

Gopal Narayan Singh University,

Jamuhar, Sasaram, Rohtas (Bihar)

NARAYAN INSTITUTE OF AGRICULTURAL SCIENCES

APPROVED BY	DATE
S. S.	22.06.2024
Academic Council	18.07.2024
Board of Management	07.08.2024
Governing Body	25/11/2024



ORDINANCES AND SYLLABUS

GOVERNING TO COURSES OF

M.Sc. (Ag.) Entomology & Ph.D.

in

DEPARTMENT OF ENTOMOLOGY

NARAYAN INSTITUTE OF AGRICULTURAL SCIENCES

GOPAL NARAYAN SINGH UNIVERSITY, JAMUHAR, SASARAM

Jyoti
22/6/24

Amel
22/06/24

Satyam
22/06/24

Sanjay

Himanshu
22.06.24

Aditya
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ORDINANCES GOVERNING ADMISSION TO M.Sc. (Ag.) COURSES

1.0	ADMISSION
1.1	MODE OF ADMISSION
	Admission to the M.Sc. (Ag.) courses shall be made on merit computed on the basis of marks obtained by candidates in a competitive examination called Post Graduated Entrance Test for Agriculture, herein-after abbreviated 'PGET-Ag' to be conducted by the Controller of Examinations, Gopal Narayan Singh University, on a date and centers to be announced from time to time.
1.2	ELIGIBILITY
	<p>I. Candidates with four years B.Sc. (Ag.)/ B.Sc. (Hons.) Ag./ B.Sc. (Horticulture)/ B.Sc. (Hons.) Horticulture Degree with credit based course programme under the guidelines of ICAR or an equivalent qualification.</p> <p>II. Candidate with four years B.Sc. (Horticulture)/ B.Sc. (Hons.) Horticulture Degree with credit based course programme under the guidelines of ICAR or an equivalent qualification will be considered for all the courses of M.Sc. (Ag.) course except M.Sc. (Ag.) Agronomy.</p> <p>III. At least 6.00/10 or 2.5/4, 3.5/5, 4.0/6 OGPA for general candidates. For SC/ST/OBC/EWS/PwD candidates OGPA of 5.5/10, 2.0/4, 3.0/5, and 3.5/6 are required in qualifying examinations as per university guidelines.</p> <p>IV. Has not secured more than one III division or equivalent O.G.P.A. in his/her academic career.</p>
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 the university.
1.3	NUMBER OF SEATS
	Total number of seats available is 25. Reservation will be applicable as per the rules of Bihar Government.
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	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.
1.5.1	SYLLABUS FOR THE ENTRANCE EXAMINATION The question paper shall be based on B.Sc. (Ag.)/ B.Sc. (Hons.) Ag./ B.Sc. (Horticulture)/ B.Sc. (Hons.) Horticulture Degree courses generally taught at graduation level as approved by ICAR.
1.6	MERIT LIST FOR ADMISSION

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1.6.1	EVALUATION Four marks shall be awarded for each correct answer whereas one mark shall be deducted for each incorrect answer
1.6.2	Candidates shall be selected in order of merit on the basis of the aggregate marks secured at the PGET-Ag. of that academic session.
1.6.3	In case of equal marks at the PGET-Ag the <i>inter-se</i> 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 PGET-Ag. (ii) If the OGPA at the above [vide 1.6.3 (i)] examination happen to be the same, the date of birth would be the basis, i.e., the candidate senior in the age would rank higher.
1.6.4	In all matters relating to M.Sc. (Ag.) admission decision of a Committee comprising the Admission Committee of Institute and the Admission Committee of the respective Department shall be final.
1.6.5	Scrutiny/re-evaluation of the answer books of the PGET-Ag shall not be done.
1.6.6	The candidates shortlisted for counseling will be informed individually by registered post/ speed post/ e-mail / university webpage.
1.6.7	A candidate / candidates selected for admission under PWD (Persons with Disabilities) category may be referred to a Medical Board of the University (if needed) for their Medical Examination to ensure that candidates with disabilities are medically fit to pursue their chosen course of study.
1.7	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	Notwithstanding anything contained in these ordinances, the Entrance Test Notification approved by the Academic Council for the concerned academic year shall be final.

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ORDINANCES GOVERNING ADMISSION TO Ph.D. COURSES

2.0	ADMISSION
	Admissions shall be made in the disciplines where M.Sc. (Ag.) courses are being offered.
2.1	MODE OF ADMISSION
	The admission to the Ph.D. programme shall be through the Agriculture Research Entrance Test (RET)/RET Exempted conducted by the university. In the event of seats remaining vacant after the closer of admission in the first semester candidates may also be admitted in the second semester of the academic year from among the successful candidates of the RET including those who could not turn up in the first semester.
2.2	MINIMUM ELIGIBILITY REQUIREMENT AND CALCULATION OF ACADEMIC RECORD
	<p>MINIMUM ELIGIBILITY</p> <p>A candidate, seeking admission to the Ph.D. programme in the respective faculty, shall be required to have passed the qualifying examination [M.Sc. (Ag.)] 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/EWS/PwD candidates OGPA of 6.0/10, 2.0/4, 3.0/5, 3.5/6 is required as per university guidelines. A candidate must not have more than one III division or equivalent grade point average in his/her academic career.</p> <p>CALCULATION OF ACADEMIC RECORD:</p> <p>Formula for calculating academic index</p> <p>Case 1: Where postgraduate degree is considered as the qualifying examination, and</p> <p>a) Marks are awarded in Postgraduate Examination</p> $M = (X1 + 0.6 X2 + 0.25 X3 + 0.15 X4)/2$ <p>b) Marks are not awarded in Postgraduate Examination</p> $M = (0.6x X2 + 0.25x X3 + 0.15x X4)$ <p>Case 2: Where undergraduate degree is considered as the qualifying examination,</p> $M = (X2 + 0.4 X3 + 0.3 X4)/1.7$ <p>Case 3: Where the candidate has passed Higher Secondary Examination only (instead of High School & Intermediate both)</p> $M = (X1 + 0.6x X2 + 0.4x X5)/2$ <p>Where,</p> <p>M = Marks for the academic record,</p> <p>X1 = Percentage of marks obtained at the post-graduate examination,</p> <p>X2 = Percentage of marks obtained at the under-graduate examination</p> <p>X3 = Percentage of marks obtained at the intermediate/higher secondary examination,</p> <p>X4 = Percentage of marks obtained at the high school examination, and</p> <p>X5 = Percentage of marks obtained at the higher secondary examination.</p> <p>Note: 'M', X1, X2, X3, X4, X5 will be calculated up to two places of decimal. 50 Marks in Academic record means mark should be 50 and above. Rounding for lower marks not applicable.</p> <p>Example (Case 1):</p> <p>If provided X1 = 56.10%, X2 = 60.39%, X3 = 62.25%, X4 = 55.65%</p>

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$$M = [56.10 + (0.6 \times 60.39) + (0.25 \times 62.25) + (0.15 \times 55.65)]/2$$

$$M = 58.11$$

NOTE:

(i) A candidate appearing in NET/NET-JRF may also apply for the Ph.D. programme provided the result of the NET/NET-JRF examination is declared before the start of the counseling for admission to the Ph.D. programme under RET-Exempted category if he/she fulfils the other eligibility criteria.

(ii) If the applicant has passed the qualifying examination where grades are awarded and:

- a) Where the Grade Sheet does not mention the equivalent percentage of marks from grade points, the candidate should submit such a Certificate of conversion from the concerned Institution mentioning either the converted percentage, or the formula for the actual conversion of grade point average to percentage of marks.
- b) Where the Grade Sheet itself mentions the equivalent percentage of marks from grade points, or the formula for such conversion, the candidate should get both sides of the Degree/Grade Sheet photocopied showing the equivalent percentage of marks/conversion formula and enclose with the Application Form.
- c) In case there is no conversion formula for computing the percentage, CGPA (out of 10) multiplied by 10 will constitute the percentage. In case where the CGPA is available only out of 4, then CGPA multiplied by 25 will constitute the percentage.
- d) For the candidates belonging to the RET Exempted category, the minimum benchmark of obtaining the academic record of 50 shall not apply. However, the Academic Record for such candidates would still be calculated, as per the aforesaid formula, for the purposes of determining the inter se merit amongst the RET Exempted category applicants.

(iii) "Aggregate percentage of marks" will include grace marks awarded to a candidate.

(iv) A candidate already possessing a Ph.D. degree of this or any other University shall be eligible to be admitted to the Ph.D. programme for an additional Ph.D. degree in a subject other than the subject in which he/she already possesses the Ph.D. Degree. The admission of such a candidate will be at the discretion of the Vice-Chancellor, who, on the basis of specific recommendation and full justification by the Departmental Research Committee (DRC) after considering certain relevant criteria such as, the synopsis of the proposed topic, relevance of the proposed topic and its relationship with the topic of the first Ph.D., etc. will take a final decision.

Applicant must satisfy himself/herself about fulfilling the minimum eligibility requirements as prescribed above before filling the Application Form.

2.3 NUMBER OF SEATS

The number of seats shall be declared by the university as per the vacancies exist.

2.3.1 RESERVATIONS

Reservation will be applicable as per the rules of Bihar Government.

2.4 SCHEME OF AGRICULTURAL RESEARCH ENTRANCE TEST (RET)

(a) 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.

(b) RET will have two components:

- (i) Test A will be based on Subject Knowledge, Assessment of Logical and Analytical Capability and Research Methodology.

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(ii) Test B will cover Personal Interview to test aptitude for research

A. TEST - A: It is aimed as to assess the subject knowledge of the candidate at the Master's level in the concerned subject and related area. It will also contain the questions on research methodology. The MCQs would be aimed to test the logical and analytical capabilities of the candidate, rather than memory power of candidates.

- (a) 40% questions related to methodology will cover the following aspects : Foundation of Research, Problem identification and formulation, Research design, Qualitative and Quantitative Research, Measurement, Sampling, Data Analysis, Interpretation of Data, Paper Writing, Use of Encyclopedias and tools, etc. While other 60% questions would be of Master's level of the subject and areas concerned.
- (b) This will have total 100 MCQs
- (c) This test will have 120 minutes and 400 marks.
- (d) Each question will carry 04 (three) marks for correct answer and 01 (one) mark will be deducted for a wrong answer.
- (e) Candidate must secure a minimum of 35% marks in Test A to be eligible for further consideration.

B. Test - B: It will cover Personal Interview

Candidate, approximately four times of the seats, based on merit, may be called for Test B.

All eligible RET-exempt category candidates shall have to take TEST-B of the selection process.

- (a) The Test - B will be conducted in the concerned department by a Board to be appointed for the purpose and will carry a total of 20 (twenty) marks for personal interview.
- (b) The Interview Board will ask questions relating to the area in which the candidate expects to undertake research, if selected, to test his/her competence for research in the discipline.

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

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

Total merit index will be calculated among 550 marks (400 (Test A) + 30 (Academic Index) + 20 (Personal Interview)) and merit will be prepared accordingly for provisional admission.

- (i) The OGPA obtained by the candidates at the qualifying examination recognized for the purpose of appearing in the RET.
- (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.

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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:

1.	The Dean of the Faculty or his/her nominee of the Institute	---->	Chairman
2.	The Director of the Institute (in the case where the Faculty is associated with an Institute) or his/her nominee	---->	Member
3.	Concerned Head of the Department	---->	Member
4.	Two Senior faculty members of the Institute	---->	Member
5.	Academics Director or his/her nominee	---->	Member
6.	Two Senior member of the concerned DRC excluding Head or Co-ordinator	---->	Member
7.	One Faculty who belongs to SC Category	---->	Member
8.	One Faculty who belongs to ST Category	---->	Member
9.	One Faculty who belongs to OBC Category	---->	Member

- 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 RET 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 for declaration of final merit list discipline-wise by the Faculty.
- Separate merit lists shall be prepared for the RET qualified and RET-Exempted 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 RET qualified (depending on the number of total available seats in the department).
- The Department shall notify the merit list of the selected candidates and shall issue the letter of provisional admission to the candidates.
- On receipt of the letter of provisional admission, each candidate shall pay the fees and complete other official formalities pertaining to admission within stipulated or notified period of time interval.
- 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-

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	<p>supervisor/external supervisor.</p> <ul style="list-style-type: none"> • The Head of the Department/In-charges shall send a complete list of the admitted candidates along with the necessary details to the Registrar (Academic) with a copy to the Dean (Institute) within a week from the date of admission. • The records of the merit list of both the RET qualified and RET Exempted 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 each semester.
	<p>NOTE: Ph.D. Scholar shall not accept any other paid assignment apart from Research Fellowships, Research Assistantships, externally funded research project assignments etc. during the period of research and learning, provided that 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.</p>
2.5	<p>REGISTRATION</p> <p>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 RET and RET-Exempted as per Ph.D. Ordinance of the University.</p>
2.6	<p>Notwithstanding anything contained in these ordinances, the Entrance Test Notification approved by the Academic Council for the concerned academic year shall be final.</p>

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Annexure-I

Equivalent M.Sc./M.Sc.(Ag.) degrees or allied subjects for RET or RET-Exempted

Sr. No.	Disciplines of Ph.D.	Proposed
1.	Entomology	M.Sc./M.Sc. (Ag.) in Agricultural Entomology/ Entomology/ Entomology and Agricultural Zoology/ Entomology

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ORDINANCES GOVERNING COMMON ACADEMIC REGULATIONS FOR

PG AND Ph.D. PROGRAMMES

(Separate Ordinances for Special Courses will be framed)

3.1	<p>Academic Year and Registration</p> <ul style="list-style-type: none"> An academic year shall be normally from July to June of the following calendar year otherwise required under special situations. It shall be divided into two academic terms known as semesters. Dates of registration, commencement of instructions, semester end examination, end of semester and academic year, etc. shall be notified accordingly. The Academic Calendar shall be developed by the Academic Cell of the University from time to time and notified accordingly by the Registrar in advance. An orientation programme shall be organized by the Director (Institute or Faculty)/ Dean (Institute or Faculty) with the due approval from the VC or Pro-VC of the University for the benefit of the newly admitted students immediately after commencement of the semester. On successful completion of a semester, the continuing students shall register for subsequent semester on the date specified in the Academic/ Semester Calendar or specifically notified separately. Every enrolled student shall be required to register at the beginning of each semester till the completion of his/ her degree programmes. 																											
3.2	<p>Credit requirements</p>																											
3.2.1	<p>Framework of the courses</p> <p>The following nomenclature and Credit Hrs need to be followed while providing the syllabus for all the disciplines:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"></th> <th style="width: 25%; text-align: center;">Masters' Programme</th> <th style="width: 25%; text-align: center;">Doctoral Programme</th> </tr> </thead> <tbody> <tr> <td>(i) Course work</td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">Major courses</td> <td style="text-align: center;">20</td> <td style="text-align: center;">12</td> </tr> <tr> <td style="padding-left: 20px;">Minor courses</td> <td style="text-align: center;">08</td> <td style="text-align: center;">06</td> </tr> <tr> <td style="padding-left: 20px;">Supporting courses</td> <td style="text-align: center;">06</td> <td style="text-align: center;">05</td> </tr> <tr> <td style="padding-left: 20px;">Common Courses (PGS)</td> <td style="text-align: center;">05</td> <td style="text-align: center;">-</td> </tr> <tr> <td style="padding-left: 20px;">Seminar</td> <td style="text-align: center;">01</td> <td style="text-align: center;">02</td> </tr> <tr> <td>(ii) Thesis Research</td> <td style="text-align: center;">30</td> <td style="text-align: center;">75</td> </tr> <tr> <td style="text-align: center;">Total</td> <td style="text-align: center;">70</td> <td style="text-align: center;">100</td> </tr> </tbody> </table> <p>Major courses: From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken may be given *mark</p> <p>Minor courses: From the subjects closely related to a student's major subject</p> <p>Supporting courses: The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.</p> <p>Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree programme:</p> <ol style="list-style-type: none"> Library and Information Services Technical Writing and Communications Skills Intellectual Property and its management in Agriculture 		Masters' Programme	Doctoral Programme	(i) Course work			Major courses	20	12	Minor courses	08	06	Supporting courses	06	05	Common Courses (PGS)	05	-	Seminar	01	02	(ii) Thesis Research	30	75	Total	70	100
	Masters' Programme	Doctoral Programme																										
(i) Course work																												
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Minor courses	08	06																										
Supporting courses	06	05																										
Common Courses (PGS)	05	-																										
Seminar	01	02																										
(ii) Thesis Research	30	75																										
Total	70	100																										

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	<p>4. Basic Concepts in Laboratory Techniques</p> <p>5. Agricultural Research, Research Ethics and Rural Development Programmes</p>																																							
3.2.2	Supporting Courses																																							
	<p>The following courses are being offered by various disciplines (The list is only indicative). Based on the requirement, any of the following courses may be opted under the supporting courses. The syllabi of these courses are available in the respective disciplines. If required, the contents may be modified to suit the individual discipline with approval of the concerned BoS:</p> <table border="1"> <thead> <tr> <th>Code</th> <th>Course Title</th> <th>Credit Hour</th> </tr> </thead> <tbody> <tr> <td>STAT 501</td> <td>Mathematics for Applied Sciences</td> <td>2+0</td> </tr> <tr> <td>STAT 502</td> <td>Statistical Methods for Applied Sciences</td> <td>3+1</td> </tr> <tr> <td>STAT 511</td> <td>Experimental Designs</td> <td>2+1</td> </tr> <tr> <td>STAT 512</td> <td>Basic Sampling Techniques</td> <td>2+1</td> </tr> <tr> <td>STAT 521</td> <td>Applied Regression Analysis</td> <td>2+1</td> </tr> <tr> <td>STAT 522</td> <td>Data Analysis Using Statistical Packages</td> <td>2+1</td> </tr> <tr> <td>#MCA 501</td> <td>Computers Fundamentals and Programming</td> <td>2+1</td> </tr> <tr> <td>#MCA 502</td> <td>Computer Organization and Architecture</td> <td>2+0</td> </tr> <tr> <td>#MCA 511</td> <td>Introduction to Communication Technologies, Computer Networking and Internet</td> <td>1+1</td> </tr> <tr> <td>#MCA 512</td> <td>Information Technology in Agriculture</td> <td>1+1</td> </tr> <tr> <td>#BIOCHEM 501</td> <td>Basic Biochemistry</td> <td>3+1</td> </tr> <tr> <td>#BIOCHEM 505</td> <td>Techniques in Biochemistry</td> <td>2+2</td> </tr> </tbody> </table> <p># Allocated as per the availability</p>	Code	Course Title	Credit Hour	STAT 501	Mathematics for Applied Sciences	2+0	STAT 502	Statistical Methods for Applied Sciences	3+1	STAT 511	Experimental Designs	2+1	STAT 512	Basic Sampling Techniques	2+1	STAT 521	Applied Regression Analysis	2+1	STAT 522	Data Analysis Using Statistical Packages	2+1	#MCA 501	Computers Fundamentals and Programming	2+1	#MCA 502	Computer Organization and Architecture	2+0	#MCA 511	Introduction to Communication Technologies, Computer Networking and Internet	1+1	#MCA 512	Information Technology in Agriculture	1+1	#BIOCHEM 501	Basic Biochemistry	3+1	#BIOCHEM 505	Techniques in Biochemistry	2+2
Code	Course Title	Credit Hour																																						
STAT 501	Mathematics for Applied Sciences	2+0																																						
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#MCA 502	Computer Organization and Architecture	2+0																																						
#MCA 511	Introduction to Communication Technologies, Computer Networking and Internet	1+1																																						
#MCA 512	Information Technology in Agriculture	1+1																																						
#BIOCHEM 501	Basic Biochemistry	3+1																																						
#BIOCHEM 505	Techniques in Biochemistry	2+2																																						
3.2.3	Mandatory requirement of seminars																																							
	<ul style="list-style-type: none"> It has been agreed to have mandatory seminars one in Masters (One Credit) and two in Doctoral programmes (two Credits). The students should be encouraged to make presentations on the latest developments and literature in the area of research topic. This will provide training to the students on preparation for seminar, organizing the work, critical analysis of data and presentation skills. 																																							

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3.3 Residential requirements

The minimum and maximum duration of residential requirement for Masters' Degree and Ph.D. Programmes will be as follows:

PG Degree Program	Duration of Residential Requirements	
	Minimum	Maximum
Masters' Degree	2 Academic Years (4 Semesters)	5 Academic Years (10 Semesters)
Ph.D.	3 Academic Years (6 Semesters)	7 Academic Years (14 Semesters)

*Student may be allowed to discontinue temporarily only after completion of course work

In case a student fails to complete the degree programme within the maximum duration of residential requirement, his/ her admission will stand cancelled. The requirement will be treated as satisfactory in the cases in which a student submits his/ her thesis any time during the 4th and 6th semester of his/ her resident-ship at the University for Masters' and Ph.D. programme, respectively.

3.4 Evaluation of course work and comprehensive examination

- For M.Sc., multiple levels of evaluation (First Test, Midterm and Final semester) is desirable. There will not be any comprehensive exam for M.Sc. students, as it is not needed as per **ICAR's Restructured and Revised Syllabi of Post-graduate Programmes (2021)**.
- For Ph.D., the approach will be research oriented rather than exam oriented. In order to provide the student adequate time to concentrate on the research work and complete the degree in stipulated time, the examination may have to be **only semester final**. However, the course teacher may be given freedom to evaluate in terms of assignment/ seminar/ first test.
- For Ph.D., **the comprehensive examination (Pre-qualifying examination) is required after the completion of 75% of his/her academic courses**. As the students are already tested in course examinations, the **comprehensive examination will be based on oral examination by an external expert** and the evaluation should cover both the research problem and theoretical background to execute the project. This will assess the aptitude of the student and suitability of the student for the given research topic. The successful completion of comprehensive examination is to obtain the **"Satisfactory" remark by the external expert**.

3.5 Advisory System

3.5.1 Advisory Committee

There will be an Advisory Committee for every student consisting of not fewer than three members in the case of a candidate for Masters' degree and four in the case of Ph.D. degree with the Advisor as Chairperson. The Advisory Committee will have representatives from the major and minor fields amongst the members of the Post-graduate faculty accredited for appropriate P.G. level research. However, in those departments where qualified staff exists but due to unavoidable reasons Post-graduate degree programmes are not existing, the staff having Post-

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	<p>graduate teaching experience of two years or more may be included in the Advisory Committee with approval of concerned authorities (Head of Department with due permission from the Director of the Institute and the Registrar of the University) as member representing the minor.</p> <p>The number of students allotted to a PG teacher as a chairperson of Advisory Committee shall be decided by the DRC as per rules.</p> <p>The Advisor should convene a meeting of the Advisory Committee at least once in a Semester. The summary record should be communicated to the Director (Academics) of the University.</p>
3.5.2	<p>Advisor/ Co-guide/ Member, Advisory Committee from other collaborating University/ Institute/ Organization</p> <ul style="list-style-type: none"> • In order to promote quality Post-graduate research and training in cutting edge areas, the University may enter into Memorandum of Understanding (MoU) with other Universities/ Institutions for conducting research. While constituting an Advisory Committee of a student, if the Chairperson, Advisory Committee feels the requirement of involving of a faculty member/ scientist of such partnering university/ Institute/ Organization, he/ she may send a proposal to this effect to Director (Education/Institute)/ Dean (Institute) along with the proposal for consideration of Student's Advisory Committee (SAC). • The proposed faculty member from the partnering institution can be allowed to act as Co-guide/ Member by SAC mutual consent, primarily on the basis of intellectual input and time devoted for carrying out the research work at the particular institution. The faculty member/ scientist of partnering institutions in the SAC shall become a temporary faculty member of the University by following the procedure approved by the Academic Council.
3.5.3	<p>Allotment of students to the retiring persons</p> <p>Normally, retiring person may not be allotted M.Sc. Student if he/ she is left with less than 2 years of service and Ph.D. student if left with less than 3 years of service. However, in special circumstances, permission may be obtained from the Director (Institute), after due recommendation by the concerned Head of the Department.</p>
3.5.4	<p>Changes in the Advisory Committee:</p> <p>(i) Change of the Chairperson or any member of the Advisory Committee is not ordinarily permissible. However, in exceptional cases, the change may be effected with due approval of the Director (Academics).</p> <p>(ii) Normally, staff members of the university on extra ordinary leave or on study leave or who leave the University service will cease to continue to serve as advisors of the Post-graduate students of the University. However, the Director (Institution) may permit them to continue to serve as advisor subject to the following conditions:</p> <p>(a) The concerned staff member must be resident in India and if he/ she agree to guide research and must be available for occasional consultations;</p> <p>(b) An application is made by the student concerned duly supported by the Advisory Committee;</p> <p>(c) In case of a Ph.D. student, he/ she must have completed his/her</p>

	<p>comprehensive examinations and the research work must be well in progress and it is expected that the student will submit the thesis within a year;</p> <p>(d) The Head of the Department and the Dean of the College concerned agree to the proposal;</p> <p>(e) The staff member, after leaving the University service is granted the status of honorary faculty's membership by the Vice-Chancellor on the recommendation of the Director (Education/Institute)/ Dean (Institute) for guiding as Chairperson or Member, Advisory Committee the thesis/ theses of the student(s) concerned only.</p> <p>(iii) In case the Chairperson/ member of a Student's Advisory Committee retires, he/ she shall be allowed to continue provided that the student has completed his course work and minimum of 10 research credits and the retiring Chairperson/ member stays at the Headquarters of the College, till the thesis is submitted.</p> <p>(iv) If the Chairperson/ member proceeds on deputation to another organization, he/ she may be permitted to guide the student provided his/ her new organization is at the Headquarters of the College and his/ her organization is willing for the same.</p> <p>(v) The change shall be communicated to all concerned by the Head of Department.</p>
3.6	<p>Evaluation of research work</p> <ul style="list-style-type: none"> It is highly desirable for Ph.D. programme and this should be done in each semester as an essential part of research evaluation. The Student Advisory Committee shall review the progress of research and scrutinize reports submitted by the student per semester. Midterm evaluation of Ph.D. (to move from JRF to SRF) is a mandatory requirement for all the funding agencies. Hence, the second review of semester progress report need to be done after completion of two years. The successful completion enables the students to become eligible for SRF.
3.6.1	<p>Prevention of plagiarism</p> <p>An institutional mechanism should be in place to check the plagiarism. The students must be made aware that manipulation of the data/ plagiarism is punishable with serious consequences.</p>
3.7	<p>Learning through online courses</p> <ul style="list-style-type: none"> In line with the suggestion in new education policy and the initiatives taken by ICAR and MHRD in the form of e-courses, MOOCs, SWAYAM, etc. and also changes taking place globally in respect of learning through online resources shall be promoted for the students to enrol in identified online courses. It is expected that the provision of integrating available online courses with the traditional system of education would provide the students opportunities to improve their employability by imbibing the additional skills and competitive edge. The Committee recommends the following points while integrating the online courses: <ul style="list-style-type: none"> (i) Board of Studies (BoS) of each Faculty shall identify available online courses and a student may select from the listed courses. The interested

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	<p>students may provide the details of the on-line courses to the BoS for its consideration.</p> <p>(ii) A Postgraduate student may take up to a maximum of 20% credits in a semester through online learning resources.</p> <p>(iii) The host institute offering the course does the evaluation and provide marks/ grades.</p>
<p>3.8</p>	<p>Internship during Masters programme</p> <p>Internship for Development of Entrepreneurship in Agriculture (IDEA)</p> <p>Currently, a provision of 30 credits for dissertation work in M.Sc. programmes 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.</p> <p>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.</p> <p>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.</p> <p>The main objectives of the programme:</p> <ol style="list-style-type: none"> 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 <p>Following criteria for IDEA will be taken into consideration:</p> <ul style="list-style-type: none"> • 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 and 10 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

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3.9	<p>Teaching assistantship</p> <ul style="list-style-type: none"> • Teaching assistantship shall be encouraged. This will give the required experience to the students on how to conduct courses, practical classes, evaluation and other related academic matters. This is an important part of Ph.D. training all over the world and it is expected to address the shortage of faculty in many institutions/ universities. • Teaching Assistantships shall be awarded on semester to semester basis on the recommendation of a screening/ selection committee to be constituted by the Vice Chancellor. All classes and assignments given to the Teaching Assistants, including tutorials, practicals and evaluation work shall be under the supervision of a faculty member who would have otherwise handled the course/ assignment. • At the end of each term, Teaching Assistants shall be given a certificate by the concerned Head of the Department, countersigned by the Director/Dean, specifying the nature and load of assignments completed.
3.10	<p>Registration of project personnel (SRF/ RA) for Ph.D.</p> <ul style="list-style-type: none"> • A provision may be made to enable the project personnel (SRF/ RA) is working with this institute to register for the Ph.D. However, this can be done only if they are selected based on some selection process such as walk-in-interview. The prior approval of PI of the project is mandatory to consider the application of project personnel (SRF/ RA) for Ph.D. admission. • The candidates need to submit the declaration stating that the project work shall not be compromised because of Ph.D. programme. Further, in order to justify the project work and Ph.D. programme, the number of course credits should not be more than 8 in a semester for the project personnel (SRF/ RA) who intend to register for Ph.D.
3.11	<p>Compliance with the National Education Policy-2020</p> <ul style="list-style-type: none"> • While implementing the course structure and contents, the provisions of National Education Policy-2020 shall be emphasised.
3.12	<p>All the clauses mentioned in this unit i.e. form 3.5 to 3.11 will be applicable by the university with little more amendments as needed.</p>

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**ORDINANCES GOVERNING COMMON ACADEMIC REGULATIONS FOR
PG AND Ph.D. PROGRAMMES IN THE UNIVERSITY**

4.0	RESIDENTIAL REQUIREMENT (As Provided in Unit 3.3)
4.1	CREDIT AND COURSE REQUIREMENT (As Provided in Unit 3.2.1)
4.2	SEMINAR
	<p>A student will be required to deliver a course seminar (One Credit) in his Masters. The seminar will be assessed (in terms of grade) by a seminar evaluation committee comprising the Head of the Department, one senior most teacher other than the Head of the Department and the Seminar In-charge. In case the seminar is unsatisfactory the student will deliver the Seminar again in the same semester.</p> <p>The research scholars should be encouraged to make presentations on the latest developments and literature in the area of research topic. Similarly, the seminar topics for the PG students (M.Sc. (Ag.)) will be decided by the seminar incharge. This will provide training to the students on preparation for seminar, organizing the work, critical analysis of data and presentation skills.</p>
4.3	CREDIT LOAD PER SEMESTER
4.3.1	Credits offered by a student will be decided by the Chairman of the Advisory Committee.
4.3.2	A student will offer a minimum of 8 credits and a maximum of 18 credits in each semester including thesis credits.
4.3.3	A student will offer at least one core course in each of the first four semesters.
4.3.4	The minimum prescribed load will not be mandatory beyond the first four semesters of study.

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ORDINANCES GOVERNING CREDIT AND COURSE REQUIREMENTS OF Ph.D.

5.0	RESIDENTIAL REQUIREMENT (As Provided in Unit 3.3)
5.1	COURSE & CREDIT REQUIREMENT (As Provided in Unit 3.2.1) # Minimum one course from the major discipline in each semester, including core courses, must be offered during the first four semesters
5.2	CREDIT LOAD PER SEMESTER
	RPC of a student will 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.
5.3	SEMINAR
	A Ph.D. student will deliver seminars as prescribed below to the satisfaction of the Departmental Research Committee and the Members of the Research Progress Committee (RPC).
5.3.1	COURSE SEMINAR
	A student will be required to deliver a course seminar before the end of the fourth semester. The seminar will 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.
5.3.2	Research Plan Proposal Seminar
	<ul style="list-style-type: none"> (a) By the end of the second semester the candidate will submit to the RPC, a research plan proposal generally consisting of preamble, definition of the problem, approaches, results anticipated and references, in about 8 to 10 pages. (b) The RPC and the DRC will examine the research plan proposal of the candidate and the candidate will 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, will approve the proposal and the topic of research, and will forward its recommendation along with the second relevant 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 quality of the research plan proposal, the candidate will 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 will be done. But, if only the seminar is unsatisfactory, the candidate will 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 will 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.

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	<p>(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.</p> <p>(h) The residential requirement of three years will be counted on the basis of the semester ending 30th June / 31st December, whichever is applicable (This clause is applicable to Ph.D. students only)</p>
5.3.3	THESIS PRE-SUBMISSION SEMINAR
	This seminar will be delivered only after the completion of at least four 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 and fulfills the minimum residential requirements. This seminar will be based on the research work carried out by the candidate.
5.3.4	The seminar (5.3.3) will be judged as satisfactory / unsatisfactory by the members of the RPC of the candidate and DRC of the department.
5.3.5	If unsatisfactory, the candidate will be required to deliver it again on a date and time specified by the RPC.

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ORDINANCES GOVERNING EVALUATION OF COURSE WORK

6.0	EXAMINATIONS		
	The student's achievements will 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 will 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 or Practical Courses only		
	(a) Mid-semester examination	One	40%
	(b) End-Semester Examination	One	60%
6.1	MID-SEMESTER EXAMINATION		
	The mid-semester examination will be of two hour's duration and will generally cover approx. 50 percent of the total course.		
6.2	END-SEMESTER EXAMINATION		
	This examination covering the entire subject matter of a course will be held at the end of each semester. The duration of the examination will be of 3 hrs.		
6.2.1	The End Term Examination will be confidential and may be internally examined.		
6.2	SUBMISSION OF GRADE		
	The Grades will be sent within 10 days of the conduct of the examinations, and the answer books of all the examinations will be returned to the Controller of Examinations.		
6.2.1	SIGNIFICANCE OF GRADES		
	The examinations conducted throughout the semester will be evaluated in numerals assigning 100 marks to each course. The numerical rating will be converted to ten point system by placing a decimal before the last digit called here-in-after "grade"		
	GRADE For M.Sc. (Ag.)/Ph.D.	EXPRESSION	
	8.00 and above	Excellent	
	7.00-7.99	Good	
	6.00-6.99	Fair	
	Below 6.0	FAIL	
6.2.2	EQUIVALENCE OF GRADES IN PERCENT AND AS DIVISION		
	M.Sc. (Ag.)/ Ph.D		
	Grade x 10.0 = % marks		
	70% and above = First Division		
	Above 65% but below 70% = Second Division		
	Below 60% = Fail		
6.3	CALCULATION OF GP, GPA, and OGPA		

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Grade point and overall grade point average will be calculated as illustrated here under							
Credits (Theory + practical)	Marks				Grade		OGPA 53.6 ÷ 7 = 7.657
	Mid-term	End-term	Pract	Total	Grade	Grade Point (GP)	
3 (2+1)	25	33	22	80	8.0	24.0	
2 (2+0)	28	50	-	78	7.8	15.6	
2(0+2)	18	-	52	70	7.0	14.0	
7 (4+3)						53.6	
Note :- Grade Point (GP) : Grade x Credit Grade Point Average : GP/Credit Over All Grade Point Average (OGPA) : Total GP/Total Credits Grade : Total Marks in a Course /10							
6.5	MINIMUM GRADE POINT REQUIREMENT FOR PASSING A COURSE /SEMESTER /DEGREE PROGRAMME						
Minimum grade points required are given below :							
Passing requirement of				M.Sc.(Ag.)/Ph.D.			
A course				6.0			
A semester				6.5			
An academic year				6.5			
Degree Programme				6.5			
6.5.1	Significance of OGPA						
M.Sc.(Ag.)/Ph.D				EXPRESSION			
8.00 and above				Excellent			
7.00-7.99				Good			
6.50-6.99				Fair			
Below 6.50				FAIL			
6.6	PROMOTION FROM FIRST SEMESTER TO SECOND SEMESTER/CURRENT ACADEMIC YEAR TO THE NEXT ACADEMIC YEAR						
6.6.1	A student who maintains or fails to maintain the minimum prescribed GPA/OPGA at the end of I semester of an Academic year shall not be promoted to the II semester of that Academic year.						
6.6.2	A student who maintains the minimum prescribed GPA/OGPA 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) and Ph.D.] in any course will be declared to have passed that Academic year and will be promoted to the next Academic year.						
6.6.3	Ph.D. students(s) admitted in the second semester will be promoted to the next semester on the basis of his / her performance in the Semester of admission.						
6.7	Repeat Examination						
A repeat examination will be held for both the odd and even semesters before the commencement of mid term examinations of their successive semester 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 will be required to produce valid reasons for the absence. Those students who have not allowed appearing in end term exam due to short attendance or any other reason in the semester must have to register themselves for the said End Term							

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	Examinations. Then only, he/she can be eligible for repeat examination otherwise declared fail in that academic year.			
6.7.1	The weightage of the Repeat examination will be as under:			
	PARTICULARS OF COURSE	EXAMINATION		
		THEORY	PRACTICAL	
		Theory + Practical course	70%	30%
		Theory only	100%	--
	Practical course only	100%	
6.7.2	The grade obtained in repeat examination by the students will be the final for the computation of GP/OGPA, with remark "R"(repeat) on the transcript.			
6.7.3	There will be a provision of only one repeat exam for each semester.			
6.7.4	In case a student appearing in the repeat examination vice clause 6.7.3 supra fails to obtain the minimum prescribed GP/GPA/OGPA he/she will be declared to have failed in the class where studying.			
6.7.5	The repeat examination will also be evaluated as provided under clause 6.7.1.			
6.8	TRANSCRIPT OF A STUDENT			
	<p>The transcript of a student will indicate:</p> <p>(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.</p> <p>(ii) A transcript will be issued for each of the semesters.</p> <p>(iii) Successive transcripts will carry forward the GPA/OGPA unto the last semester. A combined transcript will be issued after the completion of the degree programme.</p> <p>(iv) The status of a re-admitted student will be indicated on the transcript as Re-admitted in the semester where re-admitted.</p> <p>(v) The result will be indicated as: PASSED / FAILED / PROMOTED as may be applicable.</p> <p>(vi) Course/courses repeated by candidates will be indicated by a suffix "(R)".</p> <p>(vii) The transcripts will carry the following formula for the conversion of OGPA into percent marks:</p> <p style="text-align: center;">% Marks = OGPA X 10</p>			
6.9	MERIT OF A STUDENT			
6.9.1	The merit will be decided on the basis of OGPA obtained.			
6.9.2	Students having same OGPA will be bracketed together.			
6.9.3	A student who has improved his/her OGPA by repeating course/courses or by re-admission or by studying extra semester, over and above the minimum prescribed, will not be eligible for merit.			
6.9.4	A student who has dropped a semester will also not be eligible for merit.			

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

7.0	ADVISORY COMMITTEE FOR M.Sc. (Ag.) STUDENTS
7.1	A student enrolled in Master's degree programme will be guided by an Advisory Committee comprising three members, two representing the major discipline and one representing the minor discipline.
7.1.1	The Supervisor of the candidate thesis, appointed by the Admission Committee of the Department concerned, will 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 will be nominated from such a discipline where the student is going to offer maximum credits.
7.1.2	FUNCTION OF THE ADVISORY COMMITTEE
	The Advisory Committee will guide the student in the choice of courses in the major, minor disciplines, supporting courses and selection of suitable research problem for thesis and in all other matters relating to his/her academic activities.
7.1.3	The details of the programme of work prepared by the Advisory Committee will be submitted to Head of the Department for onward transmission to the Controller Examinations before the end of each Semester.
7.2	THESIS SUPPLICATION
7.2.1	A M.Sc. (Ag.) student will submit his/her thesis towards the end of the fourth semester.
7.2.2	A student submitting his/her thesis after the stipulated date will be required to register in the current semester with ZERO credits and pay full semester fees.
7.2.3	A student who submits his/her thesis after completion of fourth semester (vice clause 7.3.1 supra) shall be awarded degree of the academic session in which he/she submitted the thesis.
7.2.4	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.
7.2.5	The thesis will be submitted loose-bound initially which will be hard-bound after the viva-voce examination.
7.4	THESIS EVALUATION
7.4.1	APPOINTMENT OF EXAMINER(S)
	The M.Sc. (Ag.) thesis will be evaluated by the Chairman of the Advisory Committee along with the members of Advisory Committee and One External Examiner. The name of External Examiner will 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.
7.4.2	The examiners will give a detailed report on the thesis making a clear recommendation whether "Accepted / Rejected / To be Revised".
7.4.3	In case the proposed external examiner rejects the thesis it will be sent to another examiner on panel, whose report will be final.
7.4.4	In case the any examiner recommends revision, the revised thesis will be sent to the same examiner for final recommendation (if he had demanded so in his

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	Evaluation Report).
7.4.5	Re submission will be permitted once only.
7.5	In case the thesis reports are "Satisfactory", viva-voce examination will be conducted only when he/she has successfully completed all the examinations and obtained required grades as per clause 6.5. The viva-voce examination will be conducted by the members of the Advisory Committee and the External Examiner who has evaluated the thesis. The examiners will submit a comprehensive viva-voce report making clear recommendation whether "Satisfactory/Unsatisfactory".
7.5.1	In case the External Examiner who has evaluated the thesis declines to conduct the viva-voce examination, it will be conducted by the members of the Advisory Committee and another external examiner from the panel appointed by the Board of Examiners of the Department.
7.5.2	In case the viva-voce report is "Unsatisfactory" the repeat viva-voce examination will be conducted as per clause 7.5 after a lapse of 1 (one) weeks from the last viva-voce examination.
7.5.3	In case the student fails again (7.5.2) he/she will be declared "Failed" and removed from the rolls of the Institute.
7.6	DECLARATION OF RESULT
	The final result of an M.Sc. (Ag.) student will only be declared when he/she has successfully completed all the requirements.

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ORDINANCES GOVERNING SPECIAL EXAMINATIONS AND RESEARCH WORK OF Ph.D.

8.0	RESEARCH COMMITTEE																		
8.1	<p>Subject to the general superintendence of the Academic Council, the following Committees will deal with all matters connected with the Ph.D. programme of the University in accordance with these ordinances:</p> <p>a) the Research Degree Committee of the University (RDCU/PGRC)/PGRC b) the Departmental (DRC) c) The Research Programme Committee (RPC)</p>																		
8.2	<p>The RDCU/PGRC will consist of the following;</p> <table border="0"> <tr> <td>i) The Vice-Chancellor</td> <td>Chairman</td> </tr> <tr> <td>ii) The Rector (if any)</td> <td>Member</td> </tr> <tr> <td>iii) The Director of the Institute (in case where the faculty is associated with an institute)</td> <td>Member</td> </tr> <tr> <td>iv) Dean of the faculty</td> <td>Member</td> </tr> <tr> <td>v) Heads of the Departments</td> <td>Member</td> </tr> <tr> <td>vi) Faculty members of the concerned DRC</td> <td>Member</td> </tr> <tr> <td>vii) Supervisor and Co-Spervisor (if any) of the concerned Ph.D. scholar</td> <td>Member</td> </tr> <tr> <td>viii) Emeritus Scientists/ Emeritus Professors/ Visiting Professors/ Honorary Professors/Adjunct Faculty (if any) in the concerned Faculty.</td> <td>Special Invitees</td> </tr> <tr> <td>ix) Registrar</td> <td>Secretary</td> </tr> </table> <p>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, will also be the members of the RDCU/PGRC.</p> <p>As the Secretary, the Registrar will convene all the meetings of the RDCU/PGRC.</p>	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	Member	vi) Faculty 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
i) The Vice-Chancellor	Chairman																		
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iii) The Director of the Institute (in case where the faculty is associated with an institute)	Member																		
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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																		
8.3	<p>The DRC will consist of the following:</p> <p>i) Head of the Department ii) All faculty members of the Department iii) One Associate Professor (on rotation as per seniority) + One Assistant Professor (on rotation as per seniority) of the Member Department, according to seniority, by rotation every two years. iv) Supervisor and Co-Supervisor (if any by invitation) 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</p>																		

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	will consist of the following:										
	<table border="1"> <tr> <td>(i)</td> <td>The Dean of the concerned Faculty</td> <td>Chairman</td> </tr> <tr> <td>(ii)</td> <td>All teachers of the Department</td> <td>Member</td> </tr> <tr> <td>(iii)</td> <td>A Senior teacher of a sister Department nominated by the Dean in consultation with the Head of the Department</td> <td>Member</td> </tr> </table>	(i)	The Dean of the concerned Faculty	Chairman	(ii)	All teachers of the Department	Member	(iii)	A Senior teacher of a sister Department nominated by the Dean in consultation with the Head of the Department	Member	
(i)	The Dean of the concerned Faculty	Chairman									
(ii)	All teachers of the Department	Member									
(iii)	A Senior teacher of a sister Department nominated by the Dean in consultation with the Head of the Department	Member									
	<p>viii) The DRC will appoint one of its members as Secretary and Convener.</p> <p>ix) The DRC will 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.</p> <p>x) In the case of Faculties consisting of a single department, a senior teacher of sister Faculty recommended by the Dean of the concerned Faculty will also be a member of the DRC.</p>										
8.4	<p>The RPC will consist of the following.</p> <table border="0"> <tr> <td>i) Supervisor of the concerned Ph.D. Scholar</td> <td>Chairman</td> </tr> <tr> <td>ii) Co-supervisor (if any) of the concerned Ph.D. Scholar</td> <td>Member</td> </tr> <tr> <td>iii) A nominee of the Chairman of DRC</td> <td>Member</td> </tr> <tr> <td>iv) One expert in the field from the Department/School</td> <td>Member</td> </tr> <tr> <td>v) One or two experts from outside Department/School of the Faculty</td> <td>Member(s)</td> </tr> </table> <ul style="list-style-type: none"> • Experts mentioned in Clauses 8.4 (iv) and (v) above will be nominated by the supervisor of the candidate and approved by the DRC. • In the case of Faculties consisting of a single department, Clause 8.4 (v) will not be applicable. • A teacher who is not eligible to guide a Ph.D. scholar as per Clause 9.1 (a) or due to not satisfying the conditions laid down in Clause 9.1 (d) read with Clause 9.1 (k) or the one referred under Clause 9.1 (c) of these ordinances cannot become a member of any of the research committees mentioned above. • The DRC and RPC will not make any recommendation that is not in conformity with these ordinances and/or such other directives as may be issued by the RDCU/PGRC and/or the Academic Council in regard to the Ph.D. programme from time to time. 	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/School	Member	v) One or two experts from outside Department/School of the Faculty	Member(s)
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/School	Member										
v) One or two experts from outside Department/School of the Faculty	Member(s)										

9.0	GUIDELINES FOR APPOINTMENT OF SUPERVISOR / CO-SUPERVISOR
9.1	<p>Appointment of Supervisors and Co-Supervisors:</p> <p>(a) Every candidate, after admission to the Ph.D. programme (payment of Fee) will be assigned a Research Supervisor, by the DRC of the concerned Department. The DRC may, if necessary, assign a Co-Supervisor, in the same</p>

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- (b) The external part-time research scholar will 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 will 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 **after completion of course 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 will be appointed as an external supervisor by the concerned DRC.
- (d) The permanent Professor of the University regular Associate/Assistant Professor of the University with at least two research publications in refereed journals 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 if approved by the university.
- (f) Scientists/Scientific Officers/Research Officers/Research Fellows, who are appointed for a period of not less than 5 years under research projects in the University and who hold Ph.D. degree will 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) Research, Academic and Non-Academic Officers of the University, who hold Ph.D. degree, may also be considered for appointment as Co-supervisors of Ph.D. scholars provided the professional qualification and experience of such officers is found to be academically relevant to the research area of the Ph.D. scholar by the concerned DRC.
- (h) 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 will 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.
- (i) Professors Emeritus/Distinguished Professor/UGC Scientists/Fellows appointed by the University or any national organization, will be eligible to guide Ph.D. scholars, provided their tenure of appointment left in the University as emeritus professor/scientist/fellows is for a period not less than two years at the time of enrolment of research scholar(s).

- (j) A faculty member on retirement may continue to be the supervisor, if he/she is reemployed or appointed as Professor Emeritus/Distinguished Professor/UGC Scientist/Fellow on retirement.
- (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) The teachers of the University, **who do not possess the doctoral degree and/or who have enrolled as Ph.D. scholars** in the University or in any other Institute/University, **will 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.
- (n) 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 will 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, will be governed by the ordinances of the faculty / department to which he/she is transferred.

9.2

Quota of Ph.D. Scholars

- (a) The maximum number of full time candidates who can be supervised by a faculty member at any time will 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 will be counted towards the quota of both the supervisor and the co-supervisor.
- (c) All full time research scholars registered for Ph.D. will be counted within the quota till they submit their theses or their registration term or period is exhausted.
- (d) A faculty member can supervise a maximum number of two external candidates at any time and it will 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 will 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 will be same as that allotted to a Professor.
- (g) The teachers of the University will also be permitted to guide Ph.D. Scholars

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	<p>admitted in other Universities, provided that</p> <p>(i) there is a vacancy with the guide under whom the candidate intends to work</p> <p>(ii) the sponsoring university seeks prior permission in the matter and</p> <p>(iii) the concerned DRC approves it.</p>
9.3	<p>Appointment of a New Supervisor:</p> <p>(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 will 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 will be required.</p> <p>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.</p> <p>(b) If the supervisor of a candidate expires or is terminated from the University service, he/she will cease to be the supervisor.</p> <p>(c) If the supervisor of a candidate is placed under suspension, he/she will cease to be the supervisor during the entire period of his/her suspension.</p> <p>(d) If a teacher, except for the one governed by the Clauses 9.1 (h), (i) and (j), retires/resigns from the University service, he/she will cease to be the supervisor.</p> <p>(e) In all the cases, where the existing supervisor of a candidate ceases to be the supervisor, the DRC will 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 will appoint a new supervisor.</p> <p>(e) If a candidate, for cogent reasons, intends to change his/her supervisor, it will be permitted by the DRC by the mutual consent of present supervisor, proposed supervisor and the candidate.</p>
9.4	TIME PERIOD REQUIREMENTS
9.4.1	<p>Minimum period of research work required for the submission of thesis</p> <p>The minimum period of work required for submitting the thesis for the full-time candidates admitted to the Ph.D. programme will be as follows:</p> <p>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 will be three years or six semesters.</p> <p>NOTE: The aforesaid residence period will be calculated from the date of deposition of fees by the candidate at the time of admission.</p>
9.4.2	Maximum Period for the Submission of Thesis

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	<p>(a) If a candidate fails to submit the thesis at the end of the stipulated period as prescribed in Clause 9.4.1, 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 the thesis.</p> <p>(b) If a candidate fails to submit the thesis within the extended period as stipulated in Clause 9.4.2 (a) due to cogent reasons, he/she may be given additional one year 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 six years.</p> <p>(c) Under extraordinary circumstances, the RDCU/PGRC may grant a further extension of one years for the submission of the thesis, for which the candidate will 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 will be given under any circumstances.</p>
9.4.3	<p>Residency Period</p> <p>(a) A Ph.D. Scholar will be required to be present in the University for a prescribed period, which is known as the Residency Period.</p> <p>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 with minimum residence period (as stipulated before) subject to the condition that a candidate has to apply for no objection certificate from his/her employer and it will be routed through DRC.</p>
9.4.4	<p>The DRC may recommend a full-time Ph.D. scholar to pursue a part of his/her research work at a place outside 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 RDCU/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 these ordinances.</p>
9.5	Research Programme Committee (RPC)
9.5.1	The RPC will be constituted as per clause 8.0 of ordinance.
9.5.2	The DRC may also appoint a Co-Supervisor on recommendation of the Chairman of the Advisory Committee of the student.
9.5.3	FUNCTIONS OF THE RPC
	<p>The RPC of a Ph.D. student will:</p> <ol style="list-style-type: none"> Prescribe major, minor, supportive and remedial courses, Finalize research plan proposal of the research work, and. Guide the student in all matters related to his/her academic activities.
9.6	ALLOCATION OF STUDENTS TO A SUPERVISOR

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	Allocation of students to a supervisor for guiding thesis will 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.
9.6.1	QUOTA OF Ph.D. STUDENTS UNDER A SUPERVISOR Vide clause 9.2 (a) Quota of Ph.D. Scholars, of the Ph.D. Ordinance of the University.
9.6.2	VACANCY UNDER A SUPERVISOR
	A seat will 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.
9.7	REGISTRATION PERIOD and EXTENSION OF REGISTRATION PERIOD Vide clause 9.2 - Time period Requirements of Ph.D. Ordinance of the University.
9.8	Research Plan Proposal (RPP)
	Within 15 days from the date of the RPP seminar a student will submit six copies of a detailed RPP through his/her RPC to the Head of the Department. The RPP will be considered by the DRC including the Chairman of the RPC of the student. If the RPP is not approved, the candidate will 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 will be provided to the student and the supervisor.
9.8.1	Ordinarily a Ph.D. student will start his/her research work only after approval of the Thesis RPP.
9.8.2	Research Plan Proposal (a) At the end of the second semester the candidate will 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 will also indicate the topic of the research, although not necessarily the precise title of the thesis. (b) The RPC and the DRC will examine the research plan proposal of the candidate and the candidate will 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, will approve the proposal and the topic of research, and will 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 will 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 will be done. But, if only the seminar is unsatisfactory, the candidate will deliver only the seminar again within one month. 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 9.8.2 (d), the minimum residential period requirement of such a

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	candidate shall be extended by number of semesters in which the candidates research plan proposal and the RPP seminar are approved by the DRC not extending the stipulated period of residential requirement.
9.9	PROGRESS REPORT
9.9.1	<p>Progress Report:</p> <p>(a) The DRC and RPC will monitor the academic/research progress of each candidate. For this purpose, the candidate will 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.</p> <p>(b) The candidate will make presentation on the progress of his/her research work through a seminar and the RPC will evaluate the progress made by the candidate and submit its recommendations to the concerned DRC.</p> <p>(c) The Chairman of the DRC will forward the progress report with specific recommendations to the Registrar (Academic) with a copy to the Dean/Director.</p> <p>(d) Progress of a candidate in any semester will be deemed to be unsatisfactory if the candidate is absent for a period more than that specified in Clause 10.12.</p> <p>The candidate will submit progress reports for each semester till the submission of the thesis. The last progress report of the candidate will be submitted to Registrar (Academic), in the manner prescribed, within three days of submission of thesis.</p>
9.10	CHANGE OF TOPIC OF RESEARCH
9.10.1	MAJOR CHANGES
	In case of "major" change(s) the Ph.D. student will be required to submit a fresh RPP and deliver the RPP seminar again. The minimum residential requirement of six semesters for supplication for the thesis for such a candidate will be counted from the semester in which the revised RPP was approved. However, the maximum residential period will not exceed 14 semesters counted from the date of his/her admission.
9.10.2	MINOR CHANGE
	In case of a "minor" change the candidate may be allowed to continue research as planned earlier incorporating the change.
9.11	COMPREHENSIVE EXAMINATION
9.11.1	A student will be eligible to appear in the comprehensive examination as soon as he/she successfully completes his/her course requirements.
9.11.2	The comprehensive examination is applicable for Ph.D. candidate only and that also will be in the form of oral examined by an external examiner along with the RPC committee.
9.11.3	The external examiner will be appointed by the Dean from a panel of three names submitted by the Chairman of the RPC and approved by the D.R.C.
9.11.4	The examiners will submit a comprehensive report making clear recommendation as "Satisfactory/Unsatisfactory".
9.11.5	In case the performance of a student is judged "Unsatisfactory" he/she will be required to appear again, after a lapse of at least 12 weeks from the last oral

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	examination, which will be conducted vide clause 9.11.5 & 9.11.6.
9.12	THESIS PRE-SUBMISSION SEMINAR
9.12.1	This seminar will be delivered only after the completion of at least four semesters from the semester in which the synopsis seminar was delivered and only when the candidate has successfully completed his/her comprehensive examinations. This seminar will be based on the research work carried out by the candidate.
9.13	THESIS SUPPLICATION
9.13.1	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 will 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 will be attached at the end of the thesis. The evidence for submission/acceptance of the papers will be submitted to the Office of the Deputy Registrar (Academic) at the time of submission of thesis.
9.13.2	<p>A Ph.D. student will ordinarily supplicate his/her Ph.D. thesis within Six months form the date of the Pre- Submission Seminar. The Ph.D. student will submit:</p> <p>(a) 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 9.4.2), failing which he/she will be required to deliver a fresh pre- submission seminar.</p> <p>(b) The candidate will submit the thesis to the Registrar (Academic), duly forwarded by the Head of the Department. While submitting the thesis, the candidate will submit the following:</p> <ol style="list-style-type: none"> 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 Hindi or English language 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. <p>(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.</p> <p>(d) The candidate will 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 will be attached at the end of the thesis. The evidence for submission/acceptance of the papers will be submitted to the Office of the Registrar (Academic) at the time of submission of thesis.</p>

- (e) The candidate will 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 will have been submitted for the award of any other degree or diploma of any university.
- (g) The thesis will 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 will send the thesis/abstract to the office of the Controller of Examinations within one week working after the submission

9.14 THESIS EVALUATION

9.14.1 Panel of Examiners

- (a) The Supervisor will propose a panel of examiners of at least eight experts from within the Country in the area of the Ph.D. thesis for consideration of DRC immediately after the pre-submission seminar of the candidate. However, the supervisor will have the liberty to propose a panel of four foreign examiners, out of eight, if he considers appropriate.
- (b) The panel will not include the names of the supervisor and co-supervisor. In the case of a research scholar who has done any part of his/her work in another institution, the panel of examiners will not include any person working in that institution. The panel will not include the name/names of any person/persons with whom the candidate has published a research paper.
- (c) Complete and current addresses of all the examiners proposed in the panel with their e- mail addresses, telephone, mobile and/or FAX numbers will be provided by the Supervisor.
- (d) The Panel of Examiners shall be considered and approved by the concerned DRC. All the examiners as listed in the panel will be from the specific area of research work and if required, the DRC may modify the panel.
- (e) The Supervisor of the candidate/Chairman of DRC will obtain prior consent of all the members of the proposed panel of examiners with regard to inclusion of their names in the panel before forwarding it to the concerned Dean of the Faculty for appointment of Examiners.
- (f) Before forwarding the thesis/abstract to the Academic section of the University, the Head of the Department will ensure that the Board of Examiners has been constituted for the evaluation of thesis.

9.14.2 Board of Examiners

- (i) The Board of Examiners will consist of two examiners.
- (ii) The panel of Examiners duly approved by the DRC will 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) for records.
- (iii) The Dean of the concerned Faculty will communicate to the Controller of

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	<p>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 will 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 will also be endorsed to the Registrar (Academic) for records.</p>
<p>9.14.3</p>	<p>The Controller of Examinations will 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 will 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 will be completed within three days of receipt of soft copy of abstract.</p> <p>The examiner's consent via email may be accepted and thesis may be forwarded for the evaluation.</p> <p>If no information is received from an examiner within 15 days period from first communication to the examiner, a reminder will be issued. If, however, no information is received from an examiner within 30 days period from first communication to the examiner, his/her appointment will be cancelled and a new examiner will 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 will be appointed from the panel of names in accordance with the Clause 9.14.2.</p>
<p>9.14.4</p>	<p>Thesis Evaluation</p> <p>(a) The Controller of Examinations will 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 will be completed within three days of receipt of Thesis.</p> <p>(b) The examiners will be requested to submit their individual reports within one months of the receipt of the thesis.</p> <p>(c) In case, an examiner does not send his/her report within the above period, a reminder will be sent to him/her over e-mail. This will be followed by a subsequent reminder after a fortnight.</p> <p>(d) In the event of the report not being received from the examiner within 8 weeks, his/her examinership will be cancelled and a new examiner will 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 will be appointed from the panel of names in accordance with the Clause 9.14.2.</p> <p>(e) The examiners will examine the thesis specifically with a view to judge whether the thesis is a piece of research work characterized by:</p> <p>(i) substantial contribution to the subject,</p> <p>(ii) a fresh approach towards interpretation of facts or theories, or</p>

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	<p>(iii) Evidence of creativity and originality.</p> <p>(f) The examiner will be required to give his/her opinion about candidate's ability for critical examination and sound judgment.</p>
9.14.5	Examiner's Report
	<p>(a) The examiners will submit the report on a prescribed form as given in <i>Annexure - E(1)</i>, and will make one of the following recommendations:</p> <p>i) The thesis be accepted for the award of the Ph.D. degree.</p> <p>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.</p> <p>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 will specifically mention whether the thesis must be referred back to him/her for re- evaluation or not.</p> <p>iv) The thesis be rejected.</p> <p>(b) If both the examiners recommend acceptance of the thesis for the award of the Ph.D. degree, the thesis will be accepted.</p> <p>(c) If both the examiners recommend rejection of the thesis for the award of the Ph.D. degree, the thesis will be rejected.</p> <p>(d) If the examiner(s) raise some queries/seek clarifications, the candidate will be required to give satisfactory answers to the queries at the time of Viva-Voce.</p> <p>(e) If one or both the examiners recommend revision of the thesis, the candidate will resubmit the thesis after revision. If a specific examiner asks for the revised thesis to be referred back to him/her, it will be sent to him/her. Otherwise the revised thesis will be assessed by the DRC for satisfactory compliance of the desired revision.</p> <p>(f) If the revised thesis is to be referred back to an examiner, the examiner will submit his/her report on a prescribed form as given in <i>Annexure - E(2)</i>. The examiner will recommend the revised thesis to be either accepted or rejected. Then depending on the recommendation of the other examiner, an appropriate action will be taken as per Clauses 8.13.5 (c), (d), (e), (f) or (h).</p> <p>(g) If one examiner recommends rejection of the thesis and the other recommends acceptance, then a third examiner will be appointed as per Clause 9.14.2 from the panel of already approved examiners. In such cases, Clause 9.14. 5 (i) will apply.</p> <p>(h) The third examiner, if appointed, will 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, will become null and void for all purposes.</p> <p>(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</p>

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	<p>mentioned in Clauses 9.14.5 (c), (e) or (f) will be taken.</p> <p>In case the third examiner recommends the rejection of the thesis, his/her recommendation will be final and the thesis will be rejected.</p>
9.14.6	<p>In the case of any ambiguous recommendations by any examiner, the Controller of Examinations will approach the examiner concerned for a clear recommendation. If a clear recommendation is not forthcoming the matter will be referred to the Vice-Chancellor for his/her decision.</p>
9.14.7	<p>After the reports from both the examiners are received, the Controller of Examinations will inform the supervisor and co-supervisor (if any) for appropriate action.</p>
9.14.8	<p>VIVA-VOCE EXAMINATION</p> <p>Viva-Voce of the Ph.D. Ordinance of the University except that the Viva-Voce Board will consist of</p> <ol style="list-style-type: none"> The RPC One External Examiner D.R.C. Nominee <p>The Supervisor of the thesis will be Chairman of the Viva-Voce Board.</p> <p><u>Viva-Voce</u></p> <ol style="list-style-type: none"> If the thesis has been accepted for the award of the degree, the candidate will 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 will be adequately notified so as to enable other faculty members and students to attend it. The supervisor and the co-supervisor (if any), will 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 (VVC). The VVC will 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 will be the chairman of the VVC. In the case of external candidates, the external supervisor and co-supervisor, if any, may be invited for the Viva-Voce as examiner(s). In the case of non-availability of the Indian Examiner for conducting the Viva-Voce, the Vice-Chancellor may appoint another examiner. 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 will arrange to conduct the Viva-Voce. In such cases, the Ph.D. work will be deemed to have been carried out under the guidance of the original Supervisor/Co-Supervisor only. The VVC will be provided with the reports of all the examiners before the Viva-Voce. The VVC will submit a comprehensive report on the performance of the candidate at the Viva-Voce, including the discussions over various points raised. The VVC will recommend one of the following: <ol style="list-style-type: none"> that the degree be awarded,

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	<p>ii) that the candidate be re-examined in a second Viva-Voce, iii) that the degree be not awarded and the thesis be rejected.</p> <p>(i) If the VVC recommends that the degree be awarded, the candidate will 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.</p> <p>If the VVC recommends for a second Viva-Voce, it will be conducted normally after a period of three months but within six months from the date of the first Viva-Voce.</p> <p>(k) 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 will be conducted via online or offline mode (whichever is suitable).</p>
9.14.9	<p>Review of Examiners" Report in case the Thesis is Rejected</p> <p>The Vice-Chancellor will have the power to constitute an independent three-member review panel to investigate the cause of rejection of thesis. The review panel will 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 these Ordinances.</p>
9.14.10	<p>Award of the Degree</p> <p>a) The reports of all the examiners and the Viva-Voce examination will be placed before the concerned RDCU/PGRC for consideration. In the case of unanimous recommendations, the RDCU/PGRC will 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 RDCU/PGRC will take its specific decision based on the reports of the examiners as well as the VV examination.</p> <p>b) After the approval of thesis by the RDCU/PGRC for the award of the degree, the provisional degree will be issued to the candidate by the Controller of Examinations for which the candidate will 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 will apply separately. However, the examiners" reports in case of thesis rejected by examiners will be treated as confidential document and will not be disclosed.</p> <p>c) The year of award of the Ph.D. degree will 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 will be the year of submission of revised thesis.</p>

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	<p>d) The Ph.D. degree certificate will 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/ School/Centre in which the candidate was admitted for the Ph.D. programme.</p> <p>e) After the approval of the thesis for the award of the degree, the abstract will be published in the “Abstracts of Accepted Theses for the Ph.D. Degree” of the University.</p> <p>Once a thesis has been approved for the award of the Ph.D. degree, the candidate will, 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.</p>
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ORDINANCES DEFINING OTHER TERMS

10.0	ACADEMIC YEAR
	The Academic year will be divided into two (2) semesters of approximately 120 working days each including examinations.
10.1	FEEES
	Students will pay fees as prescribed by the University from time to time.
10.2	COURSES/ DISCIPLINES
10.2.1	MAJOR DISCIPLINE
	The particular course in which a student is enrolled will be his/her major discipline.
10.2.2	MINOR DISCIPLINE
	A related discipline other than the major discipline in which a student offers at least six credits of courses will constitute his/her minor discipline.
10.2.3	CORE COURSE
	Compulsory course prescribed for all the students of the Major Discipline.
10.2.4	OPTIONAL COURSE
	Courses of the Major discipline that a student can elect on the advice of the RPC.
10.2.5	<p>i. MINOR COURSES Courses of sister discipline that a student admitted to a Major Discipline can elect on the advice of the RPC.</p> <p>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.</p>

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10.2.6	OFFERING OF THE SAME COURSE : A student cannot offer the same course again in any degree programme unless failed.
10.2.7	ADDITIONAL COURSE M.Sc.(Ag.)/ Ph.D. student may be advised to take additional courses to make up any deficiency. Such a course will be called as Additional Course. The grades awarded in such courses will not be considered for the calculation of GPA/OGPA. However, the student will be required to pass the course. The Additional Courses offered will appear in their transcript under the title 'Additional Course'.
10.3	REGISTRATION
10.3.1	REGISTRATION IN A SEMESTER The students will be required to pay their fees within 5 days of the admission.
10.3.2	REGISTRATION IN A COURSE The students of M.Sc. (Ag.) / Ph.D. will be required to register for course/courses within 3 days of the start of the semester.
10.4	CANCELLATION OF ADMISSION/REGISTRATION OF A M.Sc.(Ag.)/ Ph.D. STUDENT The Admission of a student is liable to be cancelled by an Act of Indiscipline as per University rules on the occurrence of any one of the following: i. If he/she fails to deposit fees within 10 days of the start of the semester. ii. If he/she fails to attend classes, and absents continuously for 10 days or more without permission. iii. If a M.Sc. (Ag.)/Ph.D student fails to register in any course / thesis credits within stipulated period of 10 days in any of the semester(s) unless he/she has dropped that semester(s). iv. If the attendance of a M.Sc. (Ag.) student is less than 25% in any semester. v. If the two consecutive progress reports of a Ph.D. student are not satisfactory, or not submitted at all or his/her attendance is less than 75% in any semester / term.
10.5	ABSENCE FROM EXAMINATION A candidate who fails to appear at any of the examinations will be marked absent and awarded ZERO mark in the Examination/s.
10.6	RE-ADMISSION Students who have failed to maintain the minimum prescribed GP/GPA/OGPA or who have been detained from appearing in the examination due to shortage of attendance may be readmitted (provided the attendance is more than 25%) on application, if otherwise eligible. A student can be re admitted only once in the same class.
10.6.1	RE ADMISSION OF A FAILED STUDENT A post graduate student (M.Sc. (Ag.)/ Ph.D.) may be readmitted in the same semester where he/she failed. He/She will be required to complete the degree programme within _____ identical period prescribed to be counted from the date of

	In case a re-admitted student (readmitted on failure or after detention) fails again at the end of each semesters in the main as well as in the repeat examinations, he/she will be removed from the rolls of the Institute.
10.6.2	READMISSION OF A STUDENT DETAINED FROM APPEARING IN EXAMINATIONS
	Students having at least 25% attendance in aggregate may be readmitted on application. Those having less than 25% attendance will not be eligible for readmission. A M.Sc. (Ag.)/Ph.D. student may be readmitted in the current semester.
10.7	DROPPING OF A COURSE
	A M.Sc. (Ag.)/Ph.D. student with approval of his/her supervisor and the Head of the Department may drop a course within 15 days of registration (shall be mentioned in academic calender).
10.8	TEMPORARY WITHDRAWAL FROM STUDIES
	<p>The Dean may allow temporary withdrawal to a student on any one of the following :</p> <ul style="list-style-type: none"> (i) Illness of self to be supported by medical certificate; (ii) Death of parent/ Guardian or in the case of married student, the spouse or children. (iii) Any extra-ordinary condition where the Vice Chancellor at his discretion approve so. (iv) Temporary withdrawal will only be allowed after the completion of minimum prescribed residential period (for Ph.D.) for taking up any employment during the course programme. A M.Sc. (Ag.) 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 comprehensive examination, provided his/her application has been approved and forwarded by the RPC and D.R.C. <p>Other Conditions</p> <ul style="list-style-type: none"> (i) A student who has been allowed temporary withdrawal will complete his/her degree programme within the prescribed maximum registration period. (ii) 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) will not be refunded. (iii) A M.Sc.(Ag.)/Ph.D. student will have an option to join in the current semester. (iv) All such students who have been granted temporary withdrawal will join within five (5) days of the start of the semester. (v) A M.Sc. (Ag.) student will submit his/her application through his supervisor and the Head of the Department whereas a Ph.D. student will submit his/her application through the Supervisor RPC and DRC.

10.9	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.
10.10	UNFAIR MEANS
	Students found using unfair means during any examination will be punished as per the University Ordinances applicable at that time.
10.11	ATTENDANCE REQUIREMENT
	As per University rules
10.12	LEAVE OF A RESEARCH STUDENT
10.12.1	Leave Rules
	(a) A Ph.D. scholar will be eligible to avail a leave of 30 days in an academic year. He/she will 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. Further, male/female candidates will be eligible for paternity/maternity leaves as per University rules once during their entire tenure as research scholars.
	(b) The leave will be granted by the Head of the Department on the recommendation of the supervisor/co-supervisor.
10.12.2	LEAVE OF ABSENCE ON RESEARCH ASSIGNMENT
	After the approval of his/her synopsis a Ph.D. student may be allowed leave of absence for those many days in a semester recommended by the RPC and DRC for carrying out research related work outside University. This period will be counted while calculating his/her attendance. The student will submit his/her application to the Head of the Department through his/her RPC.
10.13	CONDUCT OF VIVA-VOCE (ORAL) EXAMINATION IN THE ABSENCE OF CHAIRMAN OF THE ADVISORY COMMITTEE / RPC.
10.13.1	In the absence of the Chairman the Viva-voce (Oral) examinations of M.Sc. (Ag.) and Ph.D. students will be conducted under the Chairmanship of Co-supervisor, if any or the Head of the Department with prior permission of the competent authority (The Dean/Director).
10.13.2	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).
10.14	TITLE OF THE DEGREES
	The degrees to be awarded after the successful completion of various courses will have the following titles.
10.14.1	Master of Science (Agriculture) Entomology
10.14.2	DOCTOR OF PHILOSOPHY DEGREE will be awarded in the same subject as given under clause 10.14.1.
10.14.3	Specializations within a degree (M.Sc.(Ag.)/Ph.D.) may be indicated within the brackets suffixed after the degree.
10.15	COMMITTEES OF THE INSTITUTE / DEPARTMENT
10.15.1	INSTITUTE ADMISSION COMMITTEE
	The Admission Committee will comprise the following:

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	i. Director ----- Chairman ii. Dean ----- Member iii. Two Senior Most Teachers ----- Member iv. S.C. Representative ----- Member v. S.T. Representative ----- Member vi. O.B.C. Representative ----- Member vii. Dy. Registrar ----- Secretary
10.15.2	ADMISSION COMMITTEE OF THE DEPARTMENT
	The Admission Committee will comprise the following: i. Head of the Department ----- Chairman ii. Two Senior Most Teachers ----- Member iii. S.C. Representative ----- Member iv. S.T. Representative ----- Member v. O.B.C. Representative ----- Member vi. A permanent teacher to be co-opted on rotation basis to act as Secretary of the Committee.
10.15.3	BOARD OF EXAMINERS OF THE DEPARTMENT
	The Board of Examiners will comprise the following: i. Head of the Department ----- Chairman ii. Two Senior Most Teachers ----- Member
Note:	
<p><i>From the date when these Ordinances come into operation all previous ordinances on the subject will cease to have effect. Provided that this revocation will 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.</i></p> <p>Notwithstanding anything contained in these Ordinances, any question which is not covered by these Ordinances or any difficulty arising out of these Ordinances, will be dealt with by the Academic Council.</p>	

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FORMAT FOR THE PRESENTATION AND APPROVAL OF RESEARCH PLAN PROPOSAL

This is to certify

(a) that Sri/Ms, a bonafide research scholar of this department, has given a detailed seminar on his Research Plan Proposal before the RPC and DRC as detailed below:

Topic:

Date/Time:

- (b) that his/her Research Plan Proposal has been examined in view of academic merit and that the RPC and DRC is satisfied/not-satisfied by the content and quality of Proposal,
- (c) that his/her presentation was excellent/good/satisfactory/not-satisfactory and that he/she was able/unable to defend the proposal and answer he proposal related questions,
- (d) that he/she is allowed/not-allowed to submit the Research Plan Proposal.

In case of unsatisfactory Proposal/presentation following suggestions are given by the RPC and DRC:

Date:

Place:

(Signature of Head of Department
/Coordinator of School/Centre)

Signature of RPC Members

Signature of DRC Members

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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. Chapters covering the work of the candidate
15. Conclusion
16. References
17. Appendices
18. List of papers communicated/accepted/published/presented.
19. Copies of acknowledgment/acceptance letter in case the papers are communicated/accepted.
20. Copies of manuscripts/reprints of the papers communicated/accepted/published.
21. 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/Coordinator of the School with seal)


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Anurag Singh





ANNEXURE - C

COURSE/COMPREHENSIVE EXAMINATION/PRE-SUBMISSION
SEMINAR COMPLETION CERTIFICATE

This is to certify

- (a) that Sri/Ms , a bonafide research scholar of this department, has satisfactorily completed the Ph.D. course work and has been successful in comprehensive examination,
- (c) That his/her open Ph.D. thesis Pre-Submission seminar on (topic)..... was held on (date). In the department from (time).
- (d) that the DRC is satisfied/not-satisfied with the quality of the work of candidate,
- (e) 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,
- (f) 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

Coordinator of School/Centre)

Signature of DRC Members

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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.

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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.

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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

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Encl: Detailed report on separate sheet(s).

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11. ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

11.1 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.

11.2 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.

11.3 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. Six courses (PGS 501-PGS 506) 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

Subject	Master's programme	Doctoral programme
Major	20	12
Minor	08	06
Supporting	06	05
Common Compulsory Courses (PGS)	05	-
Seminar	01	02
Comprehensive Exam	-	Non-Credit Course
Thesis/Research	30	75
Total Credits	70	100
Compulsory Non Credit Courses	See relevant section	

CREDIT REQUIREMENTS
for
M.Sc. (Ag.) ENTOMOLOGY

Framework of the courses:

The following nomenclature and credit hours have been followed while preparing the syllabus:

Masters' Programme		
(i)	Course work	Credit Hours
	Major Courses	20
	Minor Courses	08
	Supporting Courses	06
	Common Courses (PGS)	05
	Seminar	01
(ii)	Thesis Research	30
	Total Credit Hrs.	70

A. MAJOR COURSE		
Course Code	Course Title	Credit Hours
Core Courses		
		3 (2+1)
ENT-501*	Insect Morphology	3 (2+1)
ENT-502*	Insect Anatomy and Physiology	3 (1+2)
ENT-503*	Insect Taxonomy	3 (2+1)
ENT-504*	Insect Ecology	3 (2+1)
ENT-505*	Biological Control of Insect Pests and Weeds	3 (2+1)
ENT-506*	Toxicology of Insecticides	3 (2+1)
ENT-508*	Concepts of Integrated Pest Management	2 (2+0)
ENT-509*	Pests of Field Crops	3 (2+1)
ENT-510*	Pests of Horticultural and Plantation Crops	3 (2+1)
ENT-511*	Post-Harvest Entomology	2 (1+1)
Optional Courses		
ENT-507	Host Plant Resistance	2 (1+1)
ENT-512	Insect Vectors of Plant Pathogens	2 (1+1)
ENT-513	Principles of Acarology	2 (1+1)
ENT-514	Vertebrate Pest Management	2 (1+1)
ENT-515	Techniques in Plant Protection	1 (0+1)
ENT-516	Apiculture	3 (2+1)
ENT-517	Sericulture	3 (2+1)
ENT-518	Lac Culture	3 (2+1)
ENT-519	Molecular Approaches in Entomology	3 (2+1)
ENT-520	Plant Quarantine, Biosafety and Biosecurity	2 (2+0)
ENT-521	Edible and Therapeutic Insects	2 (1+1)
ENT-522	Medical and Veterinary Entomology	2 (1+1)
ENT-523	Forest Entomology	2 (1+1)
Master's Seminar and Research		
ENT-591	Master's Seminar	1 (0+1)
ENT-599	Master's Research	30 (0+30)
*Compulsory Major Courses		

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B. MINOR COURSE		
Course Code	Course Title	Credit Hours
PL PATH-501	Mycology	3(2+1)
PL PATH-502	Plant Virology	3(2+1)
PL PATH-503	Plant Pathogenic Prokaryotes	3(2+1)
PL PATH-504	Plant Nematology	3(2+1)
PL PATH-505	Principles of Plant Pathology	3(2+1)
PL PATH-506	Techniques in Detection and Diagnosis of Plant Diseases	2(0+2)
PL PATH-507	Principles of Plant Disease Management	3(2+1)
PL PATH-508	Epidemiology and Forecasting of Plant Diseases	1(1+0)
PL PATH-509	Disease Resistance in Plants	2(2+0)
PL PATH-510	Ecology of Soil-borne Plant Pathogens	2(1+1)
PL PATH-511	Chemicals and Botanicals in Plant Disease Management	3(2+1)
PL PATH-512	Detection and Management of Seed Borne Pathogens	3(2+1)
PL PATH-513	Biological Control of Plant Diseases	2(1+1)
PL PATH-514	Integrated Disease Management	3(2+1)
PL PATH-515	Diseases of Field and Medicinal Crops	3(2+1)
PL PATH-516	Diseases of Fruits, Plantation and Ornamental Crops	3(2+1)
PL PATH-517	Diseases of Vegetable and Spices Crops	3(2+1)
PL PATH-518	Post-Harvest Diseases	3(2+1)
PL PATH-519	Plant Quarantine and Regulatory Measures	1(1+0)

C. SUPPORTING COURSE		
Course Code	Course Title	Credit Hours
STAT-501	Mathematics for Applied Sciences	2(2+0)
STAT-502	Statistical Methods for Applied Sciences	4(3+1)
STAT-511	Experimental Designs	3(2+1)
STAT-512	Basic Sampling Techniques	3(2+1)
STAT-521	Applied Regression Analysis	3(2+1)
STAT-522	Data Analysis Using Statistical Packages	3(2+1)
MCA-501	Computers Fundamentals and Programming	3(2+1)
MCA-502	Computer Organization and Architecture	2(2+0)
MCA-511	Introduction to Communication Technologies, Computer Networking and Internet	2(1+1)
MCA-512	Information Technology in Agriculture	2(1+1)
BIOCHEM-501	Basic Biochemistry	4(3+1)
BIOCHEM-505	Techniques in Biochemistry	4(2+2)

D. COMMON COMPULSORY COURSES (PGS)		
Course Code	Course Title	Credit Hours
PGS-501	Library and Information Services	1(0+1)
PGS-502	Technical Writing and Communications Skills	1(0+1)
PGS-503	Intellectual Property and its management in Agriculture	1(1+0)
PGS-504	Basic Concepts in Laboratory Techniques	1(0+1)
PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes	1(1+0)

M.SC. (AG.) ENTOMOLOGY
SEMESTER WISE COURSE DISTRIBUTION

Note:

- (i) The ideal semester wise course distribution is given below.
- (ii) Students may opt for any course (as mentioned under ICAR's Agriculture and Allied Sciences Volume-1/ Restructured and Revised Syllabi of Post-graduate Programmes-2021) with the permission and approval of Ad(Major Discipline/Department) for fulfilling their requirements for minor, supporting and common compulsory courses (PGS) which are subsequently running under other departments of the institute or faculties of the university at the consequent odd or even semester.
- (iii) The detail syllabus of all the courses can be referred from the ICAR's Agriculture and Allied Sciences Volume-1/ Restructured and Revised Syllabi of Post-graduate Programmes-2021.

Course Code	Subject	Course Credit
First Semester (I)		
ENT-501*	Insect Morphology	3 (2+1)
ENT-502*	Insect Anatomy and Physiology	3 (2+1)
ENT-503*	Insect Taxonomy	3 (1+2)
	(Supporting Course I)*	-
	(Minor Course I)	-
	Common Compulsory Courses (PGS I)	-
	Common Compulsory Courses (PGS II)	-
ENT-599	Master's Research	1 (0+1)
Second Semester (II)		
ENT-504*	Insect Ecology	3 (2+1)
ENT-505*	Biological Control of Insect Pests and Weeds	3 (2+1)
ENT-508*	Concepts of Integrated Pest Management	2 (2+0)
	(Supporting Course II)*	-
	(Minor Course II)	-
	Common Compulsory Courses (PGS III)	-
	Common Compulsory Courses (PGS IV)	-
ENT-599	Master's Research	2 (0+2)
Third Semester (III)		
ENT-506*	Toxicology of Insecticides	3 (2+1)
	(Minor Course II)	-
	Common Compulsory Courses (PGS V)	-
ENT-599	Master's Research	11 (0+11)
Fourth Semester (IV)		
ENT-591	Master's Seminar	1 (0+1)
ENT-599	Master's Research	16 (0+16)

***Compulsory courses**

A sample in fulfillment of ideal semester wise course distribution and its syllabus is given below:

Course Code	Subject	Course Credit
First Semester (I)		

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ENT-501*	Insect Morphology	3 (2+1)
ENT-502*	Insect Anatomy and Physiology	3 (2+1)
ENT-503*	Insect Taxonomy	3 (1+2)
STAT-502*	Statistical Methods (Supporting Course)	3(2+1)
MPP-507	Diseases of Field and Medicinal Crops (Minor I)	3(2+1)
PGS-501	Library and information services	1(0+1)
PGS-505	Agricultural research, research ethics and rural development programme	1(1+0)
Second Semester (II)		
ENT-504*	Insect Ecology	3 (2+1)
ENT-505*	Biological Control of Insect Pests and Weeds	3 (2+1)
ENT-508*	Concepts of Integrated Pest Management	2 (2+0)
STAT-511*	Experimental Designs (Supporting Course)	3(2+1)
MPP-508	Diseases of Fruits, Plantation and Ornamental Crops (Minor II)	3(2+1)
PGS-504	Basic concepts in laboratory techniques	1(0+1)
Third Semester (III)		
ENT-506*	Toxicology of Insecticides	3 (2+1)
MPP-509	Diseases of Vegetables and Spice Crops (Minor III)	3(2+1)
PGS-502	Technical writing and communication skills	1(0+1)
PGS-503	Intellectual property and its management in agriculture	1(1+0)
Fourth Semester (IV)		
ENT-591	Master's Seminar	1 (0+1)
ENT-599	Master's Research	30 (0+30)

COURSE CONTENTS/SYLLABUS IN MAJOR SUBJECT

ENT-501	Insect Morphology	3(2+1)
Aim of the course:		
To acquaint the students with the external morphology of the insect's body and the functioning of various body parts.		
Theory		
Unit I	External Morphology: Insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. Head- Origin, structure and modification; mouthparts, antennae, their types and functioning; tentorium and neck sclerites. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; legs: structure and modifications. Abdomen- Segmentation and appendages; genitalia and their modifications; embryonic and post-embryonic development.	
Unit II	Insect sense organs (mechano-, photo- and chemo- receptors); organogenesis at pupal stage; insect defense; chaetotaxy; morphological traits in relation to forensic entomology.	
Unit III	Types of immature stages in insect orders, morphology of egg, nymph/ larva and pupa, identification of different immature stages of crop pests and stored product insects. Comparative study of life history strategies in hemi-metabola and holometabola, immature stages as ecological and evolutionary adaptations, significance of immature stages for pest management.	
Practical		
<ul style="list-style-type: none"> Preparation of permanent mounts of different body parts and their appendages of taxonomic importance including male and female genitalia; 		

- Dissection of genitalia. Types of immature stages in insects; their collection, rearing and preservation;
- Identification of immature insects to orders and families, in endopterygote orders, viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key.

Learning outcome:

Students are expected to have a complete understanding of the comparative morphology of the external features of insects that can be utilized in taxonomy, ecology and applied entomology.

Suggested Reading

- Chapman RF. 1998. *The Insects: Structure and Function*. Cambridge Univ. Press, Cambridge.
- Chu HF. 1992. *How to Know Immature Insects*. William Brown Publication, Iowa.
- Duntson PA. 2004. *The Insects: Structure, Function and Biodiversity*. Kalyani Publishers, New Delhi.
- Evans JW. 2004. *Outlines of Agricultural Entomology*. Asiatic Publ., New Delhi.
- Gillott C. 1995. *Entomology*, 2nd Ed. Plenum Press, New York, London.
- Gullan PJ and Cranston PS. 2000. *The Insects, An Outline of Entomology*, 2nd Ed. Blackwell Science, UK.
- Peterson A. 1962. *Larvae of Insects*. Ohio University Press, Ohio.
- Richards OW and Davies RG. 1977. *Imm's General Text Book of Entomology*. 10th Ed. Chapman and Hall, London.
- Snodgrass RE. 1993. *Principles of Insect Morphology*. Cornell Univ. Press, Ithaca.
- Tembhore DB. 2000. *Modern Entomology*, Himalaya Publishing House, Mumbai.
- Stehr FW. 1998. *Immature Insects*. Vols. I, II. Kendall Hunt Publication, Iowa.

ENT-502		Insect Anatomy and Physiology	3(2+1)
Aim of the course:			
To impart knowledge about the anatomy and physiology of insect body systems; nutritional physiology; and their applications in entomology.			
Theory			
Unit I	Scope and importance of insect physiology; physiology of integument, moulting, chemistry of cuticle, biosynthesis of chitin; growth, hormonal control, metamorphosis and diapause; pheromone secretion, transmission, perception and reception.		
Unit II	Physiology and mechanism of digestion, circulation, respiration, excretion, reproduction, secretion (exocrine and endocrine glands) and nerve impulse transmission in insects.		
Unit III	Importance of insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.		
Practical			
<ul style="list-style-type: none"> • Latest analytical techniques for analysis of free amino acids of haemolymph; • Determination of chitin in insect cuticle; • Examination and count of insect haemocytes; preparation and evaluation of various diets; • Consumption, utilization and digestion of natural and artificial diets. 			
Learning outcome:			

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Students are expected to have a thorough understanding of insect growth and development, physiology of exoskeleton, endoskeleton and different organ systems; action and role of hormones, pheromones, physiology of nutrition and its application.

Suggested Reading

- Chapman RF. 1998. *The Insects: Structure and Function*. Cambridge Univ. Press, Cambridge.
- Chu HF. 1992. *How to Know Immature Insects*. William Brown Publication, Iowa.
- Duntson PA. 2004. *The Insects: Structure, Function and Biodiversity*. Kalyani Publishers, New Delhi.
- Evans JW. 2004. *Outlines of Agricultural Entomology*. Asiatic Publ., New Delhi.
- Gillott C. 1995. *Entomology*, 2nd Ed. Plenum Press, New York, London.
- Gullan PJ and Cranston PS. 2000. *The Insects, An Outline of Entomology*, 2nd Ed. Blackwell Science, UK.
- Peterson A. 1962. *Larvae of Insects*. Ohio University Press, Ohio.
- Richards OW and Davies RG. 1977. *Imm's General Text Book of Entomology*. 10th Ed. Chapman and Hall, London.
- Snodgrass RE. 1993. *Principles of Insect Morphology*. Cornell Univ. Press, Ithaca.
- Tembore DB. 2000. *Modern Entomology*, Himalaya Publishing House, Mumbai.
- Stehr FW. 1998. *Immature Insects*. Vols. I, II. Kendall Hunt Publication, Iowa.

ENT-503		Insect Taxonomy	3(1+2)
Aim of the course:			
To sensitize the students on the theory and practice of classifying organisms (with special reference to animals) and the rules governing the same. To introduce the students to the classification of insects up to the level of families with hands-on experience in identifying the families of insects with an emphasis on the practical aspects.			
Theory			
Unit I	History of insect classification; principles of systematics and its importance. Identification, purpose, methods character matrix, taxonomic keys. Descriptions- subjects of descriptions, characters, nature of characters, analogy v/s homology, parallel v/s convergent evolution, intraspecific variation in characters, polythetic and polymorphic taxa, sexual dimorphism. Brief evolutionary history of insects- introduction to phylogeny of insects and Classification of Superclass Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta- and the Orders contained. International Code of Zoological Nomenclature, Phylocode, its brief explanation and uses. Process of speciation and interbreeding allopatric species. Molecular systematics, DNA barcoding, karyological and biochemical approaches in taxonomy. Insect labeling protocols and procedures.		
Unit II	Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera – Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera.		

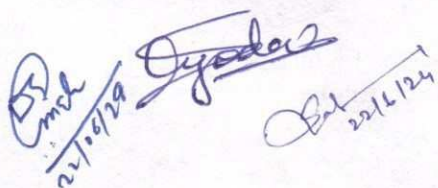
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Unit III	Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them (Continued). Division Neoptera – Subdivision Endopterygota, Section Neuropteroid- Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.
Practical	
<ul style="list-style-type: none"> • Study of Orders of insects and their identification using taxonomic keys; • Keying out families of insects of different major Orders: Odonata, Orthoptera, Blattodea, Mantodea, Isoptera, Hemiptera, Thysanoptera, Phthiraptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera; • Field visits to collect insects of different orders. 	
Learning outcome:	
Students are expected to know the evolution of arthropods, especially insects and other hexapods, and their hierarchical classification. Acquire working skills for collecting, mounting, and preserving insects. Understand the basic concepts of taxonomic hierarchy, identification, taxonomic characters, variations, taxonomic keys and preparation of taxonomic papers. Identify insects of economic importance up to family levels, taking up the insect orders of agriculture and veterinary importance	
Suggested Reading	
<ul style="list-style-type: none"> - CSIRO 1990. <i>The Insects of Australia: A Text Book for Students and Researchers</i>. 2nd Ed. Vols. - I and II, CSIRO. Cornell Univ. Press, Ithaca. - Freeman S and Herron JC. 1998. <i>Evolutionary Analysis</i>. Prentice Hall, New Delhi. - Gullan PJ and Cranston PS. 2010. <i>The Insects: An outline of Entomology</i>. 4th Ed. Wiley-Blackwell Publications, West Sussex, UK. - Mayr E. 1971. <i>Principles of Systematic Zoology</i>. Tata McGraw Hill, New Delhi. - Richards OW and Davies RG. 1977. <i>Imm's General Text Book of Entomology</i>. 10th Ed. Chapman and Hall, London. - Ross HH. 1974. <i>Biological Systematics</i>. Addison Wesley Publ. Company. - Triplehorn CA and Johnson NF. 1998. <i>Borror and DeLong's Introduction to the Study of Insects</i>. - 7th Ed. Thomson/ Brooks/ Cole, USA/ Australia. 	

ENT- 504	Insect Ecology	3(2+1)
Aim of the course:		
To teach the concepts of ecology, basic principles of distribution and abundance of organisms and their causes. Study life tables, constructing life tables, organization of communities, diversity indices. Train students in sampling methodology, calculation of diversity indices, relating insect population fluctuations to biotic and/ or abiotic causes.		
Theory		
Unit I	History and definition. Basic Concepts. Organisation of the Biological world. Plato's Natural Balance vs Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between the two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology.	
Unit II	Basic concepts of abundance- Model vs Real world. Population growth basic models-Exponential vs Logistic models. Discrete vs Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal	


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	yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies of insect life tables. Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) – aestivation, hibernation.
Unit III	Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions- Basic factors governing the interspecific interactions- Classification of interspecific interactions – The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of niche ecological homologues, competitive exclusion. Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies.
Unit IV	Community ecology- Concept of guild, Organisation of communities- Hutchinson Ratio, May's d/w , Relation between the two and their association with Dyar's Law and Prizbram's law. Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity-stability debate, relevance to pest management. Pest management as applied ecology. Climate change and insect pest/ natural enemy population; ecological engineering.

Practical

- Types of distributions of organisms;
- Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- Measures of central tendencies, Poisson Distribution, Negative Binomial Distribution;
- Determination of optimal sample size. Learning to fit basic population growth models and testing the goodness of fit;
- Fitting Holling's Disc equation;
- Assessment of prey-predator densities from natural systems and understanding the correlation between the two;
- Assessing and describing niche of some insects of a single guild;
- Calculation of niche breadth, activity breadth and diagrammatic representation of niches of organisms;
- Calculation of diversity indices- Shannon's, Simpson's and Avalanche Index and understanding their associations and parameters that affect their values;
- Problem solving in ecology. Field visits to understand different ecosystems and to study insect occurrence in these systems.

Learning outcome:

The students are expected to be well versed with the basic concepts of ecology, ecological succession, population ecology, community ecology, nutritional ecology and different insect-ecosystem interactions. Quantification of insect diversity and abundance, life table analyses, predator prey and host-parasitoid relations, functional and numerical responses, niche breadth and overlap.

Suggested Reading

- Begon M, Townsend CR and Harper JL. 2006. *Ecology: From Individuals to Ecosystems*. 4th Ed. Blackwell Publishing, USA/ UK/ Australia.
- Chapman JL and Reiss MJ. 2006. *Ecology: Principles and Applications*. 2nd Ed. Cambridge Univ. Press, Cambridge.
- Fowler J, Cohen L and Jarvis P. 1998. *Practical Statistics for Field Biology*. 2nd Ed. John Wiley & Sons, Chichester, West Sussex, PO19 8SQ, England.

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- Gotelli NJ and Ellison AM. 2004. *A Primer of Ecological Statistics*. Sinauer Associates, Inc., Sunderland, MA.
- Gotelli NJ. 2001. *A Primer of Ecology*. 3rd Ed. Sinauer Associates, Inc., Sunderland, MA
- Gupta RK. 2004. *Advances in Insect Biodiversity*. Agrobios, Jodhpur.
- Krebs CJ. 1998. *Ecological Methodology*. 2nd Ed. Benjamin-Cummings Publ. Co., New York.
- Krebs CJ. 2001. *Ecology: The Experimental Analysis of Distribution and Abundance*. 5th Ed. Benjamin-Cummings Publ. Co., New York.
- Magurran AE. 1988. *Ecological Diversity and its Measurement*. Princeton Univ. Press, Princeton.
- Price PW. 1997. *Insect Ecology*. 3rd Ed. John Wiley, New York.
- Real LA and Brown JH. (Eds). 1991. *Foundations of Ecology: Classic Papers with Commentaries*. University of Chicago Press, Chicago.
- Schowalter Timothy D. 2011. *Insect Ecology – An Ecosystem Approach*. 3rd Ed. Academic Press, London, UK/ CA, USA.
- Southwood TRE and Henderson PA. 2000. *Ecological Methods*. 3rd Ed. Methuen and Co. Ltd., London.
- Speight MR, Hunta MD and Watt AD. 2006. *Ecology of Insects: Concepts and Application*. Elsevier Science Publ., The Netherlands.
- Townsend Colin R, Begon Michael and Harper John L. 2008. *Essentials of Ecology*. 3rd Ed. Blackwell Publishing, USA/ UK/ Australia.
- Wilson EO, William H and Bossert WH. 1971. *A Primer of Population Biology*. Harvard University, USA.
- Wratten SD and Fry GLA. 1980. *Field and Laboratory Exercises in Ecology*. Arnold, London.

ENT-505		Biological Control of Insect Pests and Weeds	3(2+1)
Aim of the course:			
To train the students with theory and practice of biological control, mass production techniques and field evaluation of various biological control agents like parasitoids, predators and various entomopathogenic microorganisms.			
Theory			
Unit I	History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.		
Unit II	Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa, etc., their mode of action. Biological control of weeds using insects. Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens.		
Unit III	Mass production of quality bio-control agents- techniques, formulations, economics, field release/ application and evaluation. Development of insectaries, their maintenance.		
Unit IV	Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control. Climate change and insect pest/ natural enemy population; ecological engineering.		
Practical			
<ul style="list-style-type: none"> • Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers; • Visits to bio-control laboratories to learn rearing and mass production of egg, egg- 			

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<p>larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds;</p> <ul style="list-style-type: none"> • Field collection of parasitoids and predators. Hands-on training in culturing, identification of common insect pathogens. Quality control and registration standards for biocontrol agents.
<p>Learning outcome:</p> <p>Students are expected to have a good understanding of the role of natural enemies in managing pest populations below those causing economic damage. Learn the techniques for mass production of quality bio-agents and their optimal use in IPM.</p>
<p>Suggested Reading</p> <ul style="list-style-type: none"> - Burges HD and Hussey NW. (Eds). 1971. <i>Microbial Control of Insects and Mites</i>. Academic Press, London. - De Bach P. 1964. <i>Biological Control of Insect Pests and Weeds</i>. Chapman and Hall, New York. Dhaliwal GS and Arora R. 2001. <i>Integrated Pest Management: Concepts and Approaches</i>. Kalyani Publishers, New Delhi. - Gerson H and Smiley RL. 1990. <i>Acarine Biocontrol Agents – An Illustrated Key and Manual</i>. Chapman and Hall, New York. - Huffaker CB and Messenger PS. 1976. <i>Theory and Practices of Biological Control</i>. Academic Press, London. - Ignacimuthu SS and Jayaraj S. 2003. <i>Biological Control of Insect Pests</i>. Phoenix Publ., New Delhi. Saxena AB. 2003. <i>Biological Control of Insect Pests</i>. Anmol Publ., New Delhi. - Van Driesche and Bellows TS. Jr. 1996. <i>Biological Control</i>. Chapman and Hall, New York. - Wratten SD and Fry GLA. 1980. <i>Field and Laboratory Exercises in Ecology</i>. Arnold, London.

ENT-506	Toxicology of Insecticides	3(2+1)
Aim of the course:		
To orient the students with structure and mode of action of important insecticides		
Theory		
Unit I	Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.	
Unit II	Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature; categorization of insecticides on the basis of toxicity – criteria for bees, beneficial insects and other insects in general; structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrololes, insect growth regulators, microbials, botanicals, new promising compounds/ new insecticide molecules; nanopesticides; drawbacks of insecticide abuse.	
Unit III	Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity. bioassay definition, objectives, criteria, factors, problems and solutions	
Unit IV	Insecticide metabolism; insect-pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.	
Unit V	Insecticide residues, their significance and environmental implications; procedures of insecticide residue analysis. Insecticide Act, registration procedures, label claim, and quality control of insecticides; safe use of	

insecticides; diagnosis and treatment of insecticide poisoning.	
Practical	
<ul style="list-style-type: none"> • Insecticide formulations and mixtures; • Laboratory and field evaluation of bio-efficacy of insecticides; • Bioassay techniques; • Probit analysis; • Evaluation of insecticide toxicity; • Toxicity to beneficial insects; • Pesticide appliances; • Working out doses and concentrations of pesticides; • Procedures of residue analysis. 	
Learning outcome:	
Students are expected understand the concept of toxicity, bio-efficacy, insecticide formulations, modes of action of insecticides, estimation of insecticide residues and have significant know-how about the functioning of various types of spray equipments.	
Suggested Reading	
<ul style="list-style-type: none"> - Chattopadhyay SB. 1985. <i>Principles and Procedures of Plant Protection</i>. Oxford and IBH, New Delhi. - Dodia DA, Petel IS and Petal GM. 2008. <i>Botanical Pesticides for Pest Management</i>. Scientific Publisher (India), Jodhpur. - Dovener RA, Mueninghoff JC and Volgar GC. 2002. <i>Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry</i>. ASTM, USA - Gupta HCL.1999. <i>Insecticides: Toxicology and Uses</i>. Agrotech Publ., Udaipur. - Ishaaya I and Degheele (Eds.). 1998. <i>Insecticides with Novel Modes of Action</i>. Narosa Publ. - House, New Delhi. - Ishaaya I and Degheele D. 1998. <i>Insecticides with Novel Modes of Action: Mechanism and Application</i>. Norosa Publishing House, New Delhi. - Krieger RI. 2001. <i>Handbook of Pesticide Toxicology</i>. Vol-II. Academic Press. Orlando Florida. Mathews GA. 2002. <i>Pesticide Application Methods</i>. 4th Ed. Intercept. UK. - Matsumura F. 1985. <i>Toxicology of Insecticides</i>. Plenum Press, New York. - Otto D and Weber B. 1991. <i>Insecticides: Mechanism of Action and Resistance</i>. Intercept Ltd., UK. - Pedigo LP and Marlin ER. 2009. <i>Entomology and Pest Management</i>, 6th Edition, Pearson Education Inc., Upper Saddle River, New Jersey 07458, U.S.A. - Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. <i>Insecticides in Agriculture and Environment</i>. - Narosa Publ. House, New Delhi. - Prakash A and Rao J. 1997. <i>Botanical Pesticides in Agriculture</i>. Lewis Publication, New York. Roy NK. 2006. <i>Chemistry of Pesticides</i>. Asia Printograph Shahdara Delhi. 	

ENT-508	Concepts of Integrated Pest Management	2(2+0)
Aim of the course:		
To familiarize the students with principles of insect pest management, including concept		

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and philosophy of IPM. Train students in computation of ETL and implementing IPM programmes.

Theory	
Unit I	History, origin, definition and evolution of various terminologies. Importance of resistance, principles, classification, components, types and mechanisms of resistance. National and international level crop protection organizations; insecticide regulatory bodies; synthetic insecticide, bio-pesticide and pheromone registration procedures; label claim of pesticides – the pros and cons.
Unit II	Concept and philosophy, ecological principles, economic threshold concept and economic consideration. Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.
Unit III	Tools of pest management and their integration- legislative, quarantine regulations, cultural, physical and mechanical methods; semiochemicals, biotechnological and bio-rational approaches in IPM. Pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; costbenefit ratios and partial budgeting; case studies of successful IPM programmes. ITK-s in IPM, area-wide IPM and IPM for organic farming; components of ecological engineering with successful examples.
Unit IV	Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses; global and Indian scenario of crop losses. Computation of EIL and ETL; crop modeling; designing and implementing IPM system. Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world.
Unit V	Insecticide residues, their significance and environmental implications; procedures of insecticide residue analysis. Insecticide Act, registration procedures, label claim, and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Learning outcome:

Students are expected to have significant knowledge of IPM concepts, estimation of losses due to insect pests, computation of ETL, EIL and should be able take management decisions.

Suggested Reading

- Dhaliwal GS and Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publishers, New Delhi.
- Horowitz AR and Ishaaya I. 2004. Insect Pest Management: Field and Protected Crops. Springer, New Delhi.
- Ignacimuthu SS and Jayaraj S. 2007. Biotechnology and Insect Pest Management. Elite Publ., New Delhi.
- Norris RF, Caswell-Chen EP and Kogan M. 2002. Concepts in Integrated Pest Management. Prentice Hall, New Delhi.
- Pedigo RL. 2002. Entomology and Pest Management. 4th Ed. Prentice Hall, New Delhi.
- Subramanyam B and Hagstrum DW. 1995. Integrated Management of Insects in Stored Products. Marcel Dekker, New York.

COURSE CONTENTS/SYLLABUS IN MINOR SUBJECT

PL PATH-515	Diseases of Field and Medicinal Crops	3(2+1)
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Aim of the course: To acquaint with diseases of Field and Medicinal Crops and their management.	
Theory	
Unit I	Diseases of Cereal crops- Rice, wheat, barley, pearl millet, sorghum and maize.
Unit II	Diseases of Pulse crops- Gram, urdbean, mungbean, lentil, pigeonpea, soybean and cowpea.
Unit III	Diseases of Oilseed crops- Rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor.
Unit IV	Diseases of Cash crops- Cotton, sugarcane.
Unit V	Diseases of Fodder legume crops- Berseem, oats, guar, lucerne.
Unit VI	Medicinal crops- Plantago, liquorice, mulathi, rosagrass, sacred basil, mentha, ashwagandha, Aloe vera.
Practical	
<ul style="list-style-type: none"> Detailed study of symptoms and host parasite relationship of important diseases of above-mentioned crops; Collection and dry preservation of diseased specimens of important crops. 	
Suggested Reading	
<ul style="list-style-type: none"> Joshi LM, Singh DV and Srivastava KD. 1984. Problems and Progress of Wheat Pathology in South Asia. Malhotra Publ. House, New Delhi. Rangaswami G. 1999. Diseases of Crop Plants in India. 4th Ed. Prentice Hall of India, New Delhi. Ricanel C, Egan BT, Gillaspie Jr AG and Hughes CG. 1989. Diseases of Sugarcane, Major Diseases. Academic Press, New York. Singh RS. 2017. Plant Diseases. 10th Ed. Medtech, New Delhi. Singh US, Mukhopadhyay AN, Kumar J and Chaube HS. 1992. Plant Diseases of Internatiobnal Importance. Vol. I. Diseases of Cereals and Pulses. Prentice Hall, Englewood Cliffs, New Jersey 	

PL PATH-516	Diseases of Fruits, Plantation and Ornamental Crops	3(2+1)
Aim of the course: To acquaint with diseases of fruits, plantation, ornamental plants and their management.		
Theory		
Unit I	Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, almond, strawberry, citrus, mango, grapes, guava, ber, banana, pineapple, papaya, fig, pomegranate, date palm, custard apple and their management.	
Unit II	Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management.	
Unit III	Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, tulip, carnation, gerbera orchids, marigold, chrysanthemum and their management.	
Practical		
<ul style="list-style-type: none"> Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops; Collection and dry preservation of diseased specimens of important crops. 		
Suggested Reading		
<ul style="list-style-type: none"> Gupta VK and Sharma SK. 2000. Diseases of Fruit Crops. Kalyani Publishers, New Delhi. Pathak VN. 1980. Diseases of Fruit Crops. Oxford & IBH, New Delhi. Singh RS. 2000. Diseases of Fruit Crops. Oxford & IBH, New Delhi. 		

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- Walker JC. 2004. Diseases of Vegetable Crops. TTPP, India.

PL PATH-517		Diseases of Vegetable and Spices Crops	3(2+1)
Aim of the course: To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.			
Theory			
Unit I	Nature, prevalence, factors affecting disease development of tuber, bulb, leafy vegetable, crucifers, cucurbits and solanaceous vegetables. Diseases of crops under protected cultivation.		
Unit II	Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceous vegetable crops.		
Unit III	Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger. Biotechnological approaches in developing disease resistant transgenics.		
Practical			
<ul style="list-style-type: none"> Detailed study of symptoms and host pathogen interaction of important diseases of vegetable and spice crops. 			
Suggested Reading			
<ul style="list-style-type: none"> Chaube HS, Singh US, Mukhopadhyay AN and Kumar J. 1992. Plant Diseases of International Importance. Vol. II. Diseases of Vegetable and Oilseed Crops. Prentice Hall, Englewood Cliffs, New Jersey. Gupta VK and Paul YS. 2001. Diseases of Vegetable Crops. Kalyani Publishers, New Delhi Gupta SK and Thind TS. 2006. Disease Problem in Vegetable Production. Scientific Publ., Jodhpur. Sherf AF and McNab AA. 1986. Vegetable Diseases and their Control. Wiley Inter Science, Columbia. Singh RS. 1999. Diseases of Vegetable Crops. Oxford & IBH, New Delhi. Walker JC. 1952. Diseases of Vegetable Crops. McGraw-Hill, New York. 			

COURSE CONTENTS/SYLLABUS IN SUPPORTING COURSE

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, 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		

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	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 IV	Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data
Practical	
<ul style="list-style-type: none"> • 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 	
Suggested Reading	
<ul style="list-style-type: none"> – Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press. – Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press. – Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley. – Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan. – Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill. – Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition. – Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley. – Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed . John Wiley – http://freestatistics.altervista.org/en/learning.php. – http://www.statsoft.com/textbook/stathome.html. 	

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.	

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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.
Practical	
<ul style="list-style-type: none"> • 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 • Non-parametric tests. ANOVA: One way, Two Way, SRS 	
Suggested Reading	
<ul style="list-style-type: none"> - Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. - Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer. - Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley. - Federer WT. 1985. Experimental Designs. MacMillan. - Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd. - Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. - Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. - www.drs.icar.gov.in. 	

COURSE CONTENTS/SYLLABUS IN COMMON COURSE (PGS)

PGS-501	Library and Information Services	1(0+1)
Objective:		
To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.		
Practical	Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.	

PGS-502	Technical Writing and Communications Skills	1(0+1)
Objective:		
To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).		
Practical (Technical Writing)	<ul style="list-style-type: none"> • Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.; • Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); 	

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- Writing of abstracts, summaries, précis, citations, etc.; Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings:

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

PGS-503	Intellectual Property and Its Management In Agriculture	1(1+0)
<p>Objective: The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.</p>		
Theory	<p>Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.</p>	

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Suggested Readings:

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

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

PGS-504	Basic Concepts in Laboratory Techniques	1(0+1)
Objective: To acquaint the students about the basics of commonly used techniques in laboratory.		
Practical	<ul style="list-style-type: none"> • Safety measures while in Lab; • Handling of chemical substances; • Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; • Washing, drying and sterilization of glassware; • Drying of solvents/ chemicals; • Weighing and preparation of solutions of different strengths and their dilution; • Handling techniques of solutions; • Preparation of different agro-chemical doses in field and pot applications; • Preparation of solutions of acids; • Neutralisation of acid and bases; • Preparation of buffers of different strengths and pH values; • Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; • Electric wiring and earthing; • Preparation of media and methods of sterilization; • Seed viability testing, testing of pollen viability; • Tissue culture of crop plants; • Description of flowering plants in botanical terms in relation to taxonomy. 	
Suggested Readings: <ul style="list-style-type: none"> - Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press - Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co. 		

PGS-505		1(1+0)
Agricultural Research, Research Ethics and Rural Development Programmes		
Objective: To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.		
Theory		
Unit I	History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.	
Unit II	Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.	
Unit III	Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.	
Suggested Readings:		
<ul style="list-style-type: none"> - Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ. - Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar. - Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ. - Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ. 		

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CREDIT REQUIREMENTS
for
Ph.D. in ENTOMOLOGY

The following nomenclature and Credit Hrs need to be followed while providing the syllabus for all the disciplines:

	Doctoral Programme
(ii) Course work	
Major courses	12
Minor courses	06
Supporting courses	05
Common Courses (PGS)	-
Seminar	02
(ii) Thesis Research	75
Total	100

Ph.D. in ENTOMOLOGY

Course Code	Subject Course	Credit
Core Courses		
ENT 601	Insect Phylogeny and Systematics	3 (1+2)
ENT 602	Insect Physiology and Nutrition	3 (2+1)
ENT 603	Insect Ecology and Diversity	3 (2+1)
ENT 605	Bio-inputs for Pest Management	3 (2+1)
ENT 606	Insect Toxicology and Residues	3 (2+1)
Optional Courses		
ENT 604	Insect Behavior	2 (1+1)
ENT 607	Plant Resistance to Insects	2 (1+1)
ENT 608	Acarology	2 (1+1)
ENT 609	Molecular Entomology	2 (1+1)
ENT 610	Integrated Pest Management	2 (2+0)

Doctoral Research and Seminar

Course Code	Subject Course	Credit
ENT 691	Doctoral Seminar – I	1 (0+1)
ENT 692	Doctoral Seminar – II	1 (0+1)
ENT 699	Doctoral Research	75 (0+75)

Ph.D. in ENTOMOLOGY

SEMESTER WISE COURSE DISTRIBUTION

Course Code	Subject Course	Credit
First Semester		
ENT 601 *	Insect Phylogeny and Systematics	3 (1+2)
ENT 602 *	Insect Physiology and Nutrition	3 (2+1)
Minor courses		
Supporting courses		
Common Courses		
Second Semester		
ENT 603 *	Insect Ecology and Diversity	3 (2+1)
ENT 605 *	Bio-inputs for Pest Management	3 (2+1)
Minor courses		
Supporting courses		
Common Courses		
Third Semester		
ENT 606 *	Insect Toxicology and Residues	3 (2+1)
Minor courses		
Supporting courses		
Common Courses		
Fourth Semester		
	(Major Optional course)*	
Minor courses		
Supporting courses		
Common Courses		

*Compulsory courses

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SYLLABUS

Major Courses

ENT 601	Insect Phylogeny and Systematics	3 (1+2)
<p>Aim of the course To familiarize the students with different schools of classification, phylogenetics, classical and molecular methods, evolution of different groups of insects. Detailed study about the International Code of Zoological Nomenclature; ethics and procedure for taxonomic publications.</p>		
<p><u>THEORY</u></p>		
<p>Unit I Detailed study of three schools of classification- numerical, evolutionary and cladistic. Methodologies employed. Development of phenograms, cladograms, molecular approaches for the classification of organisms. Methods in identification of homology. Species concepts, speciation processes and evidences. Zoogeography.</p>		
<p>Unit II Study of different views on the evolution of insects- alternative phylogenies of insects: Kukalova Peck and Kristensen. Fossil insects and evolution of insect diversity over geological times.</p>		
<p>Unit III Detailed study of International Code of Zoological Nomenclature, including appendices to ICZN; scientific ethics. Nomenclature and documentation protocols and procedures; report preparation on new species; deposition of holotypes, paratypes, and insect specimens as a whole in national and international repositories – requirements and procedures.</p>		
<p>Unit IV Concept of Phylocode and alternative naming systems for animals. A detailed study of selected representatives of taxonomic publications – small publications of species descriptions, works on revision of taxa, monographs, check lists, faunal volumes, etc. Websites related to insect taxonomy and databases. Molecular taxonomy, barcoding species and the progress made in molecular systematics.</p>		
<p><u>PRACTICAL</u></p>		
<ul style="list-style-type: none"> • Collection, curation and study of one taxon of insects- literature search, compilation of a checklist, study of characters, development of character table, and construction of taxonomic keys for the selected group; • Development of descriptions, photographing, writing diagrams, and preparation of specimens for “type like” preservation, Submission of the collections made of the group; • Multivariate analysis techniques for clustering specimens into different taxa, and development of phenograms; • Rooting and character polarization for developing cladograms and use of computer programmes to develop cladograms. 		

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Learning outcome

- Scholars are expected to understand the concepts of taxonomic hierarchy, study taxonomic characters, variations, intra-specific phenotypic plasticity; prepare taxonomic keys for specific groups and write taxonomic papers and reviews.
- Scholars should be able to identify insects of economic importance up to family/ generic levels and specialize in any one group of insects up to species level identification.

Suggested Reading

- CSIRO 1990. *The Insects of Australia: A Text Book for Students and Researchers*. 2nd Ed. Vols. I and II, CSIRO. Cornell Univ. Press, Ithaca.
- Dakeshott J and Whitten MA. 1994. *Molecular Approaches to Fundamental and Applied Entomology*. Springer-Verlag, Berlin.
- Freeman S and Herron JC. 1998. *Evolutionary Analysis*. Prentice Hall, New Delhi.
- Hennig W. 1960. *Phylogenetic Systematics*. Urbana Univ. Illinois Press, USA.
- Hoy MA. 2003. *Insect Molecular Genetics: An Introduction to Principles and Applications*. 2nd Ed. Academic Press, New York.
- Mayr E and Ashlock PD. 1991. *Principles of Systematic Zoology*. 2nd Ed. McGraw Hill, New York.
- Mayr E. 1969. *Principles of Systematic Zoology*. McGraw-Hill, New York.
- Quicke DLJ. 1993. *Principles and Techniques of Contemporary Taxonomy*. Blackie Academic and Professional, London.
- Ross HH. 1974. *Biological Systematics*. Addison Wesley Publ. Co., London.
- Wiley EO. 1981. *Phylogenetics: The Theory and Practices of Phylogenetic Systematics for Biologists*. Columbia Univ. Press, USA.

ENT 602	Insect Physiology and Nutrition	3 (1+2)
Aim of the course		
To impart knowledge to the students on detailed physiology of various secretory and excretory systems, moulting process, chitin synthesis, physiology of digestion, transmission of nerve impulses, nutrition of insects, pheromones, etc.		
<u>THEORY</u>		
Unit I		
Physiology and biochemistry of insect cuticle and moulting process. Biosynthesis of chitin, chitin-protein interactions in various cuticles, hardening of cuticle.		
Unit II		
Digestive enzymes, digestive physiology in phytophagous, wood boring and wool feeding insects, efficiency of digestion and absorption, role of endosymbionts in insect nutrition, nutritional effects on growth and development; physiology of excretion and osmoregulation, water conservation mechanisms.		
Unit III		
Detailed physiology of nervous system, transmission of nerve impulses, neurotransmitters and modulators. Production of receptor potentials in different types of sensilla, pheromones and other semiochemicals in insect life, toxins and defense mechanisms.		
Unit IV		
Endocrine system and insect hormones, physiology of insect growth and development-metamorphosis, polymorphism and diapause. Insect behavior in IPM- Concept of super-normal stimuli and behavioral manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.		

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PRACTICAL

- Preparation of synthetic diets for different groups of insects;
- Rearing of insects on synthetic, semi-synthetic and natural diets;
- Determination of co-efficient of utilization;
- Qualitative and quantitative profile of bio-molecules: practicing analytical techniques for analysis of free amino acids of haemolymph;
- Zymogram analyses of amylase;
- Determination of chitin in insect cuticle;
- Examination and count of insect haemocytes.

Learning outcome

- The scholars are expected to have thorough theoretical and practical knowledge of insect physiology that can be made use of in practical/ applied entomological aspects.
- Understand how physiological systems in insects are integrated to maintain homeostasis.

Suggested Reading

- Ananthkrishnan TN. (Ed.). 1994. *Functional Dynamics of Phytophagous Insects*. Oxford and IBH, New Delhi.
- Bernays EA and Chapman RF. 1994. *Host-Plant Selection by Phytophagous Insects*. Chapman and Hall, London.
- Kerkut GA and Gilbert LI. 1985. *Insect Physiology, Biochemistry and Pharmacology*. Vols. I- XIII. Pergamon Press, Oxford, New York.
- Muraleedharan K. 1997. *Recent Advances in Insect Endocrinology*. Association for Advancement of Entomology, Trivandrum, Kerala.
- Rockstein, M. 1978. *Biochemistry of Insects*, Academic Press.
- Simpson, SJ. 2007. *Advances in Insect Physiology*, Vol. 33, Academic Press (Elsevier), London, UK.

ENT 603	Insect Ecology and Diversity	3 (1+2)
Aim of the course To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics. Study insect-plant interactions; get acquainted with biodiversity and conservation.		
<u>THEORY</u>		
Unit I Characterization of distribution of insects- Indices of Dispersion, Taylor's Power law. Island Biogeography. Population dynamics- Life tables, Leslie Matrix, Stable age distribution, Population projections. Predator-Prey Models- Lotka-Volterra and Nicholson-Bailey Model. Crop Modeling- an introduction.		
Unit II Insect Plant Interactions. Fig-figwasp mutualism and a quantitative view of types of associations. Role of insects in the environment. Adaptations to terrestrial habitats. Evolution of insect diversity and role of phytophagy as an adaptive zone for increased diversity of insects. Evolution of resource harvesting organs, resilience of insect taxa and the sustenance of insect diversity- role of plants. Herbivory, pollination, predation, parasitism. Modes of insect-plant interaction, tri-trophic interactions. Evolution of herbivory, monophagy vs polyphagy. Role of plant secondary metabolites. Meaning of stress- plant stress and herbivory. Consequences of herbivory to plant fitness and response to stress. Constitutive and induced plant		

defenses. Host seeking behavior of parasitoids.

Unit III

Biodiversity and Conservation- RET species, Ecological Indicators. Principles of Population genetics, Hardy Weinberg Law, Computation of Allelic and Phenotypic frequencies, Fitness under selection, Rates of Evolution under selection. Foraging Ecology- Optimal foraging theory, Marginal Value Theorem, and Patch departure rules, central place foraging, Mean-variance relationship and foraging by pollinators, Nutritional Ecology.

Unit IV

Reproductive ecology- Sexual selection, Mating systems, Reproductive strategies – timing, egg number, reproductive effort, sibling rivalry and parent-offspring conflict. Agro-ecological vs Natural Ecosystems – Characterization, Pest Control as applied ecology-case studies.

PRACTICAL

- Methods of data collection under field conditions;
- Assessment of distribution parameters, Taylor's power law, Iwao's patchiness index, Index of Dispersion, etc.;
- Calculation of sample sizes by different methods;
- Fitting Poisson and Negative Binomial distributions and working out the data transformation methods;
- Hardy-Weinberg Law, Computation of Allelic and Phenotypic Frequencies – Calculation of changes under selection, Demonstration of genetic drift;
- Assessment of Patch Departure rules. Assessment of Resource size by female insects using a suitable insect model, fruit flies/ *Goniozus*/ Female Bruchids, etc.;
- A test of reproductive effort and fitness;
- Construction of Life tables and application of Leslie Matrix – population projections, Stable age distribution;
- Exercises in development of Algorithms for crop modeling;

Learning outcome

- The scholar is expected to develop expertise in methods of data collection for insect population studies, data transformation for analyses, diversity estimates, assessing distribution parameters, study the impact of abiotic and biotic factors on the distribution and abundance of insects.
- Should gain significant knowledge on construction of life tables and their analyses, assessment of resource size by female insects, reproductive effort and fitness.

Suggested Reading

Barbosa P and Letourneau DK. (Eds.). 1988. *Novel Aspects of Insect-Plant Interactions*. Wiley, London.

Elizabeth BA and Chapman RF. 1994. *Host-Plant Selection by Phytophagous Insects*. Chapman and Hall, New York.

Freeman S and Herron JC. 1998. *Evolutionary Analysis*. Prentice Hall, New Delhi.

Gotelli NJ and Ellison AM. 2004. *A Primer of Ecological Statistics*. Sinauer Associates, Sunderland, MA.

Gotelli NJ. 2001. *A Primer of Ecology*. 3rd Ed., Sinauer Associates, Sunderland, MA, USA.

Krebs C. 1998. *Ecological Methodology*. 2nd Ed. Benjamin-Cummings Publ. Co., New York.

Krebs CJ. 2001 *Ecology: The Experimental Analysis of Distribution and Abundance*. 5th Ed. Benjamin-Cummings Publ. Co., New York.

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ENT 604	Insect Behaviour	2 (1+1)
Aim of the course		
To acquaint the students with a thorough understanding of how natural selection has led to various survival strategies manifested as behavior in insects.		
<u>THEORY</u>		
Unit I		
Defining Behaviour- Concept of umwelt, instinct, fixed action patterns, imprinting, complex behavior, inducted behavior, learnt behavior and motivation. History of Ethology- development of behaviorism and ethology, contribution of Darwin, Frisch, Tinbergen and Lorenz; Studying behavior- Proximate and Ultimate approaches, behavioural traits under natural selection, genetic control of behavior and behavioural polymorphism.		
Unit II		
Orientation- Forms of primary and secondary orientation including taxes and kinesis; Communication- primary and secondary orientation, responses to environmental stimuli, role of visual, olfactory and auditory signals in inter- and intra-specific communication, use of signals in defense, mimicry, polyphenism; evolution of signals.		
Unit III		
Reproductive behavior- mate finding, courtship, territoriality, parental care, parental investment, sexual selection and evolution of sex ratios; Social behavior- kin selection, parental manipulation and mutualism; Self organization and insect behavior.		
Unit IV		
Foraging- Role of different signals in host searching (plant and insects) and host acceptance, ovipositional behavior, pollination behavior, co-evolution of plants and insect pollinators. Behaviour in IPM- Concept of super-normal stimuli and behavioural manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.		
<u>PRACTICAL</u>		
<ul style="list-style-type: none"> • Quantitative methods in sampling behavior; • Training bees to artificial feeders; • Sensory adaptation and habituation in a fly or butterfly model, physical cues used in host selection in a phytophagous insect, chemical and odour cues in host selection in phytophagous insect (DBM or gram pod borer), colour discrimination in honey bee or butterfly model, learning and memory in bees, role of self-organization in resource tracking by honeybees; • Evaluation of different types of traps against fruit flies with respect to signals; • Use of honey bees/ <i>Helicoverpa armigera</i> to understand behavioural polymorphism with respect to learning and response to pheromone mixtures, respectively. 		
Learning outcome		
<ul style="list-style-type: none"> • Scholars are expected to be well versed with the behavior and orientation of insects towards exploitation as a tool in IPM. 		
Suggested Reading		
<p>Ananthkrishnan TN. (Ed.). 1994. <i>Functional Dynamics of Phytophagous Insects</i>. Oxford and IBH, New Delhi.</p> <p>Awasthi VB. 2001. <i>Principles of Insect Behaviour</i>. Scientific Publ., Jodhpur.</p> <p>Bernays EA and Chapman RF. 1994. <i>Host-Plant Selection by Phytophagous Insects</i>. Chapman and Hall, London.</p> <p>Brown LB. 1999. <i>The Experimental Analysis of Insect Behaviour</i>. Springer, Berlin.</p> <p>Krebs JR and Davies NB. 1993. <i>An Introduction to Behavioural Ecology</i>. 3rd Ed.</p>		

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Chapman and Hall, London.

Manning A and Dawkins MS. 1992. *An Introduction to Animal Behaviour*. Cambridge University Press, USA.

Mathews RW and Mathews JR. 1978. *Insect Behaviour*. A Wiley-InterScience Publ. John Wiley and Sons, New York.

ENT 605	Bio-inputs for Pest Management	3 (2+1)
Aim of the course To appraise the students with advanced techniques in handling of different bio- agents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.		
<u>THEORY</u>		
Unit I Scope of classical biological control and augmentative bio-control; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts, dynamics of bio-agents <i>vis-à-vis</i> target pest populations.		
Unit II Bio-inputs: mass production of bio-pesticides, mass culturing techniques of bio- agents, insectary facilities and equipments, basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices.		
Unit III Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies, survivorship analysis and ecological manipulations, large-scale production of bio-control agents, bankable project preparation.		
Unit IV Scope of genetically engineered microbes and parasitoids in biological control, genetics of ideal traits in bio-control agents for introgressing and for progeny selections, breeding techniques of bio-control agents.		
<u>PRACTICAL</u>		
<ul style="list-style-type: none">• Mass rearing and release of some commonly occurring indigenous natural enemies;• Assessment of role of natural enemies in reducing pest populations;• Testing side effects of pesticides on natural enemies;• Effect of semio-chemicals on natural enemies, breeding of various bio-control agents, performance of efficiency analyses on target pests;• Project document preparation for establishing a viable mass-production unit/ insectary;• Observation of feeding behavior acts of predatory bugs/ beetles.		
Learning outcome <ul style="list-style-type: none">• Scholars are expected to learn the mass multiplication techniques of the more common and economically feasible natural enemies to be exploited under IPM programmes.• They should be able to guide entrepreneurs for establishing a viable mass-production unit/ insectary.		

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Suggested Reading

- Burges HD and Hussey NW. (Eds.). 1971. *Microbial Control of Insects and Mites*. Academic Press, London.
- Coppel HC and James WM. 1977. *Biological Insect Pest Suppression*. Springer Verlag, Berlin.
- De Bach P. 1964. *Biological Control of Insect Pests and Weeds*. Chapman and Hall, London.
- Dhaliwal, GS and Koul O. 2007. *Biopesticides and Pest Management*. Kalyani Publishers, New Delhi.
- Gerson H and Smiley RL. 1990. *Acarine Biocontrol Agents – An Illustrated Key and Manual*. Chapman and Hall, New York.
- Huffaker CB and Messenger PS. 1976. *Theory and Practices of Biological Control*. Academic Press, London.

ENT 606	Insecticide Toxicology and Residues	3 (2+1)
Aim of the course To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.		
<u>THEORY</u>		
Unit I Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides. Modes of action of newer insecticide molecules; developments in bio-rational approaches; SPLAT; RNAi technology for pest management.		
Unit II Biochemical and physiological target sites of insecticides in insects; developments in biorationals, bio-pesticides and newer molecules; their modes of action and structural – activity relationships; advances in metabolism of insecticides.		
Unit III Joint action of insecticides; activation, synergism and potentiation.		
Unit IV Problems associated with pesticide use in agriculture: pesticide resistance; resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.		
Unit V Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; bound and conjugated residues, effect on soil fertility; insecticide laws and standards, and good agricultural practices.		
<u>PRACTICAL</u>		
<ul style="list-style-type: none">• Residue sampling, extraction, clean-up and estimation of insecticide residues by various methods;• Calculations and interpretation of data;• Biochemical and biological techniques for detection of insecticide resistance in insects;• Preparation of EC formulation using neem oil.		

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Learning outcome

- Scholars are expected to be well versed with the latest technologies of bioassays, insecticide/ pesticide residue analysis and solving problems associated with insect resistance to insecticides.

Suggested Reading

Busvine JR. 1971. *A Critical Review on the Techniques for Testing Insecticides*. CABI, London. Dhaliwal GS and Koul O. 2007. *Biopesticides and Pest Management*. Kalyani Publishers, New

Delhi.

Hayes WJ and Laws ER. 1991. *Handbook of Pesticide Toxicology*. Academic Press, New York.

Ishaaya I and Degheele (Eds.). 1998. *Insecticides with Novel Modes of Action*. Narosa Publ.

House, New Delhi.

Matsumura F. 1985. *Toxicology of Insecticides*. Plenum Press, New York.

O' Brien RD. 1974. *Insecticides Action and Metabolism*. Academic Press, New York.

Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. *Insecticides in Agriculture and Environment*.

Narosa Publ. House, New Delhi.

Prakash A and Rao J. 1997. *Botanical Pesticides in Agriculture*. Lewis Publ., New York.

ENT 607	Plant Resistance to Insects	2 (1+1)
Aim of the course		
To familiarize the students with recent advances in resistance of plants to insects and acquaint with the techniques for assessment and evaluation of resistance in crop plants.		
<u>THEORY</u>		
Unit I		
Importance of plant resistance, historical perspective, desirable morphological, anatomical and biochemical adaptations of resistance; assembly of plant species – gene pool; insect sources – behaviour in relation to host plant factors.		
Unit II		
Physical and chemical environment conferring resistance in plants, role of trypsin inhibitors and protease inhibitors in plant resistance; biochemistry of induced resistance – signal transduction pathways, methyl jasmonate pathways, polyphenol oxidase pathways, salicylic acid pathways; effects of induced resistance; exogenous application of elicitors.		
Unit III		
Biotechnological approaches in host plant resistance- genetic manipulation of secondary plant substances; incorporation of resistant gene in crop varieties; marker- aided selection in resistance breeding.		
Unit IV		
Estimation of plant resistance based on plant damage- screening and damage rating; evaluation based on insect responses; techniques and determination of categories of plant resistance; breakdown of resistance in crop varieties.		
<u>PRACTICAL</u>		
<ul style="list-style-type: none"> • Understanding mechanisms of resistance for orientation, feeding, oviposition, etc., allelochemical bases of insect resistance; 		

- Macroculturing of test insects like aphids, leaf/ plant hoppers, mites and stored grain pests;
- Field screening- microplot techniques, infester row technique, spreader row technique and plant nurseries;
- Determination of antixenosis index, antibiosis index, tolerance index, plant resistance index.

Learning outcome

Scholars are expected to identify sources of resistance in different crops and varieties; their utilization in resistance breeding programmes involving screening techniques for specific pests.

Suggested Reading

Panda N. 1979. *Principles of Host Plant Resistance to Insects*. Allenheld, Osum and Co., New York.
 Rosenthal GA and Janzen DH. (Eds.). 1979. *Herbivores – their Interactions with Secondary Plant Metabolites*. Vol. I, II. Academic Press, New York.
 Sadasivam S and Thayumanavan B. 2003. *Molecular Host Plant Resistance to Pests*. Marcel Dekker, New York.
 Smith CM, Khan ZR and Pathak MD. 1994. *Techniques for Evaluating Insect Resistance in Crop Plants*. CRC Press, Boca Raton, Florida.

ENT 608	Acarology	2 (1+1)
Aim of the course		
To acquire a good working knowledge of identification of economically important groups of mites up to the species level, a detailed understanding of the newer acaricide molecules and utilization of predators.		
<u>THEORY</u>		
Unit I		
Comparative morphology of Acari, phylogeny of higher categories in mites, knowledge of commonly occurring orders and families of Acari in India. Diagnostic characteristics of commonly occurring species from families Tetranychidae, Tenuipalpidae, Eriophyidae, Tarsonemidae, Phytoseiidae, Bdellidae, Cunaxidae, Stigmaeidae, Pymotidae, Cheyletidae, Acaridae, Pyroglyphidae, Orthogalumnae, Argasidae, Ixodidae, Sarcoptidae. Soil mites in India.		
Unit II		
Management of economical important species of mites in agriculture, veterinary and public health; storage acarology.		
Unit III		
Mites as vectors of plant pathogens; mode of action, structure-activity relationships of different groups of acaricides; problem of pesticide resistance in mites, resurgence of mites.		
Unit IV		
Predatory mites, their mass production and utilization in managing mite pests, acaropathogenic fungi- identification, isolation and utilization.		
<u>PRACTICAL</u>		
<ul style="list-style-type: none"> • Identification of commonly occurring mites up to species, preparation of keys for identification; • Collection of specific groups of mites and preparing their identification keys; • Rearing phytoseiid mites and studying their role in suppression of spider mites; 		

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- Management of mite pests of crops using acaricides, phytoseiid predators, fungal pathogens, etc.

Learning outcome

- Scholars should be able to identify major mite pests, their management and predatory mites that can be used in biological control.
- They are also expected to learn the rearing techniques of predatory Phytoseiid mites.

Suggested Reading

Evans GO.1992. *Principles of Acarology*. CABI, London.
 Gerson H and Smiley RL. 1990. *Acarine Bio-control Agents- An Illustrated Key and Manual*. Chapman and Hall, New York.
 Gupta SK. 1985. *Handbook of Plant Mites of India*. Zoological Survey of India, Calcutta. Krantz GW. 1970. *A Manual of Acarology*. Oregon State University Book Stores, Corvallis, Oregon.
 Sadana GL. 1997. *False Spider Mites Infesting Crops in India*. Kalyani Publ. House, New Delhi.

ENT 609	Molecular Entomology	2 (1+1)
Aim of the course		
To familiarize the students with DNA recombinant technology, marker genes, transgenic plants, and biotechnological advances in sericulture and apiculture.		
<u>THEORY</u>		
Unit I		
Introduction to molecular biology; techniques used in molecular biology.		
Unit II		
DNA and RNA analysis in insects- transcription and translocation mechanisms. DNA recombinant technology, identification of genes/ nucleotide sequences for characters of interest. Genetic improvement of natural enemies. Cell lines, genetic engineering in baculoviruses, <i>Bt</i> and entomopathogenic fungi.		
Unit III		
Genes of interest in entomological research- marker genes for sex identification, neuropeptides, JH esterase, St toxins and venoms, chitinase, CPTI; lectins and proteases. Transgenic plants for pest resistance and diseases.		
Unit IV		
Insect gene transformation; biotechnology in relation to silkworms and honey bees; introduction of lectin genes for pest suppression; DNA finger printing for taxonomy and phylogeny. Genetic improvement of inebriate tolerance of natural enemies.		
Unit V		
DNA-based diagnostics; insect immune systems in comparison to vertebrates; molecular basis of metamorphosis; Sf transgenic technology and implications; molecular biology of baculo viruses; insecticide resistance. Resistance management strategies in transgenic crops.		
<u>PRACTICAL</u>		

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- Isolation of DNA/ RNA;
- Purity determinations, purification of total DNA from animal tissues;
- Base pair estimation;
- Agarose gel electrophoresis;
- Quantitative enzyme profile of alimentary canal;
- Restriction mapping of DNA;
- Demonstration of PCR, RFLP and RAPD techniques.

Learning outcome

The scholars are expected to have mastered the molecular techniques applicable in entomological research like isolation of insect DNA, purification, DNA barcoding and utilizing these techniques in molecular systematics and biological control aspects.

Suggested Reading

- Bhattacharya TK, Kumar P and Sharma A. 2007. *Animal Biotechnology*. 1st Ed., Kalyani Publication, New Delhi.
- Hagedon HH, Hilderbrand JG, Kidwell MG and Law JH. 1990. *Molecular Insect Science*. Plenum Press, New York.
- Hoy MA. 2003. *Insect Molecular Genetics: An Introduction to Principles and Applications*. 2nd Ed. Academic Press, New York.
- Oakeshott J and Whitten MA. 1994. *Molecular Approaches to Fundamental and Applied Entomology*. Springer Verlag.
- Rechcigl JE and Rechcigl NA. 1998. *Biological and Biotechnological Control of Insect Pests*. Lewis Publ., North Carolina.
- Roy U and Saxena V. 2007. *A Hand Book of Genetic Engineering*. 1st Ed., Kalyani Publishers, New Delhi.
- Singh BD. 2008. *Biotechnology (Expanding Horizons)*. Kalyani Publishers, New Delhi.
- Singh P. 2007. *Introductory to Biotechnology*. 2nd Ed. Kalyani Publishers, New Delhi.

ENT 610	Integrated Pest Management	2 (2+0)
Aim of the course		
To acquaint the students with recent concepts of integrated pest management; surveillance and data base management; successful national and international case histories of integrated pest management, non-conventional tools in pest management.		
<u>THEORY</u>		
Unit I		
Principles of sampling and surveillance, database management and computer programming; simulation techniques, system analysis and modeling.		
Unit II		
Study of case histories of national and international programmes, their implementation, adoption and criticism; global trade and risk of invasive pests; updating knowledge on insect outbreaks and their management.		
Unit III		
Genetic engineering and new technologies- their progress and limitations in IPM programmes, deployment of benevolent alien genes for pest management- case studies; scope and limitations of bio-intensive and ecological based IPM programmes; application of IPM to farmers' real time situation.		

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Unit IV

Challenges, needs and future outlook; dynamism of IPM under changing cropping systems and climate; insect pest management under protected cultivation; strategies for pesticide resistance management.

Learning outcome

- Having gained sufficient experience in advanced studies of IPM the scholars should be able to independently frame IPM schedules for major crops/ cropping ecosystems (cereal/ pulse crop/ oilseed crop based/ vegetable crop based agro-ecosystems).

Suggested Reading

- Dhaliwal GS and Arora R. 2003. *Integrated Pest Management – Concepts and Approaches*. Kalyani Publishers, New Delhi.
- Dhaliwal GS, Singh R and Chhillar BS. 2006. *Essentials of Agricultural Entomology*. Kalyani Publishers, New Delhi.
- Flint MC and Bosch RV. 1981. *Introduction to Integrated Pest Management*. Springer, Berlin.
- Koul O and Cuperus GW. 2007. *Ecologically Based Integrated Pest Management*. CABI, London.
- Koul O, Dhaliwal GS and Curperus GW. 2004. *Integrated Pest Management –Potential, Constraints and Challenges*. CABI, London.
- Maredia KM, Dakou D and Mota-Sanchez D. 2003. *Integrated Pest Management in the Global Arena*. CABI, London.
- Metcalf RL and Luckman WH. 1982. *Introduction to Insect Pest Management*. John Wiley and Sons, New York.
- Norris RF, Caswell-Chen EP and Kogan M. 2002. *Concepts in Integrated Pest Management*. Prentice Hall, New Delhi.
- Pedigo RL. 1996. *Entomology and Pest Management*. Prentice Hall, New Delhi.
- Subramanyam B and Hagstrum DW. 1995. *Integrated Management of Insects in Stored Products*. Marcel Dekker, New York.

Supporting courses

Code	Course Title	Credit Hours
STAT 501	Mathematics for Applied Sciences	2+0
STAT 502	Statistical Methods for Applied Sciences	3+1
STAT 511	Experimental Designs	2+1
STAT 512	Basic Sampling Techniques	2+1
STAT 521	Applied Regression Analysis	2+1
STAT 522	Data Analysis Using Statistical Packages	2+1
MCA 501	Computers Fundamentals and Programming	2+1
MCA 502	Computer Organization and Architecture	2+0
MCA 511	Introduction to Communication Technologies, Computer Networking and Internet	1+1
MCA 512	Information Technology in Agriculture	1+1
BIOCHEM 501	Basic Biochemistry	3+1

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BIOCHEM 505	Techniques in Biochemistry	2+2
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STAT 501	Mathematics for Applied Sciences	2+0
Aim of the course		
This course is meant for students who do not have sufficient background of Mathematics. The students would be exposed to elementary mathematics that would prepare them to study their main courses that involve knowledge of Mathematics. The students would get an exposure to Linear Algebra, differentiation, integration and differential equations etc.		
Theory		
Unit I		
Set theory-set operations, finite and infinite sets, operations of set, function.		
Unit II		
Vectors and vector spaces, Matrices notations and operations, laws of matrix algebra; transpose and inverse of matrix, Eigen values and Eigen vectors. Determinants evaluation and properties of determinants, Solutions of Linear Equations.		
Unit III		
Variables and functions, limits and continuity of specific functions. Differentiation: theorems of differentiation, differentiation of logarithmic, trigonometric, exponential and inverse functions, Differentiation of function of a function, derivatives of higher order, partial derivatives. Application of derivatives, determination of points of inflexion, maxima and minima.		
Unit IV		
Integration, methods of integration, reduction formulae, definite and indefinite integral, Applications of integration in Agriculture, Differential Equations.		
Suggested Reading		
<ul style="list-style-type: none"> • Hohn FE. 2013. Elementary Matrix Algebra, 3rd Ed., Kindle Edition • Harville D.A. 1997. Matrix Algebra from a Statistician's Perspective. Springer. • Hohn F.E. 1973. Elementary Matrix Algebra. Macmillan. • Searle S.R. 1982. Matrix Algebra Useful for Statistics. John Wiley. Stewart J. 2007. Calculus. Thompson. • Thomas G.B. Jr. and Finney R.L. 1996. Calculus. 9th Ed. Pearson Edu. 		

STAT 502	Statistical Methods for Applied Sciences	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, 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.
Practical <ul style="list-style-type: none"> • 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
Suggested Reading <ul style="list-style-type: none"> • Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press. • Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press. • Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley. • Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan. • Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill. • Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition. • Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley. • Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed . John Wiley. • http://freestatistics.altervista.org/en/learning.php. • http://www.statsoft.com/textbook/stathome.html.

STAT 511	Experimental Designs	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.		

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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.
Practical
<ul style="list-style-type: none"> • 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.
Suggested Reading
<ul style="list-style-type: none"> • Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. • Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer. • Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley. • Federer WT. 1985. Experimental Designs. MacMillan. • Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd. • Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. • Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. • www.drs.icar.gov.in.

STAT 512	Basic Sampling Techniques	2+1
Aim of the course		
This course is meant for students of agricultural and animal sciences other than Statistics. The students would be exposed to elementary sampling techniques. It would help them in understanding the concepts involved in planning and designing their surveys, presentation of survey data analysis of survey data and presentation of results. This course would be especially important to the students of social sciences.		
Theory		
Unit I		
Concept of sampling, sample survey vs complete enumeration, planning of sample survey, sampling from a finite population.		
Unit II		
Simple random sampling with and without replacement, sampling for proportion, determination of sample size, inverse sampling, Stratified sampling.		
Unit III		
Cluster sampling, Multi-stage sampling, systematic sampling; Introduction to PPS sampling,		
Unit IV		
Use of auxiliary information at estimation, Ratio product and regression estimators. Double Sampling, sampling and non-sampling errors.		

Practical

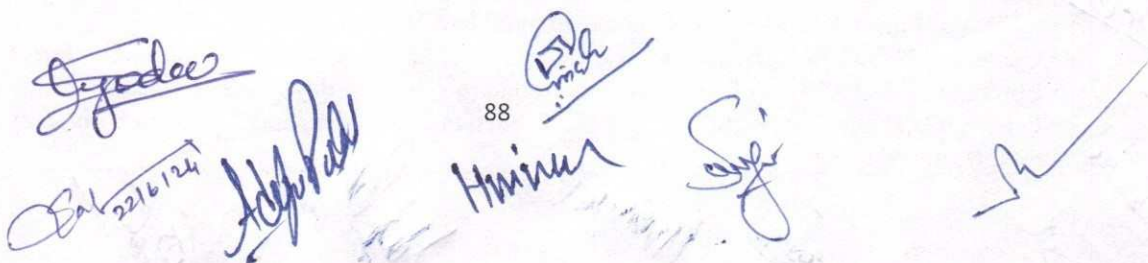
- Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.;
- Simple random sampling, determination of sample size, inverse sampling, stratified sampling, cluster sampling and systematic sampling;
- Estimation using ratio and regression estimators;
- Estimation using multistage design, double sampling.

Suggested Reading

- Cochran WG. 1977. Sampling Techniques. John Wiley.
- Murthy MN. 1977. Sampling Theory and Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
- Singh D, Singh P and Kumar P. 1982. Handbook on Sampling Methods. IASRI Publ.
- Sukhatme PV, Sukhatme BV, Sukhatme S and Asok C. 1984. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.
- Cochran WG. 2007. Sampling Techniques, 3rd Edition. John Wiley & Sons Publication

STAT 521	Applied Regression Analysis	2+1
Aim of the course		
This course is meant for students of all disciplines including agricultural and animal sciences. The students would be exposed to the concepts of correlation and regression. Emphasis will be laid on diagnostic measures such as autocorrelation, multi collinearity and heteroscedasticity. This course would prepare students to handle their data for analysis and interpretation.		
Theory		
Unit I		
Introduction to correlation analysis and its measures, Correlation from grouped data, correlation, Rank correlation, Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.		
Unit II		
Problem of correlated errors; Auto correlation; Heteroscedastic models, Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multi collinearity, Regression analysis; Method of least squares for curve fitting; Testing of regression coefficients; Multiple and partial regressions.		
Unit III		
Diagnostic of multiple regression equation; Concept of weighted least squares; regression equation on grouped data; Various methods of selecting the best regression equation.		
Unit IV		
Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial.		
Practical		
<ul style="list-style-type: none"> • Correlation coefficient, various types of correlation coefficients, partial and multiple, testing of hypotheses; • Multiple linear regression analysis, partial regression coefficients, testing of hypotheses, residuals and their applications in outlier detection; • Handling of correlated errors, multi collinearity; • Fitting of quadratic, exponential and power curves, fitting of orthogonal polynomials. 		

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Suggested Reading

- Kleinbaum DG, Kupper LL, Nizam A. 2007. Applied Regression Analysis and Other Multivariable Methods (Duxbury Applied) 4th Ed.
- Draper NR and Smith H. 1998. Applied Regression Analysis. 3rd Ed. John Wiley.
- Ezekiel M. 1963. Methods of Correlation and Regression Analysis. John Wiley.
- Koutsoyiannis A. 1978. Theory of Econometrics. MacMillan.
- Kutner MH, Nachtsheim CJ and Neter J. 2004. Applied Linear Regression Models. 4th Ed. With Student CD. McGraw Hill.

STAT 522	Data Analysis Using Statistical Packages	2+1
Aim of the course		
This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students a hands on experience in the analysis of their research data. This course is useful to all disciplines.		
Theory		
Unit I		
Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.		
Unit II		
Test for normality; Testing of hypothesis using chi-square, t and F statistics and Z-test		
Unit III		
Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.		
Unit IV		
Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.		
Unit V		
Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.		
Practical		
<ul style="list-style-type: none"> • Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data; • Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for large samples - Chi-squares test, F test, one-way analysis of variance; • Designs for Factorial Experiments, fixed effect models, random effect models, mixed effect models, estimation of variance components; • Linear regression, Multiple regression, Regression plots; • Discriminant analysis - fitting of discriminant functions, identification of important variables; • Factor analysis. Principal component analysis - obtaining principal component. 		
Suggested Reading		
<ul style="list-style-type: none"> • Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley. • Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press. • Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmont, California. • Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall. • Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California. • Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley. • Erickson B.H. and Nosanchuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes. 		

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- Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.
- Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.
- Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.
- Weisberg S. 1985. Applied Linear Regression. John Wiley.
- Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.
- Wetherill GB. 1986. Regression Analysis with Applications. Chapman & Hall.
- Cleveland WS. 1994. The Elements of Graphing Data, 2nd Ed., Chapman & Hall
- <http://freestatistics.altervista.org/en/learning.php>.
- <http://freestatistics.altervista.org/en/stat.php>.
- http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
- <http://www.stat.sc.edu/~grego/courses/stat706/>.
- www.drs.icar.gov.in.

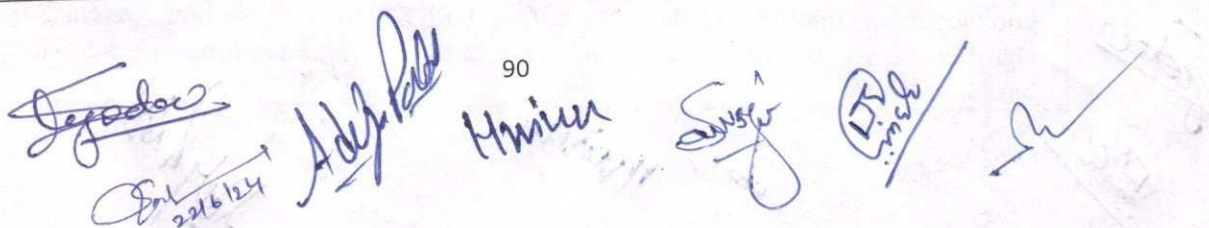
Compulsory Common Courses (Needs to be studied; if had not undertaken during M.Sc. (Ag.) Entomology)

Course Code	Course Title	Credit Hours
PGS-501	Library and Information Services	0+1
PGS-502	Technical Writing and Communications Skills	0+1
PGS-503	Intellectual Property and its Management in Agriculture	1+0
PGS-504	Basic Concepts in Laboratory Techniques	0+1
PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0

PGS-501	Library and Information Services	0+1
<p>Objective To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.</p>		
<p>Practical Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.</p>		

PGS-502	Technical Writing and Communications Skills	0+1
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Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc.
To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
 - Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
writing of abstracts, summaries, précis, citations, etc.,
 - Commonly used abbreviations in the theses and research communications;
 - Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
 - Writing of numbers and dates in scientific write-ups;
 - Editing and proof-reading;
 - Writing of a review article;
 - Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
 - Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
 - Accentual pattern: Weak forms in connected speech;
 - Participation in group discussion;
 - Facing an interview;
- Presentation of scientific papers

Suggested Readings

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

PGS-503	Intellectual Property and its Management in Agriculture	1+0
Objective The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy		

Theory

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

Suggested Readings

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

PGS-504	Basic Concepts in Laboratory Techniques	0+1
Objective To acquaint the students about the basics of commonly used techniques in laboratory.		
Practical <ul style="list-style-type: none">• Safety measures while in Lab;• Handling of chemical substances;• Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vascupets;• Washing, drying and sterilization of glassware;• Drying of solvents/ chemicals;• Weighing and preparation of solutions of different strengths and their dilution;• Handling techniques of solutions;• Preparation of different agro-chemical doses in field and pot applications;• Preparation of solutions of acids;• Neutralisation of acid and bases;• Preparation of buffers of different strengths and pH values;• Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;• Electric wiring and earthing;• Preparation of media and methods of sterilization;• Seed viability testing, testing of pollen viability;• Tissue culture of crop plants;		

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- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
2. Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
<p>Objective</p> <p>To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.</p>		
<p>Theory</p> <p>UNIT I</p> <p>History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.</p> <p>UNIT II</p> <p>Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.</p> <p>UNIT III</p> <p>Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.</p>		
<p>Suggested Readings</p> <ol style="list-style-type: none"> 1. Bhalla GS and Singh G. 2001. <i>Indian Agriculture - Four Decades of Development</i>. Sage Publ. 2. Punia MS. <i>Manual on International Research and Research Ethics</i>. CCS Haryana Agricultural University, Hisar. 3. Rao BSV. 2007. <i>Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives</i>. Mittal Publ. 4. Singh K. 1998. <i>Rural Development - Principles, Policies and Management</i>. Sage Publ. 		

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