

# **REGULATIONS, SCHEME AND SYLLABUS**

**FOR**

**The Compulsory Course Work in**

**Ph D PROGRAMME**

**AT**

**School of Biosciences**

**MAHATMA GANDHI UNIVERSITY**

**KOTTAYAM, KERALA, INDIA**

**(W.E.F. 2011 ADMISSIONS)**

## REGULATIONS

Each student admitted to Ph D Programme shall be required to undertake course work for a period of one semester within a continuous period of two semesters. The course shall be arranged by or under the supervision of the School of Biosciences in the subjects coming under the purview of Biosciences, Botany, Zoology and Pharmacy. The course work shall be worth 12 credits and shall be as per the following scheme. The pattern of evaluation and grading will be as per the regulations of the Mahathma Gandhi University

## SCHEME OF EXAMINATION

Course	Subject	Credits
Course –I	Research Methodology	<b>4</b>
Course –II	Biological Techniques	<b>4</b>
Course –III	Special Course (A course in the specific area of research which will include detailed review of the current scholarly information in the area of research of each student)	<b>4</b>
Course IV	Research and Publication Ethics (Special Course added in 2020 as per UGC Instruction)	<b>2</b>

Syllabi for Course I & II are given below. Syllabus for the special course (Course –III) for each scholar shall be designed by the doctoral committee in consultation with the supervising teachers.

# Syllabus for Ph D Compulsory Course Work in Ph D Programme

## Course -I: SBS DC IC1701: Research Methodology (4 Credits)

**Unit -1: Science and Research** – definition – history – evolution of scientific inquiry, verification versus falsification – objectivity; facts, theory and concepts - epistemology.

**Goals of research** - characteristics and purpose of research; **Essential qualities of a researcher** – scientific temperament and attitude.

**Methods of research:** scientific method *versus* arbitrary method – requisites for scientific methods. **Logical scientific methods:** deductive method – inductive method – deductive inductive method – patterns of deductive inductive logical process; **Different types of inductive logical methods** – method of causal connections – method of difference – method of concomitant variation – method of residues – method of agreement – joint method of agreement and difference; **Other logical methods** - method of description and classification – evolutionary methods.

**Unit II: Various types of research:** descriptive –analytical –fundamental – applied – qualitative – quantitative – conceptual – empirical – Surveys – longitudinal- cross sectional – correlation- experimental- quasi-experimental- Ex-post facto research - critical and action oriented research - biographical, phenomenological, ethnographical, case studies.

**Data and Method of data collection:** Observations - field investigations – direct studies - reports, records or experimental observations; type of data: categorical – nominal or ordinal, continuous or mixed; primary data – secondary data; limitations and precautions in data collection.

**Steps in doing research:** Review of literature – primary and secondary sources; National institutions useful in search of literature – NISCAIR; Library resources – Journals/periodicals - reviews – abstracts – treatise – monographs – searching of web resources – electronic databases – critical review of literature – identification of research gaps; Defining or selection or identification of a research topic or problem – formulation of a hypothesis - significance of hypothesis - types of hypothesis - relevance and assumptions in research - developing of a research plan – execution of research work - exploration – description – diagnosis – experimentation - meaning and nature of experimental research - treatments – variation and variables - sample populations.

**General Laboratory etiquette** – rules and regulations – safety measures.

**Unit III: Statistical applications in research – Introduction to statistics** - probability theories – probability distributions – binomial, poisson and normal; **Testing of hypothesis**– standard deviations – standard error - point and interval estimates – confidence levels - confidence limits – levels of significance – Set theory and its applications - regression and correlations - parametric and non parametric statistics.

**Estimates of central tendencies:** mean – median, mode and proportions – variations – variance; transforming of data - one sample test - two sample tests / chi-square test, association of attributes; t-test, f- Test, z –test, c-test, analysis of variance (ANOVA) – one way ANOVA with equal number of replicates – two-way ANOVA - co-efficient of variations - index number, time series analysis - diagrammatic and graphical representations of statistical inferences.

**Use of Computer in Research:** Introduction to computer fundamentals, hardware, software. MS-Office: MS Word, Excel, Power Point: Introduction to spread sheet applications, Data entries, statistical, logical and financial functions, computer aided graphical applications and data analysis – SPSS, M-stat.

**Experimental design** – different types of design - completely randomized design – concept of blocking, randomized complete block design, Latin Square Design - important concepts related to selection of a design – sample design - sampling theory – sampling techniques – steps in sampling - random and non-random sampling - sampling errors - Type-I error - Type-II error– sample size – advantages and limitations of sampling - control observation - merits – demerits.

**Unit IV: Scientific writing and presentation of scientific data:** Research Proposals, Research paper, Research Reports, Dissertation or Thesis. **Style of scientific writing** – structure and language – ‘Title’ rules - preparation of ‘Abstracts’ - ‘Introduction’ rules – rules for presenting ‘Materials and Methods’ – rules for presenting ‘Results’ – concept of ‘Discussion’ – method of ‘Conclusion’ – concept of ‘Acknowledgement’ – reference styles – presentation of tables and figures - matrix of rows and columns representing variables, figures – visual organization of data/observations – pictures, pie charts, line charts, bar charts, flow charts, organizational charts, cartogram charts, Gantt charts, Scatter plot charts – Symbols and legends – photographs and micrographs – Peer review - editing the final drafts manuscript submission

**Unit –V: Presentation Tools:** Introduction to presentation tool, features and functions, creating presentation, customizing presentation, showing presentation – oral and poster presentations; Microsoft Power Point and pdf slides - open office or similar tool.

**Research in the social contexts:** Bio-ethical issues – bio-safety - environmental impacts – ecological ethics – rights of future generations – issues of commercialization – intellectual property rights –problems related to trade of biological items – ethics in publications - plagiarism

### **Seminars/Assignments related to Course –I**

1. **Seminar:** Each student must summarize and critically evaluate the ideas in a published thesis: This is to evaluate the authors' theory and research design to provide examples of how a student might apply these ideas to his/her own research projects. Then the scholar is expected to work either individually or in a group to discuss critically a published thesis in a seminar.
2. **Assignment** Preparation of Project proposal: This is one of the main requirement for the Course –I. The paper will serve as an important exercise in how to design a research project related to his/her thesis work.

### **References**

1. Panneerselvam R (2004). Research Methodology, Prentice Hall of India, New Delhi,.
2. Jerrord H Z (1999) Biostatistical analysis, Prentice Hall International, London
3. Imre Lakatos (1970) Falsification and the Methodology of Scientific Research Programme. In Imre Lakatos and Alan Musgrave (eds.), Criticism and the Growth of Knowledge, Cambridge University Press
4. Wayne C Booth, Gregory G Colomb, and Joseph M Williams (1995). The Craft of Research, Chicago University of Chicago Press
5. Dina A. Zinnes (1980). Three Puzzles in Search of a Researcher, International Studies Quarterly, Vol. 24 (September), pp. 315-342
6. Catherine Marshall and Gretchen B. Rossman (1989). Designing Qualitative Research Newbury Park, London and New Delhi: Sage Publications
7. Montgomery, Douglas C. (2007), Design and Analysis of Experiments, Wiley India.
8. Carlos CM (200). Intellectual Property Rights, the WTO and Developing Countries: The TRIPS agreement and policy options, Zed Books, New York
9. Day RA (1992) How to write and publish a scientific paper, Cambridge University Press, London
10. Golafshani N (December 2003). Understanding reliability and validity in qualitative research. The Qualitative Report, 8 (4) 597-607.
11. Leedy PD and Ormrod JE (2004) Practical Research: Planning and design, Prentice Hall India, New Delhi
12. Anthony M, Graziano AM and Raulin ML (2009) Research Methods: A Process of Inquiry, Allyn and Bacon
13. Bordens K and Abbott B (2005). Research designs and methods: A process approaches (6th Ed.). Columbus, OH: McGraw-Hill Higher Education. ISBN: 978-0-0728-8764-8

## **Course -II SBS DC IC1702: Biological Techniques**

**Unit-1:** pH, Buffers, Henderson –Hasselbalch equation, pH electrode. Solutions, methods of expressing concentration of solution. Methods to quantify proteins and nucleic acids, spectrophotometry and spectrofluometry. Centrifugation in Biochemical research, relative centrifugal force, differential centrifugation, density gradient centrifugation, low speed, high speed, refrigerated and ultracentrifuge. Microscope, Numerical aperture, magnification, bright field microscope, phase contrast, fluorescence, confocal, interference and polarization microscopes. Electron microscopes and specimen preparation. Radioactive isotopes in biological research, units of radioactivity, half life period, labeling, detection and measurement of radioactivity. Radioisotopes and safety.

**Unit –II:** Isolation and purification of biomolecules- lipids, proteins and nucleic acids. Iodine value and saponification value. Solvent extraction. Precipitation of proteins, salt and organic solvents for protein precipitation, dialysis, thin layer chromatography, gel filtration, ion exchange chromatography, affinity chromatography, high performance liquid chromatography, gas liquid chromatography, polyacrylamide gel electrophoresis-native and SDS Isoelectric focusing, ELISA. DNA, RNA and plasmid isolation, agarose electrophoresis, competent cell preparation and transformation, restriction digestion, ligation and expression. Sequencing of DNA and amino acid. Structural analysis of biomolecules, spectroscopical analysis-GC, GC/MS, LC/MS, FT/IR, NMR, X ray crystallography.

**Unit III:** Microbial staining techniques – simple staining and differential staining – bacterial culture-media and methods. Sterilization techniques in microbiology – antibiotic sensitivity tests – diffusion and dilution techniques. Cultivation of fungi – cultivation of viruses. Molecular typing and phylogenetic analyses.

Immunological techniques: Testing for the evaluation of immunomodulatory effects; Agglutination, precipitation, Western Blotting, Radio Immuno Assay, Immunofluorescence.

**Unit IV:** Environmental Analyses: soil and water sampling techniques – soil chemical analyses – extraction of metals – microwave digestion - soil biological studies – soil microbiological studies – AM fungi and spore counts - water sampling - water chemical analyses – aquatic biological techniques – quadrat studies for terrestrial communities – culture of AM fungi – Algal culture

Plant anatomical, morphological techniques - taxonomic techniques – chemotaxonomy and numerical taxonomy – molecular characterization in the identification of new organisms

Fermentation process control – production of industrially useful enzymes using bioreactors

**Unit V:** Plant and animal tissue culture techniques – sterilization of explants– preparation of culture media - development of different protocols – inoculation – culture maintenance – disinfections of culture rooms.

**Animal physiology** – haematological analyses - respiratory testing – bioelectricity recording – histological techniques - Techniques in Cancer Research

In vitro study of anti oxidants – free radical scavenging, super oxide scavenging, nitric oxide scavenging, peroxide scavenging; antifungal and anti - microbial leprotic activities.

Toxicity – systemic, local, ANS, CVS, anti diuretic anti cancer, analgesic, anti inflammatory, anti asthmatic, immune stimulant, immune suppressor activities.

Plant derived medicines – general methods of isolation, purification, identification and estimation of phyto-constituents. CPCSEA guidelines, transgenic animals.

### **Seminars/Assignments related to Course –II**

**Seminar:** Each student must present a seminar on a biological technique which he/she will be using in his/her research

**Assignment:** Each student must submit an assignment on a biological technique as per the directions of the course coordinator

### **References:**

1. Glick BR and Psternak JJ (1998) Molecular Biotechnology: Principles and applications of recombinant DNA, ASM Press
2. Sharma BK (2000) Instrumental Methods of Chemical Analyses
3. Khandpur RS (2004) Handbook of Biomedical Instrumentation, Tata Mc Graw Hil
4. Brigal L W (1998) A Biologist Guide to Principles and Techniques of Practical Biochemistry
5. APHA, 1998. Standard methods for the examination of water and wastewater. American Public Health Association, 1015 Fifteenth Street, NW, Washington, DC.
6. Trivedy, R.K.& P. K. Goel (1986) Chemical and Biological Methods for Water Pollution Studies, Environmental Publications, Karad 415 110, India
7. Monica Cheesbrough (2005 ) Medical Laboratory Manual for tropical countries, Vol 2, , LBS

8. Mackie and Mc Cartney (2002) Practical Medical Microbiology, Curchil-Livingstone
9. Dube RC and Maheswary DK (2002) S Chand and Company Ltd., New Delhi
10. Sambrook J and Russel D (2001) Molecular Cloning, A Laboratory Manual, 3<sup>rd</sup> Edition, Cold Spring Harbor, New York
11. Widmaier Raff and Strang (2005) Vander's Human Physiology – the Mechanism of Body function, McGraw-Hill, Ne York
12. Ronald Darnley Gibbs (1974) Chemotaxonomy of flowering plants. Volume 1 & 2, Betterworldbooks, New York
13. Peter H. A. Sneath (1973) Numerical Taxonomy: The Principles and Practice of Numerical Classification, W H Freeman & Co

**Course III: SBS DC IE1703:**

**Elective Course (Syllabus need to be designed by the Research Guides from time to time)**

**Course IV (UGC Course with Code CPE-RPE): SBS DC IE 1704:**



**About the course****Course Code: CPE- RPE****Overview**

- This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

**Pedagogy:**

- Class room teaching, guest lectures, group discussions, and practical sessions.

**Evaluation**

- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

### Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
<b>Theory</b>		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
<b>Practice</b>		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	<b>Total</b>	<b>30</b>

### Syllabus in detail

#### THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
  - Introduction to philosophy: definition, nature and scope, concept, branches
  - Ethics: definition, moral philosophy, nature of moral judgements and reactions
- RPE 02: SCIENTIFIC CONDUCT (5hrs.)**
  - 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
- RPE 03: PUBLICATION ETHICS (7 hrs.)**
  - 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 contributorship
  - Identification of publication misconduct, complaints and appeals
  - Predatory publishers and journals

#### PRACTICE

- RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**
  - Open access publications and initiatives

2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

- A. Group Discussions (2 hrs.)**

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

- B. Software tools (2 hrs.)**

Use of plagiarism software like Turnitin, Urkund and other open source software tools

- **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**

- A. Databases (4 hrs.)**

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

- B. Research Metrics (3 hrs.)**

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics