



Department of Biotechnology

Pre- Ph.D.

Biotechnology

Course Contents

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Syllabus

Hemvati Nandan Bahuguna Garhwal University

(A Central University)

Srinagar, Garhwal, 246 174, Uttarakhand

**Paper – I: Research Methodology****(Course Core: S0LS/PBT/C001)****(Credits: - 4)****Unit – I**

Research: Need and purpose, problem identification, objectives and significance, scope and limitation.

Synopsis: Preparation, introduction of the problem, importance of literature survey. Importance and designing of the problem to be undertaken. Use of books, journals and internet for literature survey. Referencing technique etc.

Scientific writing: History and basic concepts (validity, reliability, objectivity and subjectivity) characteristics and format.

Steps to better writing, flow method, organization of material and style.

Unit – II

Methods: Data collection, types of data: Primary and secondary, Techniques of sampling, sample size, frequency, bias, error, Data summarization and interpretation.

Field survey, Site selection, Source selection for data acquisition. Qualitative and quantitative data.

Unit – III

Preparation and presentation of data: Tabulation of data, summarization of monthly and seasonal data, drawing figures, graphs etc. Formatting of a Research paper, citing of references, foot notes etc. Abstracting, methodology expression of results, interpretation and discussion.

Presentation, oral, poster, use of audio-visual aids, skill of presentation. Response to audience.

Unit – IV

Biostatistics: Sampling techniques: Simple and random sampling, systematic sampling, stratified sampling, multistage sampling, cluster sampling, multiphase sampling, sample size.

Data representation: Tabular and diagrammatic representation of data.

Measures of central tendency: Use of mean, mode, median.

Measures of dispersion: Use of range, variance, standard deviation, standard error.

Correlation, multiple correlations, regression, multiple regressions, standard error of estimate.

Test of significance: t-test, 95% confidence limit, chi square test, F-test, multivariate test.

Recommended Books: -

1. Holmes, Moody, Dine: Research Methods for the Biosciences, 1st Indian ed., Oxford University Press, 2006.
2. N. Gurumani: Research Methodology for Biological Sciences, 1st ed., MJP Publishers, 2008.
3. Petter Laake, et all, Research Methodology in the Medical and Biological Sciences 2007 [1 ed.] Elsevier/AP
4. Schmauder: Methods in Biotechnology, Taylor & Francis Publishers, 2003
5. Wilson and Walker: Principles & Techniques, 4th ed. Cambridge low price ed., 1995.

**Paper-II: A) Research and Publication Ethics (RPE) & General Biotechnology****(Course Core: S0LS/PBT/C002)****(Credits: - 3)****(2credit)****Unit I (RPE)****THEORY:**

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

PRACTICE:

- **RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)**
 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 Suggester, etc.
- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**
 - A. Group Discussions (2hrs.)**
 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 (2hrs.)**
 1. Use of plagiarism software like Turnitin, Urkund and other open source software tools.
- **RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)**
 - A. Databases (4hrs.)**
 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, CITE Score
2. Metrics: h-index, g index, i10 index, altmetrics

Unit II (General Biotechnology)

(1credit)

Introduction, History and scope of biotechnology, Overview of the structure and organization of chromosome, Gene expression, steps in gene cloning and use of cloning vectors, Applications of recombinant DNA technology, PCR and its applications, Overview of Site directed mutagenesis, DNA libraries, blotting techniques, molecular markers.

Gene therapy and its types, CRISPR, Omics approach in Biotechnology, Introduction to cell line, Animal cell culture and its applications, Next generation sequencing techniques, Biosensors.

Recommended Books: -

1. Beall, J. (2012). Predatory publishers are corrupting open access, Nature, 489 (7415), 179-179.
2. Bird, A (2006), Philosophy of Science. Routledge.
3. Health Sciences, 1-10. Retrieved from
4. http://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. <https://doi.org/10.1038/489179a>
<https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019, ISBN:978-81939482-1-17.
7. MacIntyre, Alasdair (1967) A short History of Ethics. London
8. 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 Academies Press
9. P. Chaddah, (2018) Ethics in Competitive research: Do not get scooped; do not get plagiarized, ISBN: 978-9387480865
10. Resnik, D.B. (2011) What is ethics in research & why is it important. National Institute of Environmental
11. Gene cloning T.A Brown:
12. Molecular Biotechnology, Glick & Pasternak: Panima Publ. Corporation, 1994
13. Molecular biology & Biotechnology (3rded), Walker &Gingold: Panima Publ. Corporation, 1999
14. Lewin: Genes, Vol. VII Oxford, 1998, Inded.



Paper- III: Tools & Techniques
(Course Code:S0LS/PBT/E 001A)

(Credits: - 4)**Unit – I**

General principle, instrumentation and application of chromatography.
 2D gel electrophoresis.
 Centrifugation – Types of centrifugation, laboratory operation and application. Digital probes and meters.
 Spectroscopic methods: principle and applications of UV-visible, IR, NMR.

Unit- II

Principle and applications of X ray crystallography. Application of ELISA, RIA and blotting techniques. Types of microscopes and application in biology.
 Techniques of Microtomy, radiotracer techniques.

Unit – III

Fundamentals of Computer, Concepts of Hardware and Software, Operating System.
 Working with Microsoft office (MS-WORD, EXCEL, POWER POINT, etc).
 Basic idea of Internet, search through internet and Database search.
 Use of internet networks in research activities.

Unit – IV**Biochemical calculation & Lab management.**

General idea of buffer system. Preparation of buffers such as (phosphate buffer, Tris-cl etc.)
 General idea of concentration measurement of solution viz. molarity normality, molality etc.)
 Management of laboratories chemicals, glassware's and working with equipments, Laboratory setting.

Recommended Books: -**Recommended Books: -**

1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991.
2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989.
3. Biochemical Technique: Theory & Practical J.F. Robytt & B.J. White. Waveland Press, Inc.
4. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press
5. Jayraman: Laboratory Manual in Biochemistry
6. Arnold L. Demain & Julian E. Davies: Manual of Industrial Microbio. & Biotech. 2nded.

**Paper-III: Bioinformatics and Intellectual Property Rights****(Course Code:S0LS/PBT/E 001B)****(Credits: - 4)****Unit I**

Introduction and scope of Bioinformatics, Bioinformatic Resources, Computer Advancements and their importance in Bioinformatics, Browsers and Search engines, Biological databases and their types; Nucleotide search, Protein Search, Protein sequence information sources: PIR, ExPASy, UniProt KB, SwissProt, TrEMBL, BLAST search, KEGG pathways.

Unit - II

Sequence Alignment: types and applications, Tools for Sequence Alignment, Multiple sequence alignment tools, Phylogenetic Analysis and tools, Homology Modeling, Domain Search and Prediction, Secondary structure Prediction, Tertiary structure Prediction, Visualization tools.

Unit - III

Introduction to Intellectual property rights- Aims and objectives.
History of intellectual property and Indian patent act.
Types of Intellectual properties- Patents, Trademarks, Copyright and related rights, Industrial design, trade secret, Geographical indications etc.
History of agreements and treaties in intellectual property rights

Unit - IV

Intellectual property as a factor in research and development
Legal and IPR issues in biotechnology, Incremental innovation
World intellectual property organization (WIPO)-about, roles and functions
Patent infringement and remedies, Licensing and franchising
Few case studies related to IPR

Recommended Books: -

1. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
2. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
3. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
4. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
5. Karen F. Greif and Jon F. Merz, Current Controversies in the Biological Sciences -Case Studies of Policy Challenges from New Technologies, MIT Press
6. World Trade Organisation. <http://www.wto.org>
7. World Intellectual Property Organisation. <http://www.wipo.int>

**Paper IV: Microbial Technology****(Course Code: S0LS/PBT/E 002A)****(Credits: - 4)****Unit – I**

Fermentation: A Historical prospective, types of fermentation, principle of microbial growth kinetics, Isolation of culture, screening and preservation.

Unit – II

Experimental design for improvement of fermentation.

Substrates for fermentation; Media development for industrial fermentation process, carbon sources, Nitrogen sources & inorganic components, industrial waste as raw material for fermentation.

Types of bioreactors (CSIR, bubble column, fluidized –bed, trickling, filter etc.)

Unit –III

Down stream processing: Downstream process economics and cost cutting strategies, process design criteria for bio-products. General idea of product identification separation & purification techniques

Unit – IV

Products of fermentation (raw material, microorganisms used, production and purification): Ethanol, Acetone, Citric acid, Enzymes, Glycerol Single cell protein, Antibiotics (Penicillin, Streptomycin).

Metagenomics: Approaches and applications.

Recommended Books: -

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.



Paper IV: Plant Biotechnology
(Course Code: S0LS/PBT/E002B)

(Credits: - 4)

Unit – I

Introduction to cell & tissue culture, Tissue culture media composition & preparation.
Initiation and maintenance of callus and cell suspension culture.

Unit – II

Organogenesis, protoplast isolation, culture and fusion.
Production of haploids, somaclonal variations, cryopreservation

Unit – III

Production of secondary metabolites from plant cell cultures, Technology of plant cell culture for production of chemicals.
Agrobacterium mediated gene transfer. Direct gene transfer method.

Unit – IV

Plant genetic engineering for production of herbicide resistance, insect resistance, disease resistance & virus resistance.
Application of plant biotechnology for the production of industrial enzymes, antigens (edible vaccines) & plantibodies.

Recommended Books: -

1. P.K. Gupta: Elements of Biotechnology, Rastogi and Co. Meerut, 1996
2. R.J. Hanry: Practical Application of Plants Molecular Biology, Champan and Hall, 1997
3. H.D. Kumar: Modern Concepts of Biotechnology, Vikas Publ. Pvt. Ltd.
4. B.D. Singh: Biotechnology, Kalyani Publ.
5. Bhojwani SS and Razdan MK: Plant Tissue Culture: Theory and Practice- Elsevier
6. Stewart CN. Plant Biotechnology and Genetics. 2007. Wiley.