**Central University of Haryana**
**School of Interdisciplinary and Applied Sciences**
**Department of Biochemistry**

**Ph.D. Biochemistry**
**SCHEME AND CURRICULUM (2021-22)**

| Semester | Core/Elective | Course code | Title of the paper | Credit |
|---|---|---|---|---|
| I | Core | SIAS BC 02 01 01 C 4004 | Research Methodology | 4 |
| | Core | SIAS BC 02 01 02 C 4004 | Advanced Analytical Techniques | 4 |
| | Core | SIAS BC 02 01 03 C 2002 | Research and Publication Ethics (RPE) | 2 |
| | Elective | SIAS BC 02 01 01 E 4004 | Advanced Biochemistry | 4 |
| | Elective | SIAS BC 02 01 02 E 4004 | Advanced Immunology | 4 |
| | **Total** | | | **14** |

**Course title: Research Methodology** **Credit: 4**

**Course code: SIAS BC 02 01 01 C 4004** **Lectures: 60**

**Course objective:** To provide knowledge about tools and techniques related with scientific communication, research methodology and biosafety in biological experiments.

**Learning outcomes:**

- Understanding the existence of scientific knowledge
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies
- Understand the importance and level of biosafety
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**Unit 1. 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; Defining a research problem.

**Unit 2. Experimental approaches and methodology**

Experimental designs to address the research problem; Pros and cons of different experimental strategies; Finalization of experimental design; Tools and techniques to execute experiments; Means to validate and analyze data; Use of statistical tools for analyzing the significance and interpretation of the data; Methods of recording observations and documentation

**Unit 3. Presentation and publication**

Skills for scientific writing and research presentation – Term paper, Research project, Research report, Thesis, Research article and Review; Organization of the research document in to different sections (Introduction, Methodology, Results, Discussion, and Summary and Conclusions, Bibliography); Oral presentation skills. Use of electronic tools for bibliographic formatting and checking Plagiarism.

**Unit 4. Protection of Research Data.**

Patents and Intellectual property rights. Patent filing Indian & abroad. Patent search.

## Suggested readings


1. Rumsey DJ. Statistics essentials for dummies for dummies; 1 edition. 2019
2. Blokdyk G. Biosafety level A Complete Guide. 5STARCooks. 2019
3. Nambisan P. An Introduction to ethical, safety and intellectual property rights issues in Biotechnology. Academic Press; 1 edition. 2017
4. Gastel, Barbara, and Robert A. Day. How to write and publish a scientific paper. ABC-CLIO, 2016
5. Ruxton DG, Colegrave N. Experimental design for the life sciences. Oxford University Press; 4 edition. 2017

**Course title: Advanced Analytical Techniques** **Credit: 4**

**Course code: SIAS BC 02 01 02 C 4004** **Lectures: 60**

**Course objective:** To provide an advanced understanding of the core principles of various techniques used in biological experiments.

**Learning outcomes:**

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

**Unit 1. Recombinant DNA techniques and genomics**

Use of Restriction and modification enzymes in cloning; Plasmid vector; Transformation and Plasmid isolation; DNA sequencing (Sanger's chain termination method, and automated DNA sequencing); Next generation sequencing (NGS); Real time PCR and Microarrays, Electrophoretic Mobility Shift Assay (EMSA).

**Unit 2. Proteomics**

UV and fluorescence spectroscopy; Circular Dichroism; Mass spectrometry, Chromatography; Gel filtration, Ion exchange and Affinity chromatography. 2D gel electrophoresis; Immunochemical detection of proteins, HPLC, ELISA.

**Unit 3. Microbial and cellular techniques**

Microscopic techniques; Compound, Phase-contrast, Confocal and Electron Microscopy, Cell disruption and fractionation of organelles; Isolation and purification of membrane proteins; cell-cell and cell-virus fusion methods; Flow cytometry, Atomic Force Microscopy; Types of Biosafety cabinets.

**Unit 4. Animal models in biology**

Handling and maintenance of animals, Ventilated cages, Different routes of injections and collection of various biological components, Formulation of feed and design of experiment.

**Suggested readings**


1. Blokdyk G. Analytics Techniques: A Complete Guide.5STARCooks. 2019
2. Rune M. Mass Spectrometry Data Analysis in Proteomics.Humana; 3rd ed. 2020
3. Hofmann A, Clokie S.Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.Cambridge University Press; 8 edition. 2018
4. Freshney, R.I. Culture of Animal cells: A Manual of Basic Technique and specialized applications. 7th edition. Wiley-Blackwell. 2016
5. Brown TA. Gene cloning and DNA analysis: An introduction.Wiley-Blackwell; 7th edition. 2016

**Course title: Research and Publication Ethics** **Credit: 2**

**Course code: SIAS BC 02 01 03 C 2002** **Lectures: 30**

**Course objective:** To learn philosophy of science, research misconduct and integrity, publication plagiarism and ethics.

**Learning Outcomes:**

- Learn to identify the FFP in research and ethics of publication.
- Hands on session help to find research misconduct, predatory publication, publications metrics and plagiarism.
- To learn database citation and indexing of publication.

***Part A: THEORY***

**Unit1 Philosophy & ethics**

Introduction of Philosophy; definition, nature and scope, concept, branches. Ethics; definition, moral philosophy, nature of moral judgments and reactions.

**Unit II Scientific conduct**

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific Misconduct; falsification, fabrication and Plagiarism (FFP), Redundant publications; duplicate and overlapping publications, salami slicing.

**Unit III Publication ethics**

Publication ethics; definition, introduction and importance. Best Practices/ standards setting initiatives and guidelines: COPE, WAME etc., Conflict of Interest, Publication misconduct: definition, concept, problems lead to unethical behavior and vice-versa, types, Violation of publication ethics, authorship and contributor-ship, Identification of publication misconduct, complaint and appeals, Predatory publications and journals.

***Part B: PRACTICE***

**Unit IV Open access publishing**

Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright and self-achieving policies, Software tools to identify predatory publications developed by SPPU, Journal finder Journal suggestion tools vis. JANE, Elsevier journal finder, Springer journal suggested etc.

**Unit V Publication misconduct**

Group discussion; Subject specific ethical issues, FFP, Authorship, Conflict of interest, Complaint and appeals; example and fraud from India and abroad. Software tools; turnitin, urkund and other open source plagiarism tools.

**Unit VI Database and research metrics**

Database: Indexing citation database; Web of Science and Scopus etc., Research metrics; Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite score, Metrics; h index, g index, i10, altmetrics.

**Suggested readings**


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

**Course title: Advanced Biochemistry** **Credit: 4**

**Course code: SIAS BC 02 01 01 E 4004** **Hour: 60 hour**

**Course objective:** To understand the biochemistry of biomolecules and their role in research

**Learning Outcome**

- Understanding of basic principles of Biochemistry
- Understanding proteins, proteomics and enzymes, computational biochemistry and cell culture

**Unit I: Biological macromolecules**

Carbohydrates-Structure, reactions and functions of monosaccharides, disaccharides, polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins. Glycolysis, TCA Cycle. Lipids - Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids and lipoproteins. Fatty acid oxidation and synthesis. Nucleic acids - Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations.

**Unit II Protein, proteomics and enzymes**

Protein Structure, stabilizing forces of protein, Protein Isolation, Proteomics- 2D gel electrophoresis, 2DIGE, free flow electrophoresis, blue native gel electrophoresis, Mass spectrometry in proteomics, tagging methods for MS proteomics, isotope coded affinity tagging, tagging for tandem MS, Enzyme- working mechanism, Enzyme kinetics– Michaelis-Menten, Briggs and Haldane theory (rapid equilibrium and steady state theory). Pre-steady state kinetics, Enzyme Inhibition: Types of reversible inhibitors, Partial inhibition, substrate inhibition and allosteric inhibition. Industrial Enzymes.

**Unit III: Computational biochemistry**

Properties of amino acids and peptide bonds, Ramachandran Plot. Motifs and Folds; Protein structure related databases, Protein Data Bank format, Structure visualization of proteins. Protein Fold Classification, Protein structure comparison, CATH and SCOP Databases. Protein structure prediction methods. Homology modeling. Molecular Docking and Drug design (Basic concepts).

**Unit IV Immunology and cell culture**

Host Defense systems; Hematopoiesis, cells of the immune system; Components and connections between Innate and Adaptive Immunity; Immunoglobulins (Ig) and their organization; Complement system; Structure Function and Organization of MHC. Cell and tissue culture types and techniques, organ, callus, cell suspension and protoplast culture. Organogenesis, somatic

embryogenesis and somoclonal variation. Transfection techniques, applications of animal culture. Stem cells-basis and differentiation.

**Suggested readings**


1. Palmer T. Enzymes. East – West Press Pvt. Ltd., Delhi. 2004
2. Colowick SP., et al., Methods in Enzymology; Vol. 152, Academic Press. 1987
3. Nicholas C. Price and Lewis Stevens. Fundamentals of Enzymology; 3rd Edn. Oxford University Press. 2012
4. Voet D. Fundamentals of Biochemistry John Wiley & Sons. 2016
5. Bourne PE, Gu J. Structural Bioinformatics (2nd edition), John Wiley & Sons, New York. 2009

**Course title: Advanced Immunology** **Credit: 4**

**Course code: SIAS BC 02 01 02 E 4004** **Hour: 60 hour**

**Course objective:**

To understand the cellular components of the immune system and their corresponding immune responses in normal and deregulated systems

**Learning Outcome**

- Review basic principles of Immunology
- Understanding molecular mechanism of dysregulation and disorders associated when immune system fails
- Understand mechanisms by which the immune system and cells interact to affect nervous system and tumor growth
- Explore therapies and various strategies being developed and employed to manipulate cell-cell interactions in immune-pathological situations.

**Unit-I**: **Introductory immunology: molecules and mediators**

Host Defense systems; Hematopoiesis, cells of the immune system; Components and connections between Innate and Adaptive Immunity; Immunoglobulins (Ig) and their organization; Complement system; Structure Function and Organization of MHC.

**Unit-II**: **Breaking tolerance: autoimmunity & dysregulation**

Deficiencies/Defects of Immune Cells; Central & Peripheral Tolerance; Mucosal Immunity & Immunopathology; Regulation of Immunity & the Microbiome; Epigenetics & Modulation of Immunity; Hypersensitivity; Inflammation and autoinflammation; T cell mediated autoimmune diseases; Antibody-mediated autoimmune diseases; Infectious Diseases; Transplantation; Immune Regulation in Pregnancy.

**Unit-III: System immunology: Stem cell/cancer and neuro immunology**

Stem Cell and Cancer Immunology; Tumor Origination and Progression; Tumor Antigens; Immunosurveillance; Immune Cell Trafficking; Immune response during Metastasis and Invasion Neuroimmunology Blood-Brain Barrier; Brain tumours; Acute, Persistent and latent neurotropic viral infections; Bacterial and parasitic infections; Myasthenia Gravis and Guillain-Barre; Alzheimers; Transmissible spongiform encephalopathies.

**Unit-IV: Applications and immunotherapy**

Cytokines and their Therapeutic uses; Antibody and Vaccine development strategies (Recombinant, Combined and polyvalent vaccines); DC Vaccines; Methods to evaluate immune responses; Recent techniques in Immuno-disorder diagnostics; Current topics in Immunotherapy: Success and failures.

**Suggested Reading**


1. Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company. Kuby Immunology. 8th ed. 2018. ISBN: 978-1319114701.
2. Murphy KM and Beaver C, WW Norton and Company. Janeway's Immunobiology 9th ed. 2017. ISBN: 978-0815345510.
3. Delvis PJ, Martin SJ, Burton DR and Roitt, IM. Roitt's Essential Immunology. 13th ed., Wiley-Blackwell. 2017. ISBN: 978-1118415771.
4. Cancer Immunotherapy (Second edition), edited by Prendergast and Jaffee
5. Robert Weinberg. The Biology of Cancer (2nd edition). Garland Science