

PAPER-1: RESEARCH METHODOLOGY

Course Outcome

CO 1: Identification of problem, hypothesis, framing objectives

CO 2: Literature survey, report writing, formats of writing

CO 3: Practical approach to advanced tools and techniques in microbiology

CO 4: Knowledge and implications of Data collections, data analysis, tests of significances

CO 5: Applications of computers and software's in microbiological analysis, statistical analysis

CO 6: Internet, Literature search techniques, citations, H index

CO 7: Bioinformatics, Sequence analysis, NGS

UNIT 1: Research Methodology

12hr

Introduction, Scope, Identification of problem, Formulation of Research Objectives, Hypothesis Testing, Components of research design, Good Laboratory practices, Bio-Safety level, Laboratory designing

Intellectual Property Rights, Patent Laws, Patenting of Microorganisms

Bioethics, Institutional Ethics Committee, Model/Experimental Organisms: *E. coli*, *Drosophila melanogaster*, *Coenorhabditis elegans*, *Arabidopsis thaliana*, Mouse, Rat, Guinea pig, Rabbit, CPCSEA Guidelines- Maintenance, Handling, Treating and Collection of Biological Samples and Waste disposal.

Literature Survey and Review: Report writing, Pre-writing considerations, Thesis writing, Formats of Report writing, Formats of Publications in Research Journals.

Plagiarism: Tools and Software for detection

UNIT 2: Advanced Tools and Techniques

18hr

Microscopic techniques: Electron microscopy, Confocal Microscopy, Fluorescent Microscopy, Live Cell imaging,

Chromatography: Principle, protocols and application of GLC, HPLC

Electrophoresis: 2D Gel Electrophoresis, PFGE, DGGE, Western, Southern and Northern Blotting

Spectroscopy: Principles and Applications of UV-Visible, Mass Spectroscopy, LC-MS, NMR Spectroscopy, MALDI-ToF

Isotopes in Research: Radio Labeling, Autoradiography, radioimmunoassay, Use of Radioisotopes in Microbiological Research

Immunological Techniques: Precipitation, ELISA, Immunohistochemistry, Immunofluorescence

Molecular Analysis: PCR, Real Time PCR, DNA Microarray, DNA Sequencing, Cloning and Expression Vector, Construction of vector, Construction of Vectors, Whole DNA-methylome Protein Microarray and Protein Sequencing

Nano-Technology: Microbial Nanoparticles; Principles and Applications

UNIT 3: Quantitative Data Analysis

06hr

Data Collection: Types, Methods and Tools

Normal, Binomial, distributions: Properties and Significances.

Test of Significances: Student *t*-test, F-test, Chi-square test,

Correlation and regression, ANOVA, Multiple-range test.

UNIT 4: COMPUTER APPLICATIONS

12hr

Introduction to Spread Sheet Application, Features and Functions, using Formula and Functions, Data sorting, Generation Charts/Graphs and other features, Molecular modelling Presentation Tools: Features and Functions, Creating and Customizing Presentation.

ICT: Meaning, Advantages and Uses.

Basics of Internet, Search Engines and Advanced Search Techniques, JIF, JCI and Citation Search, H-index, Literature search techniques.

Statistical Data Analysis using Computers and Software; TOOLPAK, COSTAT, SPSS.

Microbial Sequence Analysis: Using Bioinformatics tools; BLAST, EMBL, GENE BANK, PDB Next Generation Sequencing Methods.

References

Kothari, C.R., 1985, Research methodology-Methods and techniques, Newdelhi, Wiley Eastern Limited.

Das, S.K., 1986, An introduction to Research, Kolkata, Mukherjee and Company Pvt.Ltd.

Misra R P., 1989, Research Methodology: A handbook, Newdelhi, Concept publishing company.

Kumar R., 2005, Research methodology-A step-by-step guide for beginners, (2nd ed.), Singapore, Pearson education.

Bhattacharya, D.K., 2006, Research methodology, (2nd ed.), Newdelhi, Excel books.

Panneerselvam R., 2012, Research Methodology, Newdelhi, PHI Learning Pvt. Ltd.

Khan, Irfan Ali, 2008, Fundamentals of biostatistics, Ukaaz publications.

Rosner B.A., 2011, Fundamentals of biostatistics, Cengage learning.

Katz.J.M., 2009, From research to Manuscript: A guide to scientific writing, USA, Springer science.

Saravanavel, P., 1990. Research methodology, Allahabad, kitabmahal.

Rastogi and Sani., Microbes and Microbial technology, 2011, pp 29-57, Molecular techniques to assess microbial community structure, function and dynamics in the EMnvironment.

A K Beg and M H Mahbubani., Applications of the polymerase chain reaction in environmental. Microbiology Res. 19921 : 151-159.

The Metagenomics of soil by Rolf Daniel, 470/june 2005/vol 3.

Metagenomics: DNA Sequencing of Environmental samples, Susannah green tringe and Edward M. Rubin, 806/November 2005/volume 6.

Persing, H.D. *et al.* 2004, Molecular Microbiology : Diagnostic principles and practice, Washington D C., ASM Press.

Chandler D.E. and Roberson R.W. 2009, Bioimaging: current concept in light and electron microscopy, Singapore, Jones and Bartlett Publishers.

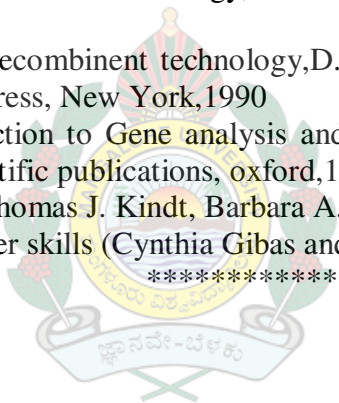
Muralidharan V.S. and Subramania A. 2010, Nanoscience and technology, New Delhi Ane books Pvt.Ltd .

Scott R.P.W. 2012, Principles and practice of Chromatography (chrom- Ed book series) , Reese-Scott partnership.

Miller J.M., 2009, Chromatography: Concepts and Contrasts, USA, John Wiley and Sons, Inc.

Banwell, C.N. and McCash, E.M., 2012, Fundamentals of molecular spectroscopy, 4th Ed., New Delhi, Tata McGraw Hill Education Pvt.Ltd.

- Braun R., Introduction to Instrumental Analysis, Newyork, McGraw Hill book Company.
- Rodney F.Boyer- Modern Experiemental Biochemistry - 3rd Edition- 2000
- Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery (S.C. Rastogi , N. Mendiratta and P. Rastogi)
- Introduction to Bioinformatics, (Atwood, T.K. and parry – smith D J).
- The search for Bioactive compounds from Microorganisms by S Omura.
- Annal reviews in Microbiology volumes 46 and 48 by L. N. Ornston, a balows and E P Greenberg (eds). Academic press.
- Advances in applied Microbiology volumes 6, 10, 17 by D. Perlman and umbreit (eds). Academic press.
- Sambrook J, Fritsch E.F. and maniatitis (1999) Molecular cloaning, volume I, II,III 2ND edition, Coldspring harbor laboratory press, Newyork
- DNA Cloaning : A practical approach D.M. Glover and D.B. Hames, R L Press, Oxford 1995.
- Molecular and cellular method in biology and medicine, P.B. Kaufman, W. Wu, D. Klim and L.J. Cseke , CRC press Florida 1995.
- Methods in Enzymology guide to Molecular Cloaning techniques, vol.152 S.L. Berger and A .R. Kimmel, academic press inc, Sam Diego 1996.
- Methods in Enzymology gene expression technology, vol. 185 D. Goedel, academic press Inc, san diego, 1990.
- DNA science : a first course in Recombinant technology,D.A.Mickloss and G.A. Freyer, cold spring Harbor Laboratory press, New York,1990
- Genetic engineering : An Introduction to Gene analysis and Exploitation in Eukaryotes, S.m. Kingsman, Blackwell Scientific publications, oxford,1998.
- Kuby: immunology; RA goldsby,Thomas J. Kindt, Barbara A. Osborne
- Developing bioinformatics computer skills (Cynthia Gibas and Per Jambeck).



COURSE-2: RESEARCH AND PUBLICATION ETHICS (RPE)

Unit 01(Theory): Philosophy and Ethics (4hrs.)

Introduction to philosophy: definition, nature and scope, concept, branches
Ethics: definition, moral philosophy, nature of moral judgements and reactions

Unit 02(Theory): Scientific conduct (4hrs.)

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

Unit 03(Theory): Publication ethics (7hrs.)

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

Unit 04(Practice): Open access publishing (4hrs.)

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 Suggester, etc.

Unit 05(Practice): 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

Unit 06(Practice): 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

References

- Bird, A. (2006). *Philosophy of Science*. Routledge.
- MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.
- P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865
- 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.
- Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance*(2019), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf