DEPARTMENT OF ENVIRONMENTAL SCIENCES
MAHARSHI DAYANAND UNIVERSITY ROHTAK-124001

PROGRAM ARCHITECTURE, DURATION, SCHEME OF EXAMINATION, WORKLOAD/WEEK AND CREDITS
For Ph.D. (Course Work)
(w.e.f. 2020-21)

Duration: One Semester (Six months)

Total Credit requirement: 14 credits

Program structure: Ph.D in Environmental science

Program Specific Outcomes: Over the course of Ph.D. studies, students in the program will

PSO1: Learn **s**cientific and technical skills focusing on solving/addressing a particular problem or an issue in environmental science.
PSO2: Analyze and determine pollution using Environmental Analytical Techniques and Biostatistics and Computational Techniques.
PSO3: Compilation of collected and analyzed data in form of a report/article/thesis.
PSO4: Acquire the knowledge and skills needed for the environmental design and management.

SEMESTER 1						
Course Code	**Nomenclature of Course**	**Theory marks (end semester examination)**	**Internal Assessment marks**	**Maximum marks**	**Hours /Week**	**Credits**
20ENVPH11C1	Research Methodology	80	20*	100	4	4
20MPCC1	Research and Publication Ethics	40	10**	0	2	2
20ENVPH11C3	Tools and techniques in Environmental Sciences	80	20*	100	4	4
20ENVPH11C4	Biostatistics and Computer Sciences	80	20*	100	4	4
Total marks/Credits				**350**	**14**	**14**

Note: The compulsory course on "Research and Publication Ethics" shall be offered by Ch. Ranbir Singh Institute of Social and Economic Change for all UTDs/Centres/Institutes passed vide Resolution No. 27 of the 271st meeting of EC held on 29.7.2020.

***Internal Assessment:**
Two assignments of 5 marks each
Two presentations of 5 marks each

****Internal Assessment:**
One assignments of 5 marks each
One presentations of 5 marks each

Ph.D. Course Work syllabus

Name of the Program	Ph.D. Course work in Environmental Sciences	**Program Code**	ENVPH
Name of the Course	Research Methodology	**Course Code**	20ENVPH11C1
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To study and understand research terminology
2. To study principles of research, challenges and approval processes
3. To describe quantitative, qualitative and mixed methods approaches to research
4. To identify the components of a literature review process
5. To critically analyse published research

Course Outcomes:

By completion of course the student is able to

1. Understand basic concepts of research and its methodologies
2. Identify appropriate research topic and define research problem and parameters
3. Understand of various research designs and techniques.
4. Prepare a project/research proposal (grants) and conduct research in an appropriate manner
5. Write a research report/articles and thesis

Unit - I

Meaning of Research in Biological Sciences - Purpose, Characteristics and Types of Research - Process of Research -Formulation of objectives - Formulation of Hypotheses - Types of Hypotheses - Methods of testing Hypotheses -Research plan and its components - Methods of Research (Survey, Observation, case study, experimental, historical and comparative methods) - Difficulties in Biological research.

Unit - II

Identification and formation of research problem (Hypothesis). Elements in research methodology: Research design (CRD, RBD, LSD). Scientific database: Science Direct and Pubmed.

Unit - III

Ethical, legal, social and scientific issues in Biological Research. A brief idea about the funding agencies such as DST, DBT, ICMR, CSIR and UGC. Role of IPR in Research and Development.

Unit - IV

Writing of Research Proposal, Report and Research Paper: Meaning and types - Stages in preparation Characteristics - Structure - Documentation: Footnotes and Bibliography - Editing the final draft- Evaluating the final draft- Checklist for a good proposal/report/research paper. Basic knowledge of organizing conferences, symposia, workshop, exhibition etc.

References:

1. Basotia G. R. & Sharma, K. K. (2002). Research Methodology, Jaipur Mangal Deep Publications.
2. Chaudhary, C.M. (2009). Research methodology 1st Edition. RBSA Publishers..
3. Kothari, C.R.(2014). Research methodology: Methods and Techniques, New Age International Pvt Ltd Publis,hers.
4. Goddard, W. and Melville ,S.(2004). Research methodology: An introduction, 2nd Edition Juta Academic Publisher.
5. Prathapan, K (2014) Research Methodology for Scientific Research, I K International Publisher.

Name of the Program	Ph.D. Course work	**Program Code**	PH
Name of the Course	Research and Publication ethics	**Course Code**	20MPCC1
Hours/Week	2	**Credits**	2
Max. Marks.	40	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 8 = 40 marks)

Course Objectives:

1. To study the philosophy of ethics
2. To study the scientific conduct of research
3. To study the publication ethics
4. To know about various journal citation databases
5. To know the importance of quality publications

Course Outcomes:

By completion of course the student is able to

1. Ethics in conduct of scientific research
2. Know the scientific misconducts
3. How to avoid plagiarism and what are the penalties of plagiarism
4. Know the quality of research publications
5. Write research and review articles.

Unit - I

PHILOSOPHY AND ETHICS

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

SCIENTIFIC CONDUCT

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Unit - II

PUBLICATION ETHICS

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Unit - III

DATABASES AND RESEARCH METRICS

(A) Databases

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

(B) Research Metrics

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

Unit - IV

Practice

OPEN ACCESS PUBLISHING

1. 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 Suggested, etc.

PUBLICATION MISCONDUCT

(A) Group Discussions

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 Tumitin, Urkund and other open source software tools

References:

1. Bird, A. (2006). Philosophy of Science, Routledge
2. P. Chaddah (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarised.
3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019).
4. Beall, J (2012), Predatory publishers are corrupting open access. Nature, 489(7415), 179.
5. National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009). On being a Scientist: A guide to Responsible Conduct in Research, Third Edition, National Academic press.

Name of the Program	Ph.D. Course work in Environmental Sciences	**Program Code**	ENVPH
Name of the Course	Tools and techniques in Environmental Sciences	**Course Code**	20ENVPH11C3
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To explain basic concepts and definitions in measurement.
2. To introduce the concept of analytical instrumentation, methods, techniques and applications.
3. To develop critical thinking skills in the areas of instrument selection, method development and data interpretation
4. To solve the troubleshooting during the analysis of the samples

Course Outcomes:

By completion of course the student is able to

1. Understand the design, operational principles and practical applications of modern instrumental methods employed in chemical analysis of environmental samples.
2. Explain the concept of spectrometry and optical techniques.
3. Elucidate the working of chromatography, elemental analyser and electrophoresis, X- ray diffractometer and scanning electron microscope.
4. Explain the techniques used for analysis based on DNA and proteins biomolecules.

Unit - I

Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colorimetry, NMR, ESR, Microscopy-phase, light and fluorescence microscopes, Scanning and Transmission electron microscopes.

Unit - II

Chromatographic techniques (Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography), Atomic absorption spectrophotometry, cytophotometry and flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Principle of biophysical method used for analysis of biopolymer structure, Hydrodynamics methods, Plasma emission spectroscopy.

Unit - III

Electrophoresis, solid and liquid scintillation, X-ray florescence, X-ray diffraction. Flame photometry, Gas-liquid chromatography, High pressure liquid chromatography – auto radiography, Ultracentrifugation.

Unit - IV

Methods for measuring nucleic acid and protein interactions, DNA fingerprinting Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction.

References:

1. Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath (2009) Biophysical chemistry: Principles and techniques, Himalaya Publication House.
2. David Freifelder (1976) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W. H. Freeman and Company, San Francisco.
3. Sambrook and Russell (2007) Molecular cloning A Laboratory Manual 3rd edition Vol. 1, 2, 3, Cold Spring Harbor Laboratory Press.
4. Keith Wilson and John Walker (Eds.) (2010) Principals and Techniques of Biochemistry and Molecular Biology, Edited by, 7th Edition, Cambridge University Press.
5. Rajan Katoch (2011) Analytical Techniques in Biochemistry and Molecular Biology, Springer-Verlag New York.

Name of the Program	Ph.D. Course work in Environmental Sciences	**Program Code**	ENVPH
Name of the Course	Biostatistics and Computer Sciences	**Course Code**	20ENVPH11C4
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. Introduction to the field and survey of data and data types.
2. To describe different kinds of studies.
3. To study and understand interaction in studies.
4. To learn study design, data coordination, management, statistical analysis and reporting of study.
5. To learn the use of computer in various phases of research.

Course Outcomes:

By completion of course the student is able to

1. Identify appropriate options for collection of data.
2. Statistically analyse the collected data besides computer application.
3. Construct practical statistical models for several processes in the real-world.
4. Plan and execute Statistical experiments or investigations, analyse, and interpret data and report accurately the findings of the experiment
5. Describe statistical methods and probability distributions relevant for environmental data.

Unit - I

Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis. Correlation and linear regression of one independent variable, Basic laws and concepts of probability.

Unit - II

Definition of random variable, density function, Basic concepts of binomial and normal distributions. Sampling measurement and distribution of attributes. Moments, matrics and simultaneous linear equations, tests of hypothesis and significance.

Unit - III

Analysis of Variance: Meaning of analysis of variance with linear models. Analysis of variance for one-way classified data, analysis of variance for two-way classified data with one observation for cell, analysis of variance for two-way classified data with multiple but equal number of observations per cell (data analysis only).

Unit - IV

Computer Basics: Course introduction, MS Windows basics, File management, E-mail (PINE, EUDORA, Internet mail), File Transfer (ftp, WSftp). Office Applications: MS Office 2000/XP including MS Word, MS Excel, MSPowerPoint.

References:

1. Wayne W. Daniel, Chad L. Cross (2018) Biostatistics: A Foundation for Analysis in the Health Sciences, 11th Edition, Wiley.
2. Sukhminder Singh, M L Bansal, T P Singh, Rakesh Kumar. (2010) Statistical Methods for Research workers, 3rd Edition, Kalyani Publishers Ludhiana.
3. S.P. Gupta (1978) Elementary Statistical Methods, S. Chand Publications, New Delhi.
4. Jerrold H. Zar (2010) Biostatistical Analysis, 5th Edition, Northern Illinois University, Pearson
5. Spiegel, M.R., Stephens L.J. (2014). Statistics, 5th Edition Schaum's outlines, McGraw-Hill Education.