

Central University of Haryana
School of Interdisciplinary and Applied Sciences

Department of Pharmaceutical Sciences

SCHEME AND SYLLABUS

Ph.D. Course Work (Pharmaceutical Sciences)
(w.e.f. 2021-22)



Department of Pharmaceutical Sciences
CENTRAL UNIVERSITY OF HARYANA,
MAHENDERGARH, HARYANA

SCHEME AND CURRICULUM

Semester	Core /Elective	Paper Code	Title of the Paper	Credit
I	CC	SIAS PS 02 01 01 C 4004	Research Methodology (RM)	4
	CC	SIAS PS 02 01 02 C 4004	Advanced Pharmaceutical Research (APR)	4
	CC	SIAS PS 02 01 03 C 2002	Research and Publication Ethics (RPE)	2
	EC	SIAS PS 02 01 04 E 4004 SIAS PS 02 01 05 E 4004 SIAS PS 02 01 06 E 4004	To be opted by students from any department of the School	4
Total=14				

C: Core; E: Elective

List of EC offered by the Department of Pharmaceutical Sciences:

1. CNS Pharmacology (SIAS PS 02 01 04 E 4004)
2. Novel Drug Delivery Systems (SIAS PS 02 01 05 E 4004)
3. Natural Product Research Techniques (SIAS PS 02 01 06 E 4004)

Course: Research Methodology
Course code: SIAS PS 01 01 01 C

Credit: 4
Lectures: 60

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

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. Ethics and Safety in Biological Research

Guidelines for Biosafety and Bioethics; Institutional Biosafety Committee – Handling of Genetically modified organisms, Institutional Human and Animal Ethics Committee - compliance, concerns and approval; Safety practices and disposal of Bio-waste in the laboratory; Radioactivity and safety precautions; Handling and disposal of flammable and hazardous chemicals.

Unit 4. Presentation, Publication and Protection of Research Data

Development of 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); Use of electronic tools for bibliographic formatting and checking Plagiarism; Development of Oral presentation skills; Patents and Intellectual property rights

Students are expected to undertake the following assignments, exercises for evaluation.

1. Identification and selection of the broad area of research
2. Review of literature, formulation of research plan and submission of term paper along with references
3. Oral presentation of research plan and experimental design

Evaluation will be based on term paper and oral presentation

Suggested Readings

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Principles of Research Methodology: A Guide for Clinical Investigators (2012) 1st ed., Supino, Phyllis G., Borer, Jeffrey S, Springer, ISBN: 978-1-4614-3360-6.
3. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.
4. Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.
5. Doing Science: Design, Analysis, and Communication of Scientific Research. (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
6. Beauchamp T.L., Walters L., Kahn J.P. & Anna C. *Contemporary issues in Bioethics*. Wardsworth Publishers. Co. 2013. Print
7. Cross C.L. and Wayne W.D. *Biostatistics: Basic Concepts and Methodology for the Health Sciences*. 10th edition, Wiley. 2014. Print
8. Davis, G.B. and Straub D.W. *Writing the doctoral dissertation*. 3rd edition. Barron's Educational series. 2012. Print
9. Deepa Goel. *IPR, Biosafety and Bioethics*. 1st edition. Pearson Education. 2013. Print
10. Krishnaswamy, K.N., Mathiranjani M., and Sivakumar, A.I. *Management Research Methodology; Integration of Principles, Methods and Techniques*. Pearson Education. 2011. Print
11. Montgomery, Douglas C. *Design and Analysis of Experiments*. 8th edition. Wiley. 2013. Print
12. Rao S and Richard J. *Introduction to Biostatistics and Research Methods*. 5th edition. Prentice Hall India Learning Private Limited. 2012. Print
13. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
14. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
15. <http://dbtindia.gov.in/guidelines-biosafety>

Course objective: To provide knowledge about tools and techniques required to carry out Pharmaceutical research.

Learning Outcomes:

- Explain advanced proteomic and genomic techniques used in the drug discovery process.
- Elucidate basic cell culture techniques along with demonstration.
- Explain the cell signaling mechanisms implicated in various diseases

Unit 1.

Proteomics

UV and fluorescence spectroscopy; Protein separation techniques and instrumentation (Gel filtration, Ion exchange and Affinity chromatography, Sodium dodecyl sulphate–polyacrylamide gel electrophoresis (SDS-PAGE), Two-dimensional gel electrophoresis (2D-PAGE), Two-dimensional difference gel electrophoresis (2D DIGE); Protein Microarray: Different types; Mass spectrometry: Principles and their applications, Immunochemical detection of proteins.

Genomics

Genome Organization; Gene Sequencing; Gene mapping; Polymerase chain reaction (PCR), RT-PCR, Real-Time PCR; RNA-interference; Recombinant DNA technology; Gene therapy; Pharmacogenomics.

Unit 2. OECD Guidelines

Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines; Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies.

Unit 3. Cell culture techniques

Basic equipments used in cell culture lab; Types of Biosafety cabinets; Cell lines; various types of cell culture; Cell culture media; General procedure for cell cultures: isolation of cells, subculture, cryopreservation, Detection of contamination, characterization of cells and their application. Principles and applications of cell viability assays; Flow cytometry techniques; Confocal and Atomic Force Microscopy.

Unit 4. Cell Signaling

Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol (DAG); Detailed study of following intracellular signaling pathways: Nrf2-ARE signaling, NF- κ B signaling; Cannabinoid signaling; Endoplasmic reticulum stress, PARP-over-

activation, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway.

SUGGESTED READINGS

1. Ausubel FW. Current Protocols in Molecular Biology. Wiley-Blackwell. 2011. Print
2. The Cell, A Molecular Approach. Geoffrey M Cooper.
3. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M -L. Wong
4. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
5. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al
6. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller
7. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
8. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
9. Current protocols in molecular biology vol I to VI edited by Frederick
10. M.Ausuvel et la. Butler, M. Animal Cell Culture & Technology. 1st edition. Tailor & Francis Publishers (UK). 2004. Print
11. Freshney, R.I. Culture of Animal cells: A Manual of Basic Technique and specialized applications. 7th edition. Wiley-Blackwell. 2016. Print

Course title: Research and Publication Ethics (as per UGC guidelines)

Credit: 2

Course code: SIAS PS 01 01 03 C

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

(3 hrs)

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

Unit II Scientific Conduct

(5 hrs)

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

(7 hrs)

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

(4 hrs)

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 suggester etc.

Unit V Publication Misconduct

(4 hrs)

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

(7 hrs)

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.

Course: CNS Pharmacology

Credit: 4

Course code: SIAS PS 01 01 04 E

Lectures: 60

Course objective: To understand and identify the basic neuroscience with cellular and molecular basis of CNS-associated disorders.

Learning outcomes:

- Understanding the concept of receptors and basic neuroscience
- Explain the pathophysiology of various CNS diseases
- Understanding of animal models used for drug screening and elucidation of molecular mechanisms.
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Unit 1. Introduction to receptors:

The differences between ionotropic and metabotropic receptors, tyrosine receptor kinases and steroid receptors; interactions between metabotropic receptors and the different types of G proteins and adenylate cyclase. Involvement of G proteins and adenylate cyclase in signal transduction and the role of transcription factors; calcium homeostasis

Unit 2. Systems Neuroscience:

Communication between neuron, neuronal plasticity and cellular and molecular mechanisms of learning and memory; Sensory systems; Aplysia and hippocampal physiology; Uses of neural networks.

Unit 3. Pathophysiology of brain disorders:

Molecular and cellular mechanisms underlying the pathophysiology of Alzheimer's, Parkinson's, motor neuron; mood disorders; Ischemic Brain injury and Epilepsy; Neuropathology of the dementias; free radical damage; Excitotoxicity; Epigenetic influences on Brain disorders

Unit 4. Animal Models: Behavioral and muscle co-ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, Cerebral ischemia, anti-epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimer's and Huntington.

Suggested Readings

1. Screening methods in pharmacology (vol I & II), R.A. Turner, 1st edition; eBook ISBN: 9781483264233.
2. Neurobiology of Brain Disorders: Biological Basis of Neurological and Psychiatric Disorders 1st Edition, Michael Zigmond Joseph Coyle Lewis Rowland; ISBN: 9780123982704.
3. Systems Neuroscience, 1st edition, Cheung-Hoi YU, Albert, Li, Lina (Eds.) ISBN 978-3-319-94593-4.

Course: Novel Drug Delivery Systems

Credit: 4

Course code: SIAS PS 01 01 05 E

Lectures: 60

Course objective: The course is designed to describe novel drug delivery systems.

Learning outcome:

- Learning of various novel drug delivery systems.
- Understanding the disease/organ/cell based targeting approaches

Unit 1. Introduction to Novel drug delivery systems:

Principles of drug targeting and molecular basis of targeted drug delivery:

Receptor mediated endocytosis; Different levels of targeting-first order, second order and third order targeting; Different types of targeting-active and passive targeting.

Physico-chemical approaches of targeting: Stimuli responsive: Magnetically, thermal and pH assisted drug delivery systems, Chemical drug delivery (prodrugs), Lipid-drug/Polymer- drug conjugates

Unit 2. Disease based targeting approaches:

Novel approaches to target diseases and disorders such as cancer and infectious diseases, exploitation of disease environment for the targeted delivery of therapeutics.

Unit 3. Organ based targeting:

Novel strategies for CNS, pulmonary, liver, and colon targeting.

Unit 4. Cell/Organelles based targeting:

Mitochondria, Nuclear targeting, lymphatics/M cells, liver parenchymal cells/macrophages, hepatocytes and bone marrow cells.

Suggested Readings

1. Novel Drug Delivery System, Y.W. Chein, Vol 50, Marcel Dekker, NY.
2. Controlled Drug Delivery Systems, Robinson, Vol 29, Marcel Dekker, NY.
3. Transdermal Controlled Systemic Medications, YW Chein, Vol 31, Marcel Dekker, NY.
4. Bioadhesive DDS, E. Mathiowitz, Vol 98, Marcel Dekker, NY.
5. Nasal System Drug Delivery, K.S.E. Su, Vol 39, Marcel Dekker, NY.
6. Drug Delivery Devices, Vol 32, P Tyle Marcel Dekker, NY.

7. Polymers for Controlled Drug Delivery, P.J. Tarcha, CRC Press.
8. Pharmaceutical Biotechnology, Vyas, CBS, Delhi.
9. Biotechnology of Industrial Antibiotics, E.J. Vandamme, Marcel Dekker, NY.
10. Protein Formulation & Delivery, E.J. McNally, Vol 99, Marcel Dekker, NY.
11. Drug Targeting, M.H. Rubinstein, John Wiley, NY.

Course Title: Natural Product Research Techniques

Credit: 4

Course Code: SIAS PS 01 01 06 E

Lectures: 60

Course objective: The course is designed to describe the separation of compounds from multicomponent samples.

Learning outcome:

- Learning of various novel separation and extraction techniques.
- Understanding the basics and application of spectral techniques in natural products

Unit 1.

- a. Extraction/fractionation techniques in Natural products.
- b. Selection of TLC/HPTLC plates and sorbents, sample preparation, sample clean up, application of sample, selection of mobile phase, development (separation), factors influencing HPTLC separation, detection/visualization, instrumentation, densitometric scanners, selection of suitable wavelengths for scanning, in-situ scanning. Preparative TLC, dual-phase TLC, reverse phase TLC, flexibility and efficiency, quantification of results, documentation, purity profile of drug substances, validation of analytical parameters, comparative evaluation of HPTLC and HPLC. TLC and reversed-TLC of unknown commercial herbal products and drugs, detection and classification of components, qualitative and quantitative estimation of active constituents, analysis of herbal drug mixtures, electroplanar chromatography/electrophoresis.

Unit 2.

High performance liquid chromatography (HPLC):

Basic principles of separation, Resolution, minimum resolution, resolution as a function of solvent strength, selectivity and plate number, strategies to improve resolution, sample size effect on resolution, systematic approach to method development; Sample preparation; HPLC sorbents; Semi-preparative and preparative HPLC systems.

Column and Flash Chromatography:

Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications.

Unit 3. Hyphenated techniques:

Basic principles and applications of LC-MS, LC-NMR, and supercritical fluid chromatography

Unit-4. Spectral Techniques in Natural products:

Theory, Principle, Instrumentation and interpretation of UV, IR, NMR, and Mass Spectroscopy

Suggested readings:

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers
5. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series