

COURSE STRUCTURE AND SYLLABUS FOR PHD PROGRAMME
DEPARTMENT OF BIOTECHNOLOGY, SET, NU

COURSE STRUCTURE

| Course No. | Type of course | Name of the Paper | Credit [L+T+P] |
|----------------------|----------------------------|---|-----------------------|
| SETP01 | Paper I (School Level) | Research Methodology | 3+0+0=3 |
| SETP02 | Paper II (School Level) | Statistical methods | 3+0+0=3 |
| BTM303 | Paper III (Dept. Level) | Biosafety and Bioethics | 3+0+0=3 |
| BTM304 | Paper IV (Dept. Level) | Downstream Processing and analytical techniques | 3+0+1=4 |
| CPE-RPE | Paper V (University Level) | Research and Publication Ethics | 1+0+1=2 |
| Total Credit: | | | 15 |

Syllabus for the courses

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| SETP 01: Research Methodology (3 – 0– 0 – 3) | |
| Unit - I | <p>Research Methodology Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research Process, Criteria of Good Research, Common Problems for Researchers</p> |
| Unit - II | <p>Research Problem What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem</p> <p>Research Design Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.</p> |
| Unit - III | <p>Interpretation & Report Writing: Meaning of interpretation, technique of interpretation, Types and structures of research documentation; Approaches and guidelines for documenting and reporting research process and outcomes; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; ethical issues; scientific misconduct.</p> |
| Unit-IV | <p>Intellectual Property Right (IPR) issues IPR introduction and origin, Basics of patents: types of patents, Indian Patent Rules and validity, International Patent Rules and validity, Necessity and advantage-disadvantage of doing Patent to an invention. patent infringement- meaning, scope, litigation, case studies and examples; Commercialisation of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientists-university/organisational rules in India and abroad, collaborative research.</p> |
| References | <ol style="list-style-type: none"> 1. C. R. Kothari, Research Methodology: Methods and Techniques, New Age Publishers. 2. Krishnan Nallaperumal, Engineering Research Methodology 3. Online materials on WIPO and IPR 4. <i>On Being a Scientist: a Guide to Responsible Conduct in Research.</i> (2009). Washington, D.C.: National Academies Press. 5. Gopen, G. D., & Smith, J. A. <i>The Science of Scientific Writing.</i> American Scientist, 78(Nov-Dec 1990), 550-558. |

| SETP02: Statistical methods (3 – 0– 0 – 3) | |
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| Unit - I | <p>Sample Survey</p> <p>Elementary concept; Advantages of sample survey over census; Simple random sampling (SRS); SRSWR and SRSWOR; Drawing of random sample & estimation of average, total etc.; Sampling and non-sampling errors; Concept of stratified random sampling.</p> |
| Unit - II | <p>Statistical Methods</p> <p>Population and its parameters; Sample and its statistics; Frequency distribution; Graphical representation; Measures of central tendency; Measures of dispersion; Moments; Simple correlation and regression.</p> |
| Unit - III | <p>Tests of Significance</p> <p>Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory, Introduction to theory of estimation and confidence intervals.</p> |
| Unit-IV | <p>Probability</p> <p>Theory of probability. Random variable and mathematical expectation, Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Suggested Readings:</p> |
| References | <ol style="list-style-type: none"> 1. Anderson T. W. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley. 2. Dillon W. R & Goldstein M. 1984. Multivariate Analysis - Methods and Applications. John Wiley. 3. Goon A. M, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press. 4. Goon A. M, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press. 5. Hoel P. G. 1971. Introduction to Mathematical Statistics. John Wiley. 6. Hogg RV & Craig TT. 1978. Introduction to Mathematical Statistics. Macmillan |

BTM303 – Biosafety and Bioethics (3 – 0– 0 – 3)

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| Unit - I | Biosafety Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; risk – environmental risk assessment and food and feed safety assessment; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools. |
| Unit - II | National and international regulations International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI). |
| Unit - III | Bioethics Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy |
| Unit-IV | Research and publication Ethics: Ethics with respect to science and research, intellectual honesty and research integrity, Scientific misconduct: falsification, fabrication, plagiarism, redundant publication: duplicate and overlapping publication and salami slicing, selective reporting. Publication ethics: definition, introduction and importance, Best practice: standard settings, conflict of interest, Publication misconduct: definition, concept and problems that lead to unethical behaviour, identification of publication misconduct, predatory publisher and journals |
| References | <ol style="list-style-type: none">1. International Union for the Protection of New Varieties of Plants. http://www.upov.int2. National Portal of India. http://www.archive.india.gov.in3. National Biodiversity Authority. http://www.nbaindia.org4. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf5. Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F.(2009). Problem Formulation in the Environmental Risk Assessment for Genetically Modified Plants. <i>Transgenic Research</i>, 19(3), 425-436. doi:10.1007/s11248-009-9321-96. Craig, W., Tepfer, M., Degrassi, G., & Ripandelli, D. (2008). An Overview of General Features of Risk Assessments of Genetically Modified Crops. <i>Euphytica</i>, 164(3), 853- 880. doi:10.1007/s10681-007-9643-87. Guidelines for Safety Assessment of Foods Derived from Genetically Engineered Plants.2008. |

BTM304 Downstream Processing and Analytical Techniques (3 – 0 – 1– 4)

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| Unit - I | Characteristics of biological materials: pretreatment methods; Separation of cell mass:centrifugation, sedimentation, flocculation and filtration; Continuous operation. |
| Unit - II | Mechanical approaches: sonication, bead mills, homogenizers; non-mechanical approaches: freeze/thaw, osmotic shock, chemical lysis, enzymatic lysis; measure-ment of cell disruption, |
| Unit - III | Filtration theory; Micro and ultrafiltration; Reverse osmosis; dialysis; electro dialysis, diafiltration; pervaporation; perstraction; Multistage and continuous operation. |
| Unit - IV | Adsorption equilibrium, Van Deemter equation; Chromatography: size, charge, polarity, shape, hydrophobic interactions; Biological affinity; Process configurations (packed bed, expanded bed, simulated moving beds), modern spectroscopy, Precipitation effect of size and charge, solvent effects, ionic strength effects; Drying: solvent removal aspects, dryers (vacuum, freeze, spray) |
| Unit - V | Solvent extraction: phase equilibrium and distribution, counter-current operation, dissociative extraction, multiple stage analysis; Reciprocating-plate and centrifugal extractors; Reverse micellar extraction; Aqueous two phase, Supercritical fluid extraction; Aqueous two-phase extraction. |
| References | <ol style="list-style-type: none">1. Harrison, R.G., Todd, P., Rudge, S.R., and Petrides, D.P. (2015). <i>Bioseparations Science and Engineering</i>. 2nd Edition. Oxford University Press.2. Ladisch, M. (2000). <i>Bioseparations Engineering: Principles, Practice, and Economics</i>. Wiley.3. Doran P. (2013). <i>Bioprocess Engineering Principles</i>. 2nd Edition. Oxford. Academic Press.4. P.A. Belter, E.L. Cussler and Wei-Shou Hu., (1988), <i>Bioseparations-Downstream Processing for Biotechnology</i>, Wiley-Interscience Publication. |

CPE-RPE (1+0+1=2)

Course structure

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

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

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.)**

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 (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

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