from the University service, he/she shall cease to be the supervisor. (c) If the supervisor of a candidate is placed under suspension, he/she shall cease to be the supervisor during the entire period of his/her suspension. (d) If a teacher, except for the one governed by the Clauses 8.1.1 (h), (i) and (j), retires/resigns from the University service, he/she shall cease to be the supervisor. (e) In all the cases, where the existing supervisor of a candidate ceases to be the supervisor, the DRC shall appoint the co-supervisor, if any, as the supervisor of the candidate, provided the co-supervisor is from the same discipline. If there is no co- supervisor for the concerned candidate or the co-supervisor is from a different discipline, then the DRC shall appoint a new supervisor. (e) If a candidate, for cogent reasons, intends to change his/her supervisor, it shall be permitted by the DRC by the mutual consent of present supervisor, proposed supervisor and the candidate.	
		8.2	**TIME PERIOD REQUIREMENTS**	

			supervisor, proposed supervisor and the candidate.	
		8.2	**TIME PERIOD REQUIREMENTS**	
		8.2.1	Minimum period of research work required for the submission of thesis The minimum period of work required for submitting the thesis for the full-time candidates admitted to the Ph.D. programme shall be asfollows: 1. For candidates who are admitted to the Ph.D. programme in any department of a faculty, with Master's degree in a subject from the same faculty as qualifying degree, the minimum period of research work before the submission of the thesis shall be **3** years from the date of his/her admission, i.e., **date of deposition offee.** 2. For candidates who are admitted to the Ph.D. programme in any department of a faculty, with Bachelor's degree in a subject from the same faculty as qualifying degree, or Master's/Bachelor's degree in a subject from a different faculty as qualifying degree, the minimum period of research work before the submission of the thesis shall be **3** years from the date of his/her admission, i.e., **date of deposition offee.** **NOTE: The aforesaid residence period shall be calculated from the date of deposition of fees by the candidate at the time of admission.**	
		8.2.2	**Maximum Period for the Submission of Thesis** (a) If a candidate fails to submit the thesis at the end of the stipulated period as prescribed in Clause 8.2.1, the Head of the Department, with the recommendation of the RPC and the DRC, may grant an extension of up to **two years (one year at a time)** for the submission of thethesis. (b) If a candidate fails to submit the thesis within the extended period as stipulated in Clause 8.2.2 (a) due to cogent reasons, he/she may be given additional **one semester** of extension for submitting the thesis, by the Dean of the faculty, on the recommendation of the RPC and the DRC, such that the total period for the submission of the thesis counted from the date of his/her admission does not exceed seven years. (c) Under extraordinary circumstances, the PGRC may grant a further extension of two years for the submission of the thesis, for which the candidate shall apply giving the reasons due to which he/she was not able to submit the thesis and his/her application is duly forwarded and recommended by the concerned RPC and the DRC. No further extension shall be given under anycircumstances.	
		8.2.3	**Residency Period**	

			(a) A Ph.D. Scholar shall be required to be present in the University for a prescribed period, which is known as the ResidencyPeriod. (b) For the candidates of all categories except for the external part-time research scholars, the residency period shall be the same as the period a research scholar takes for the submission of the thesis without exceeding the total time frame provided in these ordinances. (c) For an external part-time research scholar, the residency period shall be of at least one week per semester or the minimum period required for completing the course work wherever the course work is a part of the Ph.D. programme, whichever is more. Such candidates would be required to deliver at-least two open seminars to evidence the progress of research made bythem. (d) For an external part-time research scholar, the residency period shall be of at least one week per semester during the minimum time period for submission of thesis. Such candidates would be required to deliver at-least two open seminars to evidence the progress of research made bythem. If a full time research scholar is appointed as a permanent employee (Teaching/Non- teaching) of this university then his/her candidature may be changed from full time research scholar to an internal part-time research scholar scholar with minimum residence period of 3 years subject to the condition that a candidate has to apply for no objection certificate from his/her employer and it will be routed throughDRC.	
		8.2.4	The DRC may recommend a full-time Ph.D. scholar to pursue a part of his/her research work at a place out side the University. The Dean of the concerned Faculty may approve such recommendations of DRC which are for a period of six months or less. However, if such recommendations are for a period beyond six months, the recommendations of the DRC would be placed before the PGRC, which may permit a full-time Ph.D. scholar to pursue a part of his/her research work at a place outside the University without exceeding the maximum time limit for the submission of the thesis laid down in theseordinances.	
		8.3	**Research Programme Committee (RPC)**	
		8.3.1	The RPC shall be constituted as per clause **7.0** of ordinance.	
		8.3.2	The DRC may also appoint a Co-Supervisor on recommendation of the Chairman of the Advisory Committee of the student.	
		8.3.3	**FUNCTIONS OF THE RPC**	
			The RPC of a Ph.D. student shall: i. Prescribe major, minor, supportive and remedial courses, ii. Finalize research plan proposal of the research work, and. iii. Guide the student in all matters related to his/her academic activities.	
		8.4	**ALLOCATION OF STUDENTS TO A SUPERVISOR**	
			Allocation of students to a supervisor for guiding thesis shall be done by DRC	

			as per mutual consent with the teachers and students.	
			Allocation ofstudents to a supervisor for guiding thesis shall be done by DRC in consultation with the teachers expected to be allotted students for Ph.D. thesis supervision. The DRC will allocate students to the teachers, seniority wise going downward until all the eligible teachers have received a minimum of one student.	
		8.4.1	**QUOTA OF Ph.D. STUDENTS UNDER A SUPERVISOR** Vide **clause 8.1.2 Quota of Ph.D. Scholars,** of the Ph.D. Ordinance of the University.	
		8.5.2	**VACANCY UNDER A SUPERVISOR**	
			A seat shall be considered vacant only when a student submits his/her thesis or on the expiry of eight semesters from the date of registration / or on the cancellation of his her registration.	
		8.6	**REGISTRATION PERIOD and EXTENSION OF REGISTRATION PERIOD** Vide **clause 8.2 - Time period Requirements** of Ph.D. Ordinance of the University.	
		8.7	**Research Plan Proposal (RPP)**	
			Within 15 days from the date of the **RPP** seminar a student shall submit six copies of a detailed **RPP** through his/her **RPC** to the Head of the Department. The **RPP** shall be considered by the DRC including the Chairman of the RPC of the student. If the **RPP** is not approved, the candidate shall be asked to deliver the **RPP** seminar again and submit the revised **RPP** for reconsideration of the DRC. Through his/her **RPC**. A copy of the approved RPP shall be provided to the student and the supervisor. **(Annexure-II)**	
		8.7.1	Ordinarily a Ph.D. student will start his/her research work only after approval of the Thesis RPP.	
		8.8	**PROGRESS REPORT**	
		8.8.1	**Progress Report:** (a) The DRC and RPC shall monitor the academic/research progress of each candidate. For this purpose, the candidate shall submit a progress report on a prescribed proforma in triplicate, at the end of each semester to the RPC through his/her supervisor and co-supervisor, if any. (b) The candidate shall make presentation on the progress of his/her research work through a seminar and the RPC shall evaluate the progress made by the candidate and submit its recommendations to the concerned DRC. (c) The Chairman of the DRC shall forward the progress report with specific recommendations to the Registrar (Academic) with a copy to the Dean. (d) Progress of a candidate in any semester shall be deemed to be unsatisfactory if the candidate is absent for a period more than that specified in Clause 9.12.	

	The candidate shall submit progress reports for each semester till the submission of the thesis. The last progress report of the candidate shall be submitted to Registrar (Academic), in the manner prescribed, prescribed before submission of thesis.	
8.8.2	**Research Plan Proposal** (a) At the end of the second semester the candidate shall submit to the RPC, a research plan proposal generally consisting of preamble, definition of the problem, objective of work, approaches to be adopted, in about 8 to 10 pages along with his/her second progress report. The proposal shall also indicate the topic of the research, although not necessarily the precise title of the thesis. (b) The RPC and the DRC shall examine the research plan proposal of the candidate and the candidate shall deliver a detailed seminar called "Research Plan Proposal Seminar" before the RPC and the DRC. (c) The RPC and the DRC, if satisfied with the research proposal and the seminar, shall approve the proposal and the topic of research, and shall forward its recommendation along with the second progress report of the candidate to the Registrar (Academic) with a copy to the Dean. (d) If the RPC and the DRC are not satisfied with the quality of the research plan proposal, the candidate shall submit a fresh proposal and deliver the seminar within a time limit specified by the DRC (not exceeding three months in any case), and a fresh evaluation shall be done. But, if only the seminar is unsatisfactory, the candidate shall deliver only the seminar again within one month. (e) If the candidate fails to submit the research plan proposal at the end of the second semester or the research plan proposal and/or the research plan proposal seminar of the candidate is/are not approved by the DRC even after complying with Clause 8.8.2 (d), the candidate's admission shall stand cancelled.	
8.9	**CHANGE OF TOPIC OF RESEARCH**	
8.9.1	**MAJOR CHANGES**	
	In case of "major" change(s) the Ph.D. student shall be required to submit a fresh RPP and deliver the RPP seminar again. The minimum four semesters from the date of admission for supplication for the thesis for such a candidate shall be counted from the semester in which the revised RPP was approved.	
8.9.2	**MINOR CHANGE**	
	In case of a "minor" change the candidate may be allowed to continue research as planned earlier incorporating the change.	
8.10	**COMPREHENSIVE EXAMINATION**	
8.10.1	A student shall be eligible to appear in the comprehensive examination as soon as he/she successfully completes at least 75% of his course requirements.	
8.10.2	The comprehensive examination shall be written and oral. The written	

				examination shall comprise two theory papers one from the major subject and other from the minor fields + supporting courses covering the entire course work. Each paper shall be of 100 marks. A student shall be required to secure at least 60 percent marks in each paper for passing this examination.	
			8.10.3	The question paper for the written comprehensive examination shall be prepared by the concerned course Instructors of the respective major, minor and supporting who will also examine the answer scripts. This examination shall be arranged by the Chairman in consultation with members of the RPC and the Head of the Department.	
			8.10.4	On successful completion of the aforesaid examination he/she shall qualify to appear in Oral Comprehensive examination to be conducted by the RPC along with one outside expert member from the majorfield.	
			8.10.5	The external examiner shall be appointed by the Dean from a panel of three names submitted by the Chairman of the RPC and approved by the DRC.	
			8.10.6	The examiners shall submit a comprehensive report making clear recommendation as "Satisfactory/Unsatisfactory".	
			8.10.7	In case the performance of astudent is judged "Unsatisfactory" he/she shall be required to appear again, after a lapse of at least 12 weeks from the last oral examination, which will be conducted vide clause 8.10.4.	
			8.11	**THESIS PRE-SUBMISSION SEMINAR -**	
			8.11.1	This seminar shall be delivered only after the completion of at least three semesters from the semester in which the RPP seminar was delivered and only when the candidate has successfully completed his/her oral and written comprehensive examinations. This seminar shall be based on the research work carried out by thecandidate.	
			8.11.2	A Ph.D. student is not required to be registered in a semester for delivering this seminar.	
			8.12	**THESIS SUPPLICATION** Vide **clause XIII - Submission of the** thesis of the Ph.D. Ordinance of the University	
			8.12.1	A Ph.D. student will submit his/her thesis only after the expiry of the minimum residential period provided he/she maintains the minimum prescribed OGPA for passing the degree programme, and successfully completed comprehensive examination. The candidate shall be required to have communicated / published in refereed journals, at least two research papers based on his/her research work before submitting the thesis. The reprints/proofs/pre-prints of the papers shall be attached at the end of the thesis. The evidence for submission/acceptance of the papers shall be submitted to the Office of the Deputy Registrar (Academic) at the time of submission of thesis.	
			8.12.2	A Ph.D. student shall ordinarily supplicate his/her Ph.D. thesis within **Six months** form the date of the Pre- Submission Seminar. The Ph.D. student will submit: (a) The candidate is required to submit the thesis within six months	

from the date of his/her pre-submission seminar (without exceeding the maximum time limit for the submission of the thesis as laid down in Clause 8.2.2), failing which he/she shall be required to deliver a fresh pre- submission seminar.

(b) The candidate shall submit the thesis to the Registrar (Academic), duly forwarded by the Head of the Department of the School. While submitting the thesis, the candidate shall submit the following:

1. Four hard copies and one soft copy (in a CD) of the abstract of the thesis written in about 600 words describing the salient features of his/her investigation.
2. Four hard copies and one soft copy (in a CD) of the thesis in English approved by the concerned DRC as per the format given in **Annexure – A.**
3. A declaration by the candidate as per the format given in **Annexure – B.**
4. A course/comprehensive examination/pre-submission seminar completion certificate, wherever applicable, by the Head of the Department as per the format given in **Annexure – C.**
5. A copyright transfer certificate as per the format given in **Annexure – D.**

(c) The candidate may submit the copies of the abstract (in hard and soft forms) one month before the submission of the thesis in order to expedite the process of evaluation.

(d) The candidate shall be required to have communicated/published in refereed journals, at least two research papers based on his/her research work before submitting the thesis. The reprints/proofs/pre-prints of the papers shall be attached at the end of the thesis. The evidence for submission/acceptance of the papers shall be submitted to the office of the Registrar (Academic) at the time of submission of thesis.

(e) The candidate shall also submit one copy each of the thesis and the abstract to the supervisor, co-supervisor, an external supervisor and an external co-supervisor, as the case may be.

(f) No part of the thesis shall have been submitted for the award of any other degree or diploma of any university.

(g) The thesis shall contain a copyright certificate at the beginning of the thesis on a separate page.

(h) A thesis once submitted cannot be re-submitted except when the examiner recommends for the revision of the thesis.

(i) The Academic Section shall send the thesis/abstract to the office of the Controller of Examinations within two working days after the submission.

(a) working in that institution. The panel shall not include the name/names of any person/persons with whom the candidate has published a research paper.

(b) Complete and current addresses of all the examiners proposed in the panel with their e- mail addresses and mobile number shall be provided by the Supervisor.

(c) The Panel of Examiners shall be considered and approved by the concerned

	(ii) The panel of Examiners duly approved by the DRC shall be sent by the Chairman of DRC to the Dean of the concerned Faculty, immediately after panel is approved by DRC, for the appointment of the Board of Examiners from the panel with a copy endorsed to the Office of the Registrar (Academic) forrecords. (iii) The Dean of the concerned Faculty shall communicate to the Controller of Examinations two names of external examiners to function as Primary Board of Examiner, out of the panel approved by DRC, within three days of its receipt for evaluation of thesis. He shall also send another two names of examiners, out of the same panel, as supplementary Board of Examiner, which will be used in the event of denial of examinership/ no response from the examiners in the Primary Board of Examiner. A copy of said communication shall also be endorsed to the Registrar (Academic) forrecords.
8.13.3	The Controller of Examinations shall get in touch with each examiner over e-mail with a soft copy of the abstract to secure acceptance of the examinership apart from communicating through post. The said exercise shall be undertaken by the Controller of Examinations within three days of receipt of names of appointed examiners from the Dean of the concerned Faculty. However, in case, the soft copy of the abstract is received from the Academic Section subsequent to the receipt of names in the Board of Examiners from the Dean, the said exercise shall be completed within three days of receipt of soft copy of abstract. **The examiner's consent via email may be accepted and thesis may be forwarded for the evaluation.** If no information is received from an examiner within 15 days period from first communication to the examiner, a reminder shall be issued. If, however, no information is received from an examiner within 30 days period from first communication to the examiner, his/her appointment shall be cancelled and a new examiner shall be appointed from the panel of names in the Secondary Board of Examiners. In case the Secondary Board of Examiner is exhausted, a new examiner shall be appointed from the panel of names in accordance with the Clause 8.13.2.
8.13.4	**Thesis Evaluation** (a) The Controller of Examinations shall forward the copy of the thesis to the Examiners within three days of receipt of their consent (via email or postal services) and take necessary action to get the report of the examiner expeditiously. However, in case the Thesis is received from the Academic Section subsequent to the receipt of consent, the said exercise shall be completed within three days of receipt of Thesis. (b) The examiners shall be requested to submit their individual reports within two months of the receipt of the thesis. (c) In case, an examiner does not send his/her report within the above period, a reminder shall be sent to him/her over e-mail. This shall be followed by a subsequent reminder after a fortnight. (d) In the event of the report not being received from the examiner within 12 weeks, his/her examinership shall be cancelled and a new examiner shall be appointed from the panel of names in the Secondary Board of Examiners. In case the Secondary Board of Examiner is exhausted, a new examiner shall be appointed from the panel of names in accordance with the Clause 8.13.2.

	(e) The examiners shall examine the thesis specifically with a view to judge whether the thesis is a piece of research work characterized by: **(i) substantial contribution to the subject,** (ii) a fresh approach towards interpretation of facts or theories, or (iii) Evidence of creativity and originality. (d) The examiner shall be required to give his/her opinion about candidate's ability for critical examination and sound judgment.
8.13.5	**Examiner's Report**
	(a) The examiners shall submit the report on a prescribed form as given in *Annexure – E(1)*, and shall make one of the following recommendations: i) The thesis be accepted for the award of the Ph.D. degree. ii) The thesis be accepted for the award of the Ph.D. degree subject to the candidate giving satisfactory answers, at the time of Viva-Voce, to the specific queries raised in the report. iii) The thesis, in the present form, cannot be accepted for the award of the Ph.D. degree, and the candidate be advised to revise the thesis on certain issues raised in the report and resubmit the thesis. In the case of resubmission, the examiner shall specifically mention whether the thesis must be referred back to him/her for re- evaluation or not. iv) The thesis be rejected. (b) If both the examiners recommend acceptance of the thesis for the award of the Ph.D. degree, the thesis shall be accepted. (c) If both the examiners recommend rejection of the thesis for the award of the Ph.D. degree, the thesis shall be rejected. (d) If the examiner(s) raise some queries/seek clarifications, the candidate shall be required to give satisfactory answers to the queries at the time of Viva-Voce. (e) If one or both the examiners recommend revision of the thesis, the candidate shall resubmit the thesis after revision. If a specific examiner asks for the revised thesis to be referred back to him/her, it shall be sent to him/her. Otherwise, the revised thesis shall be assessed by the DRC for satisfactory compliance of the desired revision. (f) If the revised thesis is to be referred back to an examiner, the examiner shall submit his/her report on a prescribed form as given in *Annexure – E (2)*. The examiner shall recommend the revised thesis to be either accepted or rejected. Then depending on the recommendation of the other examiner, an appropriate action shall be taken as per Clauses 8.13.5 (c), (d), (e), (f) or (h). (g) If one examiner recommends rejection of the thesis and the other recommends acceptance, then a third examiner shall be appointed as per Clause 8.13.2 from the panel of already approved examiners. In such cases, Clause 8.13. 5 (i) shall apply. (h) The third examiner, if appointed, shall be an Indian or a foreign expert, depending on whether the thesis was rejected by an Indian or a foreign examiner in the first instance. Once the third examiner is appointed, any previous recommendations of the examiner, in whose place the third examiner has been appointed, shall become null and void for all purposes.

	(i) In case the third examiner recommends acceptance or revision of the thesis or asks for clarifications, then depending on the recommendation of the other examiner (who has not rejected the thesis) an action appropriate to the case mentioned in Clauses 8.13.5 (c), (e) or (f) shall be taken. In case the third examiner recommends the rejection of the thesis, his/her recommendation shall be final and the thesis shall be rejected.
8.13.6	In the case of any ambiguous recommendations by any examiner, the Controller of Examinations shall approach the examiner concerned for a clear recommendation. If a clear recommendation is not forth coming the matter shall be referred to the Vice-Chancellor for his/her decision.
8.13.7	After the reports from both the examiners are received, the Controller of Examinations shall inform the supervisor and co-supervisor (if any) for appropriate action.
8.13.8	**VIVA-VOCE EXAMINATION** **Viva-Voce** of the Ph.D. Ordinance of the University except that the Viva-Voce Board shall consist of i. The RPC ii. One External Examiner iii. DRC Nominee The Supervisor of the thesis will be Chairman of the Viva-Voce Board. **Viva-Voce** (a) If the thesis has been accepted for the award of the degree, the candidate shall be required to defend his/her thesis in a Viva-Voce, before a duly constituted committee hereinafter referred to as Viva-Voce Committee (VVC). The date, time and venue of the Viva-Voce with other necessary details shall be adequately notified so as to enable other faculty members and students to attend it. (b) The supervisor and the co-supervisor (if any), shall arrange for the Viva-Voce of the candidate as early as possible and normally within **a month** from the date of communication to them from the Controller of Examinations for conducting the Viva-Voce. (c) The VVC shall consist of the supervisor and the co-supervisor (if any), the Indian examiner who has evaluated the thesis and a nominee of the concerned DRC. The supervisor shall be the chairman of the VVC. (d) In the case of external candidates, the external supervisor and co-supervisor, if any, may be invited for the Viva-Voce as examiner(s). (e) In the case of non-availability of the Indian Examiner for conducting the Viva-Voce, the Vice-Chancellor may appoint another examiner. (f) In the case of inability of the Supervisor or Co-Supervisor to conduct the Viva-Voce due to any reason, the Head of the Department shall arrange to conduct the Viva-Voce. In such cases, the Ph.D. work shall be deemed to have been carried out under the guidance of the original Supervisor/Co-Supervisor only. (g) The VVC shall be provided with the reports of all the examiners before the Viva-Voce. (h) The VVC shall submit a comprehensive report on the performance of the candidate at the Viva-Voce, including the discussions over various points raised. The VVC shall recommend one of the following:

	i) that the degree be awarded, ii) that the candidate be re-examined in a second Viva-Voce, iii) that the degree be not awarded and the thesis be rejected. (i) If the VVC recommends that the degree be awarded, the candidate shall submit two hardbound copies of the thesis incorporating corrections, if any, (along with 2 corresponding soft copy versions of the thesis in CDs), one for keeping in the library of the University and the other for the departmental library. The spare copies of the thesis may be returned to the candidate. (j) If the VVC recommends for a second Viva-Voce, it shall be conducted normally after a period of three months but within six months from the date of the first Viva-Voce. If a candidate, after the submission of the thesis, has gone abroad (other than SAARC countries) and is not likely to return in near future and the reports of Examiners" on the thesis are unanimous without any major critical comments or corrections, the Viva-Voce Examination shall be conducted via Video-Conferencing.
8.13.9	Review of Examiner's Report in case the Thesis is Rejected The Vice-Chancellor shall have the power to constitute an independent three-member review panel to investigate the cause of rejection of thesis. The review panel shall examine the research work and the examiners" report thereon to submit their findings to the Vice Chancellor for future improvements. It may also examine the matter to suggest as to whether the research scholar can further work on the same topic to rebuild his/her initial work and the correct course of action for achieving that and time frame needed for resubmission of his/her thesis without exceeding the total time period prescribed for submission of thesis in theseOrdinances.
8.13.10	**Award of the Degree**
	a) The reports of all the examiners and the Viva-Voce examination shall be placed before the concerned PGRC for consideration. In the case of unanimous recommendations, the PGRC shall approve the award of the Ph.D. degree provided the candidate produces "No Dues Certificate" in a prescribed form. In all other cases the concerned PGRC shall take its specific decision based on the reports of the examiners as well as the VV examination. b) After the approval of thesis by the PGRC for the award of the degree, the provisional degree shall be issued to the candidate by the Controller of Examinations for which the candidate shall apply in a prescribed form by paying prescribed fee. The candidate concerned may also be given the examiner's reports after the approval of the thesis for which he/she shall apply separately. However, the examiners" reports in case of thesis rejected by examiners shall be treated as confidential document and shall not be disclosed. c) The year of award of the Ph.D. degree shall be the same as the year of submission of the thesis, if the thesis is accepted without revision. If the thesis is recommended for revision, the year of award of the Ph.D. degree shall be the year of submission of revised thesis. d) The Ph. D. degree certificate shall mention the title of the thesis, the discipline/subject of his/her Postgraduate – discipline/subject of Ph.D. of his/her

	thesis may be returned to the candidate. (j) If the VVC recommends for a second Viva-Voce, it shall be conducted normally after a period of three months but within six months from the date of the first Viva-Voce. If a candidate, after the submission of the thesis, has gone abroad (other than SAARC countries) and is not likely to return in near future and the reports of Examiners" on the thesis are unanimous without any major critical comments or corrections, the Viva-Voce Examination shall be conducted via Video-Conferencing.
8.13.9	Review of Examiner's Report in case the Thesis is Rejected The Vice-Chancellor shall have the power to constitute an independent three-member review panel to investigate the cause of rejection of thesis. The review panel shall examine the research work and the examiners" report thereon to submit their findings to the Vice Chancellor for future improvements. It may also examine the matter to suggest as to whether the research scholar can further work on the same topic to rebuild his/her initial work and the correct course of action for achieving that and time frame needed for resubmission of his/her thesis without exceeding the total time period prescribed for submission of thesis in theseOrdinances.
8.13.10	**Award of the Degree** a) The reports of all the examiners and the Viva-Voce examination shall be placed before the concerned PGRC for consideration. In the case of unanimous recommendations, the PGRC shall approve the award of the Ph.D. degree provided the candidate produces "No Dues Certificate" in a prescribed form. In all other cases the concerned PGRC shall take its specific decision based on the reports of the examiners as well as the VV examination. b) After the approval of thesis by the PGRC for the award of the degree, the provisional degree shall be issued to the candidate by the Controller of Examinations for which the candidate shall apply in a prescribed form by paying prescribed fee. The candidate concerned may also be given the examiner's reports after the approval of the thesis for which he/she shall apply separately. However, the examiners" reports in case of thesis rejected by examiners shall be treated as confidential document and shall not be disclosed. c) The year of award of the Ph.D. degree shall be the same as the year of submission of the thesis, if the thesis is accepted without revision. If the thesis is recommended for revision, the year of award of the Ph.D. degree shall be the year of submission of revised thesis. d) The Ph. D. degree certificate shall mention the title of the thesis, the discipline/subject of his/her Postgraduate – discipline/subject of Ph.D. of his/her research and the Department in which the candidate was admitted for the Ph.D. programme. e) After the approval of the thesis for the award of the degree, the abstract shall be published in the "Abstracts of Accepted Theses for the Ph.D. Degree of the University. Once a thesis has been approved for the award of the Ph.D. degree, the candidate shall, in case of publication of the thesis in full or in part, state on the title page that it

	was a thesis approved for the award of the Ph.D. degree of the University, or based upon that thesis.

ORDINANCES DEFINING OTHER TERMS

9.0	**ACADEMIC YEAR**
	The Academic year shall be divided into two (2) semesters of approximately 120 working days each including examinations.
9.1	**FEES**
	Students shall pay fees as prescribed by the University from time to time.
9.2	**COURSES/ DISCIPLINES**
9.2.1	**MAJOR DISCIPLINE**
	The particular course in which a student is enrolled shall be his/her major discipline.
9.2.2	**MINOR DISCIPLINE**
	A related discipline other than the major discipline in which a student offers at least eight for M.Sc. (Ag.) Agronomy and six credits Ph.D. Agronomy of courses shall constitute his/her minor discipline.
9.2.3	**CORE COURSE**
	Compulsory course prescribed for all the students Major Discipline.
9.2.4	**OPTIONAL COURSE**
	Courses of the Major discipline that a student can select on the advice of the RPC.
9.2.5	i. **MINOR COURSES** Courses of sister discipline that a student admitted to a Major Discipline can select on the advice of the RPC. ii. **SUPPORTING COURSES** The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.
9.2.6	**OFFERING OF THE SAME COURSE :** A student cannot offer the same course again in any degree programme unless failed.
9.2.7	**ADDITIONAL COURSE** M.Sc. (Ag.) Agronomy/ Ph.D. Agronomy student may be advised to take additional courses to make up any deficiency. Such a course shall be called as Additional Course. The grades awarded in such courses shall not be considered for the calculation of GPA/OGPA. However, the student will be required to pass the course. The Additional Courses offered shall appear in their transcript under the title 'Additional Course".
9.3	**REGISTRATION**
9.3.1	**REGISTRATION IN A SEMESTER**
	The students shall be required to pay their fees within 5 days of the admission.
9.3.2	**REGISTRATION IN A COURSE**

	An M.Sc. (Ag.) Agronomy /Ph.D. Agronomy student with approval of his/her supervisor and the Head of the Department may drop a course within 15 days of registration.
9.8	**TEMPORARY WITHDRAWAL FROM STUDIES**
	The Dean may allow temporary withdrawal to a student on any one of the following : i. Illness of self to be supported by medical certificate; ii. Death of parent/ Guardian or in the case of married student, the spouse. iii. Temporary withdrawal shall not be allowed for taking up any employment during the course programme. iv. An M.Sc.(Ag.) Agronomy student who has completed all the requirements except the thesis submission may be allowed temporary withdrawal to take up any assignment provided his/her application has been approved and forwarded by the Supervisor & HOD. v. A Ph.D. student may be allowed temporary withdrawal to take up any assignment only when he/she has completed course work, course seminar, research work as per RPP as well as written and oral comprehensive examination, provided his/her application has been approved and forwarded by the RPC and DRC. vi. A student who has been allowed temporary withdrawal will complete his/her degree programme within the prescribed maximum registration period. vii. During the period of withdrawal the candidates will not be required to pay any fee. However, fee already paid (temporary withdrawal involving part of a semester) shall not be refunded. viii. An undergraduate student who has been allowed temporary withdrawal shall join in the same semester where he/she was allowed to withdraw. ix. An M.Sc.(Ag.) Agronomy /Ph.D. Agronomy student shall have an option to join in the current semester. x. All such students who have been granted temporary withdrawal will join within five (5) days of the start of the semester. xi. An M.Sc.(Ag.) Agronomy student will submit his/her application through his supervisor andthe Head of the Department whereas a Ph.D. Agronomy student will submit his/her application through the Supervisor RPC and DRC. xii. The temporary withdrawal shall not be granted in the First semester of Admission. vii. The residential requirement of students allowed temporary withdrawal shall be automatically extended by the duration of the withdrawal. However, such candidates shall be required to complete the degree programme within the maximum period prescribed.
9.9	**SCRUTINY**
	A student finding some discrepancy in his/her transcript will submit an application within two weeks from the date of declaration of his/her results to the Dean who will have the results scrutinized.
9.10	**UNFAIR MEANS**
	Students found using unfair means during any examination shall be punished as per the University Ordinances applicable at that time.

9.11	**ATTENDANCE REQUIREMENT**
	As per University rules
9.12	**LEAVE OF A RESEARCH STUDENT**
9.12.1	**Leave Rules** (a) A Ph.D. scholar shall be eligible to avail a leave of 30 days in an academic year. He/she shall not be entitled for any inter-semester breaks, winter and summer vacations. However, he/she is entitled for an additional leave of up to 10 days on medical grounds in an academic year. The aforesaid leave provisions are cumulative. Further, male/female candidates shall be eligible for paternity/maternity leaves as per University rules once during their entire tenure as research scholars. (b) The leave shall be granted by the Head of the Department on the recommendation of the supervisor/co-supervisor.
9.12.2	**LEAVE OF ABSENCE ON RESEARCH ASSIGNMENT**
	After the approval of his/her synopsis a Ph.D. student may be allowed leave of absence for 15 days in a semester for carrying out research related work outside University. This period shall be counted while calculating his/her attendance. The student will submit his/her application to the Head of the Department through her RPC.
9.13	**CONDUCT OF VIVA-VOCE (ORAL) EXAMINATION IN THE ABSENCE OF THE CHAIRMAN OF THE ADVISORY COMMITTEE / RPC.**
9.13.1	In the absence of the Chairman the Viva-voce (Oral) examinations of M.Sc. (Ag.) Agronomy and Ph.D. Agronomy students shall be conducted under the Chairmanship of Co-supervisor, if any or the Head of the Department with prior permission of the competent authority.
9.13.2	In the absence of a member, the Chairman of the Advisory Committee / RPC will nominate another member(s) on the Advisory Committee / RPC in consultation with the Head of the Department. The name of the member will be recorded as additional name(s).
9.14	**TITLE OF THE DEGREES**
	The degrees to be awarded after the successful completion of various courses shall have the following titles.
9.14.1	Master of Science in Agriculture specialization in Agronomy
9.14.2	DOCTOR OF PHILOSOPHY DEGREE will be awarded in the same subject as given under clause 9.14.1.
9.14.3	Specializations within a degree (M.Sc. (Ag.) Agronomy /Ph.D.) Agronomy.
9.15	**COMMITTEES OF THE INSTITUTE / DEPARTMENT**
9.15.1	**INSTITUTE ADMISSION COMMITTEE**
	The Admission Committee shall comprise the following:
	i. Director – Chairman ii. Dean iii. Two Senior most Teachers of the rank of Professor iv. SC Representative v. ST Representative vi. Assistant Registrar – Secretary
9.15.2	**ADMISSION COMMITTEE OF THE DEPARTMENT**

	However, he/she is entitled for an additional leave of up to 10 days on medical grounds in an academic year. The aforesaid leave provisions are cumulative. Further, male/female candidates shall be eligible for paternity/maternity leaves as per University rules once during their entire tenure as research scholars. (b) The leave shall be granted by the Head of the Department on the recommendation of the supervisor/co-supervisor.
9.12.2	**LEAVE OF ABSENCE ON RESEARCH ASSIGNMENT**
	After the approval of his/her synopsis a Ph.D. student may be allowed leave of absence for 15 days in a semester for carrying out research related work outside University. This period shall be counted while calculating his/her attendance. The student will submit his/her application to the Head of the Department through her RPC.
9.13	**CONDUCT OF VIVA-VOCE (ORAL) EXAMINATION IN THE ABSENCE OF THE CHAIRMAN OF THE ADVISORY COMMITTEE / RPC.**
9.13.1	In the absence of the Chairman the Viva-voce (Oral) examinations of M.Sc. (Ag.) Agronomy and Ph.D. Agronomy students shall be conducted under the Chairmanship of Co-supervisor, if any or the Head of the Department with prior permission of the competent authority.
9.13.2	In the absence of a member, the Chairman of the Advisory Committee / RPC will nominate another member(s) on the Advisory Committee / RPC in consultation with the Head of the Department. The name of the member will be recorded as additional name(s).
9.14	**TITLE OF THE DEGREES**
	The degrees to be awarded after the successful completion of various courses shall have the following titles.
9.14.1	Master of Science in Agriculture specialization in Agronomy
9.14.2	DOCTOR OF PHILOSOPHY DEGREE will be awarded in the same subject as given under clause 9.14.1.
9.14.3	Specializations within a degree (M.Sc. (Ag.) Agronomy /Ph.D.) Agronomy.
9.15	**COMMITTEES OF THE INSTITUTE / DEPARTMENT**
9.15.1	**INSTITUTE ADMISSION COMMITTEE**
	The Admission Committee shall comprise the following:
	i. Director – Chairman ii. Dean iii. Two Senior most Teachers of the rank of Professor iv. OBC Representative v. SC Representative vi. ST Representative vii. Assistant Registrar – Secretary
9.15.2	**ADMISSION COMMITTEE OF THE DEPARTMENT**
	The Admission Committee shall comprise the following: i. Head of the Department – Chairman ii. Two Senior Most Teachers iii. OBC Representative

	iv. SC Representative v. ST Representative vi. A permanent teacher to be co-opted on rotation basis to act as Secretary of the Committee.
9.15.3	**BOARD OF EXAMINERS OF THE DEPARTMENT**
	The Board of Examiners shall comprise the following: i. Head of the Department – Chairman ii. Two Senior Most Teachers

Note:

From the date when these Ordinances come into operation all previous ordinances on the subject shall cease to have effect. Provided that this revocation shall not affect the previous Ordinances so revoked or anything done or suffered under any previous Ordinance so revoked or affect any right, privilege, obligation or liability acquired, arrived or incurred under any Ordinance so revoked.

Notwithstanding anything contained in these Ordinances, any question which is not covered by these Ordinances or any difficulty arising out of these Ordinances, shall be dealt with by the Academic Council.

ANNEXURE – A

FORMAT OF THE Ph. D. THESIS

The following format may be normally adopted for the Ph. D. thesis:

1. Cover page
2. Inner cover page
3. Undertaking from the candidate
4. Self declaration certificate from the candidate and Certificate from the Supervisor/Co-Supervisor/Head of the Department (*Annexure – B*)
5. Certificate for the completion of course work/comprehensive examination in cases where the course work is a part of Ph. D. programme (*Annexure – C*)
6. Certificate for the successful completion of the pre-submission seminar (*Annexure – C*)
7. A copyright transfer certificate (*Annexure – D*)
8. Acknowledgments
9. Contents
10. List of symbols, figures and tables, if any
11. Preface of the thesis
12. Introduction
13. Literature review
14. Material and Methods
15. Results and Discussion
16. Summary and Conclusion
17. Bibliography
18. Appendices
19. List of papers communicated/accepted/published/presented.
20. Copies of acknowledgment/acceptance letter in case the papers are communicated/ accepted.
21. Copies of manuscripts/reprints of the papers communicated/accepted/published.
22. A personal profile not exceeding one page with photograph of the candidate.

References should be arranged chronologically in alphabetical order. Typical style of writing the references is given below:

(a) For single author

Surname, Initials, Title of the Article, Journal Name, Volume, Pages, Year.

(b) For two authors

Surname, Initials and Surname, Initials, Title of the Article, Journal Name, Volume, Pages, Year.

(c) For more than two authors

Surname, Initials, Surname, Initials,.....and Surname, Initials, Title of the Article, Journal Name, Volume, Pages, Year.

While citing the references in the text, the following format should be followed: Surname (Year) or Surname *et al.* (Year) *The names of the Journals should be typed as per the style followed by any standard international organization/abstracting Journal such as IEEE/ Chemical Abstracts/ Current Contents/ Physics Abstracts, etc.*

ANNEXURE – B

CANDIDATE'S DECLARATION

I, ... , certify that the work embodied in this Ph.D. thesis is my own bonafide work carried out by me under the supervision of and the co-supervision of ..... for a period of ..... from ..... toat Gopal Narayan Singh University and ..... The matter embodied in this Ph.D. thesis has not been submitted for the award of any other degree/diploma. (Name of the Institution where work has been carried out partly or fully)

I declare that I have faithfully acknowledged, given credit to and referred to the research workers wherever their works have been cited in the text and the body of the thesis. I further certify that I have not willfully lifted up some other"s work, para, text, data, results, etc. reported in the journals, books, magazines, reports, dissertations, theses, etc., or available at web-sites and included them in this Ph. D. thesis and cited as my own work.

Date: ..... (Signature of the candidate)

Place : (Name of the candidate)

Certificate from the Supervisor/Co-supervisor

This is to certify that the above statement made by the candidate is correct to the best of my/our knowledge.

.....

(External Co-supervisor's signature, Name & Designation)

.....

(External Supervisor's signature, Name &Designation)

....

(Co-supervisor's signature, Name & Designation) (Supervisor's signature, Name & Designation)

(Signature of the HOD with seal)

ANNEXURE – C

COURSE/COMPREHENSIVE EXAMINATION/PRE-SUBMISSION SEMINAR COMPLETION CERTIFICATE

(a) This is to certify that Sri/Ms ..... , a bonafide research scholar of this department/school/centre, has satisfactorily completed the Ph.D. course work and has been successful in comprehensive examination,

(b) that his/her open Ph.D. thesis Pre-Submission seminar on (topic)..... was held on (date). In the department from (time).

(c) that the DRC is satisfied/not-satisfied with the quality of the work of candidate,

(d) that the candidate described the thesis work satisfactorily/unsatisfactorily and answered the questions related with the basics understanding of the subject and thesis work satisfactorily/unsatisfactorily,

(e) that the DRC gave following suggestions for the improvement of quality of work/performance of pre-submission seminar:

Date:

Place:

(Signature of Head of Department

Signature of DRC Members

ANNEXURE-D

COPYRIGHT TRANSFER CERTIFICATE

Title of the Thesis:

Candidate's Name:

COPYRIGHT TRANSFER

The undersigned hereby assigns to the Gopal Narayan Singh University all rights under copyright that may exist in and for the above thesis submitted for the award of the Ph.D. degree.

Signature of the candidate

Note: However, the author may reproduce or authorize others to reproduce material extracted verbatim from the thesis or derivative of the thesis for author's personal use provided that the source and the University's copyright notice are indicated.

ANNEXURE – E(1)

FORMAT OF EXAMINER'S REPORT

Gopal Narayan Singh University, Jamuhar– 821305

Recommendation on Ph.D. Thesis

Name of the Candidate:

Title of the Thesis

Please give your **specific recommendation** by ticking ( ) any one of the following, with signature underneath and enclose your **detailed report** on separate sheet(s) with your signature, name and address.

The thesis **be accepted** for the award of the Ph.D. degree [ ]

OR

The thesis **is acceptable** for the award of the Ph.D. degree subject to the clarification of **certain points at the time of Viva-Voce.** [ ]
(Please enclose the points)

OR

The thesis **is not acceptable in the present form** but **may be accepted** subject to **modification/clarification/revision.** [ ]
(Please enclose your suggestions for modification etc.desired) After modification the **thesis need not be referred back to me.**

OR

The thesis **is not acceptable in the present form** but **may be accepted** subject to **modification/clarification/revision.** [ ]
(Please enclose your suggestions for modification etc. desired) After modification the **thesis should be referred back to me for final assessment.**

OR

The thesis **be rejected.** (Please enclose your comments). [ ]

Place .....

Date .....

Signature of the Examiner. .....

Name and Address of the Examiner

.....

.....

.....

Encl: (a) Detailed report on separate sheet(s),

(b) List of points for clarification.

ANNEXURE – E (2)

FORMAT OF EXAMINER'S REPORT ON REVISED THESIS

Gopal Narayan Singh University,

Jamuhar– 821305

Recommendation on Revised Ph.D. Thesis

Name of the Candidate:

Title of the Thesis:

Please give your **specific recommendation** by ticking ( ) any one of the following, with signature underneath and enclose your **detailed report** on separate sheet(s) with your signature, name and address.

The thesis **be accepted** for the award of the Ph.D. degree [ ]

OR

The thesis **be rejected.** (Please enclose your comments). [ ]

Place ..... Signature of the Examiner.....

Date ..... Name and Address of the Examiner

.....

.....

.....

Encl: Detailed report on separate sheet(s).

10. ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

10.1 Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level.
- A Ph.D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

10.2 Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG student.

10.3 Minimum Credit Requirements

- **Major subject:** The subject (department) in which the students takes admission
- **Minor subject:** The subject closely related to students major subject.
- **Supporting subject:** The subject not related to the major subject. It could be any subject considered relevant for student's research work.
- **Non-Credit Compulsory Courses**: Please see the relevant section for details. Five courses PGS are of general nature and are compulsory for Master's programme. Ph.D. students may be exempted from these courses if already studied during Master's degree.

Subject	Master's programme	Doctoral programme
Major	20	12
Minor	08	06
Supporting	06	05
Seminar	01	02
Research	30	75
Compulsory Non Credit Courses	05	-
Total Credits	**70**	**100**

SYLLABUS

Minimum Credit Requirements

Major Subject: The subject (Department) in which the students get admission in M.Sc. (Ag.) Agronomy

Subject: Master's programme for Agronomy

Courses	Minimum Credit Requirement
Major	20
Minor	08
Common Compulsory course	05
Basic supporting Courses	06
Master's Seminar	01
Master's Research	30
Total	**70**

Major Courses: 20 Credits

A. Core Curses: 12 Credits

Course Code	Course Title	Credits
AGRON- 501	Modern Concept in Crop Production	3(3+0)
AGRON – 502	Principles and Practices of Soil Fertility and Nutrient Management	3(2+1)
AGRON – 503	Principles and Practices of Weed Management	3(2+1)
AGRON – 504	Principles and Practices of Water Management	3(2+1)
AGRON-550	Master's Seminar	1(0+1)
AGRON-560	Master's Research	30(30)

B. Optional Courses :

Course Code	Course Title	Credits

SYLLABUS

Minimum Credit Requirements

Major Subject: The subject (Department) in which the students get admission in M.Sc. (Ag.) Agronomy

Subject: Master's programme forAgronomy

Courses	Minimum Credit Requirement
Major	20
Minor	08
Common Compulsory course	05
Basic supporting Courses	06
Master's Seminar	01
Master's Research	30
Total	**70**

Major Courses: 20 Credits

A. Core Curses: 12 Credits

Course Code	Course Title	Credits
AGRON- 501	Modern Concept in Crop Production	3(3+0)
AGRON – 502	Principles and Practices of Soil Fertility and Nutrient Management	3(2+1)
AGRON – 503	Principles and Practices of Weed Management	3(2+1)
AGRON – 504	Principles and Practices of Water Management	3(2+1)
AGRON-550	Master's Seminar	1(0+1)
AGRON-560	Master's Research	30(30)

B. Optional Courses :

Course Code	Course Title	Credits

AGRON- 505	Conservation Agriculture	2(1+1)
AGRON - 506	Agronomy of Major Cereals and Pulses	3(2+1)
AGRON - 507	Agronomy of Oilseed, Fiber and Sugar Crops	3(2+1)
AGRON - 508	Agronomy of Medicinal, Aromatic and underutilized Crops	3(2+1)
AGRON - 509	Agronomy of Fodder and Forage Crops	3(2+1)
AGRON - 510	Agrostology and Agro-forestry	3(2+1)
AGRON - 511	Cropping System and Sustainable Agriculture	3(2+1)
AGRON - 512	Dry land Farming and Watershed Management	3(2+1)
AGRON – 513	Principles and Practices of Organic Farming	3(2+1)

Minor Subject: **08 Credits:** Closely Related to the Major Subject

Course code	**Course title**	**Credit hours**
Soil 502	Soil fertility and fertilizer use	3 (2+1)
Soil 505	Soil erosion and conservation	3 (2+1)
Soil 508	Soil, water and air pollution	3 (2+1)
Soil 511	Management of problematic soils and water	2 (1+1)

Supporting Subject: The subject not related to the major subjects. It could be any subject considered relevant for the students research work: **06 Credits** (Soil Science/Genetics and Plant Breeding/Crop Physiology/Bio Chemistry/Statistics)

Course code	**Course title**	**Credit hours**
Plant physiology		
PP 504	Physiological and Molecular Responses of Plants to Abiotic Stresses	3 (2+1)
PP 505	Hormonal Regulation of Plant Growth and Development	3 (2+1)
PP 508	Physiology of Field Crops	2 (2+0)

relations; yield and environmental stress, use of plant growth regulators hormones for better adaptation in stress condition.

Unit V

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. Modern crop production concepts: soil less cultivation, Aero ponic, Hydroponic, Robotic and terrace farming. Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

Teaching methods/activities Classroom teaching with Audio Visual aids, group discussion, assignment and class discussion

Learning outcome Basic knowledge on soil management and crop production.

AGRON-502	Principles and practices of Soil Fertility and Nutrient Management	3(2+1)

Aim of the course

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Practical

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

Teaching methods/activities .Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome Basic knowledge on soil fertility and management.

AGRON- 505	Conservation Agriculture	2(1+1)

Aim of the course

To impart knowledge of conservation of agriculture for economic development.

Theory

Unit I

Conventional and conservation agriculture systems, sustainability concerns, conservation agriculture: Historical background and present concept, global experiences, present status in India.

Unit II

Nutrient management in conservation agriculture, water management, weed management, energy use, insect-pest and disease management, farm machinery, crop residue management, cover crop management.

Unit III

Climate change mitigation and conservation agriculture, C-sequestration, soil health management, soil microbes and conservation agriculture.

Unit IV

CA in agroforestry systems, rain fed / dryland regions

Unit V

Economic considerations in conservation agriculture, adoption and constraints conservation agriculture The future of agriculture

Practicals

- Study of long-term experiments on conservation agriculture
- Evaluation of soil health parameters,
- Estimation of C-sequestration,
- Machinery calibration for sowing different crops, weed seedbank estimation under conservation agriculture, energy requirements, economic analysis of conservation agriculture

Teaching methods/activities : Classroom teaching with Audio Visual aids, group discussion, oral presentation by students.

Learning outcome : Experience on the knowledge of various types of conservation agriculture.

AGRON- 503	Principles and Practices of Weed Management	3(2+1)

Aim of the course

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

Theory

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Practical

Identification of important weeds of different crops, Preparation of a weed herbarium, Weed survey in crops and cropping systems, Crop-weed competition studies, Weed indices calculation and interpretation with data, Preparation of spray solutions of herbicides for high and low-volume sprayers, Use of various types of spray pumps and nozzles and calculation of swath width, Economics of weed control, Herbicide resistance analysis in plant and soil,

- Bioassay of herbicide resistance residues,
- Calculation of herbicidal herbicide requirement

VII. Teaching methods/activities. Classroom teaching with AV aids, group discussion, field visit to identify weeds.

VIII. Learning outcome Basic knowledge on weed identification and control for crop production.

AGRON-504	Principles and Practices of Water Management	3(2+1)

Aim of the course

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

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement- estimation of evapo-transpiration and effective rainfall; Automated irrigation system.

Unit V

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

Unit VI

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

Unit VII

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

Unit VIII

Hydroponics,

Unit IX

Water management for crops under climate change scenario.

Practical

- Determination of Field capacity by field method
- Determination of Permanent Wilting Point by sunflower pot culture technique
- Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
- Determination of Hygroscopic Coefficient
- Determination of maximum water holding capacity of soil
- Measurement of matric potential using gauge and mercury type tensiometer
- Determination of soil-moisture characteristics curves
- Determination of saturated hydraulic conductivity by constant and falling head method
- Determination of hydraulic conductivity of saturated soil below the water table by auger hole method
- Measurement of soil water diffusivity
- Estimation of unsaturated hydraulic conductivity

Estimation of upward flux of water using tensiometer and from depth ground water table

- Determination of irrigation requirement of crops (calculations)
- Determination of effective rainfall (calculations)
- Determination of ET of crops by soil moisture depletion method16

. Determination of water requirements of crops

- Measurement of irrigation water by volume and velocity-area method
- Measurement of irrigation water by measuring devices and calculation of irrigation efficiency
- Determination of infiltration rate by double ring infiltrometer

VII. Teaching methods/activities

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

VIII. Learning outcome

Basic knowledge on water management for optimization of crop yield.

AGRON-506	Agronomy of Major Cereals and Pulses	3(2+1)

Aim of the course

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

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of:

Unit I:

Rabi cereals. Wheat,Barley,Oats,

Unit II:

Kharif cereals. Paddy, Maize, Millets (Sorghum, Pearlmillets, Fingermillet, Foxtail millet, Proso

millet, Little millet, Kodo millet etc.)

Unit III:

Rabi pulses. Gram, Lentil, Peas, French Bean

Unit IV:

Kharif pulses. Pigeon pea, Green gram, Black gram

Practical

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

Teaching methods/activities

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

Learning outcome

Basic knowledge on cereals and pulse growing in the country.

AGRON-507	Agronomy of Oilseed, Fiber and Sugar Crops	3(2+1)
Aim of the course To teach the crop husbandry of oilseed, fiber and sugar crops **Theory**		

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of:

Unit I

Rabi oilseeds – Rapeseed and mustard, Linseed, Niger and Safflower

Unit II

Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower and Soybean.

Unit III

Fiber crops - Cotton, Jute, Ramie and Mesta.

Unit IV

Sugar crops – Sugar-beet and Sugarcane.

Unit IV

Tuber Crops- Potato

Practical

- Planning and layout of field experiments
- Cutting of sugarcane sets, 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 phonological studies at different growth stages of crop
- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- Judging of physiological maturity in different crops and working out 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 rotational intensities
- Determination of oil content in oilseeds and computation of oil yield
- Estimation of quality of fiber of different fiber 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.

Teaching methods/activities

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

Learning outcome

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

AGRON-508	Agronomy of Medicinal, Aromatic and Under Utilized Crops	3(2+1)

Aim of the course

To acquaint students about different medicinal, aromatic and underutilized field crops, their package of practices and processing.

Theory

Unit I

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 their uses, export potential and indigenous technical knowledge.

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Practical

- Identification of crops based on morphological and seed characteristics.

- Raising of herbarium of medicinal, aromatic and under-utilized plants.
- Quality characters in medicinal and aromatic plants.
- Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants.

Teaching methods/activities

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

Learning outcome

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

AGRON-509	Agronomy of Fodder and Forage Crops	3(2+1)

Aim of the course

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

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor-quality fodder. Fodder production through hydroponics. Azolla cultivation.

Unit V

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

Practical

- Practical training of farm operations in raising fodder crops;
- Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF,

ADF, lignin, silica, cellulose and IVDMD, 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.

Teaching methods/activities

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

Learning outcome

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

AGRON-510	Agrostology and Agro-Forestry	3(2+1)

Theory

Aim of the course

To teach crop husbandry of different forage, fodder and agroforestry crops/trees

Along with their processing.

Unit I

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.

Unit II

Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.

Unit III

Agroforestry: definition and importance; agroforestry systems, agrisilviculture, silvipasture, agri-silvipasture, agri-horticulture, aqua-silviculture, alley cropping and energy plantation.

Unit IV

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 agroforestry Systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.

Practical

- Preparation of charts and maps of India showing different types of pastures and agro-forestry systems
- 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 silvi-pastroal 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
- Estimation of total biomass and fuel wood
- Economics of agro-forestry
- Visit to important agro-forestry research stations

Teaching methods/activities

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

Learning outcome

Basic knowledge on agro forestry, forage crops and their utility

AGRON-511	Cropping Systems and Sustainable Agriculture	2(2+0)

Aim of the course

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

Theory

Unit I

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

Unit II

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

Unit III

Above and below ground interactions and allopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

Unit IV

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Advanced nutritional tools for big data analysis and interpretation.

Unit V

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

Unit VI

Artificial Intelligence- Concept and application.

VII. Teaching methods/ activities

Classroom teaching with AV aids, group discussion, assignment.

VIII. Learning outcome

Basic knowledge on cropping system for sustainable agriculture.

AGRON-512	Dry land Farming and Watershed Management	3(2+1)

Aim of the course

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

Theory

Unit I

Definition, concept and characteristics of dry land farming; dry land versus rain fed farming; significance and dimensions of dry land farming in Indian agriculture.

Unit II

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

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

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

Concept of watershed resource management, problems, approach and components.

Practical

- Method of Seed Priming
- Determination of moisture content of germination of important dryland crops
- Determination of Relative Water Content and Saturation Deficit of Leaf
- Moisture stress effects and recovery behaviour of important crops
- Estimation of Potential ET by Thorn Thwaite method
- Estimation of Reference ET ny Penman Monteith Method
- Classification of climate by Thorn Thwaite method (based on moisture index, humidity index and aridity index)
- Classification of climate by Koppen Method
- Estimation of water balance by Thorn Thwaite method
- Estimation of water balance by FAO method
- Assessment of drought
- Estimation of length of growing period
- Estimation of probability of rain and crop planning for different drought condition
- Spray of anti-transpirants and their effect on crops
- Water use efficiency
- Visit to dryland research stations and watershed projects

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment.

Learning outcome

Basic knowledge on dry land farming and soil moisture conservation.

AGRON-513	Principles and Practices of Organic Farming	3(2+1)

Aim of the course

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

Theory

Unit I

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

Unit II

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

Unit III

Farming systems, selection of crops and crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

Unit V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

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

Teaching methods/activities

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

Learning outcome

Basic knowledge on organic farming for sustainable agriculture and development

Minor courses

Soil-502	**Soil fertility and fertilizer use**	**3 (2+1)**

Aim of the course

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

Unit I

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

Unit II

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

Unit III

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behaviour in soils and management under field conditions. Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

Unit V

Sulphur - source, forms, fertilizers and their behaviour in soils; role in crops and human health; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers.

Unit VI

Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

Unit VII

Common soil test methods for fertilizer recommendations; quantity– Intensity relationships; soil test crop response correlations and response functions.

Unit VIII

Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; speciality fertilizers concept, need and category. Current status of speciality fertilizers use in soil sand crops of India;

Unit IX

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS.

Unit X

Definition and concepts of soil health and soil quality; Long term effects of fertilizers and soil quality.

Practical

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

Soil-505	Soil Erosion and Conservation	3 (2+1)

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Unit VI

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement

Practical

- Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index
- Computation of kinetic energy of falling rain drops
- Computation of rainfall erosivity index (EI30) using rain gauge data
- Land capability classification of a watershed
- Visits to a watersheds

Soil-505	Soil Erosion and Conservation	3 (2+1)

Aim of the course

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

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Unit VI

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement

Practical

- Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index
- Computation of kinetic energy of falling rain drops
- Computation of rainfall erosivity index (EI30) using rain gauge data
- Land capability classification of a watershed
- Visits to a watersheds

Soil-508	Soil, Water and Air Pollution	3 (2+1)

Aim of the course

To make the student saw are of the problems of soil, water and air pollution associated with use of soils for crop production.

Theory

Unit I

Soil, water and air pollution problems associated with agriculture, nature and extent.

Unit II

Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants- their CPC standards and effect on plants, animals and human beings.

Unit III

Sewage and industrial effluents–their composition and effect on soil properties/ health, and plant growth and human beings; soil as sink for waste disposal.

Unit IV

Pesticides–their classification, behavior in soil and effect on soil microorganisms.

Unit V

Toxic elements–their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.

Unit VI

Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases–carbon dioxide, methane and nitrous oxide.

Unit VII

Risk assessment of polluted soil, Remediation/ amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

Practical

Sampling of sewage waters, sewage sludge, solid/ liquid industrial wastes, polluted soils and plants and their processing, Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), measurement of coliform (MPN), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents, Heavy metals in contaminated soils and plants, Management of contaminants in soil and plants to safe guard food safety, Air sampling and determination of particulate matter and oxides of Sulphur, NO2 and O2 conc. Visit to various industrial sites to study the impact of pollutants on soil and plants.

Soil-511	**Management of Problem Soils and Water**	**2 (1+1)**

Aim of the course

To educate students about basic concepts of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production.

Theory

Unit I

Area and distribution of problem soils–acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible.

Unit II

Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils-soluble salts, ESP, pH; physical, chemical and microbiological properties.

Unit III

Management of salt-affected soils; salt tolerance of crops- mechanism and ratings; salt stress meaning and its effect on crop growth, monitoring of soils salinity in the field; management principles for sandy, clayey, red lateritic and dryland soils.

Unit IV

Acid soils-nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

Unit V

Quality of irrigation water; management of brackish water for irrigation; salt balance under irrigation; characterization of brackish waters, area and extent; relationship
In water use and quality.

Unit VI

Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters. **Practical**

Characterization of acid, acid sulphate, salt-affected and calcareous soils,
Determination of cations (Na+, K+, Ca++ and Mg++) in groundwater and soil
Samples, Determination of an ions (Cl-, SO4-, CO3- and HCO3-) in ground waters and soil samples, Lime and gypsum requirements of acid and sodic soils.

Supporting courses

PP-504	Physiological and Molecular Responses of Plants to Abiotic Stresses	3 (2+1)

Aim of the course

This course aims to describe students the abiotic-stress physiology and their effects on plant growth and productivity. This will also help students gain insights into latest developments in stress physiology and stress tolerance mechanisms, approaches for crop improvement under stressful environment.

Theory

Block 1: Abiotic Stresses

Unit 1: Introduction to Abiotic Stresses

Abiotic stresses major constraints to realize potential yields of crop plants, yield losses. Drought prone areas in India- Frequency of occurrence of drought, Rain fed kharif, Rabi, Areas affected by salinity, heavy metals, water logging, high temperature scenario due to global warming.

Block 2: Drought Stress

Unit 1: Moisture Stress Responses in Plants

Drought-characteristic features; water potential in the soil-plant-air continuum. Physiological and biochemical processes affected by drought. Oxidative stress generation of ROS and other cytotoxic compounds, their effect on cellular process. Effect on total carbon gain- decrease in photosynthetic area and function, protein turn over and lipid characters, phenology-reproductive aspects, critical stages.

Unit 2: Stress Perception and Molecular Responses of Plants to Drought

Stress

Stress perception and signal transduction leading to expression of regulatory genes, stress specific kinases, stress specific transcription factors, functional genes associated with adaptive mechanisms.

Unit 3: Plant Adaptive Mechanisms to Drought

(a) Escape and desiccation avoidance mechanism

Concept of stress escape- exploiting genetic variability in phenology, Drought avoidance mechanisms- Maintenance of cell turgor, water mining by root characters. Moisture conservation- Regulation of transpiration- traits reducing heat load, Stomatal factors guard cell metabolism, moisture conservation by waxes. Water use efficiency (WUE) and concept of water productivity- regulation of transpiration efficiency-stomatal conductance, mesophyll efficiency, relevance of WUE and Passioura's model.

(b) Desiccation tolerance- Concept of acquired tolerance Decreased turgor mediated upregulation

of cellular tolerance mechanisms, Osmolytes, managing cytotoxic compounds, ROS, RCC, scavenging - enzymatic and non-enzymatic, protein turnover, stability, chaperones, membrane stability, and photo protection of chlorophylls.

Unit 4:

Approaches to Improve Drought Tolerance

Development of genetic resources- donor genotypes for specific traits, Genomic resources- genes, QTL's regulating adaptive mechanisms, Conventional, transgenic and molecular breeding approaches to improve relevant adaptive traits, concept of trait introgression.

Block 3: Salt, Heavy Metal, Water Logging, Temperature and Light Stress.

Unit 1: Salt Stress

Soil salinity-Effect of salt stress, ionic and osmotic effects; species variation in salt tolerance; glycophytes and halophytes, Salt tolerance mechanisms - exclusion, extrusion and compartmentalization, Signaling during salt stress – SOS pathway, Approaches to improve salt tolerance.

Unit 2: Heavy Metal Stress and Water Logging

Heavy metal toxicity in plants (eg., Al, Cd), tolerance mechanisms and approaches to improve. Plant response to water logging, role of hormones- ethylene, mechanism of tolerance and approaches to improve.

Unit 3: Temperature and Light Stress

High and low temperatures; effect on plants; adaptive mechanisms, evaporation cooling, concept of cellular tolerance, protein stability, chaperones, HSPs, HSFs, membranes. High light and high ionizing radiation- photo oxidation and photo inhibition; mechanisms of tolerance, plant adaptation to low light, concept of shade avoidance response (SAR).

Practical's

- Measurement of soil and plant water status.
- Drought stress imposition and measurement of physiological and biochemical changes in plants under stress –gas exchange and fluorescence measurements.
- Determination of water use efficiency as a drought resistant trait.
- Drought Susceptibility Index (DSI) -precise field technique to identify productive genotypes under stress.
- Approaches to quantify root characters
- Determination of stomatal parameters and canopy temperature as a reflection of Transpiration and root activity.
- Determination of Salinity Tolerance Index.

- Studying acclimation response - Temperature induction response.

Heat tolerance and membrane integrity- Sullivan's heat tolerance test.

- Quantification of osmolytes – proline under stress.
- Oxidative stress imposition- Quantification of oxidative stress
- Quantification of ROS under stress.
- Estimation of ABA content in leaf and root tissues under stress.
- Determination of Sodium and Potassium in plant tissue grown under salt stress.
- Estimation of antioxidant enzymes.

PP-505	Hormonal Regulation of Plant Growth and Development	3(2+1)

Aim of the course

It provides knowledge on the fundamentals of hormone biosynthesis, homeostasis, transport and signalling and the role in regulating basic physiological processes governing developmental events in plants. The role of classical hormones on developmental processes from germination, shoot and root apical meristem differentiation, flowering, seed maturation and senescence. The aim of this course is to appraise the students about structure and function of plant growth regulators.

Block 1: Plant Growth and Development: Hormonal Regulation

Unit 1: Introduction to Plant Hormones

Growth, differentiation and development regulated by plant growth substances, Definition and classification of growth regulating substances: Classical hormones, Definition and classification of growth regulating substances: Endogenous growth substances other than hormones, Synthetic chemicals.

Unit 2: Plant Hormones – Discovery and Metabolism

Discovery, biosynthetic pathways and metabolism of Auxin, Discovery, biosynthetic pathways and metabolism of Gibberellins, Discovery, biosynthetic pathways and metabolism of Cytokines, Discovery, biosynthetic pathways and metabolism of Abscisic acid, Discovery, biosynthetic pathways and metabolism of Ethylene, Discovery, biosynthetic pathways and metabolism of Brassinosteroids, Discovery, biosynthetic pathways and metabolism of Strigolactones.

Unit 3: Physiological Role of Hormones in Plant Growth and Development

Physiological functions of Auxin and use of mutants and transgenic plants in elucidating the physiological functions, Physiological functions of Gibberellins and use of mutants and transgenic plants in elucidating the physiological functions, Physiological functions of cytokines and use of mutants and transgenic plants in elucidating the physiological functions, Physiological functions of Abscisic acid and use of mutants and transgenic plants in elucidating the physiological functions,

Physiological functions of Ethylene and use of mutants and transgenic plants in elucidating the physiological functions, Physiological functions of Brassinosteroids and Strigo lactones and use of mutants and transgenic plants in elucidating the physiological functions, Discovery, biosynthetic pathways metabolism and physiological roles of Salicylic acid and Peptide hormones.

Unit 4: Endogenous Growth Substances other than Hormones

Discovery, biosynthetic pathways metabolism and physiological role of Polyamines and Karakinos, Discovery, biosynthetic pathways metabolism and physiological roles of Jasmonates and Tricontanol, Discovery, biosynthetic pathways metabolism and physiological roles of system ins Concept of death hormone, Recent developments in elucidating responses of Salicylic acid, Peptide hormones and Polyamines at physiological and molecular level, Recent developments in elucidating responses of Jasmonates, Systemins, Karrikins and Tricontanol at physiological and molecular level.

Unit 5: Hormone Signaling

Hormone signal perception, transduction - Receptors, components and mechanism (Auxin, Gibberellin, Cytokinin, ABA and Salicylic acid), Hormone signal perception, transduction - Receptors, components and mechanism (Ethylene, Jasmonate, Brassinosteroids and strigolactones), Advances in elucidating the structure and function of receptors and signalling components of important hormones.

Unit 6: Key Genes Regulating Hormone Levels and Functions

Genomics approaches to regulate hormone metabolism and its effect on plant growth and development – case studies.

Unit 7: Crosstalk of Hormones in Regulation of Plant Growth and

Development Processes

Crosstalk of Hormones in Regulation of Plant Growth and Development Processes: Floral transition,

reproductive development, Shoot and root apical meristem development

Unit 8: Practical Utility of Growth Regulators in Agriculture and Horticulture

Practical Utility of Growth Regulators in Agriculture and Horticulture: Rooting of cuttings, Vine and brewing industry, Promotion of gynoecious flowers, hybrid rice production, induction of flowering in pine apple, cucurbits, Practical Utility of Growth Regulators in Agriculture and Horticulture: Delaying of senescence and ripening, Production of dwarf plants for ornamental purpose, As herbicides, Reduction in flower and fruit drop.

Practical's

- Extraction of Auxins from plant tissue
- Separation and detection of Auxins by GC / GC-MS / HPLC / Immunological technique
- Bioassay of auxin- effect on rooting of cuttings
- Extraction of abscisic acid (ABA) from plant tissue
- Separation and detection of ABA by HPLC/Immunological technique
- ABA bioassays- effect on stomatal movement

Preparation of samples for ethylene estimation in plant tissue

- Estimation of ethylene in plant tissues using gas chromatography
- Ethylene bioassays, estimation using physico-chemical techniques- effect on breaking dormancy in sunflower and groundnut
- Extraction of Gibberellins from plant tissue- GC / GC-MS / HPLC
- Separation and detection of GA by GC / GC-MS / HPLC/Immunological technique
- GA bioassays- effect on germination of dormant seeds
- Cytokinin- extraction from plant tissue
- Separation and detection of cytokinin by GC / GC-MS / HPLC

• Cytokinin bioassays- effect on apical dominance and senescence / stay green

PP-508	Physiology of Field Crops	2 (2+0)

Aim of the course :

This course provides a broad exposure on the physiological aspects of field crops. The objective is to impart comprehensive information on physiological processes and physiological basis of growth, development and productivity of field crop plants.

Block 1: Physiology of Field Crops

Unit 1: Introduction

Origin- Variability in physiology of crop plants between wild species and cultivated. Adaptability to growing environments (ecosystems), Importance in food grain contribution.

Unit 2: Crop Establishment, Crop Growth and Development

Seed characteristic features, dormancy, viability, concept of seed priming seedling establishment and crop stand. Different crop growth stages, concept of source establishment and optimum LAI, Canopy architecture, light interception/radiation use efficiency, thermal time, heat units, GDD, determining growth duration.

Unit 3: Reproductive Growth

Photo and thermo-periodic response for flowering, sink development, sink source relationship, partitioning efficiency, improvement in HI, yield determining factors, genetic gain in yield over years, structuring of ideal plant type, limitations to improve source to sink size, options to improve yield potential.

Unit 4: Seed Nutrient Quality

Seed quality, seed as a source of nutrients, seed constituents and their improvement, concept of pathway engineering to improve seed quality.

Unit 5: Plant Nutrition

Nutrient requirement, genetic variability in nutrient acquisition under constraint conditions, specific nutrient disorders.

Unit 6: Abiotic Stress Response

Response to different abiotic stresses, plant traits/mechanics to improve adaptation to realize potential yields. Global warming responses, thermos morphogenesis, approaches to overcome the constraints.

Unit 7: Crop Specific Physiological Processes and Importance

Choosing location specific crop species exposure will be given on physiological process as described above. Besides, emphasis is on providing information on crop specific features/productivity constraints.

PP-512	Crop Growth Regulation and Management	2 (2+0)

Aim of the Course

A comprehensive information needs to be provided in this course like light regulation in polyhouse cultivation, photoperiod responses by red/far red light for synchronizing flowering,

techniques for soil less culture like aeroponics, pollen biology and hybrid production, chemical regulation of plant growth processes like flower initiation, flower sex, flower drop, fruit maturity, ripening and shelf-life, etc.

Theory

Block 1: Propagation - Crop Establishment

Unit 1: Seed as a Propogule

Concept of improving seed characteristics for crop establishment. Mechanisms of regulating seed dormancy, precocious germination, and ways to control pre-harvest sprouting in crop plants. Seed viability and its regulation, factors to minimize loss of viability and improve seedling vigour. Concept of seed priming, techniques of priming, seed priming to induce tolerance to stresses. Role of media, nutrition and PGPR's on seedling vigour and subsequent crop establishment.

Unit 2: Vegetative Propogule

Chemical and hormonal regulation of vegetative propagation. Regulation of rooting, bud sprouting, Bulb/tuber dormancy. Chemical regulation of graft union. Concept of *in vitro* micropropogation.

Block 2: Regulation of Plant Growth Processes

Unit 1: Regulation of Plant Growth and Flowering

Chemical and hormonal regulation of plant architecture, tillering, branching, bud breaking, Regulation of flowering by photo and thermos period, nutrients, chemicals and hormones, concept of speed breeding, Flowering synchrony in hybrid seed production, Sex ratio alteration, flower and fruit thinning, Pollen viability in relation to environment, harvesting, storage and transportation, Prevention of abscission, flower and fruit drop, seed and fruit growth regulation- role of hormones.

Unit 2: Fruit Ripening and its Regulation

Approaches to improve shelf life – storage environment, water loss, respiration, Modified atmosphere, gaseous environment for storage, storage disorders, chilling
Injury.

Unit 3: Concept of Senescence and its Retardation

Physiology of senescence and options to regulate, Chemical regulation of senescence, maintenance of chlorophyll during storage, role of hormones/micronutrients in reducing senescence, Concept of stay green, advantages and limitations. Relevance of stay green traits in plant breeding for crop improvement.

Block 3: Protective Cultivation–Stress Mitigation

Unit 1: Protective Cultivation Interventions to Alter Physiological Processes and Growth

Spectral characteristics of light in polyhouse, light regulation to optimize plant photosynthetic and photomorphogenic processes and plant growth, LED sources of monochromatic light to regulate growth, etiolating and flowering, High temperature induced thermomorphogenic processes, Artificial growing media, soilless cultures, aeroponics, fogoponics, Concept of CO2 fertilization. Effect of humidity on leaf expansion and growth.

Unit 2: Drought Mitigation Options and Approaches

Moisture conservation options at soil and plant level, Concept of increasing water holding capacity, role of Hydrogels – water and mineral nutrients release pattern.

Approaches to improve transpiration over evapo-transpiration, stomatal and nonstomatal regulation of water loss, antitranspirants, Osmoprotectants, ROS scavengers, plant nutrients, Root stocks in improving tolerance, Chemical regulation of flower drop due to temperature, Chemicals to improve pollen viability during abiotic stress.

Unit 3: Specific Plant Processes Regulated by Chemicals and Growth Hormones

Rooting of cuttings, Wine brewing industry, Promotion of gynoecious flower, Hybrid rice production, Induction of flowering in pine apple, cucurbits, Delaying of senescence and ripening, Production of dwarf plant for ornamental purpose, Reduction in flower and fruit drop, Increase in berry size in grapes.

STAT 502	**Statistical Methods for Applied Sciences**	**4 (3+1)**

Aim of the course

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, and tests of significance, regression and multivariate analytical techniques.

Theory

Unit I

Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation.

Unit II

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.

Unit III

Introduction to theory of estimation and confidence-intervals, Simple and multiple

Correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.

Unit IV

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the

Randomness of a sequence. Median test.

Unit V

Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

VI. Practical

- Exploratory data analysis, fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal.
- Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F.
- Confidence interval estimation and Correlation and regression analysis, fitting of Linear and Quadratic Model.
- Non-parametric tests. ANOVA: One way, Two Way, SRS.

STAT-511	**Experimental Designs**	**3 (2+1)**

Aim of the course

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

VI. Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
- Analysis with missing data,
- Split plot and strip plot designs.

STAT-511	Experimental Designs	3 (2+1)

Aim of the course

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

VI. Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
- Analysis with missing data,
- Split plot and strip plot designs.

Proposed Syllabus for Ph.D. Agronomy degree as per recommendation of ICAR's BSMA Report December, 2021

Minimum Credit Requirements

Major Subject: The subject (Department) in which the students gets admission in Ph.D Agronomy

Agronomy	12 Credits
DoctoralSeminar	02 Credit
DoctoralResearch	75 Credits

Minor Subject: The subject closely related to students major subject: **06 Credits**

Supporting Subject: The subject not related to the major subjects. It could be any subject considered relevant for the students research work: **05 Credits** (Soil Science/Genetics and Plant Breeding/Crop Physiology/Bio Chemistry/Statistics)

Subject: Agronomy Ph.Dprogramme

Courses	**Minimum Credit Requirement**
Major	12
Minor	06
Supporting courses	05
DoctoralSeminar	02
Doctoral Research	75
Total	**100**

Agronomy

Major Courses: 12 Credits

Core Curses: 06 Credits

Course Code	Course Title	Credits
AGRON -601*	Current trends in Agronomy	3(3+0)
AGRON – 608*	Research and Publication ethics	2(2+0)
AGRON -605	Integrated farming systems for sustainable Agriculture	2(2+0)
AGRON-691	Doctoral Seminar	1(0+1)
AGRON-692	Doctoral Seminar	1(0+1)
AGRON-699	Doctoral Research	75

***Core courses**

Optional Courses:

Course Code	Course Title	Credits
AGRON 602	Recent trends in crop growth and productivity	3(2+1)
AGRON 603	Irrigation management	3(2+1)
AGRON 604	Recent trends in weed management	2(2+0)
AGRON605	Integrated farming systems for sustainable Agriculture	2(2+0)
AGRON 606	Soil Conservation and Watershed Management	3(2+1)
AGRON 607	Stress Crop Production	3(2+1)

Minor Courses: 06 Credits

Course Code	Course Title	Credits
Soil 602	Modern concept in soil fertility	2(2+0)
Soil 606	Soil resource management	3(3+0)
Soil 607	Modelling of soil plant system	2(2+0)
Soil 603	Physical chemistry of soil	2(2+0)

Supporting Courses: 05 Credits

Course Code	Course Titles	Credits
PP 604	Plant Phenomics – Next Generation Phenomics Platforms	2(2+0)
PP 610	Weed Biology and Physiology of Herbicide Action	2(2+0)
PP 606	Global Climate Change and Crop Response	2(2+0)
AGM 601	Climate change and sustainable development	3(2+1)
AGM 605	Analytical tools and methods for Agro-meteorology	2(1+1)

Non credit compulsory courses

Sr. No.	Course Code	Course Title	Credits
1.	PGS-501	Library and Information Services	1(0+1)
2.	PGS-502	Technical Writing and Communications Skills	1(0+1)
3.	PGS-503	Intellectual Property Rights (IPR) and its Management in Agriculture(e-Courses)	1(1+0)
4.	PGS-504	Basic Concepts in Laboratory Techniques	1(0+1)
5.	PGS-505	Agricultural Research, Research Ethics and Rural Development Programme(e-Courses)	1(1+0)
Total Credit			5

Note :PGS courses are compulsory for those Ph.D. students who have not offererd in M.Sc. Degree programme.

Course content for Ph.D. Agronomy

AGRON-601	Current Trends in Agronomy	3(3+0)

Aim of the course

To acquaint the students about recent advances in agricultural production.

Theory

Unit I

Agro-physiological basis of variation in yield, recent advances in soil-plant-water relationship.

Unit II

Globalization of agriculture and WTO, precision agriculture, contract farming, organic farming, marketing and export potential of organic products, certification, labeling and accreditation procedures and ITK in organic farming.

Unit III

Crop residue management in multiple cropping systems; latest developments in plant management Mechanization in crop production: modern agricultural precision tools and technologies, weed management, cropping systems, grassland management, agro-forestry, allelopathy.

Unit IV

GIS, GPS and remote sensing for crop management, global warming, GM crop, seed production technology; seed certification, seed multiplication, hybrid seed production etc.

Unit V

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture and research methodology in Agronomy. Conservation agriculture, principles, prospects and importance, potential benefits of CA under climate change scenario, policy issues.

Teaching methods/activities

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

transparent; fertilizer use in relation to irrigation.

Unit V

Crop water stress – water deficits and crop growth, adoptability to the crops. Water availability with relation to nutrient availability.

Unit VI

Application of irrigation water, conveyance and distribution system, irrigation efficiency; agronomic considerations in the design and operation of irrigation projects; characteristics of irrigation and farming systems affecting irrigation management.

Unit VII

Land suitability for irrigation, land irritability classification; integrated water management in command areas, institution of water management in commands, farmer's participation in command areas; irrigation legislation.

Unit VIII

Economic analysis of irrigation and cop planning for optimum use of irrigation water

Unit IX

Crop water production function

Practical

- Determination of water infiltration characteristics and water holding capacity of soil profiles.
- Determination Moisture extraction pattern of crops
- Determination of water balance component of transplanted rice by drum culture technique
- Determination of consumptive use and water requirement of a given cropping pattern
- Determination of crop efficient of one important crop
- Planning, designing and installation of drip irrigation system
- Planning, designing and installation of sprinkler irrigation system
- Designing of drainage channel
- Measurement of irrigation efficiencies
- Determination of irrigation timing under different methods of irrigation
- Visit to irrigation command area

Teaching methods/activities

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

Learning outcome

Management of irrigation water for sustainable agriculture

AGRON-604	Recent Trends in Weed Management	2(2+0)

Aim of the course

To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems.

Theory

Unit I

Crop-weed competition in different cropping situations; changes in weed flora, various causes and effects; different methods of weed management. Migration, introduction, adaptation of weeds, Invasive weeds – biology and management. Different mechanisms of invasion – present status and factors influencing weed invasion.

Unit II

Physiological and biological aspects of herbicides, their absorption, translocation, metabolism and mode of action; selectivity of herbicides and factors affecting them.

Unit III

Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting them,

Degradation of herbicides in soil and plants- factors affecting it, primary and secondary metabolites, residue management of herbicides, adjuvants.

Unit IV

Advances in herbicide products and application techniques and methods; herbicide resistance; antidotes and crop protection compatibility of herbicides of different groups; compatibility of herbicides with other pesticides; herbicide rotation and herbicide mixtures.

Unit V

Development of transgenic herbicide resistant crops; herbicide development, registration procedures.

Unit VI

Relationship of herbicides with tillage, fertilizer, and irrigation, cropping system; bio herbicides, allelochemical and alleloherbicides, herbicide bioassays. Recent advances in nonchemical weed management including deleterious rhizobacteria, robotics, biodegradable film, etc.

VI. Teaching methods/activities

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

VII. Learning outcome

Experience on the knowledge of new herbicides, their resistance, toxicity, antidote sand residue management under different cropping systems.

AGRON-605	**Integrated Farming Systems and Sustainable Agriculture**	**2(2+0)**

Aim of the course

To apprise about different enterprises suitable for different agro climatic conditions for sustainable agriculture.

Theory

Unit I

Integrated Farming systems (IFS): definition, scope and importance; classification of IFS based on enterprises as well as under rain fed/irrigated condition in different

Land situation. Farming systems according to type of rotation, intensity of rotation, degree of commercialization, water supply, enterprises.

Unit II

Concept of sustainability in of Integrated farming systems; efficient Integrated farming systems based on economic viability and natural resources – identification and management.

Unit III

Production potential of different components of Integrated farming systems; interaction and mechanism of different production factors; stability of Integrated Farming system based on research/long term information in different systems through research; eco-physiological approaches to intercropping. Integration of components and adaptability of different farming system based on land situations and climatic condition of a region; evaluation of IFS.

Unit IV

Simulation models for intercropping; soil nutrient in intercropping; preparation of different farming system models; evaluation of different farming systems. Formation of different Integrated Farming system Models; evaluation of different Integrated Farming system models. Recycling of organic waste in farming system, in IFS.

Unit V

New concepts and approaches of farming system and organic farming; value addition, waste recycling, quantification and mitigation of Green House gases; case studies/ success stories of different Integrated Farming systems. Cropping systems and organic farming; case studies on different farming systems. Possible use of ITK in Integrated farming system.

VI. Teaching methods/activities

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

VII. Learning outcome

Experience on the knowledge of enterprises suitable for different agro climatic conditions for sustainable agriculture and their proper utilization.

AGRON-606	Soil Conservation and Watershed Management	3(2+1)

Aim of the course

To teach about different soil moisture conservation technologies for enhancing the Agricultural productivity through holistic approach watershed management.

Theory

Unit I

Soil erosion: definition, nature and extent of erosion; types of erosion, factors affecting erosion.

Unit II

Soil conservation: definition, methods of soil conservation; agronomic measures -contour cultivation, strip cropping, cover crops; mulching, tillage, cropping system vegetative barriers; improved dry farming practices; mechanical measures bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

Unit III

Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.

Unit IV

Land use capability classification, alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects, its layout.

Unit V

Drainage, methods of drainage, Drainage considerations and agronomic management; rehabilitation of abandoned *jhum* lands and measures to prevent soil erosion.

Practical

- Study of different types of erosion
- Determination of dispersion ratio
- Estimation of soil loss by Universal Soil Loss Equation
- Estimation of soil loss by wind erosion
- Measurement of runoff and soil loss
- Field studies of different soil conservation measures
- Laying out run-off plot and deciding treatments
- Identification of different grasses and trees for soil conservation
- Visit to watershed areas
- Visit to a soil conservation research centre, demonstration and training centre

Teaching methods/activities

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

Learning outcome

Experience on the knowledge of soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach watershed management.

AGRON-607	Stress Crop Production	3(2+1)

Aim of the course

To study various types of stresses in crop production and strategies to overcome them.

Theory

Unit I

Stress and strain terminology; nature and stress injury and resistance; causes of stress.

Unit II

Low temperature stress: freezing injury and resistance in plants, measurement of freezing tolerance, chilling injury and resistance in plants, practical ways to overcome the effect of low temperature tress through, soil and crop manipulations.

Unit III

High temperature or heat stress: meaning of heat stress, heat injury and resistance In plants, practical ways to overcome the effect of heat stress through soil and crop manipulations.

Unit IV

Water deficit stress: meaning of plant water deficient stress and its effect on growth and development, water deficit injury and resistance, practical ways to overcome effect of water deficit stress through soil and crop, manipulations.

Unit V

Excess water or flooding stress: meaning of excess water stress, its kinds and effects on crop plants, excess water stress injury and resistance, practical ways to overcome excess water stress through soil and crop manipulations.

Unit VI

Salt stress: meaning of salt stress and its effect on crop growth, salt stress injury and resistance in plants, practical ways to overcome the effect of salt stress through
Soil and crop manipulations.

Unit VII

Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance.

Unit VIII

Environmental pollution: air, soil and water pollution, and their effect on crop growth and quality of produce; ways and means to prevent environmental pollution.

Practical

- 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
- Measurement of electrolytic leakage
- Growing of plants in sand culture under salt stress for biochemical and physiological studies
- Studies on effect of osmotic and ionic stress on seed germination and seedling growth
- Measurement of low temperature injury under field conditions
- Studies on plant responses to excess water.

Teaching methods/activities

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

Learning outcome

Experience on the knowledge of various types of stresses in crop production and strategies to overcome these.

SOIL- 602	**Modern Concept in Soil Fertility**	**2(2+0)**

Aim of the course

To provide knowledge of modern concepts of soil fertility and nutrient use in crop production.

Theory

Unit I

Nutrient availability-concept and relationships, modern concepts of nutrient save ailability; soil colloids and nutrient availability; soil amendments and availability
Maintenance of nutrients, soil solution and plant growth; nutrient response functions and availability indices.

Unit II

Nutrient movement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply and uptake by plants; models for transformation and movement of major micronutrients in soils.

Unit III

Chemical equilibria (including solid-solution equilibria) involving nutrient ions in soils, particularly in submerged soils; Kinetic studies of nutrients in soils.

Unit IV

Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

Unit V

Modern concepts in fertilizer application; soil fertility evaluation techniques; role of soil tests in fertilizer use recommendations; site-specific nutrient management for
Precision agriculture.

Unit VI

Monitoring physical, chemical and biological changes in soils; permanent manorial Trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use.

Unit VII

Carbon– a nutrient central to soil fertility; carbon cycle in nature, stocks, pools and Fluxes; greenhouse effect and climate change; carbon sequestration vis-a-vis sustenance of soil quality and crop productivity.

Teaching methods/activities

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

Learning outcome

Experience on the knowledge of soil fertility and fertilizers in relation to plant growth and development.

SOIL -606	Soil Resource Management	3(3+0)

Aim of the course

To impart the students basic holistic knowledge on soil resource and latest developments in its sustainable use.

Unit I

Relevance of soil management to sustainable agriculture; soil as a natural resource for biomass production, filtering, buffering, transportation of solutes, gene reserves, And gelogenic source of raw materials; soil as a source and sink of greenhouse gases.

Unit II

Concept of sustainable land management (SLM); spatial variability of soils; soil quality and food security; soil quality indices, conservation agriculture in relation to soil quality; soil resilience and resistance.

Unit III

Types, factors and causes of land degradation and desertification; GLASOD classification; application of

GIS and remote sensing in monitoring, diagnosis and mapping land degradation; history, distribution, identification and description of soil erosion problems in India; forms of soil erosion; impact of soil erosion-on-site and off-site effects; strategies for erosion control and conservation; soil conservation in hilly, arid, semiarid, coastal and diara lands. Management of forest, peat and muck soils.

Unit IV

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands; land restoration and conservation techniques–erosion control, reclamation of salt affected soils; mine land reclamation, afforestation, organic products, soil faun and biodegradation.

Unit V

Watershed management-concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socio-economic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds.

Unit VI

Agro-ecological regions of India; potentials and constraints of soils of different regions; land evaluation and rationalizing land use, decision support system with relation to land management; national and international soil policy considerations.

Teaching methods/activities

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

Learning outcome

Experience on the knowledge of soil resources on research for solving field problems.

SOIL-607	**Modelling of Soil Plant System**	**2(2+0)**

Aim of the course

To train the students in concepts, methodology, technology and use of systems simulation in soil and crop studies

Theory

Unit I

Introduction, terms and definitions; classification of models; Taylor series; numerical methods of differentiation and integration.

Unit II

High level computer language: FORTRAN-its commands and usage; testing and evaluation of model.

Unit III

Description of spatially homogeneous models; K transformation model; nitrogen and phosphorus dynamics in soil.

Unit IV

Spatially heterogeneous models; equation of continuity; Simulation of water flow through soil; Explicit and Explicit-Implicit method; simulation of solute movement

Through soil with variable moisture flux by explicit-implicit method.

Unit V

Nutrient uptake model: Integration of nutrient movement in soil (mass flow and diffusion) and uptake by plants (Michaelis-Menten kinetics); Nutrient uptake model: Solubility and free ion activity model.

Teaching methods/activities

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

Learning outcome

Experience on soil modelling concept for forecasting productivity

SOIL-603	Physical Chemistry of Soil	2(2+0)

Aim of the course

To impart knowledge about modern concepts of physical chemistry of soils and clays, with emphasis on understanding the processes involved with practical significance.

Theory

Unit I

Colloidal chemistry of in organic and organic components of soils–their formation, clay organic interaction.

Unit II

Predictive approaches for cation exchange equilibria- thermodynamics, empirical and diffuse double layer theory (DDL)- relationships among different selectivity coefficients; structure and properties of diffuse double layer.

Unit III

Thermodynamics of nutrient transformations in soils; Climate change effects on minerology and surface properties of variable charge; cationic and anionic exchange and their models, molecular interaction.

Unit IV

Adsorption/desorption isotherms-Langmuir adsorption isotherm, Free unlick adsorption isotherm, normalized exchange isotherm, BET equation; selective and non-selective adsorption of ions on in organic surfaces and organic surfaces of soil
Materials (citation of utility in agricultural system).

Unit V

Common solubility equilibria-carbonates, iron oxide and hydroxides, aluminium silicate, aluminium phosphate; electrochemical properties of clays (citation of examples from agricultural use).

Teaching methods/activities

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

Learning outcome

Experience on the knowledge of soil chemical behaviour on research for solving field problems.

PP-604	Plant Phenomics-next Generation Phenomics	2(2+0)

Aim of the course

The course aims at providing cutting edge knowledge on the current progress made
In various phenotyping techniques and approaches. The students will be versed with principles of various phenotyping approaches. The aim is to provide hands-on Expertise in analysing trait diversity. Exposure will be provided on Non-invasive imaging technologies that drive the phonemics platforms. The course provides comprehensive exposure on recent developments in phenomics platforms imaging Tools/techniques and recent trends in designing specific phenemics platforms e.g. drought studies/root phenotyping etc.

Theory

Block 1: Concepts of High throughput Phenotyping and its Requirement

Unit 1: Concepts of Phenotyping

The concepts of "phene and trait" analogous to gene and allele. Genome-phenomerelationship, definition of phenotyping, GxE interaction on phenome.

Unit 2: Physio-Morphological Traits Associated with Crop Performance

Overview of phenotyping needs to complement genomic resources, specific traits associated with yield potential, stress adaptation (both biotic and abiotic stresses). Need for high throughput precision phenotyping approaches for basic studies and to generate genetic and genomic resources.

Unit 3: Features of Phenomic Platforms

Precision growth conditions, maintenance of light, temperature/VPD and RH torealize the potential crop growth response, Controlled environmental facilities for simulating challenging climatic conditions to phenotype diverse plant traits, Concept of sensors, diverse sensors and their utility in precise quantification of environmental variables, soil moisture sensors, Imaging to capture plant traits, image acquisition. Automated big data access, processing, etc.

Unit 4: Trends in Phenomics

Types of phenomic platforms- Laboratory, Greenhouse and the field-based platforms. Platforms designed for specific needs i.e., root phenotyping, drought studies etc., Crop specific phenotyping, mobile and stationary platforms, Global trends in establishing major phenomics platforms, and their characteristic features and impact.

Unit 5: Non-invasive Phenotyping Approaches

The concept of non-invasive capturing of plant growth and health, Imaging technologies - image acquisition, segmentation and data analysis, Critical aspects of Visual, IR Thermal, Fluorescence, NIR, Hyperspectral imaging, Development and validation of models for deriving relevant physiological traits from image phenome. Concepts of Plants to sensors and sensors to plants, Stationary and ground based tractor mounted sensors/imaging tools, Unmanned aerial vehicle (UAV) sensors, Machine learning and its integration to analyse ground and aerial based images.

Block 2: Applications of the Phenomics Platforms

Unit 1: Basic Studies to Assess the Crop Response

Functional validation of genes, chemicals and other interventions, Characterize the growth and stress response in contrasts to identify the relevance of adaptive trait.

Unit 2: Applied Studies Focused on Crop Improvement Programs

Characterizing the pre-released promising lines for productivity under defined environmental variables. Phenotyping germplasm accessions, mapping populations for specific traits for mapping, Concept of Phenome Wide Association Studies (PWAS). Genomic selection, gene-based crop models to predict complex traits, Impact of phenomics platform, progress made, case studies.

Teaching methods/activities

Lecture Assignment (Reading/Writing)Student presentation

Learning outcome

By the end of this course, the student will be able to understand the current progress made in various phenotyping techniques and approaches.

PP-610	Weed Biology and Physiology of Herbicide Action	2(2+0)

Aim of this course

The course is designed to provide both basic and applied knowledge on the weeds.
It will help to understand the fundamental physiology, biochemistry, and molecular
Biology of herbicides and their effects on plants; To study the physiological and molecular mechanisms of herbicide resistance. This course will provide knowledge on biology of weeds, classification and mode of action of herbicides, herbicide resistance and its management and environment friendly weed management strategies.

Theory

Block 1: Weed Biology

Unit 1: Weed Biology and its Importance in Weed Management

Introduction to weeds, Classification of weeds, Yield losses caused by weeds, Environmental impacts of

invasive weed species, Aspects of Weed biology, Germination, Dormancy and growth behaviour of weed species, Effect of environmental factors on weeds, Adaptation of weeds to different ecologies.

Unit 2: Life Cycle and Population Dynamics of Weeds

Growth duration and reproductive potential of weed species, Population dynamics,
Weed Shift due to weed management, weed Seed Bank.

Unit 3: Crop Weed Competition

Understanding the nature of crop-weed competition, critical stages of crop weed competition, and growth stages of weeds for improved control by herbicides.

Block 2: Physiology of Herbicide Action

Unit 1: Introduction to Herbicides

Introduction, Chemistry and classification of herbicides by mechanism of action,HRAC Classification, Site of Actions, Application techniques, doses, active ingredients, formulations, Absorption and translocation of soil and foliar applied herbicides, Methods to increase the efficiency of soil and foliar applied herbicide role of membranes, adjuvants, surfactants, synergists.

Unit 2: Mechanism of Action of Herbicides

Physiological and biochemical effects of herbicides: Effects on membrane structure and functions, cell division and cell development, Effects on chloroplast, photosynthesis, respiration, protein synthesis, synthesis of lipids, Molecular mechanism of action, Molecular mechanisms of herbicide resistance in relation to chloroplast gene expression.

Unit 3. Herbicide Resistance and its Management

Herbicide resistance-Definition, history, magnitude; Mechanisms of resistance: Target site and non-target site, cross and multiple resistances, Role of management
practices on resistance development, Resistance management: Strategies; HR crops, Super weeds,

Teaching methods/activities

Lectures Assignment (Reading/Writing)Text Books / reference books and materials
Student presentations

Learning outcome

After successful completion of this course, the students are expected to be able to: Understand the importance of weed biology in weed management Understand the mechanism of herbicide action Understand the problem of herbicide resistance development Appreciate and suggest sustainable weed management strategies

PP-606	Global Climate Change and Crop Response	2(2+0)

Aim of this course

Present Indian agriculture encounters tremendous challenges due to rapid climate change. Climate change exerts remarkable negative impact on food, nutritional and ecological security. It significantly affects the plant physiological processes, hence yield is severely affected. Therefore students of plant physiology need to quip themselves with knowledge and skill sets required to navigate the climate change scenario and its impact on crops physiological processes. Hence, this course is designed

Theory

Block 1: Climate Change: Crop Response and Mitigation

Unit 1: Fundamentals of Climate Change

Definition of climate change, history and evidences of climate change and its implications. Natural and anthropogenic climate change. Sources of Greenhouse Gas (GHG) emission, Global Warming Potential of GHGs, accumulation of GHGs in the atmosphere and science behind climate change, industrial revolution and GHG build-up in the atmosphere, Energy-Emission-Economy Interactions, carbon intensity of economy, carbon equity/justice.

Unit 2: Manifestations of Climate Change

Impact on monsoons, occurrence of extreme weather events, hydrological cycle and water availability,

effect on crop growing period in tropics, subtropics and temperate regions, shifts in distribution of flora and fauna, effects on biodiversity and migration of tropical plant species to higher latitudes and altitudes.

Unit 3: Major GHGs (CO2, Methane, NO2, etc.), their Production Rates, Monitoring and their Influence on Climate Change

GHGs: An Overview, - role of CO2, methane and major uncertainties. Mechanism of their production and emission from various, source and sinks of GHGs; and contribution of GHGs to global warming. Techniques used in monitoring GHGs.

Unit 4: Agricultural Practices on GHG Production

Carbon footprint analysis of agriculture and various agricultural practices contribute to climate change. Impacts of natural factors and farming practices on green house resistance development Appreciate and suggest sustainable weed management strategies gas emissions. Sources of agricultural GHG emission-Agricultural Soil Management, enteric fermentation, manure management, other sources. Opportunities to reduce GHG emission from Agriculture.

Unit 5: Direct and Indirect Effects of Climate Change on Plant Processes

Problems and Prospects of Crops with changing temperature: Growth and Development of Crop plants, Thermo-morphogenesis, phenology, Physiological processes such as photosynthesis, Net carbon assimilation, C3 and C4 plants adaptation,Respiration, Nutrient acquisition and metabolisms, Plant water relations and Heat shock proteins, Grain/seed development: Grain Quality parameters and yield.

Unit 6: Climate Change Scenario and Impact on Crops

Different scenarios for temperature, rainfall in different agro-climatic zones of India and their impact on crop growth and productivity. Major climate change (temperature, CO2, and rainfall) impact quantification using field or controlled environment experiments, meta-analysis and simulation models. Some examples of crop simulation models calibration and their application in short-term and long term predictions.

Unit 7: Ozone Depletion leading to Increased Ionizing Radiations and its Implications on Crop Growth

Role of CFCs in ozone depletion, penetration of ionizing UV radiations and its implications on crop growth.

Unit 8: Long-term and Short-term Projections of Climate Change: Effects on Natural Vegetation and Ecosystems

Response of natural ecosystems to increasing atmospheric CO2 concentration and climate warming, effect of climate change on quality of feed i.e leaf and stored grains/seeds, its implications on pollinators and pests

Unit 9: Technologies for Climate Change Mitigation in Agriculture

Agricultural biotechnology to produce crop varieties with enhanced carbon uptake. Nutrient management: Management of nitrogenous fertilizers. Tillage/residue management: 1.Conservation tillage CO2 mitigation technology; 2. Biochar: A potential technique for carbon sequestration. Methane mitigation using reduced tillage technology, change in methanogenic bacterial activity using electron acceptors. Carbon sequestration potential, concept and measurement.

Unit 10: Climate-resilient Agriculture

Conventional and biotechnological approaches to improve the crop adaptation to climate change. Relevance of "Genome wide mutants" to identify genes/processes for improved adaptation to changing environments.

Unit 11: Climate Change: Technologies for Crop response studies

Temperature Gradient Chambers, Temperature Gradient Greenhouses, Soil plant atmosphere research system (SPAR), Infra-red warming Technology, Free Air temperature enrichment technology, Soil Warming system etc.

Unit 12: Politics of Climate Change Negotiations

IPCC, Major International conventions/treaties, Kyoto Protocol, Paris Agreement, Global initiatives on Carbon sequestration, carbon trading.

Teaching methods/activities

Lecture
Assignment (Reading/Writing)
Student presentation

Learning outcome

After completion of this course, students will be able to obtain in depth and basis knowledge on crop responses to climate change.

AGM-605	Analytical Tools and Methods for Agro-meteorology	2(1+1)

Aim of the course

To impart the theoretical and practical knowledge of new tools for analysis of agro climatic features.

Theory

Unit I

Review of agro-climatic methods; characterization of agro climatic elements; sampling of atmosphere; temporal and spatial considerations; micro-macro climates.

Unit II

Network spacing; spatial and temporal methods; GIS fundamentals and applications; numerical characterization of climatic features; crop response to climate, time lags, time and distance constants, hysteresis effects.

Unit III

Influence of climate on stress-response relations; thermal time approach in agro climatology- heat and radiation use efficiency in crop plants; applications to insect-pest development and prediction; comfort indices for human and animals; impact of natural and induced variability and change of climate on crop production.

Unit IV

Instrumentation and sampling problems; design of agro-meteorological experiments.

Unit V

Basic knowledge of application of computers in agriculture; theories of computer
Language BASIC, FORTRAN, C, C++ and Visual basic.

Unit VI

Empirical and statistical crop weather models and their application with examples;
In corporation weather, soil, plants and other environment related parameters as subroutine and remote sensing inputs in models; growth and yield prediction models; crop simulation models; forecasting models for insects and diseases.

Practical

- Calculation of continentality factors.
- Climatic indices and climogram.
- Agrometeorological indices: Degree-days, photo thermal units, heliothermal units, phenothermal index.
- Heat and radiation use efficiency and other indices of crops.
- Crop growth rates.
- Analysis of the rmogram, hygrogram, hyetogram, sunshine cards etc. stream lines And wind roses and statistical analysis of climatic data.
- Working with statistical models: crop yield forecasting, crop weather relationship And insect & disease forecasting models.

- Working with crop simulation models
- Small programme writing in computer languages like BASIC, FORTRAN, C, C++and Visual basic.
- Geographical Information System.

Teaching methods/activities

Theory and practical classes, learning of computer language

Learning outcome

Knowledge on collection of agro met data, sampling design for agro meteorology, calculation of different indices and analysis of data