Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and

Choice-Based Credit System (CBCS)

in

Master of Science in Agriculture Plant Pathology
(M.Sc. (Agri) Plant Pathology)

2 Year (4 semester) Degree Program

Revised as on 01 August 2023
Applicable w.e.f. Academic Session 2023-24

AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Agriculture Science & Technology
Department of Plant Pathology

HEAD
Department of Plant Pathology
AKS University, Satna (M.P.)

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Professor B.A. Chopade
Vice - Chancellor
AKS University
Satna, 485001 (M.P.)

AKS University, Satna

Faculty of Agriculture Science and Technology

Department of Plant Pathology

Curriculum

of

M.Sc. (Agri.) Plant Pathology program

(Revised in August 2023)

AKS University, Sherganj, Panna Road, Satna-485001

AK S University

Faculty of Agriculture Science and Technology

Department of Plant Pathology

Curriculum of M.Sc. (Agri.) Plant Pathology Program

(Revised in August 2023)

From the Desk of the Vice-Chancellor

AKS University is currently undergoing a process to revamp its curriculum into an outcome-based approach of quality lies in the implementation of a curriculum that aligns with both societal and value needed needs focusing a relevant horticulture out comes. This entails dedicated and inspired faculty members, as well as impactful Plant Pathological developments. Hence, it is of utmost importance to begin by designing an outcome-based curriculum in collaboration with academia and subject expert.

The curriculum, I am pleased to observe that the Plant Pathology Department has deli gently adhered to the future prospects of the Plant Pathology. To achieve excellence in the curriculum planning pertaining to Plant Pathology by periodically updating it in order to provide to Students with sound technical knowledge of outcome-based education and to strengthen the research activities in Plant Pathology by under taking innovative approaches for the Developing the field of Plant Pathology. This curriculum will be beacon of light particularly to the student of Plant Pathology Job/Career prospects in the field of teaching, Research and Extension activities in either Government or Private sector including pesticide, biofertilizers biopesticides and other Plant Pathological business etc.

Furthermore, the curriculum takes into account the specific needs of restructuring of master's curriculum and academic regulation for the discipline under Plant Pathology. This curriculum effectively integrates the principles to improve the existing syllabus and to make it none contextual and pertinent to cater the needs of students in terms of global competitiveness and employability.

I am confident that the updated curriculum for Plant Pathology will not only enhance student's technical skills but also contribute significantly to their Employability during the process of revising. The curriculum, I am pleased to observe that the Plant Pathology department has diligently adhered to the guidelines by the ICAR PG Restructured and Revised Syllabi of Post-graduate Programs December 2021. They have maintained total credit of 75 for M.Sc. (Agri.) Plant Pathology.

Curriculum revision in an ongoing and dynamic process designed to address the continuous evolution of technological advancement and both local and global concerns. AKS University warmly invites input and suggestion from Plant Pathology experts, researchers and alumni students to enhance the curriculum and make it more students oriented. Your valuable insights will gently contribute to shaping as education that best serves the needs and aspirations of the students.

Prof. B. A. Chopade
(Vice- Chancellor)
AKS University, Satna

August 2023

AK S University

Faculty of Agriculture Science and Technology

Department of Plant Pathology

Curriculum of M.Sc. (Agri.) Plant Pathology Program

(Revised in August 2023)

Preface

As part of our commitment to ongoing enhancement, the Department of Plant Pathology consistently reviews and updates its B.Sc. (Hons.) Agriculture and M.Sc. (Agri.) Plant Pathology Program curriculum every four and two years. Through this process, we ensure that the curriculum remains aligned with the latest technological advancements, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the B.Sc. (Hons.) Agriculture and M.Sc. (Agri.) Plant Pathology Program undergoes evaluation by a panel of technocrats, industry specialists, and academicians. Following meticulous scrutiny, the revised curriculum has been formulated and is set to be implemented starting from August 01, 2023. This implementation is contingent upon the endorsement of the curriculum by the University's Board of Studies and Governing Body.

This curriculum as per guidelines by the P.G restructuring committee of ICAR under Ministry of Agriculture and Farmer welfare, Govt of India. In order to foster the holistic skill development of students, a range of practical activities, including Hands-On Training, Industrial Visits, Project planning and execution, Thesis Writing, Seminars, have been incorporated.

This curriculum is enriched with course components in aligning perfectly with the requisites P.G restructuring committee of ICAR and NAAC standards. In this curriculum, various courses of M.Sc. (Agri.) Plant Pathology enclosed such as Major core course 23 credits, Minor core course 09 credits, Common courses 05 credits, Basic supporting courses 07 credits and Master Research/ Seminar 31 credits.

To ensure a comprehensive learning experience, detailed evaluation schemes and rubrics have also been meticulously provided.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Programme Specific Outcomes has been undertaken. As the course syllabus is being meticulously developed, various elements such as session outcomes, laboratory instruction, classroom instruction, self-learning activities, assignments, and mini projects are meticulously outlined.

I hold the belief that this dynamic curriculum will undoubtedly enhance independent thinking, skills, and overall employability of the students.

Prof. (Dr.) S. S. Tomar
DEAN
Faculty of Agriculture Science and Technology
AKS University, Satna

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Department of Plant Pathology

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Dr. Doomar Singh
Associate Professor & Head
Department of Plant Pathology
AKS University, Satna

CONTENTS

AKS University, Satna

Department of Plant Pathology

Faculty of Agriculture Science & Technology

Introduction

The Department of Plant Pathology was established in July 2019. It is the only unit in the district of Satna that generates and provides essential information related to infectious and abiotic diseases of plants to a variety of clientele and stakeholders. One of our assets is the ability of our department's students and faculty to collaborate to provide students top-ranked educational and research opportunities in a collegial and friendly atmosphere.

Vision

To be a leader in research, teaching, and extension involving plant health, while serving the changing needs of society, the environment, and the University.

Mission

M-1: Focus on plant health including the identification, characterization, evolution, and management of disease-causing via graduate and postgraduate instruction, post-doctoral training, research, and outreach activities.

M-2: The mission of Department of Plant Pathology is to advance understanding of the biology of pathogenic and beneficial microbes and their interactions with plants.

M-3: Designing sustainable management strategies for economically important plant diseases.

M-4: Providing experiential educational to be a competent in resolving complex challenges of the 21st Century and secure food supply while protecting our environment.

Programme Educational Objectives (PEO)

PEO 1 To develop skill of farming by using principles and practical knowledge to fulfil the present need of the population and conserve the natural resource for future population.

PEO 2 To create innovative and sustainable temperament among the students in the field of plant protection.

PEO 3 To develop ethical, social, living and professional concepts among the students to participate in international ring and collaborative studies.

PEO 4 To develop professional skill-based strategies of low cost, sustainable, environmentally safe and adoptable by the most of the farmers/growers.

Programmee Specific Outcomes for PG

On successful completion of post-graduate program in plant pathology, the student will be able to

PSO1 Create capability of disease diagnosis and understand life-cycles of plant diseases

PSO2 Execute management of plant diseases with an integrated approach.

PSO3 Disseminate modern plant protection technology in the society

PSO Modify phytosanitary precautions between the society

Program outcomes for PG

On successful completion of post-graduate program in plant pathology, the student will be able to

PO1 Familiar with the biology and taxonomy of the major biotic, abiotic and environment causes of plant diseases.

PO2 Capable of diagnosing common diseases of agricultural and horticultural crops caused by biotic and abiotic cause.

PO3 Work with plant breeders, farmers, entomologists, and botanists in the farms and gardens where plants grow.

PO4 Engage with biological scientists and engineers to create safer living arrangements to allow plants to reach their maximum growth, yield and having potential to boost the Indian agriculture economy.

PO5 Formulate a sustainable, practicable and economically feasible approaches to integrated disease management in commercial plant species.
PO6 Use of modern technology to disease diagnosis, forecasting, disease resistance, biocontrol etc.
PO7 predict short, medium and long-term forecasting to the farmers of the locality.
PO8 Assessment of the risk associated with the presence of plant pathogens and respects the principles of phytosanitary safety in relation to himself and the surrounding environment.
PO9 Develop self-employment & entrepreneurship
PO10 Develop justified ecofriendly solution of plant disease management.

PEO	M1	M2	M3	M4
PEO1	2	3	3	3
PEO2	2	3	2	3
PEO3	1	2	2	3
PEO4	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) "-": No correlation

Structure of PG Program in M.Sc. (Agri.) Plant Pathology

The Structure of PG program in **M.Sc. (Agri.) Plant Pathology** shall have essentially the following categories of courses with the breakup of credits as given:

Components of the Curriculum
(Program curriculum grouping based on course components)

S. No.	Course Component	% of total number of credits of the program	Total number of Credits
1	Major Courses	30.67	23
2	Minor Courses	12.00	09
3	Supporting Courses	09.33	07
4	Common Courses	06.67	05
5.	Seminar	01.33	01
5	Thesis Research	40.00	30
	Total Credit	**100**	**75**

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
Minor courses: From the subjects closely related to a student's major subject
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.
Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree program:
1. Library and Information Services
2. Technical Writing and Communications Skills
3. Intellectual Property and its management in Agriculture
4. Basic Concepts in Laboratory Techniques
5. Agricultural Research, Research Ethics and Rural Development Programmes Some of these courses are already in the form of e-courses/ MOOCs. The students may be allowed to register these courses/ similar courses on these aspects, if available online on SWAYAM or any other platform. If a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/ Board of Studies (BoS).

General Course Structure and Credit Distribution

Curriculum of M.Sc. (Agri) Plant Pathology

Semester-I		**Semester-II**	
Course Title	**Credits**	**Course Title**	**Credits**
1.Mycology	**2:1=3**	1. PLANT PATHOGENIC PROKARYOTS	**2:1=3**
2.Plant Virology	**2:1=3**	2. PLANT NEMATOLOGY	**2:1=3**
3.Principles of Plant Pathology	**2:1=3**	3. DISEASES OF VEGETABLE AND SPICES CROPS	**2:1=3**
4. Principles of Plant Disease Management	**2:1=3**	4. DETECTION AND MANAGEMENT OF SEED BORNE PATHOGENS	**2:1=3**
5. STATISTICAL METHODS FOR APPLIED SCIENCES	**3:1=4**	5. EXPERIMENTAL DESIGNS	**2:1=3**
6. LIBRARY AND INFORMATION SERVICES	**0:1=1**	6. INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AG RICULTURE	**1:0=1**
7. TECHNICAL WRITING AND COMMUNICATION SKILLS	**0:1=1**	7. BASIC CONCEPTS IN LABORATORY TECHNIQUES	**0:1=1**
Total Credit	**18**	Total Credit	**17**
Semester -III		**Semester IV**	
Course Title	**Credit**	**Course Title**	**Credit**
1.TECHNICS IN DETECTION AND DIAGNOSIS OF PLANT DISEASES	**0:2=2**	1.SEMINAR	1+0=**1**
2. DISEASES OF FIELD AND MEDICINAL CROPS	**2:1=3**	2.THESIS RESEARCH	0+30=**30**
3. DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS	**2:1=3**		
4. AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	**1:0=1**		
Total Credit	**9**		**31**
Total Credit I+II+III+IV Semester	**75**		

Mandatory requirement of seminars

- It has been agreed to have mandatory seminars one in Masters (One Credit) and two in Doctoral programs (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. 3. Residential requirements
- The minimum and maximum duration of residential requirement for Masters' Degree and Ph.D. Programs shall be as follows:

Duration of Residential Requirement for Masters' Degree - Minimum 2 Academic Years (4 Semesters)
Maximum 5 Academic Years (10 Semesters)

Induction Program

Induction program for students to be offered right at the start of the first year. It is mandatory. AKS University has designed an induction program for 1st year student, details are below:

i Physical activity
ii Creative Arts
iii Universal Human Values
iv Literary

v Proficiency Modules
vi Lectures by Eminent People
vii Visits to local Areas
viii Familiarization to Dept./Branch & Innovations

Mandatory Visits/ Workshop/Expert Lectures:

i It is mandatory to arrange one industrial visit every semester for the students.

Semester wise Course Structure

Semester wise Brief of total Credits and Teaching Hours

Semester	L	T	P	Total Hour	Total Credit
Semester-I	11	0	07	25	18
Semester-II	11	0	06	23	17
Semester-III	05	0	04	13	09
Semester-IV	0	0	31	62	31
Total	27	0	48	120	**75**

Details of Semester Wise Course Structure

Semester – I

S. N.	Category	Code	Course Title	L	T	P	Total Hrs	Credits
1.	Major Course	PL PATH-501	Mycology	2	0	1	4	3
2.	Major Course	PL PATH-502	Plant Virology	2	0	1	4	3
3.	Major Course	PL PATH-505	Principles of Plant Pathology	2	0	1	4	3
4.	Minor Course	PL PATH-507	Principles of Plant disease management	2	0	1	4	3
5.	Supporting Course	STAT-502	Statistical methods for applied sciences	3	0	1	5	4
6.	Common Course	PGS-501	Library and Information Services	0	0	1	2	1
7.	Common Course	PGS-502	Technical Writing and Communication Skills	0	0	1	2	1
Total				**11**	**0**	**7**	25	18

Semester-II

SN.	Category	Code	Course Title	L	T	P	Total Hrs	Credits
1.	Major Course	PL PATH-503	Plant Pathogenic Prokaryotes	2	0	1	4	**2+1**
2.	Major Course	PL PATH-504	Plant Nematology	2	0	1	4	**2+1**
3.	Major Course	PL PATH-517	Diseases of Vegetable & Spices Crops	2	0	1	4	**2+1**
4.	Minor Course	PL PATH-512	Detection and Management of Seed borne Pathogens	2	0	1	4	**2+1**
5.	Supporting Course	STAT-511	Experimental Designs	2	0	1	4	2+1

6.	Common Course	PGS-503	Intellectual Property and its management in Agriculture	1	0	0	1	1+0
7.	Common Course	PGS-504	Basic concept in Laboratory Techniques	0	0	1	2	0+1
Total				11	0	6	23	**17**

Semester-III

SN.	Category	Code	Course Title	L	T	P	Total Hr	Credits
1.	Major Course	PL PATH-506	Techniques in Detection& Diagnosis of Plant Diseases	0	0	2	4	0+2
2.	Major Course	PL PATH-515	Diseases of Field& Medicinal Crops	2	0	1	4	2+1
3.	Minor Course	PL PATH-516	Diseases of Fruits, Plantation &Medicinal Crops	2	0	1	4	2+1
4.	Common Course	PGS-506	Agricultural Research, Research Ethics and Rural Development Programs	1	0	0	1	1+0
Total				**5**		**4**	**13**	**5+4**

Semester-IV

SN.	Category	Code	Course Title	L	T	P	Total Hrs	Credits
1.	Major Course	PL PATH-591	Seminar	0	0	1	2	1
2.	Major Course	PL PATH-599	Thesis Research	0	0	30	60	30
Total				**0**	**0**	**31**	**62**	**31**

Total Credits = 75

Course Code: PL PATH-501
Course Title: Mycology
Pre-requisite: Student should have basic knowledge of Plant Science
Aim of the course: To study the nomenclature, classification and characters of fungi.
Rationale: Most of plant diseases are caused by fungi therefore detailed study of mycology is necessary in this programme
Course Outcomes: Upon successful completion of the course a student will be able to:
PL PATH 501.1: Describe terminology, concepts importance and somatic characters of fungi
PL PATH 501.2: Demonstrate and understanding life cycle of Stramenopila and protists; Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota
PL PATH 501.3: Compare the characters of Kingdom Stramenopila; Hypochytriomycota, Oomycota and Labyrinthulomycota
PL PATH 501.4: Determine the characters of kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota and test them
PL PATH 501.5: Determine the characters of kingdom fungi under Basidiomycota

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Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Major	PL PATH-501	Mycology	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			2	2	1	1	6	2+1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 markseach (CA)	Class Test2 (2 best out of 3) 10 markseach (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total Marks (CA+CT +SA+CA T+AT)		
Major	PL PATH-501	Mycology						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH501.1: Describe terminology, concepts importance and somatic characters of fungi.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand definition, basic terminology concept and importance of Mycology. **SO1.2** Recognize the world mycologists **SO1.3** Importance of culture collection and herbarium of fungi. **SO1.4** Identify the somatic characters **SO1.5** Test the reproduction in fungi.	• Detailed comparative study of different groups of fungi; • Collection of cultures and live specimens	Unit1: Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi. 1.1 Definition of different terms, basic concepts 1.2 Importance of mycology in agriculture, relation of fungi to human affairs 1.3 History of mycology 1.4 Importance of culture collection and herbarium of fungi 1.5 Somatic characters of fungi 1.6 Reproduction in fungi	1.Collection and preservation of herbarium 2.History of mycology

SW-1 Suggested Sessional Work (SW):
Assignments: i) Definition of different terms use in mycology, importance of mycology in Agriculture

PL PATH501.2: Demonstrate and understanding life cycle of Stramenopila and protists; Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Identify the modern concepts of nomenclature of fungi. **SO2.2**Revise the classification of fungi	• Saccardoan classification and classification based on conidiogenesis	Unit 2: Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists. The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota.	1. Concept of nomenclature

SO2.3 Differentiate the general characters of protists **SO2.4** Compare life cycles of protist fungi	• Vegetative structures and different types of fruiting bodies produced by slime molds	2.1Modern concept of nomenclature and classification 2.2Classification of kingdom fungi: Stramenopila and Protists 2.3The general characteristics of protists 2.4Life cycle in the Phylum Plasmodiophoromycota 2.5Life cycle in the Phylum Dictyosteliomycota 2.6Life cycle in the Phyla Acrasiomycota and Myxomycota.	

SW-1 Suggested Sessional Work (SW):

Assignments: i) Classification of kingdom fungi, life cycles of different protists

PL PATH501.3: Compare the characters of Kingdom Stramenopila; Hypochytriomycota, Oomycota and Labyrinthulomycota

Approximate Hours

Item	Approx. Hrs
CI	4
LI	6
SW	1
SL	1
Total	12

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Identify the characters of stramenopila **SO3.2**Compare the life cycle of respective genera **SO3.3** Differentiate the general characters of Hypochytriomycota **SO3.4** Compare life cycles of different genera of oomycetes	• Study of different characters of stramenopiles and true fungi • Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota. • Somatic and reproductory structures of Pythium, Phytophthora, downy mildews and Albugo,	Unit 3: Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota 3.1Characters of kingdom Stramenopila 3.2 life cycles of respective genera under Hypochytriomycota 3.3 life cycles of respective genera under Oomycota 3.4 life cycles of respective genera under Labyrinthulomycota	1. Characters and life cycles of Stramenopila

SW-1 Suggested Sessional Work (SW):

Assignments: i) life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota

PL PATH501.4: Determine the characters of kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota and test them

Approximate Hours

Item	Approx. Hrs
CI	7
LI	6
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Identify the characters of Kingdom fungi **SO4.2**Determine the life cycles of respective genera of Kingdom fungi **SO4.3** Differentiate the general characters of different phyla **SO4.4** Collect fungi of different genera of Chytridiomycota, Zygomycota, Ascomycota	• Zygomycetes: Sexual and asexual structures of Mucor, Rhizopus, General characters of VAM fungi. • Ascomycetes; fruiting structures, Erysiphales, and Eurotiales; • General identification characters of Pyrenomycetes, Discomycetes, Loculoascomycetes and Laboulbenio-mycetes	Unit 4: Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi. 4.1 General characters, ultrastructure of Kingdom fungi 4.2 life cycles of respective genera under Chytridiomycota 4.3 life cycles of respective genera under Zygomycota 4.4 life cycles of respective genera under Ascomycota; Archiascomycetes, Ascomycetous yeasts 4.5 life cycles of respective genera under Ascomycota; Pyrenomycetes, Plectomycetes, Discomycetes 4.6 life cycles of respective genera under Ascomycota; Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi 4.7 Anamorphs of ascomycetous fungi	1. Characters and life cycles of Kingdom fungi

SW-1 Suggested Sessional Work (SW):
Assignments: i) life cycles of respective genera under Chytridiomycota, Zygomycota, Ascomycota

PL PATH501.5: Determine the characters of kingdom fungi under Basidiomycota

Approximate Hours

Item	Approx. Hrs
CI	7
LI	6
SW	1
SL	1
Total	15

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Identify the characters of phylum basidiomycota **SO5.2**Determine the life cycles of respective genera of Uridinales **SO5.3**	• Study of Basidiomycetous fungi and their ultrastructural characters • Study of fungi under Hyphomycetes and Coelomycetes and	Unit 5: Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi.	1. life cycle pattern in rusts and smuts

Differentiate the general characters of the genera of Ustilaginales **SO5.4** Collect fungi of different genera of Uridinales and Ustilaginales	their teliomorphic and anamorphic states, • Application of molecular approaches and techniques for identification of fungal pathogens	5.1 General characters Basidiomycota 5.2 Mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes 5.3 Mode of reproduction, types of basidiocarps and economic importance of Uridinales 5.4 Mode of reproduction, types of basidiocarps and economic importance of Ustilaginales 5.5 life cycle pattern in rusts and smuts 5.6 Mitosporic fungi 5.7 Molecular characterization of plant pathogenic fungi	

SW-1 Suggested Sessional Work (SW):

Assignments: i) Life cycle patterns of wheat rusts, mitosporic fungi and molecular characterization of rust fungi.

Brief of Hours suggested for the Course Outcome

i)

Course Outcomes	Class Lecture (C)	Lab instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+ Sl)
PL PATH 501.1: Describe terminology, concepts importance and somatic characters of fungi	6	6	1	2	09
PL PATH 501.2**:** Demonstrate and understanding life cycle of Stramenopila and protists; Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota	6	6	1	1	08
PL PATH 501.3: Compare the characters of Kingdom Stramenopila; Hypochytriomycota, Oomycota and Labyrinthulomycota	4	6	1	1	06
PL PATH 501.4: Determine the characters of kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota and test them	7	6	1	1	09
PL PATH 501.5: Determine the characters of kingdom fungi under Basidiomycota	7	6	1	1	09
Total Hours	30	30	05	06	71

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Introduction, history and importance of fungi	03	04	03	10
CO-2	Nomenclature & classification of fungi	02	04	04	10
CO-3	Kingdom Stramenopila	03	03	04	10
CO-4	kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota	02	03	05	10
CO-5	Kingdom fungi under Basidiomycota	03	03	04	10
Total		13	17	20	50

Legend: **R: Remember, U: Understand, A: Apply**

The end of semester assessment for Fundamentals of Plant Pathology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case study
3. Group Discussion
4. Role Play
5. Demonstration
6. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Plant Pathology	Agrios GN.	Academic Press, New York. (Indian Ed.)	2005 5th Ed.
2	Introductory Mycology	Alexopoulos CJ, Mims CW and Blackwell M	John Wiley & Sons, New York.	2002. 5th Ed.
3	The Fungi – An Advanced Treatise...	Ainsworth GC, Sparrow FK and Susman HS	Academic Press, New York	1973. Vol. IV (A & B)
4	Fungi: Experimental Methods in Biology	Maheshwari R.	CRC Press, US	2016.2nd ed.
5	An Introductory Mycology	Mehrotra RS and Arneja KR.	Wiley Eastern, New Delhi.	1990.
6	Text book of Mycology	Sarbhoy AK.	ICAR, New Delhi.	2000.
7	Introduction to Fungi.	Webster J.	Cambridge Univ. Press, Cambridge, New York.	1980. 2nd Ed.
8	Mycology And Microbiology: A Textbook for UG And PG Courses	Manoharachary C	Scientific Publishers, 9788172339890	1st Ed. 2016
9	Agrios Plant Pathology	Richard Oliver	Academic Press, New York. (Indian Ed.)	2023 6th Ed.
10	Applied Mycology	Rai And Mahendra and Paul D Bridge	Cabi Publishing	2009

Curriculum Development Team

1. Associate Professor & Head, Dr. Doomar Singh and Dr. Moti Lal, Department of Plant Pathology, AKS University

Cos, POs and PSOs Mapping

Course Title: Mycology

Course Code: PL PATH 501

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability:	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Describe terminology, concepts importance and somatic characters of fungi	2	3	2	3	3	3	3	2	3	3	3	3	3	3
CO2: Demonstrate and understanding life cycle of Stramenopila and protists; Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO3: Compare the characters of Kingdom Stramenopila; Hypochytriomycota, Oomycota and Labyrinthulomycota	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO4: Determine the characters of kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota and test them	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO5: Determine the characters of kingdom fungi under Basidiomycota	1	1	2	2	3	3	3	3	2	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	**CO1:** Describe terminology, concepts importance and somatic characters of fungi	SO 1.1 SO 1.2 SO 1.3 SO 1.4	• Detailed comparative study of different groups of fungi; • Collection of cultures and live specimens.	Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi. 1.1,1.2,1.3,1.4,1.5,1.6	1. Collection and preservation of herbarium **2.** History of mycology
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	**CO2:** Demonstrate and understanding life cycle of Stramenopila and protists; Plasmodiophoromycot a, Dictyosteliomycota, Acrasiomycota and Myxomycota	SO 2.1 SO 2.2 SO 2.3 SO 2.4	• Saccardoan classification and classification based on conidiogenesis • Vegetative structures and different types of fruiting bodies produced by slime molds	Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists. The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota. 2.1,2.2,2.3,2.4,2.5,2.6	1. Concept of nomenclature
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	**CO3:** Compare the characters of Kingdom Stramenopila; Hypochytriomycota, Oomycota and Labyrinthulomycota	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Study of different characters of stramenopiles and true fungi • Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota. • Somatic and reproductory structures of Pythium, Phytophthora, downy mildews and Albugo	Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota. 3.1,3.2,3.3,3.4	1.Characters and life cycles of Stramenopila
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	**CO4:** Determine the characters of kingdom fungi under Chytridiomycota, Zygomycota, Ascomycota and test them	SO 4.1 SO 4.2 SO 4.3 SO 4.4	• Zygomycetes: Sexual and asexual structures of Mucor, Rhizopus, General characters of VAM fungi. • Ascomycetes; fruiting structures, Erysiphales, and Eurotiales; • General identification characters of Pyrenomycetes, Discomycetes, Loculoascomycetes and Laboulbenio-mycetes	Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi. 4.1,4.2,4.3,4.4,4.5,4.6,4.7	1. Characters and life cycles of Kingdom fungi
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	**CO5**: Determine the characters of kingdom fungi under Basidiomycota	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Study of Basidiomycetous fungi and their ultrastructural characters • Study of fungi under Hyphomycetes and Coelomycetes and their teliomorphic and anamorphic states, • Application of molecular approaches and techniques for identification of fungal pathogens	Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi. 5.1,5.2,5.3,5.4,5.5,5.6,5.7	1. life cycle pattern in rusts and smuts

Course Code: PL PATH-502
Course Title: Plant Virology
Pre-requisite: Student should have basic knowledge of microbiology
Rationale: Losses in crops due to viruses is the main problem which is uncurable now a days. Therefore, the study of viruses, their morphology, mechanism of interaction with plants and management of the diseases caused by them is necessary to study at PG level.
Aim of the course: To acquaint with the structure, virus- vector relationship, biology and management of plant viruses.
Course Outcomes: Upon successful completion of the course a student will be able to:

PL PATH502.1: Know physical, structural and chemical properties, transmission nature of plant viruses.
PL PATH502.2: Detail classification, nomenclature, replication of plant viruses in plant system
PL PATH502.3 Understand the basic concept of isolation and purification of plant viruses with help of SEM and TEM microscope
PL PATH502.4: Assess of the risk associated with the presence of viral pathogens and respects the principles of phytosanitary safety in relation to himself and the surrounding environment
PL PATH502.5: Understand the basic concept of genetic engineering, mechanism of resistance and management of plant viruses

Category of course	Course Code	Course Title			Scheme of studies (Hours/ Week)			Total Credits
Major	PL PATH-502	Plant Virology	CI	**LI**	**SW**	SL	Total study Hours (CI+LI+SW+SL)	
			2	**2**	**1**	1	6	2+1

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) And others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	CourseCode	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment number 5 marks each (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Major	PL PATH-502	Plant Virology						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH502.1. Know physical, structural and chemical properties, transmission nature of plant viruses.

Approximate Hours

Item	Appx. Hrs.
CI	8
LI	6
SW	1
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1: recognize the historical development of virology **SO1.2:** Realize the Significance of Plant Viruses **SO1.3:** Describe the composition and structure of Plant Viruses. **SO1.4:** Understand the Origin and Evolution of Plant Viruses **SO5.5:** Explain the Nomenclature and Classification of Plant Viruses	• Purification of Plant Viruses • Detection of Plant Viruses • Determination of symptoms caused Plant Viruses	Unit1**:** History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and Baculo viruses, Satellite Viruses, Satellite RNAs, Phages, Viroids and Prions. Origin and evolution of viruses and their nomenclature and classification. **1.1:** History and economic significances of plant viruses. **1.2:** General and morphological characters of Plant Viruses **1.3:** Economic significances of plant viruses **1.4:** composition and structure of Plant Viruses **1.5:** Myco-viruses, arbo and baculo-viruses **1.6: S**atellite viruses, satellite RNAs, 1.7: Phages, viroids and Prions. **1.8:** Origin and evolution of viruses **1.9:** Nomenclature and Classification of Plant Viruses.	1.Differences between Cellular and Acellular organisms

SW-1 Suggested Sessional Work (SW):

Assignment: i) Collection and preservation of disease specimens caused by Viruses.

PL PATH 502.2: Detail classification, nomenclature, replication of plant viruses in plant system

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1: Understand the Genome organization and replication of plant viruses. **SO2.2:** Understand the response of the host to virus infection.	• Field visit to study the symptoms caused by plant viruses followed by • Bioassay of virus	**Unit 2**. Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and Symptomatical changes.	1: Compositio n and Structure of Plant Viruses

SO2.3: Explain the biochemical, physiological, and Symptomatical changes after virus infection **SO2.4:** differentiate the viral symptoms from those caused by symptoms other Pathogens **SO2.5:** Recognize movement of virus in the host	cultures on indicator plants and host differentials • Transmission of plant viruses Mechanical, graft and vector and study of disease • development);	**2.1:** Genome organization of Plant Viruses **2.2:** Replication of Plant Viruses in selected groups of plant viruses and their movement in host **2.3:** Response of the host to virus infection **2.4:** Response of the host to virus infection: biochemical **2.5:** Response of the host to virus infection: physiological Changes **2.6:** Symptomatical changes	

SW-1: Suggested Sessional Work (SW):
Assignments: i) Composition and Structure of Plant Viruses

PL PATH 502.3: Understand the basic concept of isolation and purification of plant viruses with help of SEM and TEM microscope

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Understand the transmission of viruses **SO3.2:** Operate the Isolation and purification of viruses. **SO3.3:** Identify insect vectors of Plant Viruses **SO3.4:** Demonstrate Vector transmission of Plant Viruses. **SO3.5:** Explain the mode of transmission of plant Viruses.	• Mechnical and graft transmission of viruses and study of disease development • Vector transmission of viruses and study of disease development • Isolation and purification of viruses.	**Unit 3**. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses. 3.1. Transmission of viruses: mechanical 3.2: Transmission of viruses and virus-vector relationship: insect vectors 3.3: Transmission of viruses and virus-vector relationship: Nematode and fungal 3.4: Isolation and purification of viruses 3.5: Isolation and purification of viruses	1: Isolation and Purification of Plant viruses

SW-1: Suggested Sessional Work (SW):
Assignments: i) Purification of Plant viruses
PL PATH 502.4: Assess of the risk associated with the presence of viral pathogens and respects the principles of phytosanitary safety in relation to himself and the surrounding environment

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO4.1: Detect plant viruses **SO4.2:** Identify viruses by using protein and nucleic based diagnostic techniques **SO4.3:** Understand the natural resistance to plant viruses **SO4.4:** Understand the role of genetic engineering in the plant disease resistance to virus diseases. **SO4.5:** Demonstrate the Identification of through protein and nucleic acid based diagnostic techniques	• Detection of inclusion body in • Virus infected tissues • Electron microscopy for studying viral particle morphology • Field visit to study the symptoms caused by plant viruses	**Unit 4:** Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses. 4.1. Detection of plant viruses by using protein based diagnostic techniques. 4.2: Detection and identification of plant viruses by using nucleic acid based diagnostic techniques 4.3. Identification of plant viruses by using protein and nucleic acid based diagnostic techniques. 4.4. Natural (R-genes) resistance to plant viruses 4.5. Engineering resistance to plant viruses	1.Methods of detection and identification of viruses

SW-1 Suggested Sessional Work (SW):
Assignments: i) Serology of viruses

PL PATH 502.5: Understand the basic concept of genetic engineering, mechanism of resistance and management of plant viruses

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO5.1: understand the epidemiology of viral diseases **SO5.2:** Determine the factors affecting virus diseases **SO5.3:** Identify the host range of plant viruses **SO5.4:** Understand the survival of plant viruses **SO5.5:** Determine the management strategies for diseases caused by plant viruses	• Field visit to see the effect of changing environment on development of viral diseases	**Unit 5:** Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses. 5.1. Virus epidemiology 5.2. Ecology of viruses 5.3. Host range 5.4. Survival of plant viruses 5.5. Management of diseases caused by plant viruses. 5.6. Management of diseases caused by plant viruses	Insect Vectors of Plant viruses

SW-1 Suggested Sessional Work (SW):
Assignments: i) Insect Vector of Plant disease.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+ Sl)
PLPATH 502.1: Know physical, structural and chemical properties, transmission nature of plant viruses.	8	6	1	1	16
PL PATH502.2: Detail classification, nomenclature, replication of plant viruses in plant system	6	6	1	1	14
PL PATH503.3: Understand the basic concept of isolation and purification of plant viruses with help of SEM and TEM microscope	5	6	1	1	13
PL PATH502.4: Assess of the risk associated with the presence of viral pathogens and respects the principles of phytosanitary safety in relation to himself and the surrounding environment	5	6	1	1	13
PL PATH502.5: Understand the basic concept of genetic engineering, mechanism of resistance and management of plant viruses	6	6	1	1	14
Total	30	30	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	**Unit title**	**Marks distribution**			**Total mark**
		R	U	A	
CO-1	Physical, structural and chemical properties of plant viruses.	02	03	05	10
CO-2	Classification, nomenclature, replication of plant viruses	03	03	04	10
CO-3	Isolation and purification of plant viruses	03	03	04	10
CO-4	Assess of the risk associated with the presence of viral pathogens	02	04	04	10
CO-5	Mechanism of resistance and management of plant viruses	03	03	04	10
Total		13	16	21	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with writtenexamination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case Method
3. Group Discussion
4. Demonstration
5. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Plant Pathology	Agrios GN	Academic Press, New York.	5th ed 2005
2	Symptoms of Virus Diseases in Plants	Bos L	Oxford & IBH., New Delhi	1964
3	Virus of Plants: Descriptions and Lists from VIDE Database	Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ and Watson L	CABI, Wallington	1995
4	Plant Virology – The Principles.	Gibbs A and Harrison B	Edward Arnold, London	1976
5	Mathew's Plant Virology.	Hull R	Academic Press, New York	2002. 4th Ed
6	Identification of Plant Viruses, Methods and Experiments.	Noordam D	Oxford & IBH, New Delhi	1973
7	Applied Plant Virology.	Wilson C	CABI Publishing England	20014
8	Plant Virology	Roger Hull	S. Chand 9789351073529, 9351073521	5th Ed. 2016
9	Comparative Plant Virology	Roger Hull	Elsevier Science Publishing Co Inc 9780123741547, 9780123741547	2nd Ed.
10	Agrios Plant Pathology	Richard Oliver	Academic Press, New York. (Indian Ed.)	2023 6th Ed.

Curriculum Development Team

1. Dr. Doomar Singh, Associate Professor & Head, Department of Plant Pathology, AKS University, Satna
2. Dr. Moti Lal, Associate Professor, Department of Plant Pathology, AKS University, Satna

Cos, POs and PSOs Mapping

Course Title: Plant Virology

Course Code: PL PATH 502

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability:	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO.1: Know physical, structural and chemical properties, transmission nature of plant viruses.	1	1	2	2	3	3	2	1	3	3	3	3	3	3
CO.2: Detail classification, nomenclature, replication of plant viruses in plant system	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO.3: Understand the basic concept of isolation and purification of plant viruses with help of SEM and TEM microscope	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO.4: Assess of the risk associated with the presence of viral pathogens and respects the principles of phytosanitary safety in relation to himself and the surrounding environment	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO.5: Understand the basic concept of genetic engineering, mechanism of resistance and management of plant viruses	1	3	2	2	3	3	3	2	3	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	CO.1 Physical, structural and chemical properties of plant viruses.	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	• Purification of Plant Viruses • Detection of Plant Viruses • Determination of symptoms caused Plant Viruses	Unit 1. History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and Baculo viruses, Satellite Viruses, Satellite RNAs, Phages, Viroids and Prions. Origin and evolution of viruses and their nomenclature and classification. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	1.Difference between Cellular and Acellular organisms
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	CO.2 Classification, nomenclature, replication of plant viruses	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	• Field visit to study the symptoms caused by plant viruses followed by • Bioassay of virus cultures on indicator plants and host differentials • Transmission of plant viruses Mechanical, graft and vector and study of disease • development)	Unit II Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and Symptomatical changes. 2.1,2.2,2.3,2.4,2.5,2.6	1: Composition and Structure of Plant Viruses
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	CO.3 Isolation and purification of plant viruses	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO 3.5	• Mechnical and graft transmission of viruses and study of disease development • Vector transmission of viruses and study of disease development • Isolation and purification of viruses.	Unit III. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses. 3.1,3.2,3.3,3.4,3.5	1: Isolation and Purification of Plant viruses
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	CO.4 Assess of the risk associated with the presence of viral pathogens	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	• Detection of inclusion body in Virus infected tissues • Electron microscopy for studying viral particle morphology • Field visit to study the symptoms caused by plant viruses	Unit 4: Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses. 4.1,4.2,4.3,4.4,4.5	1.Methods of detection and identification of viruses
POs 1,2,3,4,5,6,7 ,8,9,10 PSOs 1,2,3,4	CO.5 Mechanism of resistance and management of plant viruses	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Field visit to see the effect of changing environment on development of viral diseases	Unit 5: Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses. 5.1,5.2,5.3,5.4,5.5,5.6	1. life cycle pattern in rusts and smuts

Course Code: PL PATH-505
Course Title: Principles of Plant Pathology
Pre-requisite: Student should have basic knowledge of Plant Science
Rationale: The students studying M. Sc. (Agri) Plant Pathology should possess foundational understanding about plant Science
Aim of the course: To introduce the subject of Plant Pathology, its concepts and principles.

Course Outcomes: Upon successful completion of the course a student will be able to:
PL PATH505.1: Describe terminology, concept and importance of plant diseases occurred in the past.
PL PATH505.2: Develop an understanding about growth, reproduction and role of environment in plant diseases
PL PATH505.3: Enumerate and explain recognition concept and role of enzymes, toxins, growth regulators in the infection,
PL PATH505.4: Develop resistance; 'R' genes; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance
PL PATH505.5: Determine the most effective principle of disease management for use in the field level.

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Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Major	PL PATH-505	Principles of Plant Pathology	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			2	2	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT +SA+CAT+AT)		
Major	PL PATH-505	Principles of Plant Pathology	-					50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH505.1: Describe terminology, concept and importance of plant diseases occurred in the past.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 Understand definition, concept, basic terminology and importance of Plant diseases. **SO1.2** Understand the history and growth of Plant Pathology **SO1.3** Understand the Causes of Plant Disease.	• 1.Isolation and purification of plant pathogens • Inoculation of plant pathogens and proving Koch's postulates • 3.Identification of symptoms caused by Abiotic factors	Unit1: Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. **1.1:** Importance of plant diseases. 1.2**:** Definition of plant diseases 1.3: concepts of diseases in plants 1.4**:** History and growth of plant pathology 1.5**:** Biotic causes of plant diseases. 1.6: Abiotic causes of plant diseases	1: History and growth of Plant Pathology

SW-1 Suggested Sessional Work (SW):
Assignment: i) History and growth of Plant Pathology

PL PATH 505.2: Develop an understanding about growth, reproduction and role of environment in plant diseases.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1: Understand the Growth, reproduction, survival and dispersal of important plant pathogens **SO2.2:** understand the role of environment and host nutrition on disease development.	• Basic plant pathological techniques • Field visit to see the effect of environment on development of crop diseases. • Field visit for Collection and Preservation of various plant disease symptoms.	Unit 2: Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. 2.1: Growth and reproduction, of important plant pathogens 2.2: survival and dispersal of important plant pathogens 2.3: Survival of important plant pathogens 2.4: dispersal of important plant pathogens 2.5: role of environment on disease development. 2.6: role of host nutrition on disease development	1: Role of human in disease development

SW-1 Suggested Sessional Work (SW):
Assignments: i) Role of human in disease development

PL PATH 505.3: Enumerate and explain recognition concept and role of enzymes, toxins, growth regulators in the infection, Phytoalexins, PR proteins, Elicitors.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Understand the host-parasite interaction **SO3.2:** Understand the concept and phenomenon of infection and disease development in plants. **SO3.3:** Define various symptoms of plant diseases **SO3.4:** Understand the role of enzymes, toxins and growth regulators in plant disease development.	• Purification of enzymes, toxins and their bioassay • Study the Host-parasite interaction • Study the symptoms and Sign of various plant diseases • Field visit for collection and preservation of plant disease specimen.	Unit 3: Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators. 3.1: Host parasite interaction, recognition concept and infection 3.2: Host parasite interaction, recognition concept and infection 3.3: Disease development 3.4: Symptomatology 3.5: Role of enzymes 3.6: Role of toxins and Enzymes	1: Collection and Preservation of various plant disease symptoms.

SW-1 Suggested Sessional Work (SW):
Assignments: i) Collection and Preservation of various plant disease symptoms.

PL PATH 505.4: Develop resistance; 'R' genes; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO4.1: Understand the Mechanism of defense in plants **SO4.2:** understand the Defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. **SO4.3:** Understand the altered plant metabolism as affected by plant pathogens.	• Estimation of Phenolics, Phytoalexins in resistant and susceptible plants • Physiology of affected plants by pathogens • Effect of Elicitors on plant defense	**Unit 4:** Defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. 4.1. Defense strategies- oxidative burst 4.2. Defense strategies- Phenolics 4.3. Defense strategies- Phytoalexins 4.4. Defense strategies- PR proteins. 4.5. Defense strategies- Elicitors. 4.6. Altered plant metabolism as affected by plant pathogens.	Basics of Immunology

SW-1 Suggested Sessional Work (SW):
i) Assignments: Basics of Immunology

PL PATH 505.5: Determine the most effective principle of disease management for use in the field level

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO5.1: Understand the Genetics of resistance 'R' genes **SO5.2:** understand the mechanism of genetic variation in plant pathogens **SO5.3:** Understand the molecular basis for resistance: marker-assisted selection SO5.4: Understand the genetic engineering for disease resistance.	• Field visit for selection of resistant plants in an infected plant population • To study the variability in plant pathogens • Molecular assay for identify resistant gene.	**Unit 5:** Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. 1.Genetics of resistance 2. Genetics of resistance- 'R' gene 3. mechanism of genetic variation in Plant pathogens 4. molecular basis for resistance 5.Marker-assisted selection 6.Genetic engineering for disease resistance	1.Basics of Mendelian Law of Genetics, modern gene editing techniques

SW-1 Suggested Sessional Work (SW):
Assignments: i) Basics of Mendelian Law of Genetics, modern gene editing techniques: Transgenic plants, CRISPR Cas-9

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH505.1: Describe terminology, concept and importance of plant diseases occurred in the past.	6	6	1	1	14
PL PATH505.2: Develop an understanding about growth, reproduction and role of environment in plant diseases	6	6	1	1	14
PL PATH505.3: Enumerate and explain recognition concept and role of enzymes, toxins, growth regulators in the infection, Phytoalexins, PR proteins, Elicitors	6	6	1	1	14
PL PATH505.4: Develop resistance; 'R' genes; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.	6	6	1	1	14
PL PATH505.5: Determine the most effective principle of disease management for use in the field level.	6	6	1	1	14
Total Hours	30	30	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks distribution			Total mark
		R	U	A	
CO-1	Terminology and importance of plant diseases				10
CO-2	Growth and reproduction				10
CO-3	Role of enzymes, toxins, growth regulators in the infection				10
CO-4	Resistance				10
CO-5	Disease management				10
	Total				50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with writtenexamination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case studies
3. Group Discussion
4. Role Play
5. Demonstration
6. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Plant Pathology	Agrios GN	Academic Press, New York.	2005. 5 ed
2	Physiological Plant Pathology	Heitefuss R and Williams PH	Springer Verlag, Berlin, New York	1976
3	Plant Pathology	Mehrotra RS and Aggarwal A	Oxford & IBH, New Delhi.	2003. 2 ed
4	Plant Pathology	Singh RP	Kalyani Publishers, New Delhi	2012. 2 ed
5	Introduction to Principles of Plant Pathology	Singh RS	MedTech, New Delhi	2017. 5 ed
6	Disease and Insect Resistance in Plants	Singh DP and Singh A	Oxford & IBH, New Delhi	2007
7	Toxins in Plant Disease Development and Evolving Biotechnology	Upadhyay RK. and Mukherjee KG	Oxford & IBH, New Delhi.	1997
8	Agrios Plant Pathology	Richard Oliver	Academic Press, New York. (Indian Ed.)	2023 6th Ed.

Curriculum Development Team

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Cos, POs and PSOs Mapping

Course Title: Principles of Plant Pathology

Course Code: PL PATH505

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist &society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Describe terminology, concept and importance of plant diseases occurred in the past.	2	3	2	3	3	3	3	2	3	3	3	3	3	3
CO2: Develop an understanding about growth, reproduction and role of environment in plant diseases	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO3: Enumerate and explain recognition concept and role of enzymes, toxins, growth regulators in the infection, Phytoalexins, PR proteins, Elicitors	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO4: Develop resistance; 'R' genes; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO5: Determine the most effective principle of disease management for use in the field level.	1	1	2	2	3	3	3	3	2	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1:** Describe terminology, concept and importance of plant diseases occurred in the past.	SO 1.1 SO 1.2 SO 1.3	• 1.Isolation and purification of plant pathogens • Inoculation of plant pathogens and proving Koch's postulates • 3.Identification of symptoms caused by Abiotic factors	Unit1: Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. 1.1,1.2,1.3,1.4,1.5,1.6	1: History and growth of Plant Pathology
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2:** Develop an understanding about growth, reproduction and role of environment in plant diseases	SO 2.1 SO 2.2	• Basic plant pathological techniques • Field visit to see the effect of environment on development of crop diseases. • Field visit for Collection and Preservation of various plant disease symptoms.	Unit 2: Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. 2.1,2.2,2.3,2.4,2.5,2.6	1: Role of human in disease development
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO3:** Enumerate and explain recognition concept and role of enzymes, toxins, growth regulators in the infection, Phytoalexins, PR proteins, Elicitors	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Purification of enzymes, toxins and their bioassay • Study the Host-parasite interaction • Study the symptoms and Sign of various plant diseases • Field visit for collection and preservation of plant disease specimen.	Unit 3: Host parasite interaction, recognition concept and infection, symptomatology, disease development-role of enzymes, toxins, growth regulators. 3.1,3.2,3.3,3.4,3.5,3.6	1: Collection and Preservation of various plant disease symptoms.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO4:** Develop resistance; 'R' genes; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.	SO 4.1 SO 4.2 SO 4.3	• Estimation of Phenolics, Phytoalexins in resistant and susceptible plants • Physiology of affected plants by pathogens • Effect of Elicitors on plant defense	**Unit 4:** Defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. 4.1,4.2,4.3,4.4,4.5,4.6	Basics of Immunology
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO5:** Determine the most effective principle of disease management for use in the field level.	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Field visit for selection of resistant plants in an infected plant population • To study the variability in plant pathogens • Molecular assay for identify resistant gene.	**Unit 5:** Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. 5.1,5.2,5.3,5.4,5.5,5.6	1.Basics of Mendelian Law of Genetics, modern gene editing techniques

Course Code: PL PATH 507
Course Title: Principles of plant disease management
Pre-requisite: Student should have basic knowledge of principles of plant pathology
Aim of the course: To acquaint with different strategies for management of plant diseases.

Rationale: All management practices of plant diseases are based on any principle or concept. Therefore, Principles of plant disease management is included in the programme
Course Outcomes: Upon successful completion of the course a student will be able to:

PL PATH 507.1 Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods.
PL PATH 507.2 Describe the disease resistance and molecular approach for disease management.
PL PATH 507.3 Understand the role of scientists in plant disease management and concepts of management practices.
PL PATH 507.4 Identify the mode of action of antifungal, antibacterial and antiviral chemicals.
PL PATH 507.5 Demonstrate the most sustainable, environmentally safe and low cost principle of disease management among the farmers.

Course category	Course Code	Course Title	Scheme of studies (Hours/ Week)					
Minor	PL PATH 507	Principles of plant disease management	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	Total Credits
			2	1	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+ SA+CAT +AT)		
Major	PL PATH 507	Principles of plant disease management						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH 507.1: Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods

Approximate Hours

Item	Approx. Hrs
Cl	07
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the principles of plant disease management **SO1.2** Recognize the botanicals useful for disease management **SO1.3** Discuss the organic amendments and their role in disease management	• Phytopathometry	Unit1: Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control. 1.1 Principles of plant disease management 1.2 Cultural practices of plant disease management 1.3 Physical practices of plant disease management 1.4 Biological methods of plant disease management 1.5 Chemical methods of plant disease management 1.6 Amendments for disease management 1.7 Botanicals methods of plant disease control	Botanicals and their use

SW-1 Suggested Sessional Work (SW):
Assignments: i) Principles of plant disease management

PL PATH 507.2: Describe the disease resistance and molecular approach for disease management

Approximate Hours

Item	Approx. Hrs
CI	5
LI	6
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Identify Integrated control measures of plant diseases	• Methods of in-vitro evaluation of chemicals, antibiotics, bio	Unit 2: Integrated control measures of plant diseases. Disease resistance and molecular approach for disease management	Molecular approach for disease management

SO2. Describe disease resistance **SO2.3** Test molecular approach for disease management	agents against plant pathogens • Field evaluation of chemicals, antibiotics, bio agents against plant pathogens	2.1Integrated control measures of plant diseases 2.2 Disease resistance 2.3 Disease resistance 2.4Molecular approach for disease management 2.5Molecular approach for disease management	

SW-1 Suggested Sessional Work (SW):
Assignments: i) Molecular approach for disease management

PL PATH 507.3 Understand the role of scientists in plant disease management and concepts of management practices

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Identify the role of scientists in plant disease management **SO3.2** Develop concepts of pathogen **SO3.3** Evaluate the chemicals for disease management **SO3.4** Test the chemotherapy	• Field evaluation of chemicals, antibiotics, bio agents against plant pathogens • Soil solarisation, methods of soil fumigation under protected cultivation	Unit 3: History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy. 3.1 History of fungicides 3.2 History of bactericides or antibiotics 3.3 Concepts of pathogen 3.4 Immobilization 3.5 Chemical protection 3.6 Chemotherapy	History of pesticides

SW-1 Suggested Sessional Work (SW):
Assignments: i) History of fungicides, bactericides, antibiotics

PL PATH 507.4: Identify the mode of action of antifungal, antibacterial and antiviral chemicals

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Inspect the nature and properties of pesticides **SO4.2** Examine the mode of actions of different fungicides **SO4.3** Set-up **l**abel claim of fungicides	Methods of application of chemicals and bio control agents	Unit 4: Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals. Label claim of fungicides. 4.1 Nature of antifungal, antibacterial and antiviral chemicals 4.2 Properties of antifungal, antibacterial and antiviral chemicals 4.3 Mode of action of antifungal chemicals 4.4 Mode of action of antibacterial chemicals 4.5 Mode of action of antiviral chemicals 4.6 Label claim of fungicides	Label claim of fungicides

SW-1 Suggested Sessional Work (SW):
Assignments: i) Mode of action of antifungal, antibacterial and antiviral chemicals

PL PATH 507.5: Demonstrate the most sustainable, environmentally safe and low- cost principle of disease management among the farmers

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Apply the chemicals for disease management **SO5.2** Judge the role of stickers, spreaders and adjuvants **SO5.3** Estimate health and environmental hazards **SO5.4** Detect residual effects	• ED and MIC values, study of structural details of sprayers and dusters • Artificial epiphytotic and screening of resistance	Unit 5: Application of chemicals on foliage, seed and soil, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures. 5.1 Application of chemicals on foliage, seed and soil 5.2 Role of stickers, spreaders 5.3 Role of adjuvants 5.4 Health vis-a-vis environmental hazards 5.5 Residual effects 5.6 Safety measures	1. Residual effects

SW-1 Suggested Sessional Work (SW):
Assignments: i) Safety measures

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C)	Lab Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH 507.1 Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods	7	6	1	1	15
PL PATH 507.2 Describe the disease resistance and molecular approach for disease management	5	6	1	1	13
PL PATH 507.3 Understand the role of scientists in plant disease management and concepts of management practices	6	6	1	1	14
PL PATH 507.4 Identify the mode of action of antifungal, antibacterial and antiviral chemicals	6	6	1	1	14
PL PATH 507.5 Demonstrate the most sustainable, environmentally safe and low- cost principle of disease management among the farmers	6	6	1	1	14
Total Hours	30	30	05	05	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Principles of plant disease management				10
CO-2	Integrated control measures				10
CO-3	History of fungicides				10
CO-4	Nature, properties of fungicides				10
CO-5	Application of chemicals				10
Total					50

Legend: **R: Remember, U: Understand, A: Apply**

The end of semester assessment for Fundamentals of Plant Pathology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case study
3. Group Discussion
4. Role Play
5. Demonstration
6. Brainstorming

Suggested Learning Resources: (a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Plant Pathology	Agrios GN.	Academic Press, New York. (Indian Ed.)	2005 5th Ed.
2	Principles of Plant Disease Management.	Fry WE	Academic Press, New York	1982
3	Fungicides in Crop Protection.	Hewitt HG	CABI, Wallington	1998
4	Fungicides in Plant Disease Control	Nene YL and Thapliyal PN	Oxford & IBH, New Delhi	1993
5	Handbook of Systemic Fungicides	Vyas SC	Tata McGraw Hill	1993 Vols. I-III
6	Agrios Plant Pathology	Richard Oliver	Academic Press, New York. (Indian Ed.)	2023 6th Ed.

Curriculum Development Team

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2. Dr. Moti Lal, Associate Professor, Department of Plant Pathology, AKS University, Satna

Cos, POs and PSOs Mapping

Course Title: Principles of plant disease management

Course Code: PL PATH 507

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern ool usage	Plant pathologist &society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1 Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods	2	3	2	3	3	3	3	2	3	3	3	3	3	3
CO2 Describe the disease resistance and molecular approach for disease management	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO Understand the role of scientists in plant disease management and concepts of management practices	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO4 Identify the mode of action of antifungal, antibacterial and antiviral chemicals	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO5 Demonstrate the most sustainable, environmentally safe and low-cost principle of disease management among the farmers	1	1	2	2	3	3	3	3	2	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO.1** Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods	SO 1.1 SO 1.2 SO 1.3	• Phytopathometry	Unit1: Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control. 1.1,1.2,1.3,1.4,1.5,1.6,1.7	Botanicals and their use
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO.2** Describe the disease resistance and molecular approach for disease management	SO 2.1 SO 2.2 SO 2.3	• Methods of in-vitro evaluation of chemicals, antibiotics, bio agents against plant pathogens • Field evaluation of chemicals, antibiotics, bio agents against plant pathogens	Unit 2 Integrated control measures of plant diseases. Disease resistance and molecular approach for disease management 2.1,2.2,2.3,2.4,2.5	Molecular approach for disease managemen t
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO.3** Understand the role of scientists in plant disease management and concepts of management practices	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Field evaluation of chemicals, antibiotics, bio agents against plant pathogens • Soil solarisation, methods of soil fumigation under protected cultivation	Unit 3: History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy. 3.1,3.2,3.3,3.4,3.5,3.6	History of pesticides
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO.4** Identify the mode of action of antifungal, antibacterial and antiviral chemicals	SO 4.1 SO 4.2 SO 4.3	• Methods of application of chemicals and bio control agents	Unit 4: Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals. Label claim of fungicides. 4.1,4.2,4.3,4.4,4.5,4.6	Label claim of fungicides
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO.5** Demonstrate the most sustainable, environmentally safe and low-cost principle of disease management among the farmers	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• ED and MIC values, study of structural details of sprayers and dusters • Artificial epiphytotic and screening of resistance	Unit 5: Application of chemicals on foliage, seed and soil, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures. 5.1,5.2,5.3,5.4,5.5,5.6	Residual effects

Course Code: STAT-502

Course Title: Statistical Methods for Applied Science

Pre-requisite: Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

Rationale: Statistical methods involved in carrying out a study include planning, designing, collecting data, analyzing, drawing meaningful interpretation and reporting of the research findings. The statistical analysis gives meaning to the meaningless numbers, thereby breathing life into a lifeless data.

Course Outcomes:

CO1 This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.

CO2 It can be used to find the best solution to any problem be it simple or complex.

CO3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.

CO4 To understand the process of hypothesis testing and its significance. Testing of hypothesis using non-parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.

CO5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Scheme of Studies:

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Supporting	STAT-502	Statistical Methods for Applied Science	2	2	02	01	7	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 1 number 5 marks each (CA)	Class Test 2 (2 best out) 15 marks each (CT)	Practical Exam (PA)	Class Attendance (AT)	Total Marks (CA+CT +PA+AT)		
Supporting	STAT-502	Statistical Methods for Applied Science	5	30	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

STAT-502 CO-1 Know the applications of Statistics and learn and apply these techniques in the agriculture field.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	2
SW	1
SL	2
Total	11

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Apply laws of probability to concrete problems. **SO1.2** Perform statistical inference in several circumstances and interpret the results in an applied context. **SO1.3** Communicate concepts in probability and statistics using both technical and non-technical language**.** **SO1.4** Use a statistical software package for computations with data,	1) To impart knowledge on Statistical concepts like EXploratory data analysis.	**Unit-1.** Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation. **1.1**. Box-plot **1.2** Descriptive statistics **1.3** Exploratory data analysis **1.4** Theory of probability. **1.5** Random variable **1.6**Mathematical expectation	1. Prepare the assignment on Random variable and mathematical expectation.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Random variable and mathematical expectation.

STAT-502 CO-2 Find the best solution to any problem be it simple or complex.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	8
SW	1
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Recognize the binomial probability distribution and apply it appropriately. **SO2.2** Recognize the Poisson probability distribution and apply it appropriately. **SO2.3** Recognize and understand discrete probability distribution functions, in general. **SO2.4** Recognize the standard normal probability distribution and apply it appropriately. **SO2.5** Compare normal probabilities by converting to the standard normal distribution.	• Fitting of Binomial distributions. • Fitting of Poisson distributions. • Fitting of Negative Binomial distributions. • Fitting of Normal distributions.	**Unit-2** 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. **2.1** Discrete and continuous probability distributions **2.2** Binomial, Poisson, Negative Binomial **2.3**. Normal distribution, Beta and Gamma distributions and their applications **2.4** Concept of sampling distribution: chi-square, *t* and *F* distributions. **2.5** Tests of significance based on Normal, chi-square. **2.6** Tests of significance based on *t* and *F* distributions.	1. Prepare the assignment on Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications.

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Probability. Binomial & Poisson Distributions.

STAT-502 CO-3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and multiple correlation coefficient.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	6
SW	1
SL	2
Total	15

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Create and analyze scatter plots. **SO3.2** Discuss basic ideas of linear regression and correlation. **SO3.3** Create and interpret a line of best fit. **SO3.4** Calculate	1- Large sample tests, testing of hypothesis based on eXact sampling distributions ~chi square, t and F. 2- Large sample tests, testing of hypothesis based on eXact sampling distributions ~t-test. 3- Large sample tests, testing of hypothesis based	**Unit-3** Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. **3.1**. Definition of Correlation **3.2** Types of Correlation **3.3**. Scatter Diagram **3.4**. Karl Pearson's Coefficient of Correlation **3.5** Definition of Regression. **3.6**. Linear Regression Equations	1. Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.

and interpret the correlation coefficient.	on eXact sampling distributions ~F- test.		

SW-1 Suggested Sessional Work (SW):
Assignments: Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.

STAT-502 CO-4 understand the process of hypothesis testing and its significance. Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.

Approximate Hours

Item	Appx Hrs.
CI	6
LI	8
SW	1
SL	2
Total	17

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Conduct and interpret hypothesis tests for a single population mean, population standard deviation known. **SO4.2** Conduct and interpret hypothesis tests for a single population mean, population standard deviation unknown. **SO4.3** Describe hypothesis testing in general and in practice **SO4.4** Interpret the chi-square probability distribution as the sample size changes. **SO4.5** Conduct and interpret chi-square goodness-of-fit hypothesis tests.	• Confidence interval estimation and Correlation analysis • Regression analysis • Fitting of Linear and Quadratic Model.	**Unit-4** Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 4.1 Introduction to Test of Significance 4.2 One sample 4.3 Two sample test t for Means 4.4 Definition of Chi-Square 4.5 Application of Chi- square test 4.6 Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table	1. Prepare the assignment on Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table.

SW-1 Suggested Sessional Work (SW):
Assignments: Prepare the assignment on Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table

STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Approximate Hours

Item	Appx Hrs.
CI	6
LI	6
SW	1
SL	2
Total	15

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Recognize and differentiate between key terms. **SO5.2** Apply various types of sampling methods to data collection. **SO5.3** Create and interpret frequency tables.	○ Non-parametric tests. ○ ANOVA: One way • ANOVA: Two Way	**Unit-5** Introduction to Analysis of Variance, Analysis of One-Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample. **5.1** Introduction to Analysis of Variance **5.2**. Analysis of One-Way Classification **5.3**. Introduction to Sampling Methods **5.4** Sampling versus Complete Enumeration **5.5** Simple Random Sampling with and without replacement **5.6** Use of Random Number Tables for selection of Simple Random Sample.	1. Prepare the assignment on Introduction to Analysis of Variance, Analysis of One-Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration.

SW-1 Suggested Sessional Work (SW):

Assignments:

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (L I)	Sessional Work (SW)	Self Learning (S l)	Total hour (C l + LI+ SW +S l)
01: This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	06	02	01	02	15
02: It can be used to find the best solution to any problem be it simple or complex.	06	08	01	02	15
03: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	06	06	01	02	15
04: To understand the process of hypothesis testing and its significance. Testing of hypothesis using non-parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	06	08	01	02	15

05: Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	06	06	01	02	15
Total Hours	**30**	**30**	**05**	**10**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks Distribution			Total Marks
		R	U	A	
CO-1	Box-plot, Descriptive statistics	02	02	02	06
CO-2	Discrete and continuous probability distributions,	02	03	03	08
CO-3	Definition of Correlation, Scatter Diagram.	02	04	04	10
CO-4	Introduction to Test of Significance	03	04	05	12
CO-5	Introduction to Analysis of Variance, Analysis of One-Way Classification	04	05	05	14
	Total	13	18	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Statistical Methods for Applied Science will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources: Books

S. No.	Title	Author	Publisher	Edition & Year
01	An Outline of Statistical Theory	Goon AM, Gupta MK &Dasgupta B.	The World Press	1977 1st edition
02	Fundamentals of Statistics	Goon AM, Gupta MK &Dasgupta B	The World Press	1983. First edition
03	Introduction to Mathematical Statistics	Hoel PG	John Wiley	05th Ed. 1971
04	An Introduction to Multivariate Statistical Analysis	T.W. Anderson	John Wiley.	3rd Edition 2009
05	Introduction to Mathematical Statistics	Robert V. Hogg, Joseph W. McKean, Allen T. Craig	Hogg	7th Edition 2012

Curriculum Development Team:

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Cos, POs and PSOs Mapping

Course Title: Statistical Methods for Applied Science

Course Code: STAT-502

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1. This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	1	2	2	3	3	3	0	2	3	3	3	1	1	1
CO2. It can be used to find the best solution to any problem be it simple or complex.	1	1	3	2	3	3	1	1	2	3	1	2	2	2
CO3. Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	2	3	2	2	2	2	1	2	3	3	3	1	1	1
CO4. To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	2	1	2	2	3	2	1	1	2	2	3	1	1	1
CO5. Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	1	1	2	2	3	3	1	3	2	2	3	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1** Box-plot, Descriptive statistics	SO 1.1 SO 1.2 SO 1.3 SO 1.4	• To impart knowledge on Statistical concepts like EXploratory data analysis.	Unit1: Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation. 1.1,1.2,1.3,1.4,1.5,1.6	Random variable and mathematical expectation.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2** Discrete and continuous probability distributions,	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5 SO 2.6	• Fitting of Binomial distributions. • Fitting of Poisson distributions. • Fitting of Negative Binomial distributions. • Fitting of Normal distributions.	Unit 2 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. 2.1,2.2,2.3,2.4,2.5,2.6	Binomial, Poisson, Negative Binomial, Normal distribution
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO3** Definition of Correlation, Scatter Diagram.	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Large sample tests, testing of hypothesis based on eXact sampling distributions ~ chi square, t and F. • Large sample tests, testing of hypothesis based on eXact sampling distributions ~ t-test. • Large sample tests, testing of hypothesis based on eXact sampling distributions ~ F- test.	Unit 3: Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. 3.1,3.2,3.3,3.4,3.5,3.6	Karl Pearson's Coefficient of Correlation
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO4** Introduction to Test of Significance	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	• Confidence interval estimation and • Correlation analysis • Regression analysis • Fitting of Linear and Quadratic Model.	Unit 4: Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 4.1,4.2,4.3,4.4,4.5,4.6	Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO5** Introduction to Analysis of Variance, Analysis of One-Way Classification	SO 5.1 SO 5.2 SO 5.3	• Non-parametric tests. • ANOVA: One way • ANOVA: Two Way	Unit 5: Introduction to Analysis of Variance, Analysis of One-Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample. 5.1,5.2,5.3,5.4,5.5,5.6	Introduction to Analysis of Variance, Analysis of One-Way Classification.

Course Code: PGS 501

Course Title: Library and Information Services

Pre-requisite: Student should have basic knowledge of library because course aims to familiarize the learners with the basic concept of use of library services.

Rationale: To impart to the students an understanding of knowledge classification and the theories of library classification, to develop skills in document classification and content analysis.

To select, evaluate and acquire library materials in varied formats to meet and respond to the needs of our diverse community.

To promote literacy and disseminate useful daily information to the people and encourage lifelong learning through its reading materials and resources.

To provide opportunity, ensuring freedom and equal access to information for all members of the community, to educate and enlighten them.

To maintain and preserve books, materials and resources with historical, cultural, social, economic and archival value, and other related materials in an organized collection to provide members of the community these materials and enriched their personal and professional lives.

To provide materials and resources that entertain and inspire as well as services offering space for people and information to come together, and programs that would create library awareness and consciousness.

Course Outcomes:

CO1. Compare and critique approaches to information systems, structures, and standards.

CO2. Able to understand about various concepts of Library, its functions, objective.

CO3. Connect foundational concepts, theories, and principles of information organization and access to professional contexts.

CO4. Design and develop systems and services that provide access to information.

CO5. Analyze evidence to address information challenges and opportunities.

Scheme of Studies:

Category of Course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total StudyHours (CI+LI+SW+SL)	
Common	PGS 501	Library and Information Services	1	0	1	2	4	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performance sin laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Category of Course	Couse Code	**Course**	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Sem. Asst. (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Atten dance (AT)	Total Marks (CA+CT+ SA+CAT+AT)		
Comm on	PGS 501	Library and Informatio n Services	**15**	**20**	**5**	**5**	**5**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion

Topic Covered:

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 Sic Access Catalogue and other computerized library services; Use of Internet including search engines resources; ere sources access methods.

PGS 501.1: Able to understand about the origin of Library and information Services.

Approximate Hours

Item	Appx Hrs.
Cl	1
LI	0
SW	1
SL	2
Total	4

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	(SL)
SO1.1 Understand the Concept, Definition & Characteristics of Library **SO1.2**Understand the Importance &Functions of Library **SO1.3** Understand the Role of Library and Information Services	1.1 Introduction to library, 1.2 Types of libraries, 1.3 Role of library in society 1.4 Role of Education sector, 1.5 Classification scheme, 1.6 Types of Information sources 1.7 Abstracting and indexing services, 1.8 Use of Databases, OPAC 1.9 Computerized library services 1.10 Library Services 1.11 Online Public Access Catalogue 1.12 Types of Information Centers 1.13 Library Automation 1.14 Create a Digital Library 1.15 Use of e resources		1. How to Accessioning of Books on software 2 How to Books search in Library through the OPAC 3. Difference Between Library and Information Services

SW-1 Suggested Sessional Work (SW):

Assignments: 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.

Reference Books:

Foundations of Library and Information Science By Pawan Tripathi, Ansh Book International.
Management Basics for Information Professionals by G. Edward Evans, Patricia Layzell Ward, Neal Schuman Publishers
Library Classification by Purushotham Tiwari APH Publishing Corporation

Cos, POs and PSOs Mapping

Course Title: Library and Information Services

Course Code: PGS 501

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1 Able to understand about the origin of Library and information Services	**2**	**3**	**2**	**3**	**3**	**3**	**0**	**2**	**3**	**3**	**1**	**0**	**3**	**1**
CO2. Compare and critique approaches to information systems, structures, and standards.	**2**	**2**	**1**	**2**	**2**	**2**	**0**	**3**	**2**	**2**	**2**	**0**	**3**	**1**
CO3. Connect foundational concepts, theories, and principles of information organization and access to professional contexts.	**2**	**2**	**1**	**2**	**2**	**2**	**0**	**2**	**2**	**2**	**1**	**0**	**2**	**1**
CO4. Design and develop systems and services that provide access to information.	**2**	**2**	**1**	**2**	**2**	**1**	**0**	**3**	**3**	**2**	**1**	**0**	**2**	**1**
CO5. Analyze evidence to address information challenges and opportunities.	**2**	**2**	**1**	**2**	**3**	**1**	**0**	**1**	**3**	**2**	**2**	**0**	**3**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1** Able to understand about the origin of Library and information Services	SO 1.1 SO 1.2 SO 1.3	• Introduction to library, • Types of libraries, • Role of library in society		to Accessioning of Books on software
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2.** Compare and critique approaches to information systems, structures, and standards.	SO 2.1 SO 2.2 SO 2.3	• Role of Education sector, • Classification scheme, • Types of Information sources		Books search in Library through the OPAC
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO3.** Connect foundational concepts, theories, and principles of information organization and access to professional contexts.	SO 3.1 SO 3.2 SO 3.3	• Abstracting and indexing services, • Use of Databases, OPAC • Computerized library services		Difference Between Library and Information Services
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO4.**Design and develop systems and services that provide access to information.	SO 4.1 SO 4.2 SO 4.3	• Library Services • Online Public Access Catalogue • Types of Information Centers		
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO5.** Analyze evidence to address information challenges and opportunities.	SO 5.1 SO 5.2 SO 5.3	• Library Automation • Create a Digital Library • Use of e resources		

Course Code: PGS502

Course Title: Technical writing and communication.

Pre- requisite: Understanding the principles of various technical writing including thesis, reviews, abstracts and developing communication skills through the proper use of language.

Rationale: The basic purpose of technical writing is to convey complex information in a simple manner. It explains a topic in detail using proper abstract and citations having communication skills being accessible to a general audience.

Course Outcomes:

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research- based documents.

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing)

Scheme of Studies:

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
Common	PGS 502	Technical writing and communication.	0	15	2	4	21	0+1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Proposed examination scheme (Marking) as per the recommendation of PG re-structuring' Committee of Agricultural Education Division, Indian Council of Agricultural Research for M.Sc. (Agri.)

S. No.	Category of Course/Subject	Components of Marks				Total
		Semester End Examination (External	Mid Term exam (Internal)	Assignment (Internal)	Practical Exam (Internal)	
1	Common	50	40 (20+20)	10	-	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research -based documents.

Approximate Hours

Item	Approximate Hours
CI	00
LI	08
SW	01
SL	02
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self - Learning (SL)
SO 1.1. To understand about various form writing research documents. SO 1.2. To understand about various technical writing approaches for scientific strengting of research documents. SO 1.3. To understand about editing and press reading method to avoid plagiarism.	Technical writing 1.1 Various form of scientific writing – thesis, technical papers, reviews, manuals etc. 1.2 Various part of thesis and research communication - Title page - Authorship content page - Preface - Introduction - Review of literature - Material and methods - Experimental result - Discussion 1.3 citations etc. 1.4 Commonly used abbreviations in the thesis and research communication. 1.5 Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. 1.6 Writing of numbers and dates in scientific write ups. 1.7 Editing and press reading. 1.8 Writing of review articles.		Enlisting and write description of research communication contents.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Various parts of thesis and research communications.
- Writing of abstract, summaries, précis, citations.
- Commonly used abbreviations in the thesis and research communication.
- Write down the principal of editing and press reading.

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing)

Approximate Hours

Item	Approximate Hours
CI	00
LI	07
SW	01
SL	02
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO 2.1. To understand the types, forms, tenses clauses and their uses. SO 2.2. To understand common errors, punctuation in the sentences. SO 2.3. To understand part of speech or word class and their uses. SO 2.4. To understand discussion in groups and interviews.	Communication skill- 1.1 Grammar (Tenses, part of speed, clauses, punctuation marks) 1.2 Error analysis (common error), concord, collocation, phonetic, symbols and transcription. 1.3 Accentual pattern: weak forms in connected speech. 1.4 Participation in group discussion 1.5 Facing of interview. 1.6 Presentation of scientific paper.		Enlisting and write the description of communicatio n using proper language skills.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1 Writing types of clauses.

2 Writing the sentences using correct punctuation.

3 Writing the types and forms of tenses.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research-based documents.	0	2	1	3
PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing)	0	2	1	3

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	Technical writing	00	05	05	10
CO 2	Communication skill-	03	02	05	10

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Technical writing and communication** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration. Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Spoken English	Barnes and Noble. Robert C. (Ed.).	Flourish Your Language	2005
2	Technical communication	Mike markel Stular A. Selber	Bedford/St. Martins, 12th edition	2017
3	The Essentials of Technical communication	Elizabeth tebeaux sam dragga.	Oxford university press, 4th edition	2017
4	Technical writing prosess	Kieran morgan and sanja spajic	Better on paper publications, 1th edition	2015
5	Developing quality technical information	Moira Mcfadden lanyi, Deirdrelongo	IBM press 3th edition	2014

Curriculum Development Team:

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Cos, POs and PSOs Mapping

Course Title: Technical writing and communication

Course Code: PGS502

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO.1: Learning the various form of scientific writing and implementing skills for Formulation of research- based documents.	1	1	2	2	3	3	0	3	3	3	1	0	3	0
CO.2: Acquisition of technical communication skill and articulate in English (verbal as writing)	1	1	2	2	2	2	1	3	2	2	3	0	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1** Technical writing	SO 1.1 SO 1.2 SO 1.3	1.1 Various form of scientific writing – thesis, technical papers, reviews, manuals etc. 1.2 Various part of thesis and research communication - Title page - Authorship content page - Preface - Introduction - Review of literature - Material and methods - Experimental result - Discussion 1.3 citations etc. 1.4 Commonly used abbreviations in the thesis and research communication. 1.5 Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. 1.6 Writing of numbers and dates in scientific write ups. 1.7 Editing and press reading. • Writing of review articles.		Enlisting and write description of research communication contents.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2** Communication skills	SO 2.1 SO 2.2 SO 2.3 SO 2.4	2.1 Grammar (Tenses, part of speed, clauses, punctuation marks) 2.2 Error analysis (common error), concord, collocation, phonetic, symbols and transcription. 2.3 Accentual pattern: weak forms in connected speech. 2.4 Participation in group discussion 2.5 Facing of interview. 2.6 Presentation of scientific paper		Enlisting and write the description of communication using proper language skills.

Course Code: PL PATH-503
Course Title: Plant Pathogenic Prokaryotes
Pre-requisite: Student should have basic knowledge of microbiology
Rationale: Prokaryotes are also the cause of plant diseases. Therefore, it is necessary to study their characteristics and management to sort-out the problems caused by them
Aim of the course: To acquaint with the structure, virus- vector relationship, biology and management of plant viruses.
Course Outcomes: Upon successful completion of the course a student will be able to:

PL PATH503.1: Describe the importance of Phytopathogenic prokaryotes
PL PATH503.2: Identify growth, nutrition, virulence, symptoms and dispersal of phytopathogenic prokaryotes
PL PATH503.3 Revise taxonomy and nomenclature of phytopathogenic prokaryotes
PL PATH503.4: Understand the general biology of bacteriophages, L form bacteria and plasmids.
PL PATH503.5: Identify different types of Bacteriophages, their classification and plan for management of diseases caused by phytopathogenic prokaryotes

Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Major	PL PATH-503	Plant Pathogenic Prokaryotes	CI	**LI**	**SW**	SL	Total study Hours (CI+LI+SW+SL)	
			2	**2**	**1**	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) And others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.
Note:SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	CourseCode	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Major	PL PATH-503	Plant Pathogenic Prokaryotes						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH 503.1: Describe the importance of Phytopathogenic prokaryotes

Approximate Hours

Item	Approx. Hrs
Cl	07
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1: Discuss about history and development of plant bacteriology **SO1.2:** Interpret the evolution of prokaryotic life **SO1.3:** Illustrate the prokaryotic cell with morphological characters **SO1.4:** Describe synthesis of different biochemicals by the cell **SO1.5:** Demonstrate the Mechanism of flagellar rotatory motor and locomotion, and bacterial movement	• Study of symptoms produced by phytopathogenic prokaryotes • Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria	**Unit 1:** Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and grampositive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (Sayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas. **1.1:** Prokaryotic cell: History and development of Plant bacteriology, **1.2:** Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. **1.3:** Structure of bacterial cell. Structure and composition of gram negative and gram-positive cell wall **1.4:** Synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili) **1.5:** Mechanism of flagellar rotatory motor and locomotion, and bacterial movement **1.6:** Glycocalyx (Sayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; **1.7:** Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas.	Evolution of prokaryotic life

SW-1 Suggested Sessional Work (SW)

Assignment: i) Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas

PL PATH 503.2: Identify growth, nutrition, virulence, symptoms and dispersal of phytopathogenic prokaryotes

Approximate Hours

Item	Approx. Hrs
Cl	05
LI	06
SW	1
SL	1
Total	13

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1: Identify growth & nutritional requirements **SO2.2:** Describe mechanism of infection **SO2.3:** Identify the role of virulence factors in expression of symptoms **SO2.4:** Assess **s**urvival and dispersal of Phytopathogenic prokaryotes	• Stains and staining methods • Biochemical and serological characterization	**Unit 2.** Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of Phytopathogenic prokaryotes. 2.1: Growth and nutritional requirements 2.2: Infection mechanism 2.3: Role of virulence factors in expression of symptoms 2.4: Survival of Phytopathogenic prokaryotes. 2.5: Dispersal of Phytopathogenic prokaryotes	1: Survival of Phytopathogenic prokaryotes

SW-1: Suggested Sessional Work (SW)

Assignments: i) Role of virulence factors in expression of symptoms

PL PATH 503.3: Revise taxonomy and nomenclature of phytopathogenic prokaryotes

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Revise the Taxonomy of phytopathogenic prokarya **SO3.2:** Revise classification and nomenclature of bacteria **SO3.3:** Identify the codes of Nomenclature and characteristics **SO3.4:** Assess **b**iochemical and	• Isolation of genomic DNA plasmid • Use of antibacterial chemicals/ antibiotics	**Unit 3.** Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes. 3.1: Taxonomy of phytopathogenic prokarya 3.2: Taxonomic ranks hierarchy; Identification,	1Classification and nomenclature of bacteria

molecular characterization of prokaryotes		3.3: Classification and nomenclature of bacteria, phytoplasma and spiroplasma 3.4: The codes of Nomenclature and characteristics 3.5: Biochemical and molecular characterization of phytopathogenic prokaryotes 3.6: Molecular characterization of phytopathogenic prokaryotes	

SW-1: Suggested Sessional Work (SW):
Assignments: i) Identification, classification and nomenclature of bacteria, phytoplasma and spiroplasma.

PL PATH 503.4: Estimate variability among phytopathogenic prokaryotes by special mechanism

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO4.1: Assess variability among phytopathogenic prokarya **SO4.2:** Demonstrate sexual like process in bacteria **SO4.3:** Identify specialized mechanisms of variability	• Isolation of fluorescent Pseudomonas • Preservation of bacterial cultures	**Unit 4.** Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria conjugation; transformation; transduction); and horizontal gene transfer. 4.1: Variability among phytopathogenic prokarya 4.2: General mechanism of variability (mutation) 4.3: Classification and nomenclature of bacteria, phytoplasma and spiroplasma 4.4: Specialized mechanisms of variability (sexual like process in bacteria conjugation) 4.5: Transformation 4.6: Transduction and horizontal gene transfer	1. General mechanism of variability (mutation)

SW-1: Suggested Sessional Work (SW):
Assignments: i) General mechanism of variability (mutation).

PL PATH 503.5: Identify different types of Bacteriophages, their classification and plan for management of diseases caused by phytopathogenic prokaryotes

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO5.1: Identify different Bacteriophages **SO5.2:** Demonstrate plasmids and bdellovibrios **SO5.3**: Evaluate the use of phages in plant bacteriology **SO5.4:** Plan the strategies of diseases management	• Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences • Diagnosis and management of important diseases caused by bacteria and mollicutes.	**Unit 5.** Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes. 5.1: Bacteriophages, L form of bacteria, plasmids and bdellovibrios 5.2: Structure; Infection of host cells; phage multiplication cycle 5.3: Classification of phages 5.4: Use of phages in plant pathology/ bacteriology, Lysogenic conversion 5.5: H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. 5.6: Strategies for management of diseases caused by phytopathogenic prokaryotes	1. Bacteriophages

SW-1: Suggested Sessional Work (SW):
Assignments: i) Structure; Infection of host cells; phage multiplication cycle

Brief of Hours suggested for the Course Outcome

i)

Course Outcomes	Class Lecture (C)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH503.1: Describe the importance of Phytopathogenic prokaryotes	7	6	1	1	15
PL PATH503.2: Identify growth, nutrition, virulence, symptoms and dispersal of phytopathogenic prokaryotes	5	6	1	1	13
PL PATH503.3 Revise taxonomy and nomenclature of phytopathogenic prokaryotes	6	6	1	1	14
PL PATH503.4: Understand the general biology of bacteriophages, L form bacteria and plasmids	6	6	1	1	14
PL PATH503.5: Identify different types of Bacteriophages, their classification and plan for management of diseases caused by phytopathogenic prokaryotes	6	6	1	1	14
Total Hours	30	30	05	05	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Importance of phytopathogenic prokaryotes	02	04	04	10
CO-2	Growth and nutrition of bacteria	02	04	04	10
CO-3	Taxonomy and nomenclature	02	04	04	10
CO-4	Bacteriophages and plasmides	02	04	04	10
CO-5	Management practices	02	04	04	10
Total		10	20	20	50

Legend: **R: Remember, U: Understand, A: Apply**

The end of semester assessment for Fundamentals of Plant Pathology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case study
3. Group Discussion
4. Role Play
5. Demonstration
6. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Fundamentals of Plant Bacteriology	Goto M	Academic Press, New York	1990
2	Fundamentals of Plant Bacteriology	Jayaraman J and Verma JP	Kalyani Publishers, Ludhiana	2002
3	Phytopathogenic Prokaryotes. Vols. I, II	Mount MS and Lacy GH	Academic Press, New York	1982
4	Detection of Plant Pathogens and their Management	Verma JP, Varma A and Kumar D	Angkor Publ., New Delhi	1995. Eds.
5	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.
6	Phytopathogenic Prokaryotes V2	Mark S. Mount & George H. Lacy	Academic Press	2012
7	Plant Bacteriology	Clarence I. Kado	APS Press	2013

Curriculum Development Team

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Cos, POs and PSOs Mapping

Course: Plant Pathogenic Prokaryotes

Course Code: PL PATH-503

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Describe the importance of Phytopathogenic prokaryotes	3	2	1	2	1	1	3	2	3	3	3	3	2	1
CO2: Identify growth, nutrition, virulence, symptoms and dispersal of phytopathogenic prokaryotes	2	3	3	2	3	3	3	1	3	3	3	2	3	2
CO3 Revise taxonomy and nomenclature of phytopathogenic prokaryotes	1	1	1	1	3	3	1	1	3	2	3	1	1	1
CO4: Understand the general biology of bacteriophages, L form bacteria and plasmids	1	1	2	1	1	2	2	1	2	2	3	1	2	2
CO5: Identify different types of Bacteriophages, their classification and plan for management of diseases caused by phytopathogenic prokaryotes	1	1	2	2	3	3	3	2	2	3	2	2	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1:** Importance of phytopathogenic prokaryotes	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	• Study of symptoms produced by phytopathogenic prokaryotes • Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria	Unit1: Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and grampositive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (Sayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas. 1.1,1.2,1.3,1.4,1.5,1.6,1.7	1: Evolution of prokaryotic life
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO2:** Growth and nutrition of bacteria	SO 2.1 SO 2.2 SO 2.3 SO 2.4	• Stains and staining methods • Biochemical and serological characterization	Unit 2: Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of Phytopathogenic prokaryotes. 2.1,2.2,2.3,2.4,2.5	1 Survival of Phytopathogenic prokaryotes
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO3:** Taxonomy and nomenclature	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Isolation of genomic DNA plasmid • Use of antibacterial chemicals/ antibiotics	Unit 3: Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes. 3.1,3.2,3.3,3.4,3.5,3.6	1: 1Classification and nomenclature of bacteria
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO4:** Bacteriophages and plasmides	SO 4.1 SO 4.2 SO 4.3	• Isolation of fluorescent Pseudomonas • Preservation of bacterial cultures	**Unit 4:** Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria conjugation; transformation; transduction); and horizontal gene transfer. 4.1,4.2,4.3,4.4,4.5,4.6	1. General mechanism of variability (mutation)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO5:** Management practices	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences • Diagnosis and management of important diseases caused by bacteria and mollicutes.	**Unit 5:** Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes 5.1,5.2,5.3,5.4,5.5,5.6	1. Bacteriophages

Course Code: PL PATH 504
Course Title: Plant Nematology
Pre-requisite: Student should have basic knowledge of Platyhelminthes
Aim of the course: To project the importance of nematodes in agriculture and impart of basic knowledge on all aspects of plant nematology.
Rationale: Because nematodes play direct and indirect role in causing plant diseases.

Course Outcomes: Upon successful completion of the course a student will be able to:
PL PATH 504.1 Describe nematodes of different phyla and economic importance of nematodes in agriculture
PL PATH 504.2 Differentiate the morphology and classification of plant parasitic nematodes.
PL PATH 504.3 Evaluate the damage and analyze interaction with other organisms
PL PATH 504.4 Assess plant nematode relationship and physiological specialization.
PL PATH 504.5 Develop ecofriendly management practices of damage caused by nematodes.

Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Major	PL PATH 504	Plant Nematology	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			2	2	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total marks (CA+CT+ SA+CAT+ AT)		
Major	PL PATH 504	Plant Nematology						50	50	100

Course Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH 504.1: Describe nematodes of different phyla and economic importance of nematodes in agriculture

Approximate Hours

Item	Approx. Hrs
Cl	05
LI	04
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the characters of phylum nematoda **SO1.2** Recognize the relationship with other phyla **SO1.3** Discuss the history and growth of nematology **SO1.4** Identify the importance of nematology	• Studies on kinds of nematodes- free-living, animal, insect and plant parasites	Unit1: Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry. 1.1 Characteristics of Phylum Nematoda and its relationship with other related phyla 1.2 History of Nematology 1.3 Growth of Nematology 1.4 Nematode habitats and diversity- plant, animal and human parasites 1.5 useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry.	Characteristics of Phylum Nematoda

SW-1 Suggested Sessional Work (SW):

Assignments: i) Definition of different terms use in mycology, importance of mycology in Agriculture

PL PATH504.2: Differentiate the morphology and classification of plant parasitic nematodes

Approximate Hours

Item	Approx. Hrs
CI	6
LI	4
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Identify the plant parasitic nematodes. **SO2.2**Revise the classification of nematodes **SO2.3** Revise the Physiology of nematodes **SO2.4** Compare the ecology of nematodes	Nematode extraction from soil	Unit 2: Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology 2.1 Gross morphology of plant parasitic nematodes 2.2 Broad classification of nematodes 2.3 Nematode biology 2.4 Physiology of nematodes 2.5 Physiology of nematodes 2.6 Ecology of nematodes	1. Classification of plant parasitic nematodes

SW-1 Suggested Sessional Work (SW):

Assignments: i) Physiology and ecology of nematodes

PL PATH504.3: Evaluate the damage and analyze interaction with other organisms

Approximate Hours

Item	Approx. Hrs
CI	6
LI	4
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Categorize the parasitism **SO3.**Identify the damage **SO3.3** Diagnose the diseases caused by nematodes **SO3.4**Identify interaction of nematodes with other organisms	• Extraction of migratory endoparasites, staining for sedentary endoparasites	Unit 3: Types of parasitism; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms. 3.1Types of parasitism 3.2 Nature of damage 3.3General symptomatology 3.4Interaction of plant-parasitic nematodes with fungi 3.5 Interaction of plant-parasitic nematodes with viruses 3.6 Interaction of plant-parasitic nematodes with bacteria	General symptomatology

SW-1 Suggested Sessional Work (SW):

Assignments: i) Interaction of plant-parasitic nematodes with other organisms.

PL PATH504.4: Assess plant nematode relationship and physiological specialization

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Identify the Plant nematode relationships **SO4.2** Evaluate cellular responses to infection **SO4.3** Describe the physiological specialization	Examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology	Unit 4: Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes 4.1 Plant nematode relationships 4.2 Cellular responses to infection 4.3 Physiological specialization 4.4 physiological specialization among phytonematodes	Physiological specialization among phytonematode

SW-1 Suggested Sessional Work (SW):

Assignments: i) Plant nematode relationships

PL PATH504.5: Determine the characters of kingdom fungi under Basidiomycota

Approximate Hours

Item	Approx. Hrs
CI	9
LI	6
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Identify the principles of nematode management **SO5.2** Measure different management practices **SO5.3** Develop **i**ntegrated module for a particular nematode **SO5.4** Predict nematode problem in a confined area	• Examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology	Unit 5: Principles and practices of nematode management; integrated nematode management. Emerging nematode problems, Importance of nematodes in international trade and quarantine. 5.1 Principles of nematode management 5.2Cultural practices of nematode management 5.3 Physical practices of nematode management 5.4 Biological practices of nematode management 5.5 Host resistance of nematode management 5.6 Quarantine 5.7 Integrated nematode management 5.8 Emerging nematode problems 5.9 Importance of nematodes in international trade and quarantine.	1. Plant quarantine

SW-1 Suggested Sessional Work (SW):
Assignments: i) Integrated nematode management models for problematic nematodes

Brief of Hours suggested for the Course Outcome

ii)

Course Outcomes	Class Lecture (C)	Lab Instruction (LI)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH 504.1 Describe nematodes of different phyla and economic importance of nematodes in agriculture	5	6	1	1	13
PL PATH 504.2 Differentiate the morphology and classification of plant parasitic nematodes.	6	6	1	1	14
PL PATH 504.3 Evaluate the damage and analyze interaction with other organisms	6	6	1	1	14
PL PATH 504.4 Assess plant nematode relationship and physiological specialization.	4	6	1	1	12
PL PATH 504.5 Develop ecofriendly management practices of damage caused by nematodes.	9	6	1	1	17
Total Hours	30	30	05	05	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Nematode characters	03	04	03	10
CO-2	Classification of plant parasitic nematodes	02	06	02	10
CO-3	Interaction of nematodes	03	03	04	10
CO-4	Plant nematode relationship	02	04	04	10
CO-5	Management practices	02	04	04	10
Total		12	21	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Fundamentals of Plant Pathology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	An Introduction to Plant Nematology	Dropkin VH	John Wiley & Sons, New York.	1980
2	General Nematology	Maggenti AR	Springer-Verlag, New York	1981
3	Plant Nematology	Perry RN and Moens M	CABI Publishing: Wallingford, UK	2013. 2nd Ed.
4	Plant Parasitic Nematodes in Subtropical and Tropical Agriculture	Sikora RA, Coyne D, Hallman J and Timper P	CABI Publishing, England	2018. 3rd ed.
5	Principles of Nematology	Thorne G	McGraw Hill, New Delhi	1961
6	Text Book on Introductory Plant Nematology	Walia RK and Bajaj HK	ICAR, New Delhi	2003
7	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.

Curriculum Development Team

1. Associate Professor & Head, Dr. Doomar Singh and Dr. Moti Lal, Department of Plant Pathology, AKS University

Cos, POs and PSOs Mapping

Course Title: Plant Nematology

Course Code: PL PATH 504

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1 Describe nematodes of different phyla and economic importance of nematodes in agriculture	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
CO2 Differentiate the morphology and classification of plant parasitic nematodes.	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**2**	**2**
CO3 Evaluate the damage and analyze interaction with other organisms	**1**	**2**	**1**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**2**
CO4 Assess plant nematode relationship and physiological specialization.	**1**	**1**	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**2**
CO5 Develop ecofriendly management practices of damage caused by nematodes.	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1** Describe nematodes of different phyla and economic importance of nematodes in agriculture	SO 1.1 SO 1.2 SO 1.3 SO 1.4	• Studies on kinds of nematodes- free-living, animal, insect and plant parasites	Unit1: Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry. 1.1,1.2,1.3,1.4,1.5	1. Characteristics of Phylum Nematoda
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO2** Differentiate the morphology and classification of plant parasitic nematodes.	SO 2.1 SO 2.2 SO 2.3 SO 2.4	• Nematode extraction from soil	Unit 2: Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology 2.1,2.2,2.3,2.4,2.5,2.6	1. Classification of plant parasitic nematodes
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO3** Evaluate the damage and analyze interaction with other organisms	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Extraction of migratory endoparasites, staining for sedentary endoparasites	Unit 3: Types of parasitism; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms. 3.1,3.2,3.3,3.4,3.5,3.6	1. General symptomatology
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO4** Assess plant nematode relationship and physiological specialization.	SO 4.1 SO 4.2 SO 4.3	• Examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology	Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes 4.1,4.2,4.3,4.4	1. Physiological specialization among phytonematode
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO5** Develop ecofriendly management practices of damage caused by nematodes.	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology	Principles and practices of nematode management; integrated nematode management. Emerging nematode problems, Importance of nematodes in international trade and quarantine. 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	1. Plant quarantine

Course Code: PL PATH-517
Course Title: Diseases of Vegetable and Spices Crops
Pre-requisite: Student should have basic knowledge of Plant Science
Rationale: The students studying M.Sc. (Agri) Plant Pathology should possess foundational understanding about plant Science
Aim of the course: To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.

Course Outcomes: Upon successful completion of the course a student will be able to:
PL PATH517.1: Diagnose various plant diseases and explain their life-cycles.
PL PATH517.2: Determine the relationship between disease and complex environmental factors.
PL PATH517.3 Demonstrate the quantitative, qualitative and esthetic losses caused by diseases.
PL PATH517.4: Develop integrated disease management models/strategies for particular crop.
PL PATH517.5: Utilize the skill between plant growers as a profession in disease management.

Board of Study	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Program Core	PL PATH-517	Diseases of Vegetable and Spices Crops	CI	**LI**	**SW**	SL	Total study Hours (CI+LI+SW+SL)	
			2	**2**	**1**	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End** Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT +SA+CAT+AT)		
Major	PL PATH-517	Diseases of Vegetable and Spices Crops						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI),

Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH517.1. Diagnose various plant diseases and explain their life-cycles.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self -Learning (SL)**
SO1.1 Understand the Nature, prevalence, factors affecting disease development of t vegetable crops **SO1.2** Identify and diagnose the diseases of vegetable crops **SO1.3** Choose the suitable management practices to control vegetable diseases. **SO1.4** Select the suitable management practices to control vegetable diseases **SO1.5** Integrate the suitable and sustainable management practices to avoid vegetable diseases.	• Isolation and purification of pathogens of vegetable diseases • Histo-pathological studies of host-parasite interaction • Determination of symptoms caused by abiotic stress	Unit 1: Nature, prevalence, factors affecting disease development of tuber, bulb, leafy and crucifer vegetables. **1.1:** Nature, prevalence, factors affecting disease development of tuber Crops 1.2: Nature, prevalence, factors affecting disease development of bulb crops **1.3:** Nature, prevalence, factors affecting disease development of leafy vegetables 1.4: Nature, prevalence, factors affecting disease development of leafy vegetables **1.5:** Nature, prevalence, factors affecting disease development of Cruciferous vegetable 1.6: Nature, prevalence, factors affecting disease development of Cruciferous vegetable	1: Collection and preservation of disease specimen

SW-1 Suggested Sessional Work (SW):
Assignment: i) Collection and preservation of disease specimen of vegetable crops

PL PATH 517.2: Determine the relationship between disease and complex environmental factors.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning (SL)
SO2.1 Understand the Nature, prevalence, factors affecting disease development of t vegetable crops **SO2.2:** Identify and diagnose the diseases of vegetable crops **SO2.3** Choose the suitable management practices to control vegetable diseases **SO2.4** Select the suitable management practices to control vegetable diseases **SO2.5** Integrate the suitable and sustainable management practices to avoid vegetable diseases. **SO2.6 C**ompare the protected vegetable production in to field vegetable production	• Isolation and purification of pathogens of vegetable diseases 2. Histo-pathological studies of host-parasite interaction • Determination of symptoms caused by abiotic stress Stress problems of Protected cultivation of vegetables.	Unit 2. Nature, prevalence, factors affecting disease development of cucurbits and solanaceaous vegetables and diseases of crops under protected cultivation. 2.1: Nature, prevalence, factors affecting disease development of cucurbits 2.2: Nature, prevalence, factors affecting disease development of cucurbits 2.3: Nature, prevalence, factors affecting disease development of Solanaceaous vegetables 2.4: Nature, prevalence, factors affecting disease development of Solanaceaous vegetables 2.5: Nature, prevalence, factors affecting disease development of Protected cultivation of vegetables. 2.6: Nature, prevalence, factors affecting disease development of Protected cultivation of vegetables	1 Collection of meteorological data and comparison of vegetable production under protected cultivation of vegetables

SW-1 Suggested Sessional Work (SW):
Assignments: Collection of meteorological data and comparison of vegetable production under protected cultivation of vegetables

PL PATH 517.3: Demonstrate the quantitative, qualitative and esthetic losses caused by diseases.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Identify the Various diseases according to their symptoms **SO3.2:** Understand the host-parasite interaction **SO3.3:** Differentiate the symptoms caused by biotic and	• Determination and confirmation of symptoms according to their cause • Histo-pathological studies of host-parasite interaction • Study the symptoms and Sign of various plant diseases	**Unit 3.** Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops. 3.1. Symptoms and management of diseases of root crops 3.2: Symptoms and management of diseases of Tuber crops	1: Collection and Preservation of various plant disease specimen.

abiotic stress. **SO3.4:** Integrate the suitable and sustainable management practices to avoid vegetable diseases under field and protected condition	• Field visit for collection and preservation of plant disease specimen.	3.3: Symptoms and management of diseases of bulb crops 3.4: Symptoms and management of diseases of leafy vegetable 3.5: Symptoms and management of diseases of crucifers vegetable 3.6: Symptoms and management of diseases of cucurbits and solanaceaous vegetables	

SW-1 Suggested Sessional Work (SW):
Assignments: Collection and Preservation of various plant disease specimen.

PL PATH 517.4: Develop integrated disease management models/strategies for particular crop

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self -Learning (SL)**
SO4.1: Identify the Various diseases according to their symptoms **SO4.2:** Understand the host-parasite interaction **SO4.3:** Differentiate the symptoms caused by biotic and abiotic stress. **SO4.4:** Integrate the suitable and sustainable management practices to avoid vegetable diseases under field and protected condition	• Determination and confirmation of symptoms according to their cause • Histo-pathological studies of host-parasite interaction • 3.Study the symptoms and Sign of various plant diseases • 4. Field visit for collection and preservation of plant disease specimen.	**Unit 4:** Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger. 4.1 Symptoms, epidemiology and management of diseases of spice crops- Black pepper, nutmeg 4.2. Symptoms epidemiology and management of diseases of spice crops- Saffron, Cumin 4.3. Symptoms, epidemiology and management of diseases of different spice crops coriander and turmeric 4.4. Symptoms, epidemiology and management of diseases spice crops - fennel, 4.5. Symptoms, epidemiology and management of diseases of different spice crops- fenugreek 4.6. Symptoms, epidemiology and management of diseases of different spice crops- ginger.	1.List of safe pesticides for the control of vegetable diseases

SW-1 Suggested Sessional Work (SW):
Assignments: i) List of safe pesticides for the control of vegetable diseases

PL PATH 517.5: Utilize the skill between plant growers as a profession in disease management.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self -Learning (SL)**
SO5.1 Understand the role of Biotechnology in plant pathology. **SO5.2: S**election of suitable biotechnological methods for specific plant disease	• Epical Meristem culture • protoplast fusion and assessment of disease resistance • Pollen, Anther. Embryo culture and assessment of disease resistance	**Unit 5:** Biotechnological approaches in developing disease resistant transgenic 5.1. Meristem culture for producing disease free prorogating materials 5.2 Plant tissue culture for producing disease resistant plant 5.3. Pollen, Anther. Embryo culture for producing disease free prorogating materials 5.4. Hybridization for disease resistant 5.5. Cybrids, somaclonal variation and transgenic plants 5.6. Gene transformation, Gnome editing, marker assisted selection RNA interference	1.Transgenic plant and ethical issues

SW-1 Suggested Sessional Work (SW):

Assignments: 1. transgenic plants and ethical issues

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+ Sl)
PL PATH517.1. Nature, prevalence, factors affecting disease development of tuber, bulb, leafy, crucifers vegetables	6	6	1	1	14
PL PATH517.2: Nature, prevalence, factors affecting disease development of cucurbits and solanaceaous vegetables and diseases of crops under protected cultivation	6	6	1	1	14
PL PATH517.3: Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops.	6	6	1	1	14
PL PATH517.4: Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger.	6	6	1	1	14
PL PATH517.5: Biotechnological approaches in developing disease resistant transgenic	6	6	1	1	14
Total Hours	30	30	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks distribution			Total mark
		R	U	A	
CO-1	Disease diagnosis				10
CO-2	Relationship between disease and environment				10
CO-3	Quantitative, qualitative and esthetic losses				10
CO-4	Integrated disease management				10
CO-5	Skill between plant growers				10
Total					50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case Method
3. Group Discussion
4. Role Play
5. Demonstration
6. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Plant Pathology	Agrios GN	Academic Press, New York.	20055 ed
2	Plant Diseases of International Importance. Vol. II. Diseases of Vegetable and Oilseed Crops	Chaube HS, Singh US, Mukhopadhyay AN and Kumar J	Prentice Hall, Englewood Cliffs, New Jersey	1992.
3	Diseases of Vegetable Crops	Gupta VK and Paul YS	Kalyani Publishers, New Delhi	2001
4	Disease Problem in Vegetable Production	Gupta SK and Thind TS	Scientific Publ., Jodhpur	2006
5	Vegetable Diseases and their Control	Sherf AF and Mcnab AA	Wiley Estern Science, Columbia	1986
6	Diseases of Vegetable Crops	Singh RS.	Oxford & IBH, New Delhi	1999
7	Diseases of Vegetable Crops	Walker JC	McGraw-Hill, New York	1952
8	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.
9	Introduction To Plant Diseases Identification and Management	George B. Lucas	Springer Nature	2022

Cos, POs and PSOs Mapping

Course Title: Diseases of Vegetable and Spices Crops

Course Code: PL PATH-517

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1. Nature, prevalence, factors affecting disease development of tuber, bulb, leafy, crucifers vegetables	2	3	2	3	3	3	3	2	3	3	3	3	3	3
CO2: Nature, prevalence, factors affecting disease development of cucurbits and solanaceaous vegetables and diseases of crops under protected cultivation	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO3: Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops.	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO4: Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger.	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO5: Biotechnological approaches in developing disease resistant transgenic	1	1	2	2	3	3	3	3	2	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1.** Nature, prevalence, factors affecting disease development of tuber, bulb, leafy, crucifer vegetables	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	• Isolation and purification of pathogens of vegetable diseases • Histo-pathological studies of host-parasite interaction • Determination of symptoms caused by abiotic stress	Unit1: Nature, prevalence, factors affecting disease development of tuber, bulb, leafy and crucifer vegetables. 1.1,1.2,1.3,1.4,1.5,1.6	1: Collection and preservation of disease specimen
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO2:** Nature, prevalence, factors affecting disease development of cucurbits and solanaceaous vegetables and diseases of crops under protected cultivation	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5 SO 2.6	• Isolation and purification of pathogens of vegetable diseases 2. Histo-pathological studies of host-parasite interaction • Determination of symptoms caused by abiotic stress • Stress problems of Protected cultivation of vegetables.	Unit 2: Nature, prevalence, factors affecting disease development of cucurbits and solanaceaous vegetables and diseases of crops under protected cultivation. 2.1,2.2,2.3,2.4,2.5,2.6	1 Collection of meteorological data and comparison of vegetable production under protected cultivation of vegetables
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO3:** Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops.	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Determination and confirmation of symptoms according to their cause • Histo-pathological studies of host-parasite interaction • Study the symptoms and Sign of various plant diseases • Field visit for collection and preservation of plant disease specimen.	Unit 3: Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops. 3.1,3.2,3.3,3.4,3.5,3.6	1: Collection and Preservation of various plant disease specimen.
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO4:** Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger.	SO 4.1 SO 4.2 SO 4.3 SO 4.4	• Determination and confirmation of symptoms according to their cause • Histo-pathological studies of host-parasite interaction • Study the symptoms and Sign of various plant diseases • Field visit for collection and preservation of plant disease specimen	**Unit 4:** Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger. 4.1,4.2,4.3,4.4,4.5,4.6	1.List of safe pesticides for the control of vegetable diseases
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO5:** Biotechnological approaches in developing disease resistant transgenic	SO 5.1 SO 5.2	• Epical Meristem culture • protoplast fusion and assessment of disease resistance • Pollen, Anther. Embryo culture and assessment of disease resistance	**Unit 5:** Biotechnological approaches in developing disease resistant transgenic 5.1,5.2,5.3,5.4,5.5,5.6	1.Transgenic plant and ethical issues

Course Code: PL PATH 512
Course title: Detection and Management of Seed Borne Pathogens 2+1
Course Title: Detection and Management of Seed Borne Pathogens
Pre-requisite: Student should have basic knowledge of seed morphology, germination and seed formation

Aim of the course: To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/ losses and management.
Rationale: Seed is the main part of any plant or crop and healthy seed develop healthy/disease free plant. For healthy crop production it is necessary to detect and manage seed borne pathogens.
Course Outcomes: Upon successful completion of the course a student will be able to:

PL PATH 512.1 Recognize importance of seed pathology, plant quarantine and SPS under WTO in seed industry.
PL PATH 512.2 Interpret the mechanism of seed transmission and seed to plant transmission of pathogen.
PL PATH 512.3 Detect the pathogen from seed by advanced techniques and forecast the epidemics through seed borne infection.
PL PATH 512.4 Estimate the losses due to seed borne diseases and production of healthy seed using suitable and sustainable management practices.
PL PATH 512.5 Test the toxic metabolites synthesized in the seed due to infection and its impact on human, animal and plant health.

Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					
Minor	PL PATH 512	Detection and Management of Seed Borne Pathogens	CI	LI	SW	SL	Total study Hrs (CI+LI+SW+SL)	Total Credits
			2	2	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L)
LI: Laboratory Instruction (Includes Practical performances in laboratory,field or other locations
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
Major	PL PATH 512	Detection and Management of Seed Borne Pathogens						50	50	100

Course Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH 512.1: Recognize importance of seed pathology, plant quarantine and SPS under WTO in seed industry.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the History of seed pathology **SO1.2** Describe the importance of seed pathology **SO1.3** Diagram of mono and dicot infected seeds	• Conventional techniques in the detection and identification of seedborne fungi	Unit1: History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. 1.1 History of seed pathology 1.2 Economic importance of seed pathology in seed industry 1.3 Plant quarantine 1.4 SPS under WTO 1.5 Morphology and anatomy of typical monocotyledonous infected seeds 1.6 Morphology and anatomy of typical dicotyledonous infected seeds	History of seed pathology

SW-1 Suggested Sessional Work (SW):
Assignments: i) Plant quarantine and SPS under WTO

PL PATH 512.2: Interpret the mechanism of seed transmission and seed to plant transmission of pathogen

Approximate Hours

Item	Approx. Hrs
CI	5
LI	6
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Examine the establishment and subsequent cause of disease development **SO2.**Analyze the localization and mechanism of seed transmission **SO2.3** Design seed to plant transmission of pathogens	Conventional techniques in the detection and identification of seedborne bacteria and viruses	Unit 2: Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. 2.1 Recent advances in the establishment and subsequent cause of disease development in seed and seedling	Mechanism of seed transmission

		2.2 Recent advances in the establishment and subsequent cause of disease development in seed and seedling 2.3 Localization of seed transmission in relation to seed infection 2.4 Mechanism of seed transmission in relation to seed infection 2.5 Seed to plant transmission of pathogens	

SW-1 Suggested Sessional Work (SW):
Assignments: i) Recent advances in the establishment and subsequent cause of disease development in seed and seedling

PL PATH 512.3 Detect the pathogen from seed by advanced techniques and forecast the epidemics through seed borne infection

Approximate Hours

Item	Approx. Hrs
CI	6
LI	6
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Categorize seed certification and tolerance limit **SO3.2** Estimate the losses caused by seed borne pathogens **SO3.3** Choose evolutionary adaptations of crop plants	• Advanced techniques in the detection and identification of seedborne fungi, bacteria and viruses	Unit 3: Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. 3.1 Seed certification 3.2 Tolerance limits 3.3 Types of losses caused by seed-borne diseases in true seeds 3.4 Types of losses caused by seed-borne diseases in vegetatively propagated seeds 3.5 Evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens 3.6 Evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens	Tolerance limits

SW-1 Suggested Sessional Work (SW):
Assignments: i) Types of losses caused by seed-borne diseases in true and vegetatively propagated seeds

PL PATH 512.4: Estimate the losses due to seed borne diseases and production of healthy seed using suitable and sustainable management practices

Approximate Hours

Item	Approx. Hrs
CI	5
LI	6
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Determine epidemiological factors **SO4.2** Predict the forecasting of epidemics **SO4.3** Develop forecasting model for a disease	• Advanced techniques in the detection and identification of seedborne fungi, bacteria and viruses	Unit 4: Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection. 4.1 Epidemiological factors influencing the transmission of seed-borne diseases 4.2 Epidemiological factors influencing the transmission of seed-borne diseases 4.3 Epidemiological factors influencing the transmission of seed-borne diseases 4.4 Forecasting of epidemics through seed-borne infection 4.5 Forecasting of epidemics through seed-borne infection	Epidemiological factors

SW-1 Suggested Sessional Work (SW):
Assignments: i) forecasting of epidemics through seed-borne infection

PL PATH 512.5: Test the toxic metabolites synthesized in the seed due to infection and its impact on human, animal and plant health.

Approximate Hours

Item	Approx. Hrs
CI	8
LI	6
SW	1
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Identify the toxic metabolites affecting seed quality **SO5.2** Evaluate the impact on human, animal and plant health **SO5.3** Manage seed borne diseases **SO5.4** Produce healthy seed by advanced procedures	• Relationship between seed-borne infection and expression of the disease in the field	Unit 5: Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogens/ diseases and procedure for healthy seed production. Seed health testing, methods for detecting microorganism. 5.1 Production of toxic metabolites affecting seed quality 5.2 Impact of toxic metabolites on human, animal and plant health 5.3 Impact of toxic metabolites on human, animal and plant health 5.4 Management of seed-borne pathogens 5.5 Management of seed-borne pathogens 5.6 Management of seed-borne pathogens 5.7 Procedure for healthy seed production 5.8 Procedure for healthy seed production	Toxic metabolites affecting seed quality

SW-1 Suggested Sessional Work (SW):
Assignments: i) Procedure for healthy seed production

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH 512.1 Recognize importance of seed pathology, plant quarantine and SPS under WTO in seed industry	6	6	1	1	14
PL PATH 512.2 Interpret the mechanism of seed transmission and seed to plant transmission of pathogen	5	6	1	1	13
PL PATH 512.3 Detect the pathogen from seed by advanced techniques and forecast the epidemics through seed borne infection	6	6	1	1	14
PL PATH 512.4 Estimate the losses due to seed borne diseases and production of healthy seed using suitable and sustainable management practices	5	6	1	1	13
PL PATH 512.5 Test the toxic metabolites synthesized in the seed due to infection and its impact on human, animal and plant health	8	6	1	1	16
Total Hours	30	30	05	05	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	History and importance of seed borne diseases	03	03	04	10
CO-2	Transmission of diseases	02	04	04	10
CO-3	Seed certification and losses	02	04	04	10
CO-4	Epidemiological factors	02	04	04	10
CO-5	Toxic metabolites and its impact	03	03	04	10
Total		12	18	20	50

Legend: **R: Remember, U: Understand, A: Apply**

The end of semester assessment for Fundamentals of Plant Pathology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case study
3. Group Discussion
4. Demonstration
5. Brainstorming

Suggested Learning Resources:

(a)

(b) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Principles of Seed Pathology. Vols. I & II	Agarwal VK and Sinclair JB	CBS Publ., New Delhi	1993
2	Seed Health Testing: Progress Towards the 21st Century	Hutchins JD and Reeves JE	CABI, Wallington	1997
3	Seed Pathology	Paul Neergaard	McMillan, London	1988
4	Seed Pathology	Suryanaraya na D	Vikash Publication, New Delhi	1978
5	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.

Curriculum Development Team

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Cos, POs and PSOs Mapping

Course Title: Detection and Management of Seed Borne Pathogens

Course Code: PL PATH 512

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1 Recognize importance of seed pathology, plant quarantine and SPS under WTO in seed industry	2	3	2	3	3	3	3	2	3	3	3	3	3	3
CO2 Interpret the mechanism of seed transmission and seed to plant transmission of pathogen	1	1	2	2	2	2	1	1	2	2	3	2	2	2
CO3 Detect the pathogen from seed by advanced techniques and forecast the epidemics through seed borne infection	1	2	1	1	3	2	2	1	2	2	3	2	2	2
CO4 Estimate the losses due to seed borne diseases and production of healthy seed using suitable and sustainable management practices	1	1	2	2	3	2	1	1	2	2	3	3	3	2
CO5 Test the toxic metabolites synthesized in the seed due to infection and its impact on human, animal and plant health	1	1	2	2	3	3	3	3	2	2	3	3	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1** Recognize importance of seed pathology, plant quarantine and SPS under WTO in seed industry	SO 1.1 SO 1.2 SO 1.3	• Conventional techniques in the detection and identification of seedborne fungi	Unit1: History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. 1.1,1.2,1.3,1.4,1.5,1.6	History of seed pathology
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2** Interpret the mechanism of seed transmission and seed to plant transmission of pathogen	SO 2.1 SO 2.2 SO 2.3	• Conventional techniques in the detection and identification of seedborne bacteria and viruses	Unit 2 Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. 2.1,2.2,2.3,2.4,2.5	Mechanism of seed transmission
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO3** Detect the pathogen from seed by advanced techniques and forecast the epidemics through seed borne infection	SO 3.1 SO 3.2 SO 3.3 SO 3.4	• Advanced techniques in the detection and identification of seedborne fungi, bacteria and viruses	Unit 3: Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. 3.1,3.2,3.3,3.4,3.5,3.6	Tolerance limits
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO4** Estimate the losses due to seed borne diseases and production of healthy seed using suitable and sustainable management practices	SO 4.1 SO 4.2 SO 4.3	• Advanced techniques in the detection and identification of seedborne fungi, bacteria and viruses	Unit 4: Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection. 4.1,4.2,4.3,4.4,4.5	Epidemiological factors
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO5** Test the toxic metabolites synthesized in the seed due to infection and its impact on human, animal and plant health	SO 5.1 SO 5.2 SO 5.3 SO 5.4	• Relationship between seed-borne infection and expression of the disease in the field	Unit 5: Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogens/ diseases and procedure for healthy seed production. Seed health testing, methods for detecting microorganism. 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	Toxic metabolites affecting seed quality

Course Code: STAT 512

Course Title: Experimental Designs

Pre-requisite: Experimental design is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Generally, the purpose is to establish the effect that a factor or independent variable has on a dependent variable.

Rationale: Experimental design is used to establish the effect an independent variable has on a dependent variable. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.

Course Outcomes:

CO1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

CO2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

CO3 Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

CO4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Scheme of Studies:

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Supporting	STAT 512	Experimental Designs	2	02	02	01	7	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 1 number 5 marks each (CA)	Class Test 2 (2 best out) 15 marks each (CT)	Practical Exam (PA)	Class Attendance (AT)	Total Marks (CA+CT+PA+AT)		
Supporting	STAT 512	Experimental Designs	5	30	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

STAT 512 CO-1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

Approximate Hours

Item	Appx. Hrs.
CI	3
LI	4
SW	1
SL	2
Total	10

Session Out Comes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Design of Experiment is a tool to develop an experimentation strategy that maximizes learning using a minimum of resources. **SO1.2** Extensively used by engineers and scientists involved in the improvement of manufacturing processes to maximize yield and decrease variability. **SO1.3** It is widely used in many fields with broad application across all the natural and social sciences, to name a few: Biostatistics, Agriculture, Marketing, Software engineering, Industry etc.	• Uniformity trial data analysis. • Formation of plots and blocks, Fairfield Smith Law	**Unit-1.** Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control. **1.1**. Need for designing of experiments **1.2** characteristics of a good design **1.3** Basic principles of designs- randomization, replication and local control	1. Prepare the assignment on Basic principles of designs- randomization, replication and local control.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Basic principles of designs- randomization, replication and local control.

STAT 512 CO-2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

Approximate Hours

Item	Appx. Hrs.
CI	5
LI	6
SW	1
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Good experimental design is important in all research, it helps to ensure the data collection, data analysis and conclusions from a study, are valid (true). **SO2.2** Experiments are designed to test hypotheses, or specific statements about the relationship between variables.	• Analysis of data obtained from CRD • Analysis of data obtained from RBD • Analysis of data obtained from LSD	**Unit-2** Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. **2.1** Uniformity trials **2.2** size and shape of plots and blocks **2.3**. Analysis of variance; Completely randomized design **2.4** Analysis of variance; randomized block design **2.5** Analysis of variance; Latin square design.	1. Prepare the assignment on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

STAT 512 CO-3 Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	14
SW	1
SL	2
Total	23

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Experimental methods introduce exogeneity, allowing researchers to draw conclusions about the effects of an event or a program. **SO3.2** An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.	• Analysis of factorial experiments without confounding. • Analysis of factorial experiments with confounding. • Analysis with missing data in CRD. • Analysis with missing data in RBD. • Analysis with missing data in LSD. • Split plot designs. 7- Strip plot designs	**Unit-3** Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. **3.1**. Factorial experiments, (symmetrical) **3.2** Factorial experiments, (asymmetrical) **3.3** orthogonality **3.4** partitioning of degrees of freedom **3.5**. Confounding in symmetrical factorial experiments **3.6**. Factorial experiments with control	1. Prepare the assignment on Factorial experiments with control treatment.

SW-1 Suggested Sessional Work (SW):
Assignments: Prepare the assignment on Factorial experiments with control treatment.
Other Activities (Specify):

STAT 512 CO-4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Approximate Hours

Item	Appx Hrs.
CI	16
LI	6
SW	1
SL	2
Total	25

Session Out Comes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1. Ensure your experiment is unbiased. **SO4.2** Make sure your experiment is adequately powered. **SO4.3** Consider the range of applicability of your experiment.	• Transformation of data. • Analysis of resolvable designs • Fitting of response surfaces.	**Unit-4** Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. 4.1 Split plot 4.2 Strip plot designs 4.3 Analysis of covariance 1.4 Missing plot techniques in randomized block. 4.5 Missing plot techniques in Latin square designs. 4.6 Transformations 4.7 crossover designs 4.8 balanced incomplete block design 4.9 resolvable designs 4.10 Applications of resolvable designs 4.11 Lattice design 4.12 Applications of Lattice design 4.13 Alpha design-concepts. 4.14 Randomization procedure. 4.15 Interpretation of results. 4.16 Response surfaces. Experiments with mixtures	1. Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

SW-1 Suggested Sessional Work (SW):
Assignments: Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (LI)	Sessional Work (SW)	Self - Learning (S l)	Total hour (C l + LI+ SW +Sl)
01: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	03	04	01	02	10
02: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	05	06	01	02	14
03: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	06	14	01	02	25
04: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	16	06	01	02	25
Total Hours	**30**	**30**	**04**	**08**	**74**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks Distribution			Total Marks
		R	U	A	
CO-1	Understand of basic concepts of design of experiments.	04	04	04	12
CO-2	Analyze completely randomized design,	04	04	04	12
CO-3	Understand and compute Full and confounded factorial designs with two and three levels.	04	04	04	12
CO-4	Understand the purpose for balanced incomplete block design, resolvable designs and their applications.	05	04	05	14
	Total	17	16	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Experimental Designs will be held with written examination of 50 marks **Note**. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
01	Basic Concepts and Application of Experimental Designs and Analysis	Felix Kusanedzie Sylverster Achio Edmund Ameko	Science PG	
02	Theory and Analysis of Experimental Designs	B.L. Agrawal	CBS	
03	Design and Analysis of Experiments	Angela Dean Daniel Voss	Springer	

Curriculum Development Team:

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2. Dr. V.K. Vishwakarma, Head Department of Agricultural Economics, FAST
3. Mr. Navneet Raj Rathore, Teaching Associate, Department of Agricultural Economics, FAST

Cos, POs and PSOs Mapping

Course Title: [redacted] Experimental Designs

Course Code: [redacted] STAT 512

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	1	2	2	3	3	3	0	2	3	3	3	1	1	1
CO2: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	1	1	3	2	3	3	1	1	2	3	1	2	2	2
CO3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	2	3	2	2	2	2	1	2	3	3	3	1	1	1
CO4: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	2	1	2	2	3	2	1	1	2	2	3	1	1	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO1** Need for designing of experiments, characteristics of a good design	SO 1.1 SO 1.2 SO 1.3	• Uniformity trial data analysis. • Formation of plots and blocks, Fairfield Smith Law	Unit1: Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control. 1.1,1.2,1.3,1.4,1.5,1.6	Basic principles of designs- randomization, replication and local control.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO2** Uniformity trials, size and shape of plots and blocks	SO 2.1 SO 2.2	• Analysis of data obtained from CRD • Analysis of data obtained from RBD • Analysis of data obtained from LSD	Unit 2 Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.2.1,2.2,2.3,2.4,2.5,2.6	Analysis of variance; Completely randomized design
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO3** Factorial experiments	SO 3.1 SO 3.2	• Analysis of factorial experiments without confounding. • Analysis of factorial experiments with confounding. • Analysis with missing data in CRD. • Analysis with missing data in RBD. • Analysis with missing data in LSD. • Split plot designs. • Strip plot designs	Unit 3: Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. 3.1,3.2,3.3,3.4,3.5,3.6	Factorial experiments with control treatment.
POs 1,2,3,4,5,6,7,8, 9,10 PSOs 1,2,3,4	**CO4** Introduction to Test of Significance	SO 4.1 SO 4.2 SO 4.3	• Transformation of data. • Analysis of resolvable designs • Fitting of response surfaces.	Unit 4: Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13,4.14,4 .15,4.16	Analysis of covariance and missing plot techniques in randomized block and Latin square designs

Course Code: PGS 503

Course Title: Intellectual Property and Its Management in Agriculture

Pre- requisite: To teach the physiology of Intellectual Property and Its Management in Agriculture **Rationale:** 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.

Course outcomes:

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Scheme of Studies:

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Common course	PGS 503	Intellectual Property and Its Management in Agriculture	1	0	1	1	3	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T)and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or ther locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW&SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment1 number 5 marks each (CA)	Class Test2 (2bestout) 20 marks each (CT)	Practical Exam (PA)	Class Attendance (AT)	Total Marks (CA+CT+ PA+AT)		
Common course	PGS 503	Intellectual Property and Its Management in Agriculture	5	40	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

Approximate Hours

Item	Appx. Hrs
Cl	04
LI	0
SW	01
SL	02
Total	07

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Student will understand the Historical perspectives and need for the introduction of Intellectual Property Right. **SO1.2** Student will recognize the TRIPs and various provisions in TRIPS Agreement. **SO1.3** Student will understand different Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs		**Unit-1.0** 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. **1.1** Historical perspectives and need for the introduction of Intellectual Property Right regime. **1.2** TRIPs and various provisions in TRIPS Agreement. **1.3** Intellectual Property and Intellectual Property Rights (IPR). **1.4** Benefits of securing IPRs.	1. Role of IPR and its benefits. 2. Role of TRIPS and its benefits

SW-1 Suggested Sessional Work (SW):
Assignments: Preparation of file and write the role of IPR and TRIPS and their purpose.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

Approximate Hours

Item	Appx. Hrs
Cl	04
LI	0
SW	01
SL	02
Total	07

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
SO2.1 Students will understand the Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout **SO2.2**Students will understand the trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection. **SO2.3** Students will identify the role of Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.		**Unit-2** 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. **2.1** Indian Legislations for the protection of various types of Intellectual Properties. **2.2** Fundamentals of patents, copyrights, geographical indications, designs and layout. **2.3** trade secrets and traditional knowledge and trademarks. **2.4** protection of plant varieties and farmers' rights and biodiversity protection. **2.5** Protectable subject matters, protection in biotechnology. **2.6** protection of other biological materials, ownership and period of protection.	1. Basic Indian Legislature. 2. Plant varieties and farmers' rights act (2001). 3. Biodiversity act (2002).

Suggested Seasonal Work (SW):
Assignments: I.Note on Plant varieties and farmers' rights act (2001).
II. Note on Biodiversity act (2002).

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement.

Approximate Hours

Item	Appx. Hrs
Cl	05
LI	0
SW	02
SL	01
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Students will identify the National Biodiversity protection initiatives and Convention on Biological Diversity. **SO3.2** Students will understand the International Treaty on Plant Genetic		**Unit-3:** 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. **3.1** National Biodiversity protection	1. Plant Genetic Resources.

Resources for Food and Agriculture and Licensing of technologies. **SO3.2** Students will understand the Material transfer agreements, Research collaboration Agreement and License Agreement.		initiatives. **3.2** Conventions on Biological Diversity. **3.3** International Treaty on Plant Genetic Resources for Food and Agriculture. **3.4** Licensing of technologies and Material transfer agreements. **3.5** Research collaboration Agreement and License Agreement.	

SW-3 Suggested Sessional Work (SW):

a. **Assignments**:

i. Note on Plant Genetic Resources.

ii. Note on National Biodiversity protection initiatives

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.	04	01	02	07
PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	06	02	03	11
PGS 503.3: Students will be able to understand Research collaboration Agreement, License agreement.	05	02	01	08
Total	**15**	**05**	**06**	**26**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	Historical perspectives and need for the introduction of Intellectual Property Right regime;	05	03	02	**10**
CO 2	Indian Legislations for the protection of various types of Intellectual Properties;	05	02	03	**10**
CO 3	National Biodiversity protection initiatives;	05	03	02	**10**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Intellectual Property and Its Management in Agriculture** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to organic fields
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Intellectual Property Rights in Agricultural Biotechnology	Erbisch FH and Maredia K	CABI.	1998
2	Intellectual Property Rights: Unleashing Knowledge Economy	Ganguli P	McGraw-Hill.	2001
3	Intellectual Property Rights: Key to New Wealth Generation		NRDC and Aesthetic Technologies.	2001
4	State of Indian Farmer. Vol. V. Technology Generation and IPR Issues	Ministry of Agriculture, Government of India	Academic Foundation	2004
5	Intellectual Property Rights in Animal Breeding and Genetics	Rothschild M and Scott N	CABI	2003

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Cos, POs and PSOs Mapping

Course Title: Intellectual Property and Its Management in Agriculture
Course Code: PGS 503

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.	**2**	**1**	**2**	**1**	**1**	**3**	**1**	**2**	**3**	**3**	**1**	**2**	**1**	**1**
CO.2: Students will be able to understand National Biodiversity protection initiatives, Convention on Biological Diversity.	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**1**	**2**	**2**
CO.3: Students will be able to understand Research collaboration Agreement, License agreement.	**1**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1.** Historical perspectives of IPR	SO 1.1 SO 1.2 SO 1.3		Unit1: 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. 1.1,1.2,1.3,1.4	1: Role of IPR and its benefits. Role of TRIPS and its benefits
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO2. Indian Legislations for the protection of various types of Intellectual Properties	SO 2.1 SO 2.2 SO 2.3		Unit 2: 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. 2.1,2.2,2.3,2.4,2.5,2.6	1 Basic Indian Legislature. 2. Plant varieties and farmers' rights act (2001). 3. Biodiversity act (2002).
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO3:** National Biodiversity protection initiatives	SO 3.1 SO 3.2 SO 3.3		Unit 3: 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. 3.1,3.2,3.3,3.4,3.5	1. Plant Genetic Resources.

Course Code: PGS504
Course Title: Basic Concepts in Laboratory Techniques
Pre requisite: No specific requirements

Rationale: Studying basic laboratory techniques are fundamental for scientific research, ensuring accurate experimentation and data analysis. Mastery of these skills cultivates precision, reproducibility, and safety, forming the cornerstone of scientific inquiry across disciplines and facilitating advancements in knowledge and technology.

Course Outcomes:

CO1_ PGS504 Student will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.

Scheme of Studies

Board Of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)					Total Credit (C)
			CI	LI	SW	SL	Total Study Hours	
Common course	PGS504	Basic Concepts in Laboratory Techniques	00	2	00	00	2	01

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Practical

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	**Total Marks** (PRA + ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Common course	PGS504	Basic Concepts in Laboratory Techniques							100	100

Course-Curriculum Detailing:

Laboratory techniques are important for any person conducting an experiment. Every procedure needs to be complete with accuracy and precision with proper safety measures. Student will understand the safety and details of working in scientific laboratory. Student will familiarize with various instruments and their principles. Student will practice and visualize common experimental procedures.

PGS504 **Basic Concept of Laboratory Techniques**

Approximate Hours

Item	Appx Hrs
CI	00
LI	30
SW	00
SL	00
Total	30

Session Outcomes (SOs)	Laboratory Instructions (LI)	Classroom Instructions (CI)	Self-Learning (SL)
SO. L1 Identify safety measures while in Lab SO. L2 Recognize use of glasswares. SO. L3 Discover handling of glasswares. SO. L4 Recognize Drying of solvents/ chemicals; SO. L5 Describe working with chemicals. SO. L6 Describe working with solutions. SO. L7 Articulate the technique of formulating doses of agrochemicals SO. L8 Discover handling techniques of solutions SO. L9 Identify the handling of acid and bases SO. L10 Discover the formulation of buffer and solutions of specific pH. SO. L11 Identify the use of lab instruments SO. L12 Recognize and categorize the media requirements and its types SO. L13 Discover the methods and application of viability of germplasm SO. L14 Illustrate procedure for plant tissue culture SO. L15 Recognize flowering plant by its taxonomical description	L1. Safety measures while in Lab L2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets L3. Washing, drying and sterilization of glassware L4. Drying of solvents/ chemicals L5. Handling of chemical substances; Weighing and preparation of solutions of different strengths and their dilution L6. Handling techniques of solutions L7. Preparation of different agro-chemical doses in field and pot applications L8. Preparation of solutions of acids L9. Neutralization of acid and bases L10. Preparation of buffers of different strengths and pH values L11. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath Electric wiring and earthing L12. Preparation of media and methods of sterilization L13. Seed viability testing, testing of pollen viability L14. Tissue culture of crop plants L15. Description of flowering plants in botanical terms in relation to taxonomy		

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class lecture (CL)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CL+SW+SL)
Basic Concept of Laboratory Techniques	**0+30**	**0**	0	**30**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO1	**Basic Concept of Laboratory Techniques**		**30**	**70**	**100**

Suggested Learning Resources:

Sl. No.	Title	Author	Publisher	Edition & Year
01	Laboratory Techniques in Organic Chemistry	Jerry R. Mohrig, David G. Alberg, and Gretchen M. Adams	W. H. Freeman and Company.	2014
02	Biotechnology: Expanding Horizons	B D Singh	Kalyani Publishers	2005

Cos, POs and PSOs Mapping

Course Title: Basic Concepts in Laboratory Techniques
Course Code: PGS504

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO.1: Student will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.	**3**	**2**	**2**	**2**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**2**	**1**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1.**	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5 SO 1.6 SO 1.7 SO 1.8 SO 1.9 SO 1.10 SO 1.11 SO 1.12 SO 1.13 SO 1.14 SO 1.15	1. Safety measures while in Lab 2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets 3. Washing, drying and sterilization of glassware 4. Drying of solvents/ chemicals 5. Handling of chemical substances; Weighing and preparation of solutions of different strengths and their dilution 6. Handling techniques of solutions 7. Preparation of different agro-chemical doses in field nd pot applications 8. Preparation of solutions of acids 9. Neutralization of acid and bases 10. Preparation of buffers of different strengths and pH values 11. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath Electric wiring and earthing 12. Preparation of media and methods of sterilization 13. Seed viability testing, testing of pollen viability 14. Tissue culture of crop plants 15. Description of flowering plants in botanical terms in relation to taxonomy		

Course Code: PL PATH 506
Course Title: Techniques for Detection and Diagnosis of Plant Diseases
Pre-requisite: Student should have basic knowledge of practical
Rational: For diagnosis and detection of plant pathogens different techniques are necessary. Therefore, the course is added in the programme.
Aim of the course: To impart training on various methods/ techniques/ instruments used in the study of plant diseases/ pathogens.

Course Outcomes: Upon successful completion of the course a student will be able to:
PL PATH 506.1: Detect the plant pathogens based on different techniques including biochemical microscopic Cultural studies, biological assays, serological, nucleic acid and PCR based.
PL PATH 506.2 Identify the plant pathogens phenotypically and genotypically
PL PATH 506.3 Distinguish the plant pathogens by molecular approaches
PL PATH 506.4 Choose biosensors for detection of plant pathogens
PL PATH 506.5 Select Genotypic tools for detection and diagnosis of plant viruses.

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/ Week)**					**Total Credits**
Program Core	PL PATH 506	Techniques for Detection and Diagnosis of Plant Diseases	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			0	4	0	0	4	0+2

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Scheme of Assessment:

Category of course	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Major	PL PATH 506	Techniques for Detection and Diagnosis of Plant Diseases						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Laboratory Instruction (LI). As the course progresses, students should showcase their mastery of Session Outcomes (SOs),

culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1. Detect the pathogens by different methods **SO2.** Test for identification of plant pathogens **SO3**. Identify the pathogens on molecular basis **SO4.** Detect the pathogens by using recent techniques	• Detection of plant pathogens 1. Based on visual symptoms, 2. Biochemical test 3. Using microscopic techniques, 4. Cultural studies; (use of selective media to isolate pathogens). 5. Biological assays (indicator hosts, differential hosts) 6. Serological assays 7. Nucleic acid- based techniques (Non-PCR–LAMP, Later flow microarray and PCR based- multiplex, nested, qPCR, immune capture PCR, etc.); • Phenotypic and genotypic tests for identification of plant pathogens • Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; and eukaryotic organism by ITS region) and whole genome sequencing; • Volatile compounds profiling by using GC-MS and LC-MS; • FAME analysis, Fluorescence in-situ Hybridization (FISH), Flow Cytometry, Phage display technique, biosensors for detection of plant pathogens; • Genotypic tools such as genome/ specific gene sequence homology comparison by BLAST (NCBI and EMBL) and electron microscopy techniques of plant virus detection and diagnosis.		

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+ Sl)
PL PATH 506.1: Detect the plant pathogens based on different techniques including biochemical microscopic Cultural studies, biological assays, serological, nucleic acid and PCR based.		6			06
PL PATH 506.2 Identify the plant pathogens phenotypically and genotypically		6			06
PL PATH 506.3 Distinguish the plant pathogens by molecular approaches		6			06
PL PATH 506.4 Choose biosensors for detection of plant pathogens		6			06
PL PATH 506.5 Select Genotypic tools for detection and diagnosis of plant viruses.		6			06
Total Hours		30			30

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Laboratory Exercises in Plant Pathology: An Instructional Kit.	Baudoin ABAM, Hooper GR, Mathre DE and Carroll RB	Scientific Publ., Jodhpur	1990.
2	Basic Plant Pathology Methods	Dhingra OD and Sinclair JB	CRC Press, London, Tokyo.	1986.
3	Principles of Diagnostic Techniques in Plant Pathology	Fox RTV	CABI Wallington.	1993
4	Plant Virology Protocols: From Virus Isolation to Transgenic Resistance. Methods in Molecular Biology	Forster D and Taylor SC	Humana Press, Totowa, New Jersey.	1998.
5	Diagnosis of Plant Virus Diseases	Mathews REF	CRC Press, Boca Raton, Tokyo.	1993.
6	Identification of Plant Viruses, Methods and Experiments	Noordam D	Cent. Agic. Pub. Doc. Wageningen.	1973.
7	Laboratory Manual of Plant Pathology	Pathak VN	Oxford & IBH, New Delhi.	1984.
8	Plant Pathology-Concepts and Laboratory Exercises	Trigiano RN, Windham MT and Windham AS	CRC Press, Florida.	2004.
9	Methods of Bacterial Plant Pathology	Chakravarti BP	Agrotech, Udaipur.	2005.
10	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.

Cos, POs and PSOs Mapping

Course: Techniques for Detection and Diagnosis of Plant Diseases

Course Code: PL PATH-506

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Detect the plant pathogens based on different techniques including biochemical microscopic Cultural studies, biological assays, serological, nucleic acid and PCR based.	2	3	3	2	3	3	1	2	3	3	3	3	2	1
CO.2 Identify the plant pathogens phenotypically and genotypically	2	3	3	2	3	3	1	1	3	2	3	3	3	3
CO.3 Distinguish the plant pathogens by molecular approaches	1	1	1	1	3	3	1	1	3	2	3	1	3	3
CO.4 Choose biosensors for detection of plant pathogens	3	3	3	1	3	3	1	1	2	2	3	2	3	2
CO.5 Select Genotypic tools for detection and diagnosis of plant viruses.	3	2	2	2	3	3	2	2	2	3	2	2	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1:** Different methods of diagnosis	SO 1.1 SO 1.2	• Detection of plant pathogens 1. Based on visual symptoms, 2. Biochemical test 3. Using microscopic techniques, 4. Cultural studies; (use of selective media to isolate pathogens). 5. Biological assays (indicator hosts, differential hosts) 6. Serological assays 7. Nucleic acid- based techniques (Non-PCR–LAMP, Later flow microarray and PCR based- multiplex, nested, qPCR, immune capture PCR, etc.);		
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO2:** Phenotypic, genotypic and molecular identification of plant pathogens	SO 2.1 SO 2.2	• Phenotypic and genotypic tests for identification of plant pathogens • Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; and eukaryotic organism by ITS region) and whole genome sequencing;		
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO3:** Volatile compounds profiling	SO 3.1	• Volatile compounds profiling by using GC-MS and LC-MS;		
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO4:** FAME analysis	SO 4.1 SO 4.2	• FAME analysis, Fluorescence in-situ Hybridization (FISH), Flow Cytometry, Phage display technique, biosensors for detection of plant pathogens;		
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO5:** Genotypic tools	SO 5.1 SO 5.2	• Genotypic tools such as genome/ specific gene sequence homology comparison by BLAST (NCBI and EMBL) and electron microscopy techniques of plant virus detection and diagnosis.		

Course Code: PL PATH-515
Course Title: Diseases of Field and Medicinal Crops
Pre-requisite: Student should have basic knowledge of principles of Plant pathology
Rationale: Diseases of crops are caused by different microorganism studied in plant pathology. Therefore, it is the integral part of plant pathology
Aim of the course: To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.

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

PL PATH515.1: Diagnose various plant diseases with their life-cycles.
PL PATH515.2: Determine the relationship between pathogens, host and environment
PL PATH515.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices
PL PATH515.4: Develop integrated disease management models/strategies for particular crop.
PL PATH515.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection.

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Category of course	Course Code	Course Title			Scheme of studies (Hours/ Week)			Total Credits
Major	PL PATH-515	Diseases of Field and Medicinal Crops	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			2	2	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) And others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.)
SL: Self Learning
C: Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
Major	PL PATH-515	Diseases of Field and Medicinal Crops						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH515.1. Diagnose various plant diseases with their life-cycles.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1: Understand the Nature, prevalence, factors affecting disease development of field crops **SO1.2:** Identify and diagnose the diseases of field crops **SO1.3:** Choose the suitable management practices to control field diseases. **SO1.4:** Select the suitable management practices to control field diseases **SO1.5:** Integrate the suitable and sustainable management practices to avoid field crops diseases.	• Isolation and purification of pathogens of millet Crop diseases • Detailed study of symptoms and host parasite relationship of important diseases of wheat crops. • Collection and dry preservation of diseased specimens of important crops.	**Unit 1:** Diseases of Cereal crops: Rice, wheat, barley, pearl millet, sorghum and maize. 1.1: Symptoms, Etiology, Disease cycle and management of field Crops-Rice 1.2: Symptoms, Etiology, Disease cycle and management of field Crops-Wheat 1.3: Symptoms, Etiology, Disease cycle and management of field Crops-Barley 1.4: Symptoms, Etiology, Disease cycle and management of field Crops-Pearl Millet 1.5: Symptoms, Etiology, Disease cycle and management of field Crops-Sorghum 1.6: Symptoms, Etiology, Disease cycle and management of field Crops-Maize	1: Collection and preservation of disease specimen

SW-1 Suggested Sessional Work (SW):
Assignment: Causal organisms and etiology of wheat and barley crops

PL PATH 515.2: Determine the relationship between pathogens, host and environment

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1: Understand the Nature, prevalence, factors affecting disease development of Pulse crops **SO2.2:** Identify and diagnose the diseases of Pulse crops **SO2.3:** Choose the suitable management practices to control Pulse crops diseases **SO2.4:** Select the suitable management practices to control Pulse crops diseases **SO2.5:** Integrate the suitable and sustainable management practices to avoid Pulse crops diseases.	• Isolation and purification of pathogens of Pulse crops diseases • Detailed study of symptoms and host parasite relationship of important diseases of pulse crops. • Collection and dry preservation of diseased specimens of important pulse crops.	**Unit 2**. Diseases of Pulse crops- Urdbean, Mungbean, lentil, pigeon pea, soybean and cowpea. 2.1: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Gram 2.2: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Urdbean 2.3: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Mungbean 2.4: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Lentil 2.5: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Pigeon pea 2.6: Symptoms, Etiology, Disease cycle and management of Pulse Crops- Soybean and Cowpea	1: Collection and preservation of various pulse crop disease specimen

SW-1: Suggested Sessional Work (SW):
Assignments: Life-cycles and management of pulse crop diseases

PL PATH 515.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Understand the Nature, prevalence, factors affecting disease development of Oil seed crops **SO3.2:** Identify and diagnose the diseases of Oil seed crops **SO3.3:** Choose the suitable management practices to control Oilseed crops diseases	• Isolation and purification of pathogens of oilseed crop diseases • Detailed study of symptoms and host parasite relationship of important diseases of Oil seed crops. • Collection and dry preservation	**Unit 3.** Diseases of Oilseed crops- and mustard, sesame, linseed, sunflower, groundnut, castor. 3.1. Symptoms, Etiology, Disease cycle and management Oil seed crops Crops- Rapeseed 3.2: Symptoms, Etiology, Disease cycle and management Oil seed Crops- Mustard 3.3: Symptoms, Etiology, Disease cycle and management Oil seed Crops- Sesame	1: Collection and Preservation of various oil seed crop disease specimen.

SO3.4: Select the suitable management practices to control Oilseed crops diseases **SO3.5:** Integrate the suitable and sustainable management practices to avoid Oilseed crops diseases.	of diseased specimens of important Oilseed crops.	3.4: Symptoms, Etiology, Disease cycle and management Oil seed Crops-Linseed 3.5: Symptoms, Etiology, Disease cycle and management of Oil seed Crops-Sunflower 3.6: Symptoms, Etiology, Disease cycle and management Oil seed Crops-Groundnut and Caster	

SW-1: Suggested Sessional Work (SW):
Assignments: Symptoms, causal organisms and life cycles of oilseed crops.

PL PATH 515.4: Develop integrated disease management models/strategies for particular crop.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO4.1 Understand the Nature, prevalence, factors affecting disease development of fungal diseases of cotton **SO4.2:** Identify and diagnose the diseases of Bacterial diseases of cotton **SO4.3:** Choose the suitable management practices to control diseases of Cotton and sugarcane crops **SO4.4:** Select the suitable specific management practices to control diseases of cotton and sugarcane crops **SO4.5:** Integrate the suitable and sustainable management practices to avoid cotton and sugarcane diseases.	• Determination and confirmation of symptoms according to their cause • Detailed study of symptoms and host parasite relationship of important diseases of Cash crops and fodder crops • Collection and dry preservation of diseased specimens of important Cash crops and fodder crops	**Unit 4:** Diseases of Cash crops- Cotton, sugarcane, Diseases of Fodder legume crops- Berseem, oats, guar, Lucerne. 4.1. Symptoms, Etiology, Disease cycle and management of fungal diseases of cotton 4.2. Symptoms, Etiology, Disease cycle and management of Bacterial& viral diseases of cotton 4.3. Symptoms, Etiology, Disease cycle and management of fungal & Bacterial diseases of sugarcane 4.4. Symptoms, Etiology, Disease cycle and management of Viral & Phytoplasma diseases of sugarcane 4.5. Symptoms, Etiology, Disease cycle and management of Fodder legume crops-Berseem and Guar 4.6. Symptoms, Etiology, Disease cycle and management of Fodder legume crops-Oats & Lucerne	1.List of safe pesticides for the control of fodder crops

SW-1 Suggested Sessional Work (SW):
Assignments: List of safe pesticides for the control of cotton and sugarcane crops
PL PATH 515.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO5.1: Understand the Nature, prevalence, factors affecting disease development of fungal diseases of medicinal crops **SO5.2:** Identify and diagnose the diseases of Bacterial diseases of medicinal crops **SO5.3:** 3 Choose the suitable management practices to control diseases of medicinal crops **SO5.4:** Select the suitable specific management practices to control diseases of specific medicinal crops **SO5.5:** Integrate the suitable and sustainable management practices to avoid medicinal crop diseases	• Determination and confirmation of symptoms according to their cause • Detailed study of symptoms and host parasite relationship of important diseases of Cash crops and fodder crops • Collection and dry preservation of diseased specimens of important Cash crops and fodder crops	**Unit 5:** Medicinal crops- Plantago, liquorices, mulathi, rosagrass, sacred basil, mentha, ashwagandha, Aloe Vera 5.1. Symptoms, Etiology, Disease cycle and management of Plantago 5.2. Symptoms, Etiology, Disease cycle and management of Liqorices 5.3. Symptoms, Etiology, Disease cycle and management of Mulathi 5.4. Symptoms, Etiology, Disease cycle and management of Rosagrass 5. Symptoms, Etiology, Disease cycle and management of Sacred Basil and Mentha 5.6. Symptoms, Etiology, Disease cycle and management of Ashwagandha and Aloe vera	1. Collection and Preservation of various medicinal plant disease specimens.

SW-1 Suggested Sessional Work (SW):

Assignments: Collection and Preservation of various medicinal plant disease specimens.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
PLPATH 515.1: Diagnose various plant diseases with their life-cycles.	6	6	1	1	14
PL PATH515.2: Determine the relationship between pathogens, host and environment	6	6	1	1	14
PL PATH515.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices	6	6	1	1	14
PL PATH515.4: Develop integrated disease management models/strategies for particular crop.	6	6	1	1	14
PL PATH515.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection	6	6	1	1	14
Total Hours	30	30	**5**	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks distribution			Total mark
		R	U	A	
CO-1	Diseases of cereal crops	3	3	4	10
CO-2	Diseases of pulse crops	3	3	4	10
CO-3	Diseases of oilseed crops	3	3	4	10
CO-4	Diseases of cash crops	3	3	4	10
CO-5	Diseases of medicinal crops	3	3	4	10
Total		15	15	20	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with writtenexamination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Problems and Progress of Wheat Pathology in South Asia.	Joshi LM, Singh DV and Srivastava KD	Malhotra Publ. House, New Delhi.	1984
2	Diseases of Crop Plants in India	Rangaswami G.	Prentice Hall of India, New Delhi	1999. 4th Ed.
3	Diseases of Sugarcane, Major Diseases.	Ricanel C, Egan BT, Gillaspie Jr AG and Hughes CG.	Academic Press, New York.	1989
4	Plant Diseases. 10th Ed.	Singh RS.	Medtech, New Delhi.	2017
5	Plant Diseases of International Importance. Diseases of Cereals and Pulses. Vol. I	Singh US, Mukhopadhyay AN, Kumar J and Chaube HS	Prentice Hall, Englewood Cliffs, New Jersey.	1992
6	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.

Cos, POs and PSOs Mapping

Course: Diseases of Field and Medicinal Crops

Course Code: PL PATH-515

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO.1: Diagnose various plant diseases with their life-cycles.	2	2	3	2	3	2	1	2	3	3	3	2	1	2
CO.2: Determine the relationship between pathogens, host and environment	3	3	1	2	2	2	1	1	3	2	3	2	2	2
CO.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices	2	3	2	1	2	3	1	2	3	2	3	2	3	3
CO.5: Develop integrated disease management models/strategies for particular crop.	3	3	3	1	3	3	2	1	2	2	3	2	3	2
CO.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection	3	2	2	3	3	3	2	2	3	3	3	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO: 1** Diseases of cereal crops	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	• Isolation and purification of pathogens of millet Crop diseases • Detailed study of symptoms and host parasite relationship of important diseases of wheat crops. • Collection and dry preservation of diseased specimens of important crops.	Unit 1: Diseases of Cereal crops: Rice, wheat, barley, pearl millet, sorghum and maize. 1.1,1.2,1.3,1.4,1.5,1.6	1: Collection and preservation of disease specimen
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO: 2** Diseases of pulse crops	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	• Isolation and purification of pathogens of Pulse crops diseases • Detailed study of symptoms and host parasite relationship of important diseases of pulse crops. • Collection and dry preservation of diseased specimens of important pulse crops.	Unit 2. Diseases of Pulse crops- Urdbean, Mungbean, lentil, pigeon pea, soybean and cowpea. 2.1,2.2,2.3,2.4,2.5,2.6	1: Collection and preservation of various pulse crop disease specimen
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO: 3** Diseases of oilseed crops	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO 3.5	• Isolation and purification of pathogens of oilseed crop diseases • Detailed study of symptoms and host parasite relationship of important diseases of Oil seed crops. • Collection and dry preservation of diseased specimens of important Oilseed crops.	Unit 3. Diseases of Oilseed crops- and mustard, sesame, linseed, sunflower, groundnut, castor. 3.1,3.2,3.3,3.4,3.5,3.6	1: Collection and Preservation of various oil seed crop disease specimen.
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO: 4** Diseases of cash crops	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	• Determination and confirmation of symptoms according to their cause • Detailed study of symptoms and host parasite relationship of important diseases of Cash crops and fodder crops • Collection and dry preservation of diseased specimens of important Cash crops and fodder crops	Unit 4: Diseases of Cash crops- Cotton, sugarcane, Diseases of Fodder legume crops- Berseem, oats, guar, Lucerne. 4.1,4.2,4.3,4.4,4.5,4.6	1.List of safe pesticides for the control of fodder crops
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO: 5** Diseases of medicinal crops	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5	• Determination and confirmation of symptoms according to their cause • Detailed study of symptoms and host parasite relationship of important diseases of Cash crops and fodder crops • Collection and dry preservation of diseased specimens of important Cash crops and fodder crops	Unit 5: Medicinal crops- Plantago, liquorices, mulathi, rosagrass, sacred basil, mentha, ashwagandha, Aloe Vera 5.1,5.2,5.3,5.4,5.5,5.6	1. Collection and Preservation of various medicinal plant disease specimens.

Course Code: PL PATH-516
Course Title: Diseases of Fruits, Plantation and Ornamental Crops
Pre-requisite: Student should have basic knowledge of fundamentals of plant pathology
Rationale: Diseases of crops are caused by different microorganism studied in plant pathology. Therefore, it is the integral part of plant pathology
Aim of the course: To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.
Course Outcomes: Upon successful completion of the course a student will be able to:

PL PATH516.1: Diagnose various plant diseases with their life-cycles.
PL PATH516.2: Determine the relationship between pathogens, host and environment
PL PATH516.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices
PL PATH516.4: Develop integrated disease management models/strategies for particular crop.
PL PATH516.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection.

Category of course	Course Code	Course Title	Scheme of studies (Hours/ Week)					Total Credits
Major	PL PATH-516	Diseases of Fruits, Plantation and Ornamental Crops	CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
			2	2	1	1	6	3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial(T) And others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 markseach (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
Major	PL PATH-516	Diseases of Fruits, Plantation and Ornamental Crops						50	50	100

Course Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom

Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH516.1. Identify various plant diseases with their causal etiology and life-cycles.

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1: Understand the Nature, prevalence, factors affecting disease development of fruit and plantation crops **SO1.2:** Identify and diagnose the diseases of fruit and plantation crops **SO1.3:** Choose the suitable management practices to control fruit and plantation crops **SO1.4:** Select the suitable management practices to control fruit and plantation crops **SO1.5:** Integrate the suitable and sustainable management practices to avoid fruit and plantation crops diseases.	• Isolation and purification of pathogens of temperate fruit plants • Histo-pathological studies of host-parasite interaction • Study of Symptoms of temperate fruit plant diseases	**Unit 1:** Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, 1.1: Symptoms, etiology Factors affecting disease development and disease management of apple, 1.2: Symptoms, etiology Factors affecting disease development and management of Pear 1.3: Symptoms, etiology Factors affecting disease development and management of Peach 1.4: Symptoms, etiology Factors affecting disease development and management of Plum 1.5: Symptoms, etiology Factors affecting disease development and management of Apricot 1.6: Symptoms, etiology Factors affecting disease development and management of Cherry and walnut	1: Collection and dry preservation of diseased specimens of important crops.

SW-1 Suggested Sessional Work (SW):

Assignment: Etiology and management of temperate fruit plant diseases

PL PATH 516.2: Determine the relationship between disease pathogens and environment

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1: Understand the Nature, prevalence, factors affecting disease development of fruit and plantation crops **SO2.2:** Identify and diagnose the diseases of fruit and plantation crops **SO2.3:** Choose the suitable management practices to control fruit and plantation crops **SO2.4:** Select the suitable management practices to control fruit and plantation crops **SO2.5:** Integrate the suitable and sustainable management practices diseases management	• Isolation and purification of pathogens fruit plants • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of tropical fruit crop diseases	**Unit 2.** Symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like almond, strawberry, citrus, mango, grapes, guava, ber 2.1: Symptoms, etiology Factors affecting disease development and management of almond 2.2: Symptoms, etiology Factors affecting disease development and management of Strawberry 2.3: Symptoms, etiology Factors affecting disease development and management of Citrus 2.4: Symptoms, etiology Factors affecting disease development and management of Mango 2.5: Symptoms, etiology Factors affecting disease development and management of Grapes 2.6: Symptoms, etiology Factors affecting disease development and management of Guava and Ber	1: Collection and dry preservation of diseased specimens of important crops.

SW-1: Suggested Sessional Work (SW):

Assignments:

PL PATH 516.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1: Understand the Nature, prevalence, factors affecting disease development of fruit and plantation crops **SO3.2:** Identify and diagnose the diseases of fruit and plantation crops **SO3.3:** Choose the suitable management practices to control fruit and plantation crops	• Isolation and purification of pathogens of sub- tropical fruit crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of sub- tropical	**Unit 3**. Symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like banana, pineapple, papaya, fig, pomegranate, date palm, custard apple 3.1. Symptoms, etiology Factors affecting disease development and management of Banana 3.2: Symptoms, etiology Factors affecting disease development and management of Pineapple 3.3: Symptoms and management of diseases of bulb crops	1: Collection and dry preservation of diseased specimens of important crops.

SO3.4: Select the suitable management practices to control fruit and plantation crops **SO3.5:** Integrate the suitable and sustainable management practices to avoid fruit and plantation crops diseases.	fruit crops fruit crop diseases	3.4: Symptoms, etiology Factors affecting disease development and management of Papaya and Fig 3.5: Symptoms, etiology Factors affecting disease development and management of Pomegranate 3.6 Symptoms, etiology Factors affecting disease development and management of date palm and custard apple	

SW-1: Suggested Sessional Work (SW):
Assignments: Causal organisms and symptoms of sub-tropical fruit plant diseases.

PL PATH 516.4: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO4.1: Understand the Nature, prevalence, factors affecting disease development of plantation crops **SO4.2:** Identify and diagnose the diseases of plantation crops **SO4.3:** Choose the suitable management practices to control of plantation crops diseases **SO4.4:** Select the suitable management practices to control of plantation crops diseases **SO4.5:** Integrate the suitable and sustainable management practices to avoid plantation crops diseases.	• Isolation and purification of pathogens of fruit and plantation crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of fruit and plantation crops diseases	**Unit 4.** Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, Rubber and coconut and their management. 4.1. Symptoms, etiology mode of perpetuation and management of Tea diseases 4.2: Symptoms, etiology mode of perpetuation and management of Coffee diseases 4.3: Symptoms, etiology mode of perpetuation and management of Rubber diseases 4.4: Symptoms, etiology mode of perpetuation and management of Coconut diseases	1: Collection and dry preservation of diseased specimens of important crops.

SW-1: Suggested Sessional Work (SW):
Assignments: Collection and dry preservation of diseased specimens of important crops.

PL PATH 516.5: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices

Approximate Hours

Item	Approx. Hrs
Cl	06
LI	06
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO5.1: Understand the Nature, prevalence, factors affecting disease development of ornamental plants **SO5.2:** Identify and diagnose the diseases of fruit and plantation crops **SO5.3:** Choose the suitable management practices to control ornamental plants **SO5.4:** Select the suitable management practices to control ornamental plants **SO5.5:** Integrate the suitable and sustainable management practices to avoid ornamental plants diseases.	• Isolation and purification of pathogens of fruit and plantation crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of fruit and plantation crops diseases	**Unit 5**. 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. 5.1. Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Roses 5.2 Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Gladiolus 5.3: Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Tulip 5.4: Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Carnation 5.5: Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Gerbera orchids 5.6: Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Marigold 5.7: Symptoms, life cycle of pathogen, Factors affecting disease development and management of diseases of Chrysanthemum	1: Collection and dry preservation of diseased specimens of important crops.

SW-1: Suggested Sessional Work (SW):
Assignments: **Life-cycle, etiology and management of ornamental crop diseases**
Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+ Sl)
PLPATH 516: Diagnose various plant diseases with their life-cycles.	7	6	1	1	15

PL PATH516.2: Determine the relationship between pathogens, host and environment	6	6	1	1	14
PL PATH516.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices	6	6	1	1	14
PL PATH516.4: Develop integrated disease management models/strategies for particular crop.	4	6	1	1	12
PL PATH516.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection.	7	6	1	1	15
Total Hours	30	30	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit title	Marks distribution			Total mark
		R	U	A	
CO-1	Diseases of tropical fruit plants	3	3	4	10
CO-2	Diseases of tropical fruit plants	3	3	4	10
CO-3	Diseases of sub-tropical fruit plants	3	3	4	10
CO-4	Diseases of plantation crops	3	3	4	10
CO-5	Diseases of ornamental crops	3	3	4	10
Total		15	15	20	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with writtenexamination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Visit to cement plant
4. Demonstration
5. Brainstorming

Suggested Learning Resources: (a) Books:

S.No.	Title	Author(s)	Publisher	Edition & Year
1	Diseases of Fruit Crops	Gupta VK and Sharma SK	Kalyani Publishers, New Delhi	2000
2	Diseases of Fruit Crops	Pathak VN	Oxford & IBH, New Delhi.	1980
3	Diseases of Fruit Crops	Singh RS	Oxford & IBH, New Delhi	2000
4	Diseases of Vegetable Crops	Walker JC.	TTPP, India.	2004
5	Agrios Plant Pathology	Richard Oliver	Academic Press, New York.	2023 6th Ed.

Cos, POs and PSOs Mapping

Course: Diseases of Fruits, Plantation and Ornamental Crops

Course Code: PL PATH-516

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO:1 Diagnose various plant diseases with their life-cycles.	2	2	3	2	3	2	1	2	3	3	3	2	1	2
CO.2: Determine the relationship between pathogens, host and environment	3	3	1	2	2	2	1	1	3	2	3	2	2	2
CO.3: Minimize the quantitative, qualitative and esthetic losses caused by diseases through suitable management practices	2	3	2	1	2	3	1	2	3	2	3	2	3	3
CO.4: Develop integrated disease management models/strategies for particular crop.	3	3	3	1	3	3	2	1	2	2	3	2	3	2
CO.5: Apply professional solution and demonstrate the knowledge & need for sustainable crop protection.	3	2	2	3	3	3	2	2	3	3	3	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO.1 Diseases of tropical fruit plants	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	• Isolation and purification of pathogens of temperate fruit plants • Histo-pathological studies of host-parasite interaction • Study of Symptoms of temperate fruit plant diseases	Unit 1: Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, 1.1,1.2,1.3,1.4,1.5,1.6	1: Collection and preservation of diseased specimens of important crops.
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO.2 Diseases of tropical fruit plants	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	• Isolation and purification of pathogens fruit plants • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of tropical fruit crop diseases	Unit 2. Symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like almond, strawberry, citrus, mango, grapes, guava, ber 2.1,2.2,2.3,2.4,2.5,2.6	1: Collection and preservation of various fruit disease specimens
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO.3 Diseases of sub-tropical fruit plants	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO 3.5	• Isolation and purification of pathogens of sub-tropical fruit crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of sub- tropical fruit crops fruit crop diseases	Unit 3. Symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like banana, pineapple, papaya, fig, pomegranate, date palm, custard apple 3.1,3.2,3.3,3.4,3.5,3.6	1: Collection and dry preservation of diseased specimens of important crops.
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO.4 Diseases of plantation crops	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	• Isolation and purification of pathogens of fruit and plantation crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of fruit and plantation crops diseases	Unit 4: Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, Rubber and coconut and their management. 4.1,4.2,4.3,4.4	1. Collection and dry preservation of diseased specimens of important crops.
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO.5 Diseases of ornamental crops	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5	• Isolation and purification of pathogens of fruit and plantation crops • Histo-pathological studies of host-parasite interaction • Studies of Symptoms of fruit and plantation crops diseases	Unit 5: 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. 5.1,5.2,5.3,5.4,5.5,5.6,5.7	1. Collection and dry preservation of diseased specimens of important crops.

Course Code: PGS 505

Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Pre requisite: -Student should have basic knowledge of agricultural research, research ethics, and agricultural history along with fellowship program, rural development programme.

Rationale: - The students studying agricultural research and research ethics should possess understanding about method of research application, research ethics and fellowship for research and other scholars in construction agricultural development. This encompasses familiarity with the invention and evolution of agricultural research and development of agricultural programme, students ought to acquire fundamental insights into various agricultural technologies, their applications, as well as the Indian needs in agricultural developments.

Course Outcomes:

PGS 505 CO 1: Identify the history, levels of research, economic and social welfare through research programme.

PGS 505 CO 2: Apply the functioning, role and significant of regional, national and international research.

PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.

PGS 505 CO 4**:** Analyze the various development programmes and their functioning with its impact on agricultural development

PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Scheme of studies

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			C l	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Common	**PGS 505**	Agricultural Research, Research Ethics and Rural Development Programmes	01	00	02	01	04	01

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		

Common	**PGS 505**	Agricultural Research, Research Ethics and Rural Development Programmes	15	30	00	00	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 505 CO-1 Identify the history, levels of research, economic and social welfare through research programme

Approximate Hours

Item	AppX Hrs
C l	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self - Learning (SL)
SO1.1- Introduce about the history of agriculture in brief **SO1.2** - Brief the basic concept global agricultural research system. **SO1.3 - Discuss** about the need, scope, opportunities; Role in promoting food security of global agricultural research system. **SO1.4-** Describes the reducing poverty and protecting the environment through global agricultural research system **SO1.5** Asses the functions and use of national Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions.		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; **1.1-** History of agriculture in brief **1.2-** Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment **1.3-** National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions	**1.1-** Prepare the assignment on Global agricultural research system

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Global agricultural research system

b. Mini Project: -

c. Other Activities (Specify): -

PGS 505 CO 2: Apply the functioning, role and significant of regional, national and international research.

Approximate Hours

Item	AppX Hrs
C l	3
LI	0
SW	1
SL	2
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO2.1 – introduce to the Consultative Group on International Agricultural Research (CGIAR) **SO2.2 –** learned about the International Agricultural Research Centers (IARC), **SO2.3-** Briefing the partnership with NARS, role as a partner in the global agricultural research system **SO2.4-** Briefing the strengthening capacities at national levels; International fellowships for scientific mobility **SO 2.5–**Discuss to the strengthening capacities at regional levels; International fellowships for scientific mobility	**LE2.1**	Unit-II 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 **2.1 -** Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC) **2.2-** Partnership with NARS, role as a partner in the global agricultural research system. **2.3-,** Strengthening capacities at national and regional levels; International fellowships for scientific mobility.	**2.1 –** Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system.

b. Mini Project:

c. Other Activities (Specify):

PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.

Approximate Hours

Item	AppX Hrs
C l	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO3.1 – Identify to the Research ethics **SO3.2 –** Discuss to the research integrity, research safety in laboratories **SO3.3-** Apply the welfare of animals used in research **SO3.4-** Discuss to computer ethics and standards **SO3.5**–Describe the problems in research ethics	**LE3.1**	**Unit-3** Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics **3.1-**Research ethic and research integrity **3.2-** Research safety in laboratories, welfare of animals used in research. **3.3-** Computer ethics, standards and problems in research ethics.	**3.1** Prepare the assignment on Research ethic and research integrity.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Research ethic and research integrity

b. Mini Project:

c. Other Activities (Specify):

PGS 505 CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development

Approximate Hours

Item	App X Hrs
Cl	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 –Identify the Concept and connotations of rural development. **SO1.2 -** Apply the rural development policies and strategies **SO1.3-** Asses the Rural development programmes: Community Development Programme, Intensive Agricultural District Programme. **SO1.4-** Describes the Special group – Area Specific Programme. **SO1.5**– Brief the Integrated Rural Development Programme (IRDP)	**LE1.1 -**	Unit-4.0 - I 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) 4.1- Concept and connotations of rural development, rural development policies and strategies 4.2- Rural development programmes: Community Development Programme, Intensive Agricultural District Programme 4.3- Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP)	**1.1-** Prepare the assignment on Community Development Programme.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Community Development Programme

b. Mini Project: Prepare a project report of leadership styles and influence process; leadership theories, leadership styles and effective leader

c. Other Activities (Specify):

PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	00
SW	02
SL	02
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 –Indentify Panchayati Raj Institutions and Co-operatives. **SO1.2-** Identify the Voluntary Agencies **SO1.3-** Identify the Non-Governmental Organisations **SO1.4-** Discuss the Critical evaluation of rural development policies **SO1.5-** Briefs the programmes. Constraints in implementation of rural policies and programmes	**LE1.**	**Unit-5.0** 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 **5.1-** Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations **5.2-** Critical evaluation of rural development policies and programmes **5.3-** Constraints in implementation of rural policies and programmes	**1 -** Panchayati Raj institutions

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Panchayati Raj Institutions,

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (L I)	Sessional Work (SW)	Self - Learning (S l)	Total hour (C l + LI+ SW +S l)
CO-1 Identify the history, levels of research, economic and social welfare through research programme	3	0	2	1	06
CO 2: Apply the functioning, role and significant of regional, national and international research.	3	0	2	1	06
CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.	3	0	2	1	06

CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development	3	0	2	1	06
CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	3	0	2	1	06
Total Hours	**15**	**00**	**10**	**05**	**30**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title	Marks Distribution			Total Marks
		R	U	A	
CO-1	Identify the history, levels of research, economic and social welfare through research programme.	02	03	00	05
CO-2	Apply the functioning, role and significant of regional, national and international research.	02	05	03	10
CO-3	Asses the agricultural research, research ethics with operating and safety of laboratory.	00	08	07	15
CO-4	Analyze the various development programmes and their functioning with its impact on agricultural development.	02	05	08	15
CO-5	Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program	00	03	02	05
	Total	06	24	20	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Case Method
3. Group Discussion
4. Role Play
5. Visit to Industry
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/ Whatsapp, Mobile, Online sources)
8. Brainstorming

Cos, POs and PSOs Mapping

Course: Agricultural Research, Research Ethics and Rural Development Programmes

Course Code: PGS 505

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO-1 Identify the history, levels of research, economic and social welfare through research programme	3	3	2	2	3	3	3	2	3	3	3	3	2	3
CO 2: Apply the functioning, role and significant of regional, national and international research.	2	3	3	2	3	3	3	2	3	3	3	2	3	2
CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.	1	1	1	1	3	3	1	1	3	2	3	2	2	1
CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development	1	1	2	1	1	2	2	2	2	2	3	1	2	2
CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	2	2	3	2	1	3	1	2	2	1	2	2	1	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO1: History of agriculture in brief	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit1: 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; 1.1,1.2,1.3	1Global agricultural research system
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO2: Consultative Group on International Agricultural Research (CGIAR)	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit 2: 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 2.1,2.2,2.3	1 partnership with NARS, role as a partner in the global agricultural research system
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO3: Research ethics	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit 3: Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics 3.1,3.2,3.3,3	1 Research ethic and research integrity
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	CO4: Concept and connotations of rural development, rural development policies and strategies	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		**Unit 4:** 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) 4.1,4.2,4.3	1. Community Development Programmes
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO5:** Panchayati Raj institutions	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		**Unit 5:** 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 5.1,5.2,5.3	1. Panchayati Raj institutions

Course Code: PL PATH 591

Course Title: Master's Seminar

Pre- requisite: Students should have knowledge topic selection and prepare it for presentation

Rationale: Student will become familiar with fundamental application of ICT technologies that will support them in their career and leadership development

Course Outcomes:

PL PATH 591.1. Design professional orientation on the topic with their choice of interest which will helps in development of academic and social leadership.

Scheme of Studies:

Category of course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
	PL PATH 591	**Master Seminar**	0	2	1	1	4	(0+1) = 1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Category of course	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number3 marks each (CA)	Class Test 2(2 best out of) 10 marks each (CT)	Seminar one	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA + CAT+AT)		
	PL PATH 591	Master Seminar							100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should show case their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PL PATH 591.1. Design professional orientation on the topic with their choice of interest which will helps in development of academic and social leadership.

Approximate Hours

Item	Approx. Hrs
CI	0
LI	30
SW	0
SL	2
Total	32

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 The research seminar allows students to work with ICT technologies in Vegetable Science. **SO1.2.** Research seminar helps the students to refine their skills and knowledge of the subject. **SO1.3.** Research seminar develop vocational qualities in students.	**1.** Selection of topic and collection of presentation materials by using the ICT tools related to the vegetable science on selected topic. **2.** Presentation of acquired material in PPT form.		**2.**Preparation of PPT related to concerned topic.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
PL PATH 591.1. Design professional orientation on the topic with their choice of interest which will helps in development of academic and social leadership	**30**	**0**	**2**	**32**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	Design professional orientation on the topic with their choice of interest which will helps in development of academic and social leadership	**20**	**40**	**40**	**100**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Master Seminar** will be 100 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Group Discussion
3. Demonstration
4. ICT Based Teaching Learning (Video Demonstration, Whatsapp, Mobile, Online sources)
5. Brainstorming
6. Smart board

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			
8	As per directions of course instructor.			

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3. Dr. Abhishek Singh, HOD, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
4. Dr. Bharti Sao, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
5. Dr. Mohni Parmar, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
6. Dr. S. K. Chandel, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.

Cos, POs and PSOs Mapping

Course: Master's Seminar

Course Code: PL PATH 591

Course Outcomes	Program Outcome										Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
	Agriculture knowledge	Problem analysis	Design /development of solutions	Conduct investigations of complex problems	Modern tool usage	Plant pathologist& society	Environment & sustainability	Ethics	Individual & team work:	Communication	Create capability of disease diagnosis and understand life-cycles of plant diseases	Execute management of plant diseases with an integrated approach	Disseminate modern plant protection technology in the society	Modify phytosanitary precautions between the society
CO1: Design professional orientation on the topic with their choice of interest which will helps in development of academic and social leadership	**2**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	**3**	**3**	**1**	**1**	**0**	**0**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
POs 1,2,3,4,5,6,7, 8,9,10 PSOs 1,2,3,4	**CO1:** Presentation methods	SO 1.1 SO 1.2 SO 1.3	• Selection of topic and collection of presentation materials by using the ICT tools related to the vegetable science on selected topic. • Presentation of acquired material in PPT form.		