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Item No. _____

UNIVERSITY OF MUMBAI



Program: Ph.D.

Course: Life Sciences

Syllabus for Ph.D. course work

(with effect from the academic year: 2021 - 2022)

Preamble:

The syllabus for the PhD course work has been refined in accordance to the UGC Regulations (Minimum Standards and Procedure for the Award of M. Phil and Ph. D degrees) published in the Gazette of India on 5th July 2016 and the subsequent VCD - No. Exam./ Thesis/ Univ./VCD947 of 2018.

It can be appreciated that the learner would now move from the comfort zone of the known to an exploration of the discipline at its limits. A comprehensive literature review would allow the learner to articulate the current knowledge and detect the lacunae therein.

This syllabus endeavours to sensitize the learner to the importance of a focused study, formulation of queries, and design of unbiased experimental sets that would lead to an efficient and economical investigation.

It also retains the scope to enhance the skill sets required to execute the experimental programmes. The courses in GLP, Ethics, and plagiarism have been visualized to encourage the learner to practice methods that would eventually deliver reliable results gleaned ethically.

The programme aims to train the young researcher to analyze and interpret the results obtained considering the variations expected in a biological system using bio-statistical methods, reducing the tedium with the correct application of computer based tools and techniques.

The programme also endeavours to impart communication skills and inspire an entrepreneurial attitude firmly based on sound scientific facts, upheld by ethics and values of society.

Programme Outcomes:

The learner would be able to:

1. Identify areas of research that could be addressed and formulate research questions.
2. Hypothesize and design experiments
3. Develop sustainable, robust and ethical protocols or methodology to test and validate the results.
4. Organize information and write a thesis, reports, articles and apply for grants.
5. Present, communicate and publish research findings effectively.

SYLLABUS

COURSE NO.	TOPIC	CREDITS	L/wk
PhD101	Research Methodology	4	4
	Introduction to research and Design		
	Data Collection and Analysis		
	Testing of hypothesis I		
	Testing of hypothesis II		
PhD102	Scientific Communication and GLP	4	4
	Writing and communication		
	Ethics in Research and IPR		
	GLP, Legal and Safety aspects		
	Coursework/ Workshops/ Conferences		
PhD103	Seminar/ Presentation	4	4

Paper I: Research Methodology (Credits: 4)

Course Outcome:

The learner would be able to:

1. Hypothesize and develop non-biased methodology to test the hypotheses.
2. Organize and analyse the data integrating computer tools and techniques.

Unit 1: Introduction to research and Design (15 L)

Introduction: Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India

Types of Research: Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual and Empirical.

Defining the Research Problem: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.

Unit 2: Data collection and analysis (15 L)

1. Methods of Data collection and Sampling Techniques:

Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe, Complex Random Sampling Designs Conclusion

Analysis and Interpretation of Data: Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques.

Processing and Analysis of Data: Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation.

Unit 3: Testing Hypothesis I (15 L)

Testing of Hypotheses: What is a Hypothesis? Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing Flow Diagram for Hypothesis Testing, Measuring

the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means, Hypothesis Testing for Differences between Means, Hypothesis Testing for Comparing Two Related Samples, Hypothesis Testing of proportions, Hypothesis Testing for Difference between Proportions, Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance, Testing the Equality of Variances of Two Normal Populations, Hypothesis Testing of Correlation Coefficients, Limitations of the Tests of Hypotheses.

Analysis of Variance and Covariance: Analysis of Variance (ANOVA), what is ANOVA? The Basic Principle of ANOVA, ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA , ANOVA in Latin-Square Design, Analysis of Co-variance (ANOCOVA), ANOCOVA Technique, Assumptions in ANOCOVA.

Unit 4: Testing Hypothesis II (15 L)

Testing of Hypotheses-II: (Nonparametric or Distribution-free Tests) Important Nonparametric or Distribution-free Test. Characteristics of Distribution-free or Non-parametric Tests. Chi square as a non-parametric test.

Multivariate Analysis Techniques: Growth of Multivariate Techniques. Characteristics and Applications. Classification of Multivariate Techniques. Variables in Multivariate Analysis.

Role of computers in research: Importance of computer in research, Design and Planning Phase: Designing of questionnaires, sample size, planning for pilot study. Data Analysis and Computer: Data analysis and interpretation- softwares like EXCEL, SPSS, STATA, R programme, etc. Research Dissemination: converting the results into a research article or report

References:

1. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Gupta S.P. (2008). Statistical Methods. 37 th ed. (Rev)Sultan Chand and Sons. New Delhi.
5. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.
6. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education.
7. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH)
8. Zar, J.H, 2010, Biostatistical analysis, Pearson Publications

Paper II: Scientific Communication and GLP. (Credits: 4)

Course Outcome:

The learner would be able to:

1. Write a cogent document for topic approval, synopsis and thesis of the research work.
2. Assess and improve the skills required for the research.
3. Design and execute well planned, sustainable, ethical and legally correct experiments.
4. Prepare a proposal for research grants and apply for patents.
5. Publish and present the generated results in scientific journals and conferences.

Unit 1: Writing and Communication (15 L)

Scientific writing related to Ph. D: Topic approval, reports, synopsis, and thesis writing. The thesis writing shall discuss the following - Structure of Thesis-Title page, Acknowledgement, Table of contents, List of Tables, Figures/Graphs. Introduction, Literature review, Research Materials and Methodology, Observation and Results, Discussion, Summary and Conclusions and Future scope of the same project. Bibliography/ References, Appendices if required and Plagiarism report. To be discussed in accordance to the current presentation of thesis as prescribed by the University Mumbai

Scientific Writing for Publication: Original research article writing, review paper writing, importance of Impact factors, H index and such metrics. Predatory Journals and copy type journals - concept. The formats of citations can be discussed e.g. Vancouver or APA formats.

Writing proposals for Research Funding: Any one of the formats can be discussed such as University of Mumbai Research Grants/ UGC/ DST/ ICMR/ DBT.

Presentation Skills: Introduction and perfecting presentation skills using tools such as - Visme / Haiku Deck / Canva/ Microsoft PowerPoint/ Google slides/ Libre Office.

Unit 2: Ethics in Research and IPR (15 L)

Research ethics: Introduction, Overview, and Research Misconduct, rules and regulations in India.

Mentoring: Mentor-mentee responsibilities: The roles of mentor, the role of mentee.

Regulatory Guidelines for Research in Biology: Regulation for research using animals (CPCSEA.), stem cells (DBT), microorganisms, GMO (Biosafety), plants (National Biodiversity Authority)

IPR: Historical perspective, characteristics and nature. Enforcement and Need for Protecting IPR International Organizations, treaties and conventions – World Intellectual Property Organization (WIPO) – Functions of WIPO – Membership – GATT Agreement – Major Conventions on IP – Berne Convention – Paris Convention – TRIPS agreement and Madrid Agreement

IP laws in India – International treaties signed by India

Forms of IPR: Copyright, Trademark, Patents, Industrial Designs, Trade Secrets, Geographical Indications and applications of different forms of IPR.

Procedure for patent application.

Unit 3: GLP, Legal and Safety aspects (15 L)

A. Introduction: Principle and Purpose of GLP (Standard operating procedures, Calibration of Instruments, Preventive maintenance of instruments), Major requirements - Operations and rules governing the laboratory, Laboratory support staff - their training and work schedule

B. Design of Laboratory Testing & Analysis Procedures: Protocol design and Protocol training, Test items (Control of test items, their specification and characteristics, Justification of the test system, parameters to be measured Test report format & approval), Waste Disposal (Storing, handling and care of biological systems and chemical waste, Waste disposal arrangements with local authorities), Scheduling Laboratory work; Proposed dates for the study - start and finish dates.

C. Requirements of a GLP certified lab: Design requirements, Personnel Requirements, Agencies providing GLP certification, DST enabled GLP certification

D. Good Documentation practice: Documentation format - Project Name, Previous work on project and location of that project information in the laboratory, Funding information, your name and other people working on the project, Protocols and written procedures, Raw data: storage and retention of data and material, documentation and maintenance of records, documentation of repeat analysis, summary of information, archiving and indexing, OOS (Out of Specification), Reporting and Root Cause Analysis (concepts only), Report review, approval and Archive. Laboratory maintenance records.

Unit 4: Course work/ Workshop/ Conference (15 L)

Course work as suggested by the Guide and the RAC (1 Credit)

OR

Attend workshops or conferences in the subject or related to the study, amounting to 1 Credit.

OR

Courses conducted by NPTEL / SWAYAM or any such course recognized by MHRD or UGC covering the syllabus detailed above would be recognized and the credits earned would be added to the credit score of the learner (1 Credit).

References:

IPR

1. Feroz Ali Khader, The Law of Patents-With a Special Focus on Pharmaceuticals in India, LexisNexis, 2nd Edition, 2011
2. Elizabeth Verkey, Law of Patents, Eastern Book Company, 2nd Edition, 2012
2. Richard Miller, Guy Burkill, Hon Judge Birss, Douglas Campbell, Terrell on the Law of Patents, Sweet and Maxwell, 2010
3. Janice M. Mueller, Patent Law, Wolters Kluwer, 2013
4. Martin J. Adelman et al., Patent Law in a Nutshell, West, 2013
5. Amy L. Landers, Understanding Patent Law, Lexis Nexis, 2012
6. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
7. Dr. B.L. Wadhera, Law Relating to Patent, Trademarks, Copyright & Designs
8. P. Narayanan (Eastern Law House), Intellectual Property Law

GLP:

1. GLP: Good Laboratory Practice by Isin Akyar, Acibadem University Faculty of Medicine Department of Medical Microbiology ,Turkey (2011).
2. Training Manual Good Lab Practice (GLP) Trainer WHO, TDR (second edition), (2009).
3. National GLP Compliance Monitoring Authority (NGCMA), Ministry of Science and Technology, Department of Science and Technology, New Delhi in April ,2002

Ethics:

1. ETHICS in Science Education, Research and Governance by Kambadur Muralidhar Amit Ghosh Ashok Kumar Singhvi, (ISBN: 978-81-939482-1-7) , Indian National Science Academy New Delhi, India 2019.
2. Angelina Ambrosetti John Dekkers (2010) ,The Interconnectedness of the Roles of Mentors and Mentees in Pre-service Teacher Education Mentoring Relationships. Australian Journal of Teacher Education Vol 35(6):42-55.
3. Textbook of research ethics by Sana Loue, Publisher Springer US, ISBN 978-1-4757-7317-0 Springer US.

Paper III: Seminar/Presentation: (Credits: 4):

Course Outcome:

The learner would be able to:

1. Collate and review the literature relevant to the research topic
2. Develop soft skills required for an effective presentation.
3. Engage in scientific discussion.

The topic would be decided in consultation with the guide.

It would be related to the thrust areas in the discipline.

The Researcher would use extensive literature survey to grasp the concept and explain to the evaluators.

Overall Assessment of the candidate:

The centre can adopt any one or a combination of the following methods for the assessment of the candidate: Presentations, written tests, assignments, online tests or group discussions. Please refer to point 11 under point 18 (Course work for Ph D) of the VCD: No. Exam/ Thesis/ Univ/ VCD/947 of 2018 to determine the successful completion of the coursework by the candidate.

The course work (Paper II, Unit 4) would be evaluated by the research guide based on the report submitted.

The presentation (Paper III) would be assessed by two faculty of the Department as recommended by the Head of the Department. It would be based on the quality of the review, the relevance to the subject, the understanding of the candidate and the overall presentation.

Each course will be evaluated for a total of 100 marks and the results would be converted to the equivalent grades.