



Syllabus

A.1. Research Methodology (PHDAS 101)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA101	Research Methodology	60	00	40	0	0	3	0	3

1. **Legends:** L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A1. Research Methodology (PHDAS 101)

Module 1: Introduction to Research Methods: Role and objectives of research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design. Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Numerical Methods and Statistical Analysis Curve fitting (least square), solution of polynomial equation, numerical integration (Trapezoidal rule, Simpson's rule, Gaussian quadrature), solution of ordinary differential equations (Euler's method, Runge-Kutta method, predictor-corrector method), matrix multiplication, inversion and diagonalisation.

References

- Kumar, R.(2006).**Research Methodology-A Step- By- Step Guide for Beginners**, Delhi: Pearson Education.
- Montgomery, D. C. (2007).**Design & Analysis of Experiments**. India: Wiley.
- Kothari, C. R. (2004). **Research Methodology: Methods and Techniques**. New Delhi: New Age International.

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A.2.Review of Literature (PHDA 102)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA102	Review of Literature	60	-	40	0	0	2	0	2

1. **Legends:** L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.2.Review of Literature (PHDA102)

Course Overview: *The objective of this course is to help the candidate to comprehend his/her broad field of research and be academically sound to carry out his research work. Understand the basic philosophical assumptions underlying research literature reviews for different purposes, including what, why, when, for whom, and how? Be able to manage the process of conducting a literature review, including reading, note taking strategies, coding/reference management, synthesizing and writing literature results. Be able to write a quality literature review with variations in references*

Course Content

Module 1: Understanding Review of literature: Relevance, Approach and Applications; Developing an outline for the literature review; Formulate key questions for a review. Organizing a literature search: Identify which literature bases to search; Developing the theoretical basis for the Research Question; Searching for, locating and organizing relevant professional literature

Module 2: Conducting the Review: Abstract relevant information from appropriate studies in a systematic manner; critically reviewing the literature; Rate the scientific quality of each study and the level of evidence for each question;

Module 3: Synthesizing the Review: Create evidence tables and summary tables; interpret the pattern of evidence in terms of strength and consistency; Summarize the studies' findings. Writing the review: Writing a first draft; Writing references and citations; Obtaining, giving, and making productive use of feedback; the redrafting process; Professional formatting.

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A.3.Computer Applications (PHDA 103)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA103	Computer Applications	60	-	40	0	0	2	0	2

1. **Legends:** L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Course Overview: *The candidate should gain sufficient practical knowledge for use of computer and computer software for use in research work.*

Contents

Module 1: Basic knowledge of application software's in MS- Office with focus on MS-Word- its features and applications related to presentation of text in decent format and saving the same for further use. The practical knowledge of this software should enable the candidate to type and prepare the thesis in a presentable format. MS-Excel- construction of worksheet and inserting data according to its characteristics, use of statistical tools and their presentation in the form of charts and graphs.

Module 2: Use of Internet for research work and exploring various websites and search engines for collecting quality literature review and secondary data etc. related to thesis work.

Module 3: MS- Power point – create power point presentation on a topic related to the theme of thesis and use of different presentation techniques. Use of SPSS – method of preparing data sheet and entering data according to its characteristics , use of various statistical tools on SPSS.

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A.4. Research and Publication Ethics (RPE) (PHDA 104)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA104	Research and Publication Ethics	60	-	40	0	0	2	0	2

1. **Legends:** L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.4. Research and Publication Ethics (RPE) (PHDA 104)

Module 1: Philosophy And Ethics-Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions. **Scientific Conduct**- Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data

Module 2: Publication Ethics-Publication ethics: Definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest.

Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.

Open Access Publishing- Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Module 3: Publication Misconduct, Group Discussions-Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools- Use of plagiarism software like **Tumitin, Urkund And Other Open Source Software Tools. Data Bases And Research Metrics**, Databases- Indexing databases Citation databases: Web of Science, Scopus, etc. Research Metrics- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altmetrics.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDPLPATH601	Advances in Mycology	60	00	40	30	20	2	1	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To acquaint with the advances in mycology

Theory

Unit I

General introduction, historical development and advances in mycology. Recent taxonomic criteria, morphological criteria for classification. Serological, chemical (chemotaxonomy), molecular and numerical (computer based assessment) taxonomy.

Unit II

Interaction between groups: Phylogeny, Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti.

Unit III

Population biology, pathogenic variability/ vegetative compatibility. Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation.

Unit IV

Ultra structures and chemical constituents of fungal cells, functions of cell organelles. Mitosis, meiosis, gene action and regulation. Effects of fungal interaction with host plants and other microorganisms; parasitism, symbiosis and commensalism.

Unit V

Genetic Improvement of Fungal strains. Fungal biotechnology. Fungi mediated synthesis of nano particles – characterization process and application. Mycotoxins problems and its management.

Practical

- Isolation, purification and identification of cultures, spores and mating typen determination;
- Study of conidiogenesis-Phialides, porospores, arthospores;
- Study of fruiting bodies in Ascomycotina;
- Identification of fungi up to species level;
- Study of hyphal anastomosis;
- Morphology of representative plant pathogenic genera form different groups of fungi;
- Molecular characterization of fungi.

Suggested Reading



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- Alexopoulos CJ, Mims CW and Blackwell M. 1996. Introductory Mycology. John Wiley & Sons, New York.
- Restructured and Revised Syllabi of Post-graduate Programmes Vol. 1 236
- Dube HC. 2005. An Introduction to Fungi. 3rd Ed. Vikas Publ. House, New Delhi.
- Kirk PM, Cannon PF, David JC and Stalpers JA. (Eds.). 2001. Ainsworth and Bisby's Dictionary of Fungi. 9th Ed., CABI, Wallington.
- Maheshwari R. 2016. Fungi: Experimental Methods in Biology 2nd edn. CRC Press, US.
- Ulloa M and Hanlin RT. 2000. Illustrated Dictionary of Mycology. APS, St. Paul, Minnesota.
- Webster J and Weber R. 2007. Introduction to Fungi. Cambridge University Press, Cambridge.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDPLPATH602	Advances in Plant Virology	60	00	40	30	20	2	1	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

To educate about the advanced techniques and new developments in plant virology.

Theory

Unit I

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological effects in infected plant cells. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination, pseudo recombination, component re-assortment, etc.

Unit II

Major vector groups of plant viruses and their taxonomy, virus-vector relationship, molecular mechanism of virus transmission by vectors. Terminologies used in immunology and serology. Classification, structure and functions of various domains of Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detection of viruses. Immuno/ serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses.

Unit III

Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/ q PCR) and non PCR based: LAMP, Fluorescent in situ hybridization (FISH), dot blot hybridization.

Unit IV

Plant virus genome organization (General properties of plant viral genome- information content, coding and noncoding regions), replication, transcription and translational strategies of pararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses, satellite viruses and satellite RNA. Gene expression, regulation and viral promoters. Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants.

Unit V

Techniques and application of tissue culture for production of virus free planting materials. Phylogenetic grouping system based on partial/ complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

Practical

- Purification of viruses, SDS-PAGE for molecular weight determination, production of polyclonal antiserum,



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purification of IgG and conjugate preparation;

- Acquaintance with different serological techniques (i) DAC- ELISA (ii) DAS-ELISA (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA. Nucleic acid isolation, DOT-blot, southern hybridization, probe preparation, and autoradiography;
- PCR application and viral genome cloning of PCR products, plasmid purification, enzyme digestion, sequencing, annotation of genes, analysis of viral sequences (use of gene bank, blast of viral sequences and phylogeny);
- Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology, BLAST, Clustal X/W, Tm pred and Phylogeny programs).

Suggested Reading

Davies 1997. Molecular Plant Virology: Replication and Gene Expression. CRC Press, Florida.

Fauquet et al. 2005. Virus Taxonomy. VIII Report of ICTV. Academic Press, New York.

Gibbs A and Harrison B. 1976. Plant Virology – The Principles. Edward Arnold, London.

Jones P, Jones PG and Sutton JM. 1997. Plant Molecular Biology: Essential Techniques. John Wiley & Sons, New York.

Khan J A and Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Howarth Press, New York.

Maramorosch K, Murphy FA and Shatkin AJ. 1996. Advances in Virus Research. Vol. 46. Academic Press, New York.

Pirone TP and Shaw JG. 1990. Viral Genes and Plant Pathogenesis. Springer Verlag, New York.

Roger Hull. 2002. Mathew's Plant Virology (4th Ed.). Academic Press, New York.

Thresh JM. 2006. Advances in Virus Research. Academic Press, New York.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDPLPATH605	Principles and Procedure of Certification	60	00	40	00	00	1	0	1

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

To acquaint with the certification procedures of seed and planting material.

Theory

Unit I

Introduction to certification. International scenario of certification and role of ISTA, EPPO, OECD, etc. in certification and quality control.

Unit II

Case studies of certification systems of USA and Europe. National Regulatory mechanism and certification system including seed certification, minimum seed certification standards.

Unit III

National status of seed health in seed certification. Methods for testing genetic identity, physical purity, germination percentage, seed health, etc.

Unit IV

Fixing tolerance limits for diseases and insect pests in certification and quality control programmes. Methods used in certification of seeds, vegetative propagules and in-vitro cultures.

Unit V

Accreditation of seed testing laboratories. Role of seed/ planting material health certification in national and international trade.

Suggesting Reading

- Association of Official Seed Certifying Agencies. Hutchins D and Reeves JE. (Eds.). 1997.
- Seed Health Testing: Progress Towards the 21st Century. CABI, UK. ISHI-veg Manual of Seed
- Health Testing Methods.
- ISHI-F Manual of Seed Health Testing Methods.
- ISTA Seed Health Testing Methods.
- Tunwar NS and Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed
- Certification Board, Department of Agriculture and Cooperation, Ministry of Agriculture,
- Government of India, New Delhi. US National Seed Health System.



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- e-Resources
- <http://www.aosca.org/index.htm>.
- http://www.worldseed.org/enus/international_seed/ishi_vegetable.html
- http://www.worldseed.org/en-us/international_seed/ishi_f.html
- <http://www.seedtest.org/en/content—1—1132—241.html>
- <http://www.seedhealth.org>

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total	
PHDSTAT521	Applied Regression Analysis	60	00	40	30	20	2	1	3	

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

This course is meant for students of all disciplines including agricultural and animal sciences. The students would be exposed to the concepts of correlation and regression. Emphasis will be laid on diagnostic measures such as autocorrelation, multi collinearity and heteroscedasticity. This course would prepare students to handle their data for analysis and interpretation.

Theory

Unit I

Introduction to correlation analysis and its measures, Correlation from grouped data, correlation, Rank correlation, Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.

Unit II

Problem of correlated errors; Auto correlation; Heteroscedastic models, Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multi collinearity,

Unit-III

Regression analysis; Method of least squares for curve fitting; Testing of regression coefficients; Multiple and partial regressions.

Unit IV

Diagnostic of multiple regression equation; Concept of weighted least squares; regression equation on grouped data; Various methods of selecting the best regression equation.

Unit V

Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial.

Practical

- Correlation coefficient, various types of correlation coefficients, partial and multiple, testing of hypotheses;
- Multiple linear regression analysis, partial regression coefficients, testing of hypotheses, residuals and their applications in outlier detection;
- Handling of correlated errors, multi collinearity; • Fitting of quadratic, exponential and power curves, fitting of orthogonal polynomials.

Suggested Reading



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

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