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, Immunofluroescence
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, Bionomial, 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, GENEBANK, PDB Next Generation Sequencing Methods.

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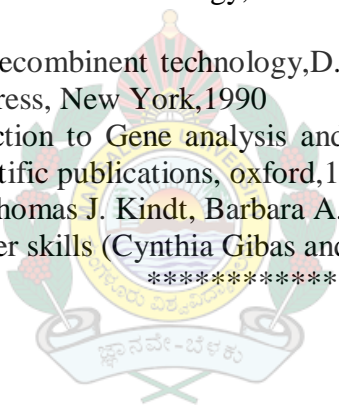
COURSE-2: RESEARCH AND PUBLICATION ETHICS (RPE)

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

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