# Rama University Uttar Pradesh, Kanpur

**Ref:** RU/FASAI/GPB/01 **Dated:** 28/05/2018

## Faculty of Agriculture Sciences & Allied Industries

### Department of Genetics and Plant Breeding

### Minutes of Meeting

### Boards of Studies

A meeting of Boards of Studies of **M.Sc. Agriculture (Genetics and Plant Breeding)** held on 28th May 2018 at 11:30 AM in Director Office. The following members were present:

1. Dr. Rajendra Prasad - Chairperson
2. Dr. Aneeta Yadav - Member
3. Dr. K. K. Mishra - Member

The following members agreed to review the minutes in Kanpur.

1. Dr. Lokendra Singh - External Member
2. Dr. Sanjay Kumar Singh - External Member

**Agenda:**

**To consider and approve the syllabus and evaluation scheme of for M. Sc. Agriculture (Genetics and Plant Breeding).**

The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later.

Dr. Rajendra Prasad
(Chairman)

***Encl.: The Recommended syllabus and evaluation scheme for consideration and approval.***

CC:
1. Dean
2. Registrar Office

## Program Outcomes of M. Sc. (Ag) Genetics and Plant Breeding

In the area of Genetics & Plant Breeding an effort has been made to retain relevant core concepts and principles of Genetics and Plant Breeding as such. However, new topics and courses have been added to infuse new blood in the area. The purpose of the Department of Genetics and Plant Breeding is to provide basic and applied knowledge of genetics and their implications in plant breeding, directed toward all aspects of crop improvement, including conventional and non conventional breeding approach, as they affect commercial crop worldwide. The mission is accomplished by providing quality education, conducting basic and applied research for the students and disseminating information among the farming community through the help of extension workers.

**Program outcomes of Genetics and Plant Breeding are:**

P.O.1: To enable students of M.Sc. Genetics and Plant Breeding in understanding the applicability of the breeding approaches for varietal development program in terms of high yielding variety, resistant to biotic and abiotic stresses, wider adoptability, to develop critical thinking and professional skills needed for successful careers in public and private sectors, the program provides training and coursework to help students develop the following skills:

a. Understanding, interpretation and synthesis of scientific literature pertaining to Genetics and Plant Breeding and related disciplines.

b. Formulating hypotheses; developing experimental designs to test these hypotheses.

c. Collecting data as per the objectives and conducting appropriate statistical analyses.

d. Interpretation and presentation of results of the respective research in Thesis form.

e. Presentation of research at professional meetings, seminars, conferences etc.

f. Publication of research in peer-reviewed scientific journals.

P.O. 2: To maintain a leadership role in Genetics and Plant Breeding and related disciplines at the state, national and international levels, the program aims to:

a. Attract, retain and train high quality Post graduate students.

b. Placement of students in different agencies or private sectors dealing with seed production and hybrid development.

P.O. 3: Suggested Areas of Research have also been added for providing directions to future researches. Apart from this, Industrial linkages, guest lectures, industry and farm visits will also be required to provide real life exposure.

P.O.4: New courses including biotechnology, molecular breeding, molecular genetics, maintenance breeding and plant genetic resources were included in the new syllabus.

P.O.5: Provisions are made to train the students in modern breeding and seed production methods through training programs.

**Program Specific Outcomes of Genetics and Plant Breeding are:**

**PSO 1:** Understanding the concepts of breeding and varietal development.

**PSO 2:** Understanding the role of biotechnology, physiology and molecular genetics in plant breeding.

**PSO 3:** Suitability of the candidates for job opportunities in different seed based industries, transgenic development etc.

## Programme Educational Outcome: Genetics and Plant Breeding

Genetic manipulation in plants has underpinned improvements in productivity and has enhanced sustainability of farming systems worldwide. As well, plant genetic diversity is fundamental to understand adaptation in natural systems. This course introduces the fundamental concepts of plant breeding and plant adaptation that are applicable to agricultural and natural systems. Extensive industry engagement is also undertaken as part of the course curriculum where students connect with industry leaders in the plant breeding discipline, whether in broad-acre cropping (e.g. wheat, barley, maize, rice, pulses breeding) or horticulture (e.g. Okra, tomato.chilli, brinjal etc.). The topics covered include: genetic diversity in relation to adaptation, productivity, pest and disease resistance and end-use quality; strategies for setting breeding objectives and maximising selection and improvement of key traits; breeding methodologies for self or cross pollinated plants.

The anticipated knowledge, skills and/or attitude to be developed by the student are:

1. Describe sources and types of genetic variation and explain their importance for plant improvement.

2. Describe the progression of stages within a modern breeding programme from the setting of breeding objectives, through the development and implementation of breeding strategies to the commercialisation of plant varieties and the protection of intellectual property.

3. Describe methods that are used in plant breeding.

4. Locate, analyse, evaluate and synthesise information relevant to plant breeding.

5. Judge which plant breeding methods are appropriate for specific objectives and situations.

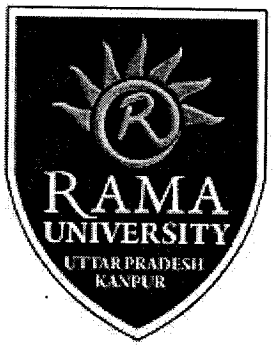
6. Formulate and justify a plan for the application of plant breeding methods to achieve a specific objective.

7. Carry out specific plant breeding activities, such as selection of parental germplasm, observation and recording of phenotypic
variation and selection among progeny.

# RAMA UNIVERSITY

Faculty of Agricultural Sciences & Allied Industries

Department of Genetics and Plant Breeding




ORDINANCE

For

M.Sc. (Ag.) GPB
PROGRAMME

ORDINANCE GOVERNING THE DEGREE OF MASTER OF SCIENCE (AGRICULTURE) GENETICS AND PLANT BREEDING / (M.SC. (Ag.) GPB

1. DEFINITIONS OF KEY WORDS:

(i) University: Rama University, Kanpur U.P.,

(ii) Academic Year: Two consecutive (one odd followed by one even) semesters constitute one academic year.

(iii) Semester: Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

(iv) There shall be subjects of studies for the Master of Science in Agriculture *i.e.* M. Sc. (Ag.) in Genetics and Plant Breeding at Rama University, Kanpur (Faculty of Agricultural Sciences & Allied Industries). Introduction of any new subject(s) of studies in PG Level at the Institute will be made in due course without modification of the ordinance.

(v) The Post-graduate Degree courses of two-year duration comprising four semesters will run under "Course and Credit System".

(vi) A candidate seeking admission to M. Sc. (Ag.) Genetics and Plant Breeding Programme is required to produce a certificate that he / she has passed the four-year B. Sc. (Ag.) Honours degree examination of Rama University or equivalent examination recognized by the ICAR and/or the UGC. The other eligibility criteria like percent of marks, OGPA etc. will be decided as per University guidelines, which may vary from time to time.

(vii) The candidate admitted for admission to the M.Sc. (Ag.) Genetics and Plant Breeding Programme shall abide by the regulations regarding the course curricula and the academic standards as prescribed by the University from time to time.

(viii) The medium of instruction and examination shall be in English.

Department and major field of specialization: Faculty of Agricultural Sciences & Allied Industries, Rama University, Kanpur offers Master's degree in the Genetics and Plant Breeding programmes with major studies in:

| M. Sc. (Ag.) | Major subject(s) |
|---|---|
| Genetics and Plant Breeding | Genetics and Plant Breeding |

2. Standing Committee (PG Programme):

a. A Standing Committee (PG Programme) shall be formed for examining the issues related to M. Sc. (Ag.) Genetics and Plant Breeding Programme of the Faculty.

b. The composition of the Standing Committee (PG Programme) shall be

i. Chairman: A Senior Professor appointed by the Dean of the Faculty.

ii. Head of the Department.

iii. PG Coordinator of each M. Sc. (Ag.) Genetics and Plant Breeding Programme.

c. Function of Standing Committee (M.Sc. (Ag.) Genetics and Plant Breeding Programme) may include:

i. Looking after the general work of M. Sc. (Ag.) Programme of the Bhavana.

ii. Reviewing academic standards including syllabus, examinations etc.

iii. Looking after matters related to examinations, evaluation etc.

3. PG Coordinator:

a. BOS/Departmental Committee of the Department offering M. Sc. (Ag.) Genetics and Plant Breeding Programme, may select a faculty member as a PG Coordinator for course.

b. The Course Coordinator will look after smooth running of M. Sc. (Ag.) Programme of the Department.

4. Academic Session and Semester Calendar:

a. The duration of M. Sc. (Ag.) Genetics and Plant Breeding Programme shall be of two academic years consisting of four semesters. The maximum allowable semesters for completion of M. Sc. (Ag.) Genetics and Plant Breeding Programme is eight (8).

b. The academic year of M. Sc. (Ag.) Genetics and Plant Breeding Programme shall be in terms of two semesters in a year. The odd semesters (i.e. First and Third) shall run in the first half of an academic year and even semesters (i.e. Second and Fourth) shall run in the second half of the same academic year. The broad schedule of two semesters is:

| | |
|---|---|
| Odd semesters (I & III) | July to December |
| Even semesters (II & IV) | January to June |

c. The commencement of each semester in a particular academic year shall be decided by the Standing Committee (PG Programme) from time to time.

d. There shall be no semester break but summer and autumn recesses and enlisted holidays will be followed as prescribed by the University.

5. Courses:

a. Code: Each course shall bear a distinguishing code (three letters and three digits) that identifies the discipline from which it is being offered.

b. Code numbers:

i. Course seminar shall be designated by Code No. MSG-591

ii. Master's research (Thesis) shall be designated by Code No. MSG-600

c. There shall be two types of courses, "credit courses" and "non-credit courses". Grade points obtained only in 'credit courses' will be considered for the classification of results. Performance in non-credit courses including Thesis will be as "Satisfactory/No satisfactory"

d. There shall be four types of credit courses, "only theory courses", "only practical courses", "composite courses" and "credit seminar". The composite courses will consist of both theory and practical components.

e. The distribution of marks in various courses of M. Sc. (Ag.) shall be:

| | | |
|---|---|---|
| i. | For 'only theory courses' | |
| | Semester Terminal Examination | 80 |
| | Internal Assessment | 20 |
| | Total | 100 |
| ii. | For 'only practical courses' | |
| | Semester Terminal Practical Examination | 80 |
| | Internal Assessment | 20 |
| | Total | 100 |

| | | |
|---|---|---|
| iii. | For 'Composite courses' i.e. Theory & Practical (60:40)<br>Semester Terminal Theory Examination<br>Internal Assessment (Theory)<br>Semester Terminal Practical Examination Total | <br>50<br>20<br>30<br>100 |
| iv. | For 'Credit seminar' | 100 |

f. Internal assessment:

Internal assessment will be done in the form of Continuous Evaluation having at least two tests of different forms (tutorial, class test as objective, essay, viva-voce, quiz type, assignment/term paper, class seminar, group discussion, interaction, small projects etc.) per course. The tests should be spread throughout the Semester but 15 days before the commencement of Terminal Examination. At least 50 % weightage should be on written form of tests. In case of the student who fails to appear in the Terminal examination of a given semester but appears in Internal Assessment (continuous evaluation) of the courses, marks of internal assessment of the student will remain valid during his/her next chances but if a student remains absent or scores low or nil marks even in internal assessment, he/she will not be permitted to reappear for internal assessment after the semester is over.

Within 15 days of conducting the Tests, the Course Instructors will submit marks in the prescribed form in duplicate to the HoD who will sign on both the copies, keep one copy for office use and forward the other copy to the Controller Examinations. The marks of the Internal Assessment should be displayed in the Department for at least seven days before forwarding the same to the Controller Examination. Once the marks of the Internal Assessment are submitted to the Controller Examination by the Department, the marks cannot be corrected or changed.

g. Marks scored in Internal Assessment are to be mentioned separately in the Mark sheet. h. Courses:

i) Major courses: The discipline in which the student shall pursue major study in his/her Master Programme. ii) Minor courses: The discipline closely related to a student's major discipline. Split minors will be permissible.

iii) Supporting courses: It could be any discipline excluding major considered relevant for student's research work or necessary for building his/her overall competence.

iv) Non-credit compulsory courses: Courses are of general nature and are compulsory for M. Sc. (Ag.) Genetics and Plant Breeding Programme. Students' require completing course as stated below:

| CODE | COURSE TITLE | CREDITS |
|---|---|---|
| PGS 202 | Library and Information Services | 0+1 |

i. One credit hour indicates one hour lecture or two hours practical work per week for the entire semester.

6. Credit Requirements:

a. A student is required to complete a minimum of 60 credits of which 40 credits shall be of course work and 20 credits shall be allocated for the research (Thesis) work.

b. A student's programme of studies shall not be more than 25 credits in any semester.

c. The total course and credit requirements for obtaining Degree shall be:

| Particulars | Minimum Credits |
|---|---|
| i) Course Work | |
| Major courses | 25 |
| Minor courses | 09 |
| Supporting courses | 05 |
| Non-credit Compulsory courses | 06 |
| Seminar | 01 |
| Total | 46 |
| ii) Comprehensive Examination | Non-Credit |
| iii) Thesis | 20 |

d. In addition to above a candidate may be permitted to opt for required number of credits from optional major courses and minor or supporting courses as suggested the Chairman of Advisory Committee.

7. Course Regulation:

a. The courses to be offered in a particular academic year or semester shall be decided by the BOS/HOD based on available facilities and faculty strength.

b. Allotment of courses, designating faculties as Course Instructors and Course Associates shall be decided by the BOS/HOD well in advance of the commencement of a semester. The Course Leader will be in rotation considering the workload of each teacher associated with a particular course.

c. Towards introduction of a new course or revision of course, University rules will be followed.

d. There shall be no rigid rule or guideline regarding the minimum number of students required for offering a course. The course will be offered even for a single student.

e. There shall be the provision of inviting the Guest Lecturers to deliver lecture on some highly specialized topics if required.

8. Course Registration:

The students will have to submit their choices for course(s) for a particular Semester in writing (in prescribed format) to the HOD through the Major Advisor and PG Coordinator of Department at least one week before the commencement of classes of the said Semester. Students intending to change the Course opted for once will be allowed to do so in the same process within 15 days after the initial Registration.

9. Advisory Committee:

a. The Advisory Committee consisting of at least three members from both major and minor subjects shall be constituted for each student.

b. Every student shall have a Major Advisor who shall be from the Major Field to which the student has been admitted. The Major Advisor shall function as the Chairman of the Advisory Committee.

c. The nomination for Chairman of the Advisory Committees of all newly admitted students shall be completed within four weeks of the first Semester by the HoD.
d. The Advisory Committee of the student should meet frequently to monitor the progress of the student.
e. A proposal for the formation of the students' Advisory Committee along with the Plan of Postgraduate Work shall be forwarded in the prescribed proforma to the HoD for approval within six weeks from the date of admission of the student.
f. The Major Advisor will select other members of the student's Advisory Committee (with the knowledge and consent of the members concerned). Co-advisor shall be from the major field of study/specialization of the Department; Member(s) one each from the Department(s) offering Minor Courses; and Member(s), from any discipline, if Major Advisor feels it necessary for the student's Thesis work.
g. Co-advisor will act as the Major Advisor of the concerned student if the original Chairman is not available due to one or more reasons (death, leaving the university, prolonged absence, ill health etc.)
h. Replacement of members of the Advisory Committee: The Chairman of the concerned student after consultation with the HoD can replace any member of the Advisory Committee due to one or more reasons as stated in Para 9. g above.
i. In case of newly admitted students, the HoD will discharge the functions of the Chairman of the Advisory Committee till the Chairman is selected as per procedure prescribed above.
j. A faculty member having a minimum of one year teaching/ research experience or Doctoral degree can be the Chairman of the Advisory Committee.

10. Plan of Post-graduate Work (PPW):

a. The programme of studies indicating the PPW of each student in prescribed format shall be finalized by his/her Advisory Committee to provide considerable latitude in the choice of courses, taking into account the requirement for research in that particular field.
b. The broad research topic of every student will be mentioned at the time of preparation of PPW. The Advisory Committee should finalize PPW within six weeks of the first Semester.

11. The Outline of Research Work (ORW):

a. The ORW in prescribed format will have to be approved by the Advisory Committee and forwarded by the Chairman of the Committee to the HoD through the PG Coordinator.
b. The ORW will be presented in the Departmental Seminar for discussion and suggestions.

12. Attendance:

Candidates should have an average attendance of 75% in every Semester to be eligible to appear for the Terminal Examination of a given Semester. Candidates having 60% and more but less than 75% attendance may be allowed to appear in the Semester Examination after paying the requisite fine as decided by the University from time to time.

13. Paper setting and Evaluation:

a. In the Semester Terminal examination question papers for fifty percent of the major courses in each semester shall be set externally and evaluated externally. But for only practical courses evaluation will jointly be made by the external and internal(s) examiners. For minor course(s) concerned BoS will make appropriate arrangement.
b. In case any external examiner fails to arrive in the practical examination, the concerned HoD may exercise the option to appoint himself or any other teacher of the University or an expert available in the vicinity other than internal examiner(s).

c. For all the non-credit compulsory courses the paper setting as well as evaluation will be made internally.

14. Examination and Regulation:

a. Semester Terminal examinations for odd Semesters shall ordinarily be held in December while for even Semesters be held in the month of June in every academic year. Standing Committee (PG Programme) will fix the period of every Semester Terminal examination preferably at the beginning of the semester. It is also expected that the Semesters of M. Sc. (Ag.) Genetics and Plant Breeding Programme in the Faculty will commence at the same time.

b. The candidates shall be required to pass all the courses mentioned in his/her PPW. He/she also needs to complete required Thesis credit hours within the stipulated period i.e. not more than eight (8) Semesters.

c. Before appearing in the end semester theory and/or practical examinations (both theory and practical examinations for composite courses) the student must pass all the backlog paper(s).

d. There shall be the provision for Review System and the evaluation will be done internally. The BoS will recommend the names of three members (HoD and other two members excluding the first examiner) for Review Examination. In case the HoD has evaluated the course, Adhyksha will act as a member in the Board replacing the HoD.

e. The duration for semester Terminal examination of different courses shall be as follows:

i) For theory courses: 3 hours ii)
For practical courses: 3 hours

f. The candidates appearing in each Semester Terminal examination of M.Sc. (Ag.) Genetics and Plant Breeding Programme shall: (i) produce a certificate from the HoD that he/she has attended at least 75 % of the in-campus classes. Relaxation, if any, will be guided by the University Ordinance; (ii) produce a certificate from HoD that his/her conduct has been good and that he/she is fit and proper candidate for the examination.

g. A student found adopting unfair means at the examination will be treated heavily and stringent action will be taken as per University rules.

h. No 'make up' examination shall be permitted in lieu of the missed Terminal theory and/or practical examination.

i. If a student fails to appear in any final theory and /or practical examination or does not secure pass marks in any course, he/she requires fresh registration for the course during the next available Semester with that course but the candidate has to complete the degree programme including all the repeat courses within eight (8) Semesters.

j. If a candidate is compelled to drop a Semester on medical ground he/she will be allowed to repeat in the next available Semester. However, he/she has to complete all the courses within eight (8) Semesters.

k. If a student has to drop a course on medical ground but having less than 75 % attendance the student shall be given 'I' grade, i.e. "incomplete", and will be allowed to repeat the course in the next available Semester. The 'I' grade shall be entered in the transcript also. In all other cases dropping of course will be declared 'Fail' in the course.

15. Fees and other Charges:

Student admitted to M.Sc. (Ag.) Genetics and Plant Breeding Programme shall pay examination fees (as per University guidelines) for each Semester Terminal Examination at the time of filling up of form for the purpose.

16. Moderation:

a. A Moderation Committee consists of at least three members may be appointed as per University rule but excluding an external moderator, shall do moderation of question papers for the Terminal Theory Examinations.
b. Separate Moderation Committee shall be formed for each M. Sc. (Ag.) Programme and that may act under the Chairmanship of HoD.

17. Scrutiny:

a. There shall be a Scrutiny Committee consisting of HoD and two other teachers of the Department to scrutinize the results of internal assessment, Terminal as well as Review examinations before finalization. The BoS of the concerned Department will approve the Committee.
b. M.Sc. (Ag.) Genetics and Plant Breeding Programme will have separate Scrutiny Committee that will act independently.

18. Credit Seminar:

a. Each student shall be required to deliver a Seminar during the course of studies on a topic relevant to the concerned discipline.
b. Code No. 380 shall be assigned for Course Seminar.
c. PG Coordinator shall act as Seminar Leader. Otherwise, HoD of Department himself or may select any faculty member as Seminar Leader.
d. Departmental students' Credit Seminar will be an open Seminar.
e. The Seminar Leader in consultation with the HoD shall fix the schedule for the Seminars.
f. The Seminar topic shall not be within the purview of the student's Thesis instead should cover a subject of topical interest.
g. Each student will prepare and distribute copies of 'Abstract' to the persons attending the Seminar. The Abstract (within 300 words) should precisely state the main theme of the talk.
h. Seminar write-up: The student shall prepare a full account (not normally exceeding 3000 words) on the topic covered in the seminar and submit to the Seminar Leader on or before the date of presentation of the Seminar.
i. Seminar evaluation: Seminar Leader and the members of the Advisory Committee will evaluate the performance of the students, taking into account all the relevant factors like, Introduction, Review of Literature, presentation of subject, capacity to draw general conclusion from literature and ability to answer questions raised and will award marks to the student.

19. Comprehensive:

a. Every student has to appear at Comprehensive Examination to be conducted by the Advisory Committee.
b. A candidate should be allowed for comprehensive examination after completion of 75% course work separately in major and minor subject(s) but before the submission of Thesis.
c. Written comprehensive examination consists of one paper in major courses and one paper in minor courses each of three hours duration having 100 marks.
d. Paper setting and evaluation will be done internally.
e. Qualifying marks will be 50% and grading will be Satisfactory/Unsatisfactory. If the performance of a student becomes unsatisfactory he/she has to appear again to a maximum of three more attempts within eight (8) Semesters. Repeat comprehensive test (s) shall be conducted at least with a gap of 30 days of the previous test.
f. The results of comprehensive examination shall be forwarded by the HoD to the Examination Section for record. The grade obtained will not be reflected in the Final transcript.

20. Thesis:

a. The thesis for the Master's Degree shall indicate student's potentialities for conducting research.
b. The topic of Thesis will be within the Major Field of specialization under the Code No. 399.
c. The subject of the Thesis should be approved by the student's Advisory Committee and the HoD at the time of formation of the student's PPW and then ORW.
d. The Thesis shall be based on the results of the student's own work. A certificate to this effect from the Major Advisor shall accompany the Thesis.
e. The Thesis shall preferably follow the following: chapters on Introduction, Review of literature, Materials and Methods, Results, Discussion, Conclusion and Summary, Future scope of research and References.
f. Thesis Seminar: A student shall deliver a seminar on the research problem before the submission of Thesis and all the faculty members may be invited to participate in the discussion and make constructive suggestions on the Thesis.
g. Thesis submission: After fulfilling the prescribed courses, residential requirements and minimum semester requirements (4 Semesters) and successfully completing the research work to the level of full satisfaction, a student shall submit the Thesis.
h. The Chairman of the student's Advisory Committee shall ensure that all members of the Advisory Committee are duly consulted before submission of the manuscript of the Thesis.
i. Each student shall submit three copies of the Thesis within the date notified by concerned HOD, one copy to deposit to the Institute Library, another to the Departmental Library, third to the Major Advisor.
j. The Thesis shall accompany a certificate to the effect that the work has not been submitted in part or full for any other degree or diploma.
k. The candidate shall submit the Thesis to the concerned HoD along with "no dues certificate" and other formalities.
l. Thesis Viva-Voce: An External Examiner shall examine the Thesis. An arrangement for viva voce shall be made by the concerned Department by an Examination Committee consisted of External Examiner, HoD and the members of the Advisory Committee of the candidate. The student shall be awarded "Satisfactory" (i.e. pass) or "non-satisfactory" (i.e. fail) in Thesis VivaVoce.
m. The grade obtained (i.e. Satisfactory/Non-satisfactory) shall be shown in the final transcript but shall not be included for the purpose of calculation of OGPA.
n. In case, the External Examiner suggests modification/re-submission, the student may be permitted to defend his/her thesis in final viva-voce, and as such of modifications as are finally agreed upon may be carried out after the viva-voce.
o. Re-examination: If a student fails (i.e. non-satisfactory) in Thesis he/she may be permitted to continue the work and/or rewrite the Thesis as per comments of the Examination Committee and resubmit it to the HoD with the recommendation of the Chairman of the Advisory Committee for permission to appear a second time. Re-examination shall not take place earlier than three months after the final semester examination but within eight (8) Semesters and as far as possible the Committee as previously constituted, will conduct it. No further reexamination is permissible and a student failing to secure 'satisfactory' grade a second time shall not qualify for the degree

21. Rights on Thesis:

a. The Thesis submitted by a student shall become the property of the Institute.

b. Whenever, an extract from the Thesis is published, there should be an acknowledgement in the form of footnote stating that the results are from the Thesis submitted for the degree from the Faculty of Agricultural Sciences & Allied Industries, Rama University.
c. All patents, designs and inventions derived from the Thesis research work shall belong to the Faculty which may, at its discretion, allow or direct any benefit thereon to be retained by or given to the author of the Thesis.
d. Copies of the Thesis submitted to the University Library or in the Departmental Library shall not be issued on loan for a period of two years from the date of submission.
e. In case where student does not take care to publish the Thesis work even after three years of completion of the degree, there stands no objection of the student to publish papers/articles by the Chairman, Advisory Committee of the concerned student.

22. Grading System:

a. There will be a ten point grading system of evaluation with grade point (GP) equals to percent marks obtained divided by 10.
b. The conversion formula will be: Percent of marks = 10 x OGPA
c. Minimum requirement: Grade point (GP) of 5.00 for passing a course and an Overall Grade Point Average (OGPA) of 5.00 for completing the M. Sc (Ag.) Genetics and Plant Breeding Programme. A candidate failing to secure minimum OGPA (5.00) will not be considered for the award of degree and shall be declared as 'failed'. If a candidate fails to secure 40 % marks in Practical examination of composite course he /she will be declared as 'fail' in the concerned course.
d. A candidate failing to obtain minimum GP (5.00) in not more than three courses, in a Semester, will be allowed to repeat the failed course(s) afresh not more than two times in next available Semesters. A candidate failing in more than three courses in a Semester has to repeat the Semester. In any circumstance the student is to complete the degree Programme including all the repeat courses within the maximum of 08 Semesters.
e. Symbols to be used in the Semester Transcript:

I = Incomplete
S = Satisfactory
NS = Non-Satisfactory R
= Repeat

Specialization of the candidate needs to be mentioned in the Semester Mark sheet/Transcript.

23. Residential Norms:

a. Residential requirement shall mean presence of the student continuously in working days/hours in the Institute/University (class room for classes, laboratories for practical and/or research, farm for field work, library for collecting information or placed somewhere on duties etc.).
b. The minimum residential requirement shall be of four Semesters from the date of admission to the University. However, with the prior written permission of the HoD, PSB through the Chairman a student may be allowed to discontinue after completion of two consecutive Semesters and renew studies even after two Semesters. Completion of semester shall mean clearing of all examinations as scheduled. He/she has to pay annual fees for the University for Retention of the studentship.
c. A student may be allowed for discontinuance only by one break and he/she shall have to complete all courses including submission of Thesis within eight semesters from the date of admission to the University, failing which his/her studentship shall be treated as cancelled.

d. A student appealing discontinuance for one or two semester(s) has to vacate hostel accommodation.

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**Faculty of Agricultural Sciences & Allied Industries**

**Rama University Uttar Pradesh, Kanpur**

Course Detail and Evaluation Scheme
(Effective from the Session 2018-19)

## M.Sc.(Ag.) GENETICS & PLANT BREEDING FIRST YEAR (SEMESTER-I)

| S.N. | Subject Code | Subject Name | Period | | | Evaluation Scheme | | | Subject Total | Credit Hours |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | CE | MTE | ETE | | |
| **Theory subjects** | | | | | | | | | | |
| 1 | MSG-101 | Principles of Genetics | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 2 | MSG-102 | Principles of Cytogenetics | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 3 | MSBT- 103 | Principles of Biotechnology | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| **Practicals / Project** | | | | | | | | | | |
| 4 | MSG -151 | Principles of Genetics | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 5 | MSG – 152 | Principles of Cytogenetics | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 6 | MSBT -153 | Principles of Biotechnology | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| **Total** | | | **6** | **0** | **3** | **150** | **120** | **330** | **600** | **9** |

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1 Attendance: 5 Marks
2 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**Convener**

Signature: .....
Name : Dr. Rajendra Prasad
Date :

**Internal Members**

Signature: 1..... 2.....
Name: Dr. Aneeta Yadav Dr. K. K. Mishra
Date:

**External Members**

Signature: 1..... 2.....
Name: Dr. Lokendra Singh Dr. Sanjay Kumar Singh
Date:

**Faculty of Agricultural Sciences & Allied Industries**

**Rama University Uttar Pradesh, Kanpur**

Course Detail and Evaluation Scheme
(Effective from the Session 2018-19)

## M.Sc.(Ag.) GENETICS & PLANT BREEDING FIRST YEAR (SEMESTER-II)

| S.N. | Subject Code | Subject Name | Period | | | EVALUATION SCHEME | | | Subject Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | CE | MTE | ETE | | |
| **Theory subjects** | | | | | | | | | | |
| 1 | MSG-201 | Principles of Plant Breeding | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 2 | MSG-202 | Principles of Quantitative Genetics | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 3 | MSBT-203 | Biotechnology for Crop Improvement | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 4 | MSG-204 | Basic Design of Experiments | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 5 | MSG-591 | Master Seminar | 0 | 0 | 1 | 0 | 0 | 100 | 100 | 1 |
| **Practicals / Project** | | | | | | | | | | |
| 6 | MSG-251 | Principles of Plant Breeding | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 7 | MSG-252 | Principles of Quantitative Genetics | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 8 | MSBT-253 | Biotechnolgy for Crop Improvement | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 9 | MSG-254 | Basic Design of Experiments Lab | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 10 | PGS 202 | Library and Information Services | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| **Total** | | | **8** | **0** | **5** | **200** | **160** | **430** | **800** | **14** |

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

3 Attendance: 5 Marks

4 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks .

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks
  a. First Mid Term Examination: 10 marks
  b. Second Mid Term Examination: 10 marks
ETE - End Term Examination: 50 Marks

**Convener**
Signature: .....
Name Dr. Rajendra Prasad
Date :

**Internal Members**
Signature: 1..... 2.....
Name: Dr. Aneeta Yadav Dr. K. K. Mishra
Date:

**External Members**
Signature: 1..... 2.....
Name: Dr. Lokendra Singh Dr. Sanjay Kumar Singh
Date:

**Faculty of Agricultural Sciences & Allied Industries**

**Rama University Uttar Pradesh, Kanpur**

Course Detail and Evaluation Scheme

(Effective from the Session 2019-2020)

## M.Sc.(Ag.) GENETICS & PLANT BREEDING SECOND YEAR (SEMESTER-III)

| S.N. | Subject Code | Subject Name | Period | | | EVALUATION SCHEME | | | Subject Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | CE | MTE | ETE | | |
| **Theory Subjects** | | | | | | | | | | |
| 1 | MSG- 301 | Cell Biology & Molecular Genetics | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 2 | MSG- 302 | Breeding for Biotic and Abiotic Stress Resistance | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 3 | SST- 303 | Principles and Practices of Seed Production | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 4 | PPA- 301 | Diseases of Field Crops | 2 | 0 | 0 | 20 | 20 | 60 | 100 | 2 |
| 5 | PGS- 301 | History of Agriculture | 1 | 0 | 0 | 20 | 20 | 60 | 100 | 1 |
| **Practicals / Project** | | | | | | | | | | |
| 6 | MSG- 351 | Cell Biology & Molecular Genetics | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 7 | MSG- 352 | Breeding for Biotic and Abiotic Stress Resistance | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 8 | MSG- 353 | Principles and Practices of Seed Production | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| 9 | PPA- 351 | Diseases of Field Crops | 0 | 0 | 1 | 30 | 20 | 50 | 100 | 1 |
| **Total** | | | **9** | **0** | **4** | **240** | **180** | **500** | **900** | **13** |

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

5 Attendance: 5 Marks

6 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks
a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks
ETE - End Term Examination: 50 Marks

**Convener**
Signature: .....
Name : Dr. Rajendra Prasad
Date :

**Internal Members**
Signature: 1..... 2.....
Name: Dr. Aneeta Yadav Dr. K. K. Mishra
Date:

**External Members**
Signature: 1..... 2.....
Name: Dr. Lokendra Singh Dr. Sanjay Kumar Singh
Date:

**Faculty of Agricultural Sciences & Allied Industries**

**Rama University Uttar Pradesh, Kanpur**

Course Detail and Evaluation Scheme
(Effective from the Session 2019-20)

## M.Sc.(Ag.) Genetics & Plant Breeding Second Year (SEMESTER-IV)

| S.N. | Subject Code | Subject Name | Period | | | EVALUATION SCHEME | | | Subject Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | CE | MTE | ETE | | |
| **Theory Subjects** | | | | | | | | | | |
| 1 | MSG-600 | Master's Research (Research Work & Thesis) | 0 | 0 | 2 | 200 | 0 | 300 | 500 | 5 |
| Total | | | 0 | 0 | 2 | 200 | 0 | 300 | 500 | 5 |

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

7 Attendance: 5 Marks

8 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**Convener**
Signature: .....
Name : Dr. Rajendra Prasad
Date :

**Internal Members**
Signature: 1..... 2.....
Name: Dr. Aneeta Yadav Dr. K. K. Mishra
Date:

**External Members**
Signature: 1..... 2.....
Name: Dr. Lokendra Singh Dr. Sanjay Kumar Singh
Date:

# EVALUATION SCHEME

# &

# SYLLABUS

# FOR

# M.Sc. (Ag)

# Genetics and Plant Breeding
# 2018-19

## Genetics and Plant Breeding

**MSG-101** **PRINCIPLES OF GENETICS** **(2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-**

This course is aims in understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problem solving skills from classical to molecular genetics.

**Theory**

**Detail Contents**

**Unit 1:** **25%**

**Unit 2:** **15%**

**Unit 3:** **15%**

**Unit 4:** **25%**

**Unit 5:** **20%**

**UNIT-1**

History of Genetics; Mitosis & Meiosis, Pre-Mendelian concepts of inheritance, Mendel's laws; Discussion of Mendel's paper; Probability, Chromosomal theory of inheritance. Multiple alleles, Sex-linkage,Linkage Detection, Linkage estimation by various methods in test crosses, intercrosses; recombination and genetic mapping in eukaryotes -classical to modern, Somatic cell genetics.

**UNIT-2**

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Epigenetics. Genetic code; Protein biosynthesis,Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Gene families and clusters.

**UNIT-3** **III**

Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Gene expression & regulation in eukaryotes.

**UNIT-4** **IV**

DNA sequencing Gene cloning, genomic and cDNA libraries, PCR-based cloning, Nucleic acid hybridization and immuno-chemical detection; DNA restriction and modification, Anti-sense RNA, Gene silencing and ribozymes; Micro-RNAs (miRNAs). Genomics: Functional, structural & comparative, proteomics, metagenomics

**UNIT-5** **V**

Methods of studying polymorphism; Transgenic bacteria and bioethics; genetics of mitochondria and chloroplasts, Extra chromosomal inheritance. Eugenics, Genetic Disorders and Behavioural Genetics.

Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium.

**Practical's**

Laboratory exercises in probability and chi-square; Demonstration of genetic principles using laboratory organisms; Gene mapping using three point test cross; Tetrad analysis; Induction and detection of mutations, complementation. Study of chromosome aberrations, (deletions, inversion, translocations); DNA extraction and PCR amplification - Electrophoresis – basic principles separation of DNA; Visit to transgenic glasshouse.

**Course Learning Outcomes (CLO)**

CO-1: Comprehensive, detailed understanding of the chemical basis of heredity specially in crop plants, to improve and develop the new varieties of plants.

CO-2: Understanding of how genetic concepts affect broad societal issues including health and diseases, food and natural resources, environmental sustainability, etc.

CO-3: The knowledge required to to design, execute, and analyze the results of genetic experimentation in plant systems.

CO-4: Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings.

CO-5: Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.

**Text books:-**


- Gardner, E.J. and Snustad, D.P. 1991. Principles of Genetics. John Wiley & Sons.
- Klug, W.S. and Cummings, M.R. 2003. Concepts of Genetics. Peterson Education.

- Lewin, B. 2008. Genes IX. Jones & Bartlett Publ.
- Russell, P.J. 1998. Genetics. The Benjamin/Cummings Publ. Co.
- Strickberger, M.W. 2008. Genetics. Pearson Education.
- Tamarin, R.H. 1999. Principles of Genetics. Wm. C. Brown Publs.
- Snustad, D.P. and Simmons, M.J. 2006. Genetics, 4th Ed. John Wiley & Sons


**Reference books:-**


- B. D. Singh. Principles of Genetics. Kalyani Publishers.
- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- P. Singh. Elements of Genetics. Kalyani Publishers.
- Gardner EJ & Snustad DP. 1991. Principles of Genetics. John Wiley & Sons.
- Klug WS & Cummings MR. 2003. Concepts of Genetics. Peterson Edu.
- Lewin B. 2008. Genes IX. Jones & Bartlett Publ.
- Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co.
- Snustad DP & Simmons MJ. 2006. Genetics. 4th Ed. John Wiley & Sons.
- Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
- Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Publs.
- Uppal S, Yadav R, Subhadra & Saharan RP. 2005. Practical Manual on Basic and Applied Genetics. Dept. of Genetics, CCS HAU Hisar.


**Signature:-**

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**MSG 102** **PRINCIPLES OF**
**CYTOGENETICS** **(2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-**

To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution.

**Theory**

**Detail Contents**

**Unit 1:** **10%**

**Unit 2:** **30%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT-1**
Chromosome architecture in prokaryotes and eukaryotes; Eukaryotic chromosome structure & organization, Artificial chromosomes- BACS, YACs, construction and its uses; Special types of chromosomes .

**UNIT-2**
Chromosomal theory of inheritance, Cell Cycle and cell division, mitosis and meiosis, Differences, significance and deviations – Synapsis, structure and function of synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over-mechanisms and theories of crossing over- recombination models, cytological basis, - Variation in chromosome structure: evolutionary significance – karyotyping techniques; Chromosome banding and painting - *in situ* hybridization and its applications, GISH, FISH.

**UNIT-3**
Structural and Numerical variations of chromosomes and their implications - Symbols and terminologies for chromosome numbers - euploidy - haploids, diploids and polyploids; Utilization of aneuploids in gene location - Variation in chromosome behaviour - somatic segregation and chimeras – endomitosis and somatic reduction; Evolutionary significance of chromosomal aberrations - balanced lethals and chromosome complexes

**UNIT-4**

Inter-varietal chromosome substitutions, Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of autopolyploidsvs allopolyploids –- Role of aneuploids in basic and applied aspects of crop breeding; their maintenance and utilization in gene mapping and gene blocks transfer – Alien addition and substitution lines – creation and utilization; Apomixis: Evolutionary and genetic disadvantage.

**UNIT-5**

Reversion of autopolyploids to diploids; genome mapping in polyploids - Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica) – Hybrids between species with same chromosome number, alien translocations - Hybrids between species with different chromosome number; Gene transfer using amphidiploids - Bridge species. Fertilization barriers in crop plants at pre-and post-fertilization levels- *In vitro* techniques to overcome the fertilization barriers in crops, Chromosome manipulations in wide hybridization; case studies – Production and use of haploids, dihaploids and doubled haploids in genetics and breeding;

**Practicals**

Preparation of tissues for cytogenetical analyses (Fixatives, fixation, dehydration, embedding, staining, cleaning etc.) - Microscopy: various types of microscopes, Mitosis in wheat, pearl millet,onion, *Aloe vera,* oilseeds, forage crops and pulses, Measuring pollen grain size in various crops with micrometer, Methods of preparing permanent slides, Pollen germination *in vivo* and *in vitro,* Identification of polyploids in different crops, Morphological observations on autopolyploids and alloployploids - Morphological observations on aneuploids, Cytogenetic analysis of interspecific and intergeneric crosses, Maintenance of Cytogenetic stocks and their importance in crop breeding, Fluorescent in situ hybridization (FISH), Genome in situ hybridization GISH.

**Course Learning Outcomes (CLO)**

CO-1: Comprehensive, detailed understanding of the structure and functions of chromosomes.

CO-2: Understanding of chromosome mapping, polyploidy and.

CO-3: Insight into the cytogenetic aspects of crop evolution

**Text books:-**


- Becker, Kleinsmith and Hardin. 2004. The World of Cell. 5th edition. Pearson Education.
- Carroll, M. 1989. Organelles. The Guilford Press, New York.
- Gupta, P.K. and Tsuchiya, T. 1991. Chromosome Engineering in Plants. Part A. Elsevier.
- Gupta, P.K. 2000. Cytogenetics. Rastogi Publications
- Johannson, D.A. 1975. Plant Microtechnique. McGraw Hill Co, New York.

- Karp, G. 1996. Cell and Molecular Biology: Concepts and Experiments. John-Wiley & Sons, Inc., 773p.
- Khush, G.S. and Rick R. 1981. Cytogenetics of Aneuploids, Academic Press.
- Sharma, A.K. and Sharma, A. 1988. Chromosome techniques: Theory and practice, Butterworth, London.


**Reference books:-**


- B. D. Singh. Principles of Genetics. Kalyani Publishers.
- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- P. Singh. Elements of Genetics. Kalyani Publishers.
- Gray P. 1954. The Mirotomist's Formulatory Guide. The Blakiston Co.
- Gupta PK & Tsuchiya T. 1991. Chromosome Engineering in Plants: Genetics, Breeding and Evolution. Part A. Elsevier.
- Gupta PK. 2000. Cytogenetics. Rastogi Publ.
- Khush GS. 1973. Cytogenetics of Aneuploids. Academic Press.


**Signature:-**

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**MSBT 103** **PRINCIPLES OF BIOTECHNOLOGY** **(2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** To impart knowledge and practical skills to use biotec crop improvement.

**Theory**

**Detail Contents**

| | |
|---|---|
| **Unit 1:** | **10%** |
| **Unit 2:** | **25%** |
| **Unit 3:** | **20%** |
| **Unit 4:** | **20%** |
| **Unit 5:** | **25%** |

**Unit-I**
History, Scope and Importance; DNA Structure, function and metabolism.

**Unit-II:**
DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their application

**Unit-III:**
Molecular Markers and their application; DNA sequencing; Applications of gene cloning in basic and applied research, QTL mapping.

**Unit-IV:**
Genetic engineering perception of biotechnology ;and Transgenics; Genomics, transcriptomics and proteomics.

**Unit-V:** General application of biotechnology in Agriculture, Medicine, Environmental remediation, Energy production, and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

**Practical**

i. Isolation of genomic and plasmid DNA

ii. Gel electrophoresis techniques
iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
iv. PCR and molecular marker analysis
v. Plant tissue culture, media preparation, cell and explant culture, regeneration and transformation

**Course Learning Outcomes (CLO)**

CO-1: Comprehensive, detailed understanding History, Scope and Importance; DNA Structure, function and metabolism.

CO-2: Understanding of recombinant DNA technology, PCR amplification.

CO-3: Insight into the General application of biotechnology in Agriculture.

**Text books:-**

1. Introduction to Biotechnology- C.M. Brown, I. Campbell and F.G. Priest
2. Plant Biotechnology – H.S. Chawala
3. Biotechnology – B.D. Singh
4. Element of Biotechnology – Prof. P.K. Gupta

**Reference books:-**


- Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.
- Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
- Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani.


**Signature:-**

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S. Singh

**MSG- 201** **PRINCIPLES OF PLANT BREEDING** **(2L + 1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective :-** To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

**Theory**

**Detail Contents**

**Unit 1:** **10%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **30%**

**UNIT-1**
History of Plant Breeding (Pre and Post Mendelian era), Objectives of plant breeding, Characteristics improved by plant breeding. - Centres of Origin-biodiversity and its significance

**UNIT-2**
Genetic basis of breeding self- and cross - pollinated crops, nature of variability, components of variation, heritability and genetic advance, genotype-environment interaction, general and specific combining ability, types of gene actions and implications in plant breeding; plant introduction and role of plant genetic resources in plant breeding. Self-incompatibility and male sterility in crop plants and their commercial exploitation.

**UNIT-3**
Breeding self pollinated crops, Pure line theory; pure line selection and mass selection methods, line breeding, pedigree, bulk, backcross, single seed descent and multiline method. Breeding methods in cross pollinated crops, population breeding-mass selection and ear-to-row methods; S1 and S2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and inter-population improvement and development of synthetics and composites.

**UNIT-4**

Breeding methods in asexually/clonally propagated crops, clonal selection.Self-incompatibility and male sterility in crop plants and their commercial exploitation; concept of plant ideotype and its role in crop improvement. Special breeding techniques- Mutation breeding,polyploids. Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds.

**UNIT-5**

Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights, DUS testing, Quality seeds-types and production.Parent selection.Combining ability and type of crosses. Biotechnology in crop improvement-An overview. Transgenic crops- current status and future prospects, integration of transgenics into breeding programmes. Molecular breeding-molecular markers (isozymes, RFLP, RAPD AFLP), mapping populations (RILs, NILs, DH, Backross), their merits and demerits, markers assisted selection

**Practicals**

Floral biology in self and cross pollinated species, selfing and crossing techniques. Selection methods in segregating populations and evaluation of breeding material.Analysis of variance (ANOVA).Estimation of heritability and genetic advance, maintenance of experimental records.Learning techniques in hybrid seed production using male-sterility in field crops.

**Course Learning Outcomes (CLO)**

CO-1: Establish the commercial plant breeding company to developed new superior crops varieties.

CO-2: Develop the insect and disease resistant varieties for environment friendly management of disease and insect.

CO-3: Serve the quality food in the market by developing high nutritive varieties.

CO-4: Increase the farm yield to get higher income on farm by developing higher yield crop varieties.

CO-5: start a consultant company to guide & supply the better varieties to the farmers.

**Text books:-**


- Allard, R.W. 1981. Principles of Plant Breeding, John Wiley & Sons.
- Chopra, V.L. 2001. Breeding Field Crops. Oxford & IBH.
- Sharma, J.R. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
- Simmonds, N.W. 1990. Principles of Crop Improvement. English Language Book Society.
- Singh, B.D. 2006. Plant Breeding. Kalyani.

**Reference books:-**


- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- **P. Singh.** Elements of **Genetics**. Kalyani Publishers
- Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
- Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.
- Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH.
- Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.


**Signature:-**

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**MSG 202 PRINCIPLES OF QUANTITATIVE GENETICS (2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** To impart theoretical knowledge and computatio[illegible] component of variation and variances, Probability, scales, mating designs and gene effects.

**Theory**

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT-I**
Probability and its application in genetic analyses; Random variables and Probability distributions.

**UNIT-II**
Genotypic and Phenotypic variation.Genetic component analyses; Partitioning of main effects and variances – ANOVA-MANOVA.

**UNIT-III**
General concepts of gene action – single and multigene models –genetical parameters and their estimations.

**UNIT-IV**

Heritability & components of gene action.Linkage & Linkage Disequilibrium.Inbreeding and covariance between relatives.

**UNIT-V**
Mating systems and designs; Combining ability – effects and variance; Genetic divergence.Heterosis; Populations- concepts and their improvement approaches.

**Practicals**

Problems on multiple factors inheritance - Partitioning of variance -Estimation of heritability and genetic advance - Covariance analysis - D2 analysis - Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms - interpretation - Diallel analysis: Hayman's graphical approach- Diallel analysis: interpretation of results - NCD and their interpretations - Line x tester analysis and interpretation of results - Estimation of heterosis: standard, mid-parental and better-parental heterosis - Estimation of inbreeding depression - Generation mean analysis: Analytical part and Interpretation – Estimation of different types of gene actions. Partitioning of phenotypic variance and co-variance into components due to genotypes, environment and genotype x environment interactions.

**Course Learning Outcomes (CLO)**

CO-1: To understand Probability

CO-2: To understand gene action – single and multigene models –genetical parameters and their estimations.

CO-3: Knowledge to Linkage & Linkage Disequilibrium.Inbreeding and covariance between relatives.

CO-4: To understand Mating systems.

**Text books:-**


- Falconer, D.S. and Mackay, J. 1998. Introduction to Quantitative Genetics. Longman.
- Mather, K. and Jinks, J.L. 1983. Introduction to Biometrical Genetics. Chapman & Hall.
- Naryanan, S.S. and Singh, P. 2007. Biometrical Techniques in Plant Breeding. Kalyani.
- Singh, P. and Narayanan, S.S. 1993. Biometrical Techniques in Plant Breeding. Kalyani.
- Singh, R.K. and Choudhary, B.D. 1987. Biometrical Methods in Quantitative Genetics. Kalyani.


**Reference books:-**


B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers

Falconer DS & Mackay J. 1998. Introduction to Quantitative Genetics. Longman.

Singh P & Narayanan SS. 1993. Biometrical Techniques in Plant Breeding. Kalyani.

**Signature:-**

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## BIOTECHNOLOGY FOR CROP IMPROVEMENT

**MSBT -203** **3 (2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** To impart knowledge and practical skills to use biotechnological tools in crop improvement.

**Detail Contents:**

Unit 1: 20%

Unit 2: 20%

Unit 3: 20%

Unit 4: 20%

Unit 5: 20%

**UNIT I**

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding.

Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic Embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

**UNIT II**

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

**UNIT III**

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression,

**UNIT IV**

Recombinant DNA technology, transgenes, method of transformation, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases.

**UNIT V**

Biotechnology applications in male sterility/hybrid breeding, molecular farming.

MOs and related issues (risk and regulations); GMO; International regulations, bio-safety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights

**Practical**

Requirements for plant tissue culture laboratory-Techniques in plant tissue culture - Media components and media preparation -Aseptic manipulation of various explants ; observations on the contaminants occurring in media – interpretations - Inoculation of explants; Callus induction and plant regeneration - Plant regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures - Visit to commercial micro-propagation unit. Transformation using *Agro-bacterium* strains.

**Course Learning Outcomes (CLO)**

CO-1: Comprehensive, detailed understanding of Biotechnology especially for crop improvement.

CO-2: Understanding Tissue culture, Recombinant DNA technology and Transgenes.

CO-3: Insight into the Molecular mapping, Marker assisted selection.

**Text books:-**


• Chopra VL & Nasim A. 1990. *Genetic Engineering and Biotechnology: Concepts, Methods and Applications*. Oxford & IBH.
• Gupta PK. 1997. *Elements of Biotechnology*. Rastogi Publ.
• Sambrook J & Russel D. 2001. *Molecular Cloning* - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.


**Reference books:-**


B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers


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**MSG 204** **BASIC DESIGN OF EXPERIMENTS** **(2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** Design of Experiments provides the statistical tools information from least amount of resources. This course is meant to expose the students to the basic principles of design of experiments. The students would also be provided with mathematical background of various basic designs involving one-way and two way elimination of heterogeneity and their characterization properties. This course would also prepare the students in deriving the expressions for analysis of experimental data.

**Theory**

**Detail Contents:**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT-I**

Basic principles of design of experiments.Uniformity trials.Analysis of variance. Completely randomized design (CRD), Randomized complete block design (RCBD), Latin square design (LSD).

**UNIT-II**

Balanced incomplete block (BIB) design, Resolvable block designs and their applications: Alpha design and Lattice design-concepts. Randomization procedure, analysis and interpretation of results.

**UNIT-III**

Factorial experiments (symmetrical as well as asymmetrical). Confounding in factorial experiments - application in 2n and 3n factorial experiments. Factorial experiments with extra treatment(s). Split plot and Strip plot designs.

**UNIT-IV**

Groups of experiments. Analysis of covariance.Missing plot technique and its application to RCBD, LSD. Cross-over design.

**UNIT-IV**

Sampling in field experiments. Transformation of data. Response surfaces. Experiments with mixtures.

**Practicals**

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments without and with confounding, Analysis of Covariance, Analysis with missing data, Split plot and strip plot designs, Groups of experiments, Transformation of data, Fitting of response surfaces.

**Course Learning Outcomes (CLO)**

At the end of the course student will be able to know

CO1. Acquaintance with some basic concepts in statistics.

CO2. Getting knowledge about some elementary statistical methods of analysis of data viz. Measures of Central Tendency, Dispersion, Moments, Skewness, and Kurtosis and to interpret them.

CO3. Analysis of data pertaining to attributes and to interpret the results.

**Text books:-**

- Cochran, W.G. and Cox, G.M. 1957. *Experimental Designs.* John Wiley and Sons.
- Panse, V.G. and Sukhatme, P.V. 1967. *Statistical Methods for Agricultural Workers.* ICAR

**Reference books:-**

• Chakrabarti MC. 1962. Mathematics of Design and Analysis of Experiments. Asia Publ. House.

• Cochran WG & Cox DR. 1957. Experimental Designs. 2nd Ed. John Wiley. • Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.

• Dey A 1986. Theory of Block Designs. Wiley Eastern.

• Kempthorne, O. 1976. Design and Analysis of Experiments. John Wiley.

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**PGS 202** **LIBRARY AND INFORMATION SERVICES** **(0L+1P)**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 1 | |

**Course objective:-**To understand basic concept of Library.

**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.

**Textbooks:**

**Reference books:**

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**SST-303 SEED PRODUCTION: PRINCIPLES AND PRACTICES (2L+1P)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** To apprise the students about the variety deterioration and s[illegible] the purity of varieties & hybrids and principles of seed production in self & cross pollinated crops.

**Theory**

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT I**

Seed as a basic input in agriculture, quality concept and importance of genetic purity in seed production; life span of varieties and factors responsible for their deterioration.

**UNIT II**

Steps in the development, evaluation, release, notification and maintenance of varieties; classification of crop plants in relation to the mode of reproduction and its modification for hybrid seed production.

**UNIT III**

Principles of hybrid seed production viz. isolation, synchronization of flowering, field inspection, rogueing etc.; special agronomical practices for seed production and effect of environment before harvest on seed quality.

**UNIT IV**

Male sterility and self incompatibility in hybrid seed production, role of insect pollinators and their management for hybrid seed production, ecology and dynamics of pollinators.

**UNIT V**

Seed quality control system and organization, suitable seed production areas, seed village concept; agencies responsible for seed production, seed industry in India, custom seed production, role of seed growers and seed producers in hybrid seed production.

**Practicals**

Seed production in rice and maize (varieties and hybrids), pollination in hybrid seed production plots of rice and maize, visit to Bajra and cotton seed production plots, visit to vegetable seed production field, hybrid seed production in cauliflower. Emasculation and pollination in bitter gourd and brinjal. Visit to seed production companies and certification agencies. Visit to seed processing units.

**Course Learning Outcomes (CLO)**

CO-1: Start a seed production program for fill full the requirement of quality seed in market and increase the income.

CO-2: Storage the pure variety seed to avoid the availability crises of pure variety seed due to adverse environmental conditions.

CO-3:To supply the disease free seed in the market to get the environment friendly cultivation of
crops.

CO-4: To increase the farm income by producing high yielding disease free quality seed and decrease the cost of cultivation also.

CO-5:Production of hybrid seed of different crops to increase the farm income.

**Text books:-**


- Agarwal, R.L. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
- Mc Donald, M.B. Jr and Copeland, L.O. 1997. *Seed Production: Principles and Practices*. Chapman & Hall.
- Poehlman, J.M. and Sleper, D.A. 2006. *Breeding Field Crops*. Blackwell.
- Singh, B.D. 2005. *Plant Breeding: Principles and Methods*. Kalyani Publishers.


**Reference books:-**


B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers

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**MSG- 301 CELL BIOLOGY AND MOLECULAR GENETICS 3 (2+1)**

| L | T | P | CR |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**Course objective:-** To impart knowledge in theory and practice about cell structure, organelles and their functions, molecules like proteins and nucleic acids.

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT I**

Ultrastructure of the cell; Differences between eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles – nucleus, plastids- chloro/chromoplast, mitochondria endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes. Bioenergetics; Ultrastructure and function of mitochondria and biological membranes; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Cell division and physiology of cell division.

**UNIT II**

Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation – Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes – ribosomes, t-RNAs and translational factors.

**UNIT III**

Transposable elements; Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes – DNA content variation, types of DNA sequences – Unique and repetitive sequences; organelle genomes; Gene amplification and its significance.

**UNIT IV**

Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging. Introduction: Gene regulation-purpose; Process and mechanisms in prokaryotes and eukaryotes; Levels of gene controls.

**UNIT V**

Gene expression-Transposons in plant gene expression, cloning-transposon tagging; Light

regulated gene expression-model systems in *Arabidopsis* and maize; Para mutations and imprinting of genes and genomes. Trans-gene expression and gene silencing mechanisms; Regulatory genes horizontal and vertical homology; Transformation-regulatory genes as visible markers; Reporter systems to study gene expression; combinatorial gene control.

**Practical**

Morphological and Gram staining of natural bacteria .Determination of growth rate and doubling time of bacterial cells in culture;

Demonstration of bacteriophage by plaque assay method; Determination of soluble protein content in a bacterial culture. Isolation, purification and raising clonal population of a bacterium; Biological assay of bacteriophage and determination of phage population in lysate; Study of lytic cycle of bacteriophage by one step growth experiment; determination of latent period and burst size of phages per cell; Quantitative estimation of DNA, RNA and protein in an organism; Numericals: problems and assignments.

**Course Learning Outcomes (CLO)**

1.The student will be able to read, understand, and critically interpret the primary biological literature in his/her area of interest.

2. The student will be able to design, conduct, analyze, and communicate (in writing and orally) biological research.

3. The student will recognize and be able to apply basic ethical principles to basic and applied biological/biomedical practice and will understand the role of biological/biomedical science, scientists, and practitioners in society.

4. The student will be able to explain ultra structure of cell.

5. The student will be able to explain the Genetic materials.

6. The student will be able to explain the importance DNA, RNA and protein in an organism; Numericals: problems and assignments.

**Text books:-**


- Klug WS & Cummings MR 2003. *Concepts of Genetics*. Scot, Foreman & Co.
- Lewin B. 2008. *IX Genes*. John Wiley & Sons
- Lodish H, Berk A & Zipursky SL. 2004. *Molecular Cell Biology*. 5TH Ed. WH Freeman.
- Nelson DL & Cox MM. 2005. *Lehninger's Principles of Biochemistry*. WH Freeman &Co.
- Russell PJ. 1996. *Essential Genetics*. Blackwell Scientific Publ.
- Schleif R.1986. *Genetics and Molecular Biology*. Addison-Wesley Publ. Co.
- Lewin B. 2008. *Genes IX*. John Wiley & Sons.


**Reference books:-**


B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers

Bruce A.2004. Essential Cell Biology. Garland.

• Russell PJ. 1996. Essential Genetics. Blackwell Scientific Publ.

• Schleif R.1986. Genetics and Molecular Biology. Addison-Wesley Publ. Co.

• Lewin B. 2008. Genes IX. John Wiley & Sons.

• Schleif R.1986. Genetics and Molecular Biology. Addison-Wesley.

• Russell PJ. 1996. Essential Genetics. Blackwell Scientific Publ.

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**MSG -302 BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE 2 (1+1)**

| L | T | P | CR |
|---|---|---|---|
| 1 | 0 | 1 | 2 |

**Course objective:-** To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress resistant varieties.

**Theory**

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT I**

Importance of plant breeding with special reference to biotic and abiotic stress resistance; Classification of biotic stresses – major pests and diseases of economically important crops - Concepts in insect and pathogen resistance; Analysis and inheritance of resistance variation; Host defence responses to pathogen invasions- Biochemical and molecular mechanisms; Acquired and induced immunity and systemic acquired resistance (SAR); Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Concept of signal transduction and other host-defense mechanisms against viruses and bacteria.

**UNIT II**

Types and genetic mechanisms of resistance to biotic stresses –Horizontal and vertical resistance in crop plants. Quantitative resistance/Adult plant resistance and Slow rusting resistance - Classical and molecular breeding methods - Measuring plant resistance using plant fitness; Behavioural, physiological and insect gain studies.

Phenotypic screening methods for major pests and diseases; Recording of observations; Correlating the observations using marker data – Gene pyramiding methods and their implications.

**UNIT III**

Classification of abiotic stresses - Stress inducing factors –moisture stress/drought and water logging & submergence; Acidity, salinity/alkalinity/sodicity; High/low temperature, wind, etc. Stress due to soil factors and mineral toxicity; Physiological and Phenological responses; Emphasis of abiotic stresses in developing breeding methodologies.

**UNIT IV**

Genetics of abiotic stress resistance; Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing

MAS procedures for identifying resistant types in important crops like rice, sorghum, wheat, cotton etc; Breeding for resistance to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment.

**UNIT V**

Exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops - Transgenics in management of biotic and abiotic stresses, use of toxins, protease inhibitors, lectins, chitnases and Bt for diseases and insect pest management- Achievements.

**Practical**

Phenotypic screening techniques for sucking pests and chewing pests – Traits to be observed at plant and insect level - Phenotypic screening techniques for nematodes and borers; Ways of combating them; Breeding strategies - Weeds – ecological, environmental impacts on the crops; Breeding for herbicide resistance - Evaluating the available populations like RIL, NIL etc. for pest resistance; Use of standard MAS procedures - Phenotypic screening methods for diseases caused by fungi and bacteria; Symptoms and data recording; use of MAS procedures - Screening forage crops for resistance to sewage water and tannery effluents; Quality parameters evaluation - Screening crops for drought and flood resistance;
factors to be considered and breeding strategies - Screening varieties of major crops for acidity and alkalinity- their effects and breeding strategies; Understanding the climatological parameters and predisposal of biotic and abiotic stress factors- ways of combating them.

**Course Learning Outcomes (CLO)**

CO-1: In this course Students learn importance of biotic and abiotic stress.

CO-2: Learner learns Horizontal and vertical resistance in crop plants.

CO-3: Learner learns to Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing MAS procedures and applies to breed improve genotypes.

**Text books:-**


Blum A. 1988. *Plant Breeding for Stress Environments*. CRC Press. Christiansen MN & Lewis CF. 1982. *Breeding Plants for Less Favourable Environments*. Wiley International.
Fritz RS & Simms EL. (Eds.). 1992. *Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics*. The University of Chicago Press.
Li PH & Sakai A. 1987. *Plant Cold Hardiness*. Liss, New York Luginpill P. 1969. *Developing Resistant Plants - The Ideal Method of Controlling Insects*. USDA, ARS, Washington DC.
Maxwell FG & Jennings PR. (Eds.). 1980. *Breeding Plants Resistant to Insects*. John Wiley & Sons.
Painter RH. 1951. *Insect Resistance in Crop Plants*. MacMillan, New York.
Russel GE. 1978. *Plant Breeding for Pest and Disease Resistance*. Butterworths.
Sakai A & Larcher W. 1987. *Frost Survival in Plants*. Springer-Verlag.
Turener NC & Kramer PJ. 1980. *Adaptation of Plants to Water and High Temperature Stress*. John Wiley & Sons.

van der Plank JE. 1982. *Host-Pathogen Interactions in Plant Disease*. Academic Press.

**Reference books:-**


B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers.

Van der Plank JE. 1982. Host-Pathogen Interactions in Plant Disease. Academic Press.


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**PPA -301** **DISEASES OF FIELD CROPS** **(2L+1P) III**

| L | T | P | CR |
|---|---|---|---|
| 1 | 0 | 1 | 2 |

**Course objective:-**To knowledge about common pathogens of different diseases, etiology, symptoms, diseases suitable management methods, Eco-friendly and economically suitable management practices may be adopted.

**Theory**

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT I**
Diseases of Cereal crops- wheat, barley, rice, pearl millet, sorghum and maize-economic importance, symptoms and disease cycle, epidemiology and management

**UNIT II**
Diseases of Pulse crops- gram, urdbean, mungbean, lentil, pigeonpea, soybean.

**UNIT III**
Diseases of Oilseed crops- rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor.

**UNIT IV**
Diseases of Cash crops- cotton, sugarcane.

**UNIV V**
Diseases of Fodder legume crops- berseem, oats, guar, lucerne, cowpea.

**Practicals**
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

**Course Learning Outcomes (CLO)**
CO-1.Student will know the common pathogens of different diseases.
CO-2. Student acquire the knowledge about etiology, and symptoms of thesediseases which helps in diagnosis of the diseases of field and horticultural crops
CO-3. By knowing means of dispersal of these diseases suitable management methods can be applied.
CO-4. Eco-friendly and economically suitable management practices may be adopted.

**Text books:-**


- Mishra, A. 2005. *Plant Pathology-Disease and Management*, Agrobios Publishers, India.
- Paul Khurana, S.M. 1998. *Pathological Problems of Economic Crop Plants and their management.* Scientific Publishers, Jodhpur, India.
- Shahid, Ahmad and Udit, N. 2007. *Eco friendly Management of Plant Diseases*. Daya Publishing House, Delhi, India.
- Wang, Guo-Liang and Valent, B. 2009. *Advances in Genetics, Genomics and Control of Rice Blast Disease*, Springer Link, Netherland.


**Reference books:-**

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**PGS 301** **HISTORY OF AGRICULTURE** **(1L+0P)**

| L | T | P | CR |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

**Course objective:-** To knowledge about Agriculture in ancient India, P management, Agricultural research, education and extension and how to overcom Indian agriculture.

**Detail Contents**

**Unit 1:** **20%**

**Unit 2:** **20%**

**Unit 3:** **20%**

**Unit 4:** **20%**

**Unit 5:** **20%**

**UNIT-I**
Agriculture in ancient India: archaeological findings and literature.

**UNIT-II**
Ancient literature on: farm implements, forecast of weather and rains, types of lands, manure, irrigation, seed and sowing.

**UNIT-III**

Pests and their management, horticulture and arboriculture, cattle management etc.

**UNIT-IV**
Agricultural research, education and extension in pre-and post-independent India. Green revolution, success, associated problems, lessons learnt.

**UNIT-V**
Challenges to Indian agriculture: future needs and capabilities, environmental problems, international agriculture and partnership. Emerging scenario and expectations.

**Course Learning Outcomes (CLO)**
CO1. Ancient Agricultural Practices & Its relevant to modern agriculture practices.

CO2 Traditional Technical Knowledge.

CO3: To study our journey (Developments) in Agriculture and Vision for the Future.

**Text books:-**

- Jain, H.K. 2010. The Green Revolution: History, Impact and Future. Studium Press LLc, Houston USA, 276 pp.
- Saxena, R.C., Choudhary, S.L. and Nene, Y.L. 2009. A Text Book on Ancient History of Indian Agriculture. Asian Agri-History Foundation, Secundarabad, 148 pp.
- Nene, Y.L. (Ed.) 2007. Glimpses of the Agricultural Heritage of India. Asian Agri-History Foundation, Secundarabad, 912 pp.

**Reference books:-**

B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers.

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