Course Curriculum and Scheme of Examination

Under Choice Based Credit System

For Ph.D. Biotechnology
Course Work

Department of Biotechnology

School of Interdisciplinary and Applied Sciences

Central University of Haryana

Jant-Pali, Mahendergarh-123031, Haryana

Session 2021-2022

Course work of Ph. D in Biotechnology

Scheme and Syllabus (w.e.f. Session 2021-22)

Semester-I

Course code	Course title	L	T	P	Type of course	Credit
SIAS BT 2 1 01 C 4105	Research Methodology	4	1	0	Core	5
SIAS BT 2 1 02 C 3003	Biosafety and IPRs	3	0	0	Core	3
SIAS BT 2 1 03 C 2002	Research and Publication Ethics	2	0	0	Core	2
SIAS BT 2 1 01 DCEC 4004	Omics Technologies*	4	0	0	DCEC	4
SIAS BT 2 1 02 DCEC 4004	Advances in Genetic Engineering*	4	0	0	DCEC	4
Total Credit						14

*One course to be selected by the student

Course Title: Research Methodology   **Credit: 5**

Course Code: SIAS BT 2 1 01 C 4105   **Contact hours: 75**

Course objective:

- To identify a research problem based on literature data and collecting data related to the problem, its analysis and presentation

Learning Outcomes: After completion of this course, the students will be able:

1. To identify a research problem from literature survey using various tools and softwares
2. To know different ways for representation of data and its analysis
3. To present a research problem in the form of a research proposal and its presentation

Unit-I

Identification and defining of the research problem: Familiarization of research areas; review of literature using appropriate resources – reviews, research papers, books and patents; Use of tools for searching literature through electronic databases, Role of Bioinformatics and its various methods/tools- Similarity search methods (BLAST, FASTA etc), Databases (NCBI, UniProt, PDB etc), Protein Structure Prediction methods, Phylogenetic Tree analysis methods, Various file formats etc. Use of electronic tools for bibliographic formatting and checking plagiarism.

Unit- II

Basic definitions and applications. Data collection and representation. Measurement of central tendencies (Mean, Median, Mode, Quartiles and percentiles). Measurement of variability (standard deviation, standard error of mean, range, mean deviation, coefficient of variation). Probability distributions (Binomial, Poisson and Normal); sampling distribution.Use of inbuilt statistical functions for the computations of mean, median, mode, SD, SE, correlation, regression coefficients etc.

Unit- III

Use of bar diagram, histogram, scatter plots, etc. Graphical tools in excel for presentation of data. Introduction to other statistical software like Graphpad Prism, Sigma Plots etc. Introduction to MSWORD word processor editing, copying moving formation, table insertion, drawing flow charts, etc.

Difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test (paired and unpaired); analysis of variance; chi square test. Introduction of multivariate statistics.

Unit- IV

Journal Club and Seminar [#]

Writing & Presentation of Research Proposal*

[#]Every student will have to participate in weekly Journal Club to be conducted by the Department and will be required to present recent research papers from reputed scientific journals along with a detailed background and a critique on the research findings. Every student shall have to deliver two Seminars on Recent Topics as per the interest of student. Seminar will be of 45 minutes during which presentation will be followed by the question season comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the supervisor/ faculty members well in advance so that the same may be displayed on the notice board. Speaker will have to write an abstract to be distributed during the Seminar in addition to two copies

of write-up giving relevant details of the background of the subject, methods used, and references/ list of sources from where the material for presentation has been collected.

*The student will prepare a detailed project grant application in a format of typical funding agency (except financial details), present and defend the proposal in a meeting of the faculty and students of the Department.

Suggested readings:

1. Biostatistics: Basic Concepts and Methodology for the Health Sciences (2014) 10th edi., Cross CL and Wayne WD.Wiley, ISBN: 978-8126551897.
2. Writing the doctoral dissertation (2012) 3rd edi., Davis GB and Straub DW. Barron's Educational series, ISBN: 978-0764147876.
3. Research Methodology: A Step-by-Step Guide for Beginners (2005) 2nd edi., Kumar R. Pearson Education. ISBN:978-1446269978.
4. How to write and publish a scientific paper (2011) Gastel B and Robert AD. 7 edi., Greenwood, ISBN: 978-0313391972

Course title: Biosafety and IPRs   **Credit: 3**
Course code: SIAS BT 2 1 02 C 3003   **Contact hours: 45**

Course objective:

- To study various biosafety measures involved in a proposed research work/study and protecting its rights through IPR

Learning Outcomes: After completion of this course, the students will be able:

4. To identify the safety risks associated with a proposed research work based on the involvement of microbes, plants and animals
5. To understand the role of different regulatory bodies in a proposed research work
6. To get information about the novelty of a research work followed by its protection by IPR

Unit-I

Biosafety: Microbes and Plants

Orientation of bio-risk management, Introduction of bio-risk, biosafety, biosecurity, bioterrorism, contaminant. Bio-risk characterization and evaluation; likelihood and consequences of risk. Bio-risk mitigation strategies; bio-risk management methodology and its implementation: Certification of equipment, Institutional Biosafety Committee, Good Laboratory Practices, Principal of Biosafety: Biosafety equipment (Primary Barriers and personal protection equipment), facility design and construction (secondary barriers). Biosafety cabinets: Class I, II (A1, A2, B1, B2) and III, biosafety level lab practices: Level 1,2,3,4, labs. Sterilization and decontamination of hazardous biological agents, GMO hazards. Development, evaluation and validation of SOPs (Standard Operating Procedures). Biological waste segregation and disposal.

Unit-II

Biosafety: Animal and Human

Safety in research (handling of bio-hazardous substances, disposal of bio-hazardous waste; Biosafety issues- Chemical, radiation, recombinant DNA, biological material), Risk groups and their categorization. Different biosafety levels, research ethics, information & significance of regulatory bodies in research

Unit-III

Intellectual Property Right (IPR)

Introduction, patent, requirement of patentability, ownership of tangible and intellectual property, foreign patent; special issues pertaining to Biotechnology patents: Disclosure requirements, ethical issues, Plant Biotechnology –UPOV and Plant Breeder's rights, IPR issues in the Indian context, Copyright vs patents; International Treaties and Conventions; Business Software patents.Procedure for filing of Indian and Foreign patents.

Unit-IV

Regulatory bodies in research: Institutional Permissions and adherence to community guidelines / standards (Institutional Ethics Committee, Institutional Biosafety committee, Institutional Animal Ethics Committee). Ethics in human research: guideline and codes of best practice (Numbering code, Declaration of Helsinki, etc).

Suggested readings:

1. IPR, Biosafety and Bioethics (2013) 1st edi., Goel D and Parashar S. Pearson Education. ISBN: 978-8131774700
2. 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/
3. World Trade Organisation. http://www.wto.org
4. World Intellectual Property Organisation. http://www.wipo.int
5. International Union for the Protection of New Varieties of Plants. http://www.upov.int
6. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
7. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
8. http://dbtindia.gov.in/guidelines-biosafety

Course title: Research and Publication Ethics   **Credit: 2**
Course code: SIAS BT 2 1 03 C 2002   **Contact hours: 30**

Course objective: To get knowledge about the ethical issues in research and publication

Learning Outcomes: After completion of this course, the students will be able:

1. To get information about ethics, intellectual honesty and scientific conduct during a research work
2. To know the concept of plagiarism and its significance in scientific writing and publication

Theory

Unit –I
Philosophy and ethics
Introduction to philosophy: definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgement and reactions.

Unit –II
Scientific conduct
Ethics with respect to science and research, intellectual honesty and research integrity, scientific misconducts: falsification, fabrication, and plagiarism, redundant publications, duplicate and overlapping publications, salami slicing, selective reporting and misrepresentation of data

Unit –III
Publication ethics
Definition, introduction, and importance, best practices/standard settings, initiatives and guidelines: COPE, WAME etc. conflicts of interest, publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types, violation of publication ethics, authorship, and contributorship, identification of publication misconduct, complaints, and appeals, predatory publishers and journals

Practice

Unit –IV
Open access publishing
Open access publications and initiatives: SHERPA/RoMEO online resources to check publisher copyrights and self-archiving policies, software tool to identify predatory publications developed by SPPO, journal finder/journal suggestion tools viz GANE, Elsevier journal finder, Springer journal suggester etc.

Unit –V
Publication misconduct
A. Group discussion – subject specific ethical issues, FFP, authorship, conflict of interest, complaint and appeals: example and fraud from India and abroad. B. Software tools – Use of plagiarism software like turnitin, urkund, and other open source software tools

Unit –VI

Databases and research matrices

A. Database – Indexing databases, citation databases: web of science, scopus, etc. B. Research matrix, impact factor of journal as per journal citation report, impact factor of journal as per journal citation report, SNIP, SJAR, IPP, Citescore, matrices, h-index, g-index, i10-index, almatrices

Suggested readings:

1. Philosophy of science, (2006), Bird, A., Routledge, ISBN 9781138705579.
2. A short history of ethics: A history of moral philosophy from the homeric age to the twentieth century (1967), MacIntyre, A., London, ISBN: 9780268161286.
3. Ethics in competitive research, do not get scooped; do not get plagiarized (2018), Chaddhah, P., ISBN-10: 9387480860
4. On being a scientist, a guide to responsible conduct in research (2009), National Academy of Science, National Academy of Engineering and Institute of Medicine, ISBN-10: 0309119707
5. Ethics in science education, research and governance (2019), Muralidhar K., Ghosh A., Singhvi A., Indian National Science Academy, ISBN: 9788193948217

Department Centric Elective Courses

Course Title: Omics Technologies   **Credit: 4**
Course Code: SIAS BT 2 1 01 DCEC 4004   **Contact hours: 60**

Course objectives:

- To provide detailed understanding and applications of major Omics technologies such as genomics, transcriptomics, proteomics and metabolomics etc.

- To provide knowledge about the data analysis of next generation sequencing.

Learning outcomes:

- Understanding of modern Omics technologies in the field of biotechnology.

- Understanding of data analysis generated through next generation sequencing.

- Better understanding of the applications of the Omics technologies in different industries.

Unit-I

    Genomics: Major genome sequencing projects, Next Generation Sequencing technologies, File formats, Basic pipeline for data analysis – quality check, adaptor trimming, Genome assembly, Genome annotation, Concepts of sequencing coverage and sequencing depth, phred score, N50, Introduction to different tools and algorithms, Data repositories and databases, Choice of sequencing platforms, Applications of genomics using case studies

Unit-II

    Transcriptomics: Introduction to typical wet lab workflow, library preparation, and analysis pipeline, Choice of sequencing methods and tools for read mapping, assembly, identification of splicing variants and differential expression analysis, Tools available for pathways analysis, Gene Ontology, Hypergeometric enrichment analysis, Biogenesis, characteristics and analysis of small RNA like microRNAs and phasiRNAs, Analysis of long non-coding RNAs, Target prediction and functional prediction for small RNAs and lncRNAs, Applications of transcriptomics using case studies

Unit-III

    Proteomics: Basic tools and techniques for protein separation and analysis, Mass spectrometry based proteomics: basic workflow and analysis pipeline, Quantitative proteomics and multiplexing, large scale analysis of protein modifications. Software packages and available tools for proteomics data analysis. Applications of mass spectrometry and proteomics using case studies.

Unit-IV

    Metabolomics: Tools and techniques available for metabolomics analysis, targeted vs non-targeted metabolomics, experimental design and sample preparation, workflow,

data analysis tools and repositories, data formats and key challenges, metabolite identification, metabolic fingerprinting, applications of metabolomics.

Suggested Readings:

1. Bioinformatics for omics data: methods and protocols (2011), Mayer, B., New York: Humana Press. ISBN 978-1617790270

2. Omics: Applications in Biomedical, Agricultural, and Environmental Sciences (2013), Barh D., Zambare V., Azevedo V. CRC Press. Taylor and Francis Group. ISBN 9781138074750

3. Applications of Advances Omics Technologies: from Genes to Metabolites (2014), Wilson and Wilsons. Elsevier. ISBN: 9780444626509

4. Genomics, Proteomics and Metabolomics in Nutraceuticals and Functional Foods (2015), Bagchi D., Swaroop A., Bagchi M. Wiley Blackwell. ISBN:9781118930427

5. Principles of Proteomics (2013), Twyman, R., Garland Science, ISBN: 978-0815344728

Course Title: Advances in Genetic Engineering   **Credit: 4**

Course Code: SIAS BT 2 1 02 DCEC 4004   **Contact hours: 60**

Course objective: To provide basic and high throughput techniques in the areas of genomics and genetic engineering.

Learning outcomes:

- Understanding of various model organisms used in Biotechnology

- Understand concept of genetic engineering including the techniques, applications and limitations
- Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation

Unit-I

Different model organisms used in biology and applied sciences research- *E. Coli*, *Saccharomyces crevices*, *Pichia pastoris*, Drosophila, *Arabidopsis*, Mice, Rat, etc; tools and techniques used in manipulation of their genome.

Unit-II

Genetic engineering and genome editing of agricultural crops – target traits such as yield, disease resistance, biotic and abiotic stress tolerance; phytoremediation using genetically modified plants; economic and environmental impact of genetically modified crops using real-time examples from already released varieties in different countries and current literature.

Unit-III

Genetic engineering of livestock including fish & poultry- target traits such as yield, disease resistance, biotic and abiotic stress tolerance; gene introgression through genome editing; bioremediation using genetically modified microbes & animals; transgenic animals and xeno-transplantation; economic and environmental impact using real time examples from current literature; ethical, moral and legal issues.

Unit-IV

Over expression of genes in heterologous systems; advantages and disadvantages of different heterologous systems for production of proteins, enzymes, monoclonal antibodies, vaccines; gene pharming and human pharmaceutical proteins.

Suggested readings:

1. Genome editing in animals, Methods and protocols (2017) Hatada I. Springer Nature, ISBN: 978-1-4939-7128-2.
2. CRISPER- methods and protocols (2015) Lundgren M, Charpentier E and Fineran P. Springer Nature, ISBN: 978-1-4939-2687-9.
3. Mammalian and avian transgenesis new approaches (2006) Pease S and Lois C. Springer Nature, ISBN: 978-3-540-28489-5.
4. Principal of cloning 2nd edition, Jose C, Keith HS Campbell JG, Ian W, Robert L. Academic Press, ISBN 978-0-12-386541-0.
5. Transgenic Plants Methods and Protocol (2012) Dunwell JM, WettenAC.Springer Nature, ISBN 978-1-61779-558-9.
6. Transgenic plants: a production system for industrial and pharmaceutical proteins Meran RL, Owen and Jan P. 1st ed., Wiley, ISBN: 978-0471964438.

7. Transgenic plant technology for remediation of toxic metals and metalloids (2019) Majeti N, Vara P, Academic press, ISBN: 978-0-12-814389-6.
8. Chen Z, Robert W and Han Z (2016) Genetically modified food: A critical review of their promise and problems. Food Science and Human Wellness, 5(3), 116-123.
9. Kamle M, Kumar P, Patra JK, Bajpai VK (2017) Current perspective on genetically modified crops and detection methods, 3 Biotech. 7(3): 219,
10. Ruchir R (2017) The Impact of genetically modified crops in modern agriculture-A review GM Crops Food. 8(4): 195–208.