

**Course Structure of Ph.D. Course Work – Pharmacy**

**Applicable from 2021 Onwards**

**DIT UNIVERSITY**

**Dehradun**



**Detailed Course Structure**

**of**

**Ph.D. Course Work – Pharmacy**

## **Course Structure of Ph.D. Course Work – Pharmacy Applicable from 2021 Onwards**

Course Category	Course Code	Course Title	L	T	P	Credit
UC	MB901	Research Methodology	4	0	0	4
DE		Elective 1	4	0	0	4
DE		Elective 2	4	0	0	4
DC	PH711	Seminar	1	0	0	1
	CPE-RPE	Research Publication Ethics	2	0	0	2

<b>List of Electives(select any two)</b>					
PH 741	Drug Regulatory Affairs	4	0	0	4
PH742	Targeted Drug Delivery Systems	4	0	0	4
PH743	Advance Pharmaceutics	4	0	0	4
PH744	Pharmacological Screening methods	4	0	0	4
PH745	Advanced Molecular Pharmacology	4	0	0	4
PH 746	Herbal Drug Manufacturing Technology	4	0	0	4
PH 747	Standardization and Pharmacological screening of herbal preparations	4	0	0	4
PH748	Advance Drug Designing	4	0	0	4
PH749	Modern Instrumental Techniques	4	0	0	4
PH750	Advance Synthetic Chemistry	4	0	0	4

***Note: Apart from above listed Elective courses, Research Scholar may choose any course across departments being offered at PG level, if it is required/suggested by the Research Committee.***

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Subject Code	MB901	Subject Title	Research Methodology						
LTP	4 0 0	Credit	4	Subject Category	UC	Year	1 <sup>st</sup>	Semester	I / II

### UNIT – I

**Fundamentals of Research:** Defining research, Objectives of research, types, research process, deductive and inductive reasoning;

Identifying and formulating a research problem, Literature review: Search for existing literature (World Wide Web, Online data bases), Review the literature selected (Case studies, review articles and Meta-analysis), Develop a theoretical and conceptual framework, Writing up the review,

Definition of variables: Concepts, indicators and variables, Types of variables, Types of measurement scales, Constructing the Hypothesis- Null(Research) and alternative, one-tailed and two-tailed testing, errors in testing. Ethical and Moral Issues in Research, Plagiarism, tools to avoid plagiarism – Intellectual Property Rights – Copy right laws – Patent rights

### UNIT – II

**Research Design:** Design of Experiments: Research Designs -Exploratory, Descriptive and Experimental, Experimental designs- Types of Experimental Designs

### UNIT – III

**Sampling, Sampling distribution, and Data Collection:** Sampling distribution, Normal and binomial distribution, Reasons for sampling, sampling technique, sampling errors. Sources of Data-Primary Data, Secondary Data, Data Collection methods

### UNIT – IV

**Statistical Data Analysis:** Descriptive and inferential statistical analysis. Testing of hypothesis with Z-test, T-test and its variants, Chi-square test, ANOVA, Correlation, Regression Analysis, Introduction to data analysis data using SPSS20.0

### UNIT – V

**Research Report:** Writing a research report- Developing an outline, Formats of Report writing, Key elements- Objective, Introduction, Design or Rationale of work, Experimental Methods, Procedures, Measurements, Results, Discussion, Conclusion, Referencing and various formats for reference writing of books and research papers, Writing a Research Proposal.

### Books Recommended:

1. Ganesan R, Research Methodology for Engineers , MJP Publishers, Chennai. 2011
2. C.R.Kothari, "Research Methodology", 5<sup>th</sup> edition, New Age Publication,
3. Cooper, "Business Research Methods", 9<sup>th</sup> edition, Tata McGraw hills publication
4. Walpole R.A., Myers R.H., Myers S.L. and Ye, King: Probability & Statistics for Engineers and Scientists, Pearson Prentice Hall, Pearson Education, Inc. 2007.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bordens K.S. and Abbott, B.b.: Research Design and Methods, McGraw Hill, 2008.
7. Morris R Cohen: An Introduction to logic and Scientific Method (Allied Publishers) – P 197-222; 391–403

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## Applicable from 2021 Onwards

<b>Subject Code</b>	<b>PH741</b>	<b>Subject Title</b>	<b>Drug Regulatory Affairs</b>						
<b>LTP</b>	<b>4:0:0</b>	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	<b>1<sup>st</sup></b>	<b>Semester</b>	I

### Course Outline:

This course is designed to impart knowledge and skills necessary for implementation of various regulatory aspects including the patent filing of any invention & also knowledge on conducting holistic research as per the GLP guidelines

### Course Objective:

The course is designed with following objectives

Upon completion of this course it is expected that the scholars will be able to implement the various regulatory principles in their professional practices and they can conduct scientific research as per GLP guidelines.

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### Unit I

- i) Indian Patent Act
- ii) Indian Patent Filing, Drafting, Writing Claims and various Forms for Filing.

#### Unit II

- i) Regulatory Regulations for MHRA, USFDA, CDSCO

#### Unit III

Good Laboratory Practices (GLP), Schedule M, Inter Regulatory Prospects on Bioavailability and Bioequivalence

#### Unit IV

- i) Clinical Ethical Regulatory Issues of Nanotechnology and Nanoparticles
- ii) Regulatory Issues on Pharmaceutical Excipient Techniques

#### Unit V

U.S. Patent Act  
Text Book: Title, Author, Publication House, Edition, Year

### Learning Outcome

Upon completion of this course the students will be able to:

Upon completion of this course it is expected that the scholars will be able to implement the various regulatory principles in their professional practices and they can conduct scientific research as per GLP guidelines.

### Recommended Books (Latest edition):

- I. GLP Regulations, 2<sup>nd</sup> Edition, Revised and Expanded by Sandy Weingberg.
- II. GMP Practices in Pharmaceuticals, Sidney H. WilligandJanes R Stokes
- III. Preparing for FDA preapproval Inspection: Martin D. Hynes
- IV. Drugs and Cosmetic Act (Schedule M)
- V. Gennaro A.R., Remington- The science and practice of pharmacy, Lippincott, Williams & Wilkins.
- VI. Banker G.S., Rhodes C.T., Modern Pharmaceutics, Marcel Dekker.
- VII. Malik Vijay, Drug & Cosmetics Act, 1940, Eastern Book Company, Lucknow.
- VIII. Guarino R.A., New Drug Approval Process, Marcel Dekker.
- IX. Sharma P.P., How to practice GMP, VandanaPrakashan, New Delhi.
- X. Sharma P.P., how to practice GLP, VandanaPrakashan, New Delhi,
- XI. World Health Organization, quality assurance of Pharmaceuticals I & I, Pharma Book Syndicate, Hyderabad.
- XII. Weinlerg S., Good Laboratory Practices, Marcel Dekker.
- XIII. The Patent Act, 1970
- XIV. The Trade Marks Act, 1999.
- XV. The Copyright Act, 1958.
- XVI. Potdar M.A., Current Good Manufacturing Practices for Pharmaceuticals, Pharma Med Press, Hyderabad.
- XVII. Rick N.G., Drug from Discovery to Approval, Wiley Black Well.
- XVIII. Swarlerick J., Boylan J., Encyclopedia / Pharmaceutical Technology Relevant Websites of Regulatory Authority of different countries.
- XIX. Introduction to the pharmaceutical regulatory process.Ira R. Berry

# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

<b>Subject Code</b>	PH742	<b>Subject Title</b>	Targeted Drug Delivery System						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

The course is designed to provide a knowledge on various drug targeted drug delivery system for effective delivery of therapeutics and nano formulations approaches for targeting drug to brain and cell specific region

### Course Objective:

The course is designed with following objectives

The research scholar will acquire a knowledge & basic concept for designing various nano formulations and factors to be considered while targeting a therapeutic molecule to brain & cell region

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### Unit I

An overview on DSS & Targeted DDS: Approaches, Approval, Mechanism & Research Updates

- i) Drug Targeting to Brain: Concepts, Approaches, Approval, Mechanism & Research Updates
- ii) Recent Brain Targeting Concept: Nose to Brain; Ear to Brain

#### Unit II

- i) Cell Specific Delivery: Concepts, Various Approaches and Recent Advances
- ii) Strategies for Specific Drug Targeting to Tumour Cells and Tumour Vasculature
- iii) Drug Delivery Applications of Nanoparticles and Nanotoxicology

#### Unit III

- i) Recent advances in Transmucosal Drug Delivery; Buccal; Soft Palatal, Trans-Labial
- ii) Ocular Drug Delivery

#### Unit IV

Targeted GI Delivery and Colon Targeting Specific Drug Delivery and Trans-Ungual

#### Unit V

- i) Self Emulsifying Drug Delivery System (SEDDS): Improving Absorption of poorly soluble drugs using SEDDS and Nano Self Emulsifying Drug Delivery System (NSEDDS)
- ii) Case Study On:
  - a) Development and Evaluation of SEDDS
  - b) Modified Release Solid Oral Dosage Forms

### Learning Outcome

Upon completion of this course the students will be able to:

The research scholar will acquire a knowledge & basic concept for designing various nano formulations and factors to be considered while targeting a therapeutic molecule to brain & cell region

### **Recommended Books (Latest edition):**

- i) Sterile Product facility design and Project Management; 2<sup>nd</sup> Edition, Jeffene Nodum, CRC Press
- ii) Modified Release Drug Delivery Techniques; Michael J. Rathbone (Marcel Dekker Inc.)
- iii) Pharmaceutical Skin Permeation Enhancement; Kenneth A. Waters and Jonathan Hadgrats
- iv) Physical Characterization of Pharmaceutical Solids; Harry G. Orittam
- v) Pharmaceutical Experimental Design; Gareth A. Lewis.
- vi) Surfactants polymer in drug delivery; Martin Malmsten
- vii) Drug delivery Nanoparticles formulation and characterization; Yashwant Pathak, Informa Publication
- viii) Dermatokinetics: S.N Murthy
- ix) Pharmaceutical Gene Delivery System; Alian Rolland

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## **Applicable from 2021 Onwards**

- x) Pharmaceutical Extrusion technology edited by IsaachGhebreSellossie
- xi) Compliance Handbook of pharmaceuticals, medical devices and biologics. Edited by Carmen Medina
- xii) Liposome technology (vol 1,2,3); Gregory Gregoriadis
- xiii) Pharmaceutical Manufacturing Encyclopedia; Marshall Sittig
- xiv) Pharmaceutical technology controlled drug release(vol:1,2,3)M.Rubinstein
- xv) Prodrug topical and ocular delivery; Kenneth B.Sloan
- xvi) Microencapsulation method and industrial application; Simon Benita
- xvii) Oral mucosal drug delivery system. Michail,J.rathbone

# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

<b>Subject Code</b>	PH743	<b>Subject Title</b>	Advance Pharmaceutics						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

The subject provides detailed knowledge on various physical and chemical factors and their role in designing effective therapeutic formulations to impart better therapeutic value

### Course Objective:

The course is designed with following objectives

The scholars will be able to apply various knowledge acquired related to designing suitable formulations by considering various physico-chemical factors of various excipients and their impact on their formulation stability and they can able to apply the knowledge for preparing various pharmaceutical dosage forms

### Course Pre/Co- requisite (if any) : Nil

### Detailed Syllabus

#### Unit I

- i) Basic Concepts of Solubility and Dissolution of Pharmaceutical Solids
- ii) Theoretical Estimation of Solubility
- iii) Thermodynamics of Solutions; Solubility by Combination of Approaches
- iv) Various Techniques for Solubilization, Experimental Methods of Determination of Solubility and its Conditions

#### Unit II

- i) Polymorphism and Transformation of Solids, Amorphous Drugs and Solid Dispersion; Analytical Techniques for Solid State Characterization; Salts Screening and Selection; Excipient Compatibility
- ii) Theory of Diffusion and Pharmaceutical Applications

#### Unit III

Polymers, Biopolymers and its properties, characterization and its applications

#### Unit IV

- i) Oral Drug Absorption, Evaluation and Prediction
- ii) Biopharmaceutical and Pharmacokinetic Evaluation of Drug molecules and Dosage Form

#### Unit V

- i) FDA Guidelines for Bioequivalence Study for NDSS
- ii) Developing predictive in-vitro test & In-vivo Evaluation for Oral Dosage Forms, Performance and In-Vitro/In-Vivo Correlation techniques and Approaches

### Learning Outcome

Upon completion of this course the students will be able to:

The scholars will be able to apply various knowledge acquired related to designing suitable formulations by considering various physico-chemical factors of various excipients and their impact on their formulation stability and they can able to apply the knowledge for preparing various pharmaceutical dosage forms

### Recommended Books (Latest edition):

- i) Developing Oral Solid Dosage Forms; Pharmaceutical Theory and Practice- Yihokiu, Academic Press
- ii) Foundation of Pharmacokinetic ACDO RESCIGNO Kulwer Academic Publishers
- iii) Handbook of Pharmaceutical Manufacturing Formulation (Volumes I, II, III, IV, V,VI);

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## **Applicable from 2021 Onwards**

Sarfaraz K. Niazi, CRC Press.

- iv) Handbook of Stability Testing in Pharmaceutical Development, Springer Publisher, Kim Huynh-Ba
- v) Handbook of Preformulation Sarfaraz K. Niazi, Informa Health Care
- vi) Pharmaceutical Preformulation and Formulation; Mark Gibson, HIS Health Gr
- vii) Pharmaceutical Product Development IVIVC, Dueshina Murthy Chilukasi Informa Health Care
- viii) Pharmaceutical Dissolution Testing, Jennifer Dressman, Taylor and Francis
- ix) Physical Pharmacy; David Attwood, PhP Pharmaceutical Press
- x) Spectroscopy of Pharmaceutical Solid; Janes S Warbrick, Taylor and Francis Group
- xi) Pharmaceutical Excipients Characterization by IR, Raman, NMR; David EiBugey and W. Paul Findlay
- xii) Polymorphism in Pharmaceutical Solid; Harry G Brittain
- xiii) Bioadhesive Drug Delivery: Fundamental, Novel approaches and development: Mathioneitzes
- xiv) Drug Delivery to Oral Cavity Molecules to Market; Tapash. K. Ghosh and Willian R. Pfister



# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

<b>Subject Code</b>	PH744	<b>Subject Title</b>	Pharmacological Screening methods						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

This subject is intended to impart the advanced knowledge on various screening principle and methods aspects of drugs acting on various systems of body and in addition, emphasis on the advances in toxicological screening using cell line technique.

### Course Objective:

The course is designed with following objectives

The research scholar will acquire a knowledge& advances in screening of various active using experimental animals and in-depth knowledge pertaining to toxicological screening of molecules using cell lines as per the regulatory guidelines.

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### Unit I

Laboratory animal handling and breeding techniques, CPCSEA guidelines, alternatives to animal studies, RRR concept. Animal research regulation and guidelines in USA, New Zealand, Canada, Europe and UK.

#### Unit II

Principles & types of bioassay, Bioassay of biological like vaccine and sera, immunoglobulin etc.

#### Unit III

Determination of LD50, Acute, sub-acute and chronic toxicity studies, Therapeutic index, OECD guidelines. Cell line toxicity.

#### Unit IV

Screening methods for evaluation of hepatoprotective, antihypertensive, antidepressant, antipsychotic, anti-inflammatory, analgesic, anticancer and anti-diabetic activity and drugs used for the treatment of brain disease and GI disorders.

#### Unit V

New drug discovery, Clinical evaluation of new drugs, Phases & types of clinical trials, protocol design, Ethics in human research, Pharmacovigilance.

GLP, GCP guidelines, CRF, IRB/IEC, inclusion criteria and exclusion criteria in Clinical research and recent amendment and advancement.

### Learning Outcome

Upon completion of this course the students will be able to:

The research scholar will acquire a knowledge& advances in screening of various active using experimental animals and in-depth knowledge pertaining to toxicological screening of molecules using cell lines as per the regulatory guidelines.

### **Recommended Books (Latest edition):**

1. Screening methods in Pharmacology, Vol.-1&2 by Robert .A. Turner and Peter Hebborn. 2. Drug discovery and evaluation by H.G.Vogel and W.H.Vogel, Springer-Verlag, Berlin Heidelberg.
3. Handbook of experimental pharmacology by S.K. Kulkarni, VallabhPrakashan, Delhi.
4. Textbook of clinical trials edited by David Machin, Simon Day and Sylvan green.

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## **Applicable from 2021 Onwards**

5. Principles of clinical research edited by Giovanna di ignazio, Di Giovanna and Haynes.
6. ICH of technical requirements for registration of pharmaceuticals for human use, ICH harmonized tripartite guidelines - Guidelines for good clinical practice, E6, May 1996.
7. Good clinical practice - Guidelines for Clinical trials on pharmaceutical products in India, Central drug standard control organization, New Delhi, Minister of Health- 2001.
8. <https://www.animaethics.org.au/legislation/international>
9. [www.who.int/tdr/publications/documents/glp-handbook.pdf](http://www.who.int/tdr/publications/documents/glp-handbook.pdf)
10. <https://www.ich.org/.../ICH.../Guidelines>
11. [www.oecd.org](http://www.oecd.org)

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## Applicable from 2021 Onwards

<b>Subject Code</b>	PH745	<b>Subject Title</b>	Advanced Molecular Pharmacology						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

The subject provides in depth knowledge on basic and advance concept of drug molecular mechanisms. Approaches for gene therapy and stem cell therapy used for the treatment of different diseases.

### Course Objective:

The course is designed with following objectives

The research scholar will acquire a knowledge & research advances in molecular mechanism of drug molecule and concept and therapeutic management in multi-drug resistance disease like tuberculosis, leprosy etc.

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### Unit I

Molecular mechanism of drug action: Receptor occupancy and cellular signaling systems such as G-proteins, cyclic nucleotides, calcium and phosphatidyl inositol, enzymes, nuclear transcription factors, Ionic channels and their modulators.

#### Unit II

Ion channel and their modulators: calcium, potassium, sodium and chloride channels

#### Unit III

Recent trends on different classes of receptors as follows and drugs acting on them Dopamine receptors, Serotonin receptors, GABA and Benzodiazepine receptors, Opioid receptors, Glutamate receptors and Histamine receptor.

#### Unit IV

Endogenous bioactive molecules: Cytokines, nitric oxide, phosphodiesterase enzyme, arachidonic acid metabolites, COX-2 regulators and their role in inflammation, Angiotensin, Bradykinin, endogenous opioids.

#### Unit V

Gene and stem cell Therapies: Basic concepts and clinical potentials of gene therapy and stem cell therapy, Impact of human genome sequence on the discovery of newer pharmacological agents. Ethical issues related to stem cells and human cloning.

Multi-drug resistance mechanism and causes in virus, bacteria, fungus and parasitic diseases, its Pharmacoepidemiology and recent research advancement in therapeutic management.

### Learning Outcome

Upon completion of this course the students will be able to:

The research scholar will acquire a knowledge & research advances in molecular mechanism of drug molecule and concept and therapeutic management in multi-drug resistance disease like tuberculosis, leprosy etc.

### **Recommended Books (Latest edition):**

1. The Pharmacological basis of therapeutics, 11ed. – Goodman and Gilman's., Mc Graw Hill
2. Pharmacotherapy; A pathophysiological Approach, Josef T. Dipiro& Robert L. Talbert ,7th. Ed., 2005, Mc Graw Hill
3. Pharmacology – Rang and Dale, 2015.
4. Fundamentals of experimental pharmacology by M.N.Ghosh., Hiltton Kolkata, 2007
5. Principles of drug action. The Basis of Pharmacology by Avram Goldstein, Lewis Aronow Harper and Row, New York, 1968.
6. Clinical pharmacology by Molmon and Morrelli.2009
7. P.I. Good, A Managers Guide to Design and Conduct of Clinical trials, Wiley-Liss, Hobokem, U.S.A., 2002.
8. B.R. Glick and J.J. Paternak, Molecular Biotechnology: Principles and Applications of DNA Recombinant Technology. ASM Press, Washington, U.S.A., 1994.

**Approved by the Academic Council at its 17<sup>th</sup> Meeting held on 24.03.2021**

# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

<b>Subject Code</b>	PH746	<b>Subject Title</b>	Herbal Drug Manufacturing						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

This course will help to understand the technologies used in industry and commercial purpose to explore the potentials of drugs of natural origin. It will also help to integrate the Indian system of traditional medicine with modern system of medicine.

### Course Objective:

The course is designed with following objectives

1. Understand the requirements of setting up herbal drug industry
2. Learn requirements of regulatory authorities in maintaining quality of herbal products.
3. Know process and procedure in patenting knowledge, molecule and product derived from natural resources.

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### **Unit-1**

Herbal drug industry: Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations. Entrepreneurship Development, Project selection, project report, technical knowledge, Capital venture, plant design, layout and construction. Pilot plant scale –up techniques, case studies of herbal extracts. Formulation and production management of herbals.

#### **Unit – 2**

Regulatory requirements for setting herbal drug industry: Quality assurance in herbal/natural drug products. Concepts of TQM, GMP, GLP, ISO-9000, AYUSH and WHO guidelines.

#### **Unit-3**

Development and evaluation of polyherbal formulations; tablets, capsule, phytosomes, novel formulations, etc. Approaches in delivery of phytoconstituents and their evaluation.

#### **Unit-4**

Analytical Evaluation of Herbal Drugs: LC-IR, LC-MS, LC-GC, GC-MS, phytoequivalence, hyphenation, Radioimmunoassay, etc

#### **Unit-5**

Recent advances in plant tissue culture; soma clonal variation, In vitro selection of plants tolerant to abiotic stress, In vitro selection of salt-tolerant plants, Characterization of salt- or drought-tolerant plants during in vitro selection, Transgenesis for abiotic stress tolerance, In vitro tissue culture as a tool for physiological and biochemical studies in plants,

### Learning Outcome

Upon completion of this course the students will be able to:

1. Understand the requirements of setting up herbal drug industry
2. Learn requirements of regulatory authorities in maintaining quality of herbal products.
3. Know process and procedure in patenting knowledge, molecule and product derived from natural resources.

### **Recommended Books (Latest edition):**

- I. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, New Delhi.

**Approved by the Academic Council at its 17<sup>th</sup> Meeting held on 24.03.2021**

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## **Applicable from 2021 Onwards**

- II. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), 1st Edition, Business horizons Robert Verpoorte, New Delhi.
- III. Quality control of herbal drugs by Pulok K Mukarjee (2002), Business Horizons Pharmaceutical Publisher, New Delhi.
- IV. PDR for Herbal Medicines (2000), Medicinal Economic Company, New Jersey.
- V. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.
- VI. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (1996), NiraliPrakashan, New Delhi.
- VII. Text book of Pharmacognosy and Phytochemistry by Vinod D. Rangarl (2002), Part I & II, Career Publication, Nasik, India.
- VIII. Plant drug analysis by H.Wagner and S.Bladt, Springer, Berlin.
- IX. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern Publisher, New Delhi.
- X. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plants by J.B.Harborne, (1999), 11nd Edition, Taylor and Francis Ltd, UK.
- XI. Herbal Medicine. Expanded Commission E Monographs by M.Blumenthal, (2004), IST Edition,
- XII. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi.
- XIII. New Delivery Systems for Controlled Drug from Naturally Occuring Materials (ACS Symposium Series) , by Nicholas Parris, LinShiu Liu, Cunixian Song, V Prasad Shastri, 27 Nov 2008

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## Applicable from 2021 Onwards

<b>Subject Code</b>	PH747	<b>Subject Title</b>	Standardization and Pharmacological Screening of Herbal Preparations						
<b>LTP</b>	4:0:0	<b>Credit</b>	4	<b>Subject Category</b>	DE	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Outline:

This course is designed to impart the knowledge, skills on preclinical screening of herbal drugs by using traditional and advanced methods. The course also provides basic information required for possible exploration of drugs for clinical use.

### Course Objective:

The course is designed with following objectives

1. Appraise the regulations and ethical requirement for the usage of experimental animals.
2. Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
3. Describe the various newer screening methods involved in the drug discovery process
4. Appreciate and correlate the preclinical data to humans

**Course Pre/Co- requisite (if any) : Nil**

### Detailed Syllabus

#### **Unit-1**

Standardization of herbal drugs:

Active principal identification, need for standardization, standardization of polyherbal formulations, pharmacopoeial standards, parameters for standardization; quality control of herbal drugs, DNA fingerprintings, genetic markers.

#### **Unit-2**

Screening of Herbal Medicines for Potential Toxicities:

Toxicity of herbs, Goals of toxicity testing of herbal drugs, Pre-clinical toxicity testing of herbs, Cell-based cytotoxicity tests, Herbal toxicokinetics, Toxicogenomic screening tools, High throughput next generation sequencing, Animal tests, General tests, Chronic toxicity/carcinogenicity,

#### **Unit-3**

Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.

Reproductive Pharmacology: Aphrodisiacs and antifertility agents

Analgesics, antiinflammatory and antipyretic agents.

Gastrointestinal drugs: anti ulcer, anti -emetic, anti- diarrheal and laxatives.

#### **Unit-4**

Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.

Cardiovascular Pharmacology: antihypertensives, antianginal, and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents, anti-cancer agents and hepatoprotective screening methods.

#### **Unit- 5**

Clinical evaluation of herbal preparations: Status of research on alternative medicine clinical trials, current guidelines and regulatory authority directives for clinical research on alternative medicine, clinical trial guidelines, search for information, design of protocol, testing of the acceptability, submission of clinical trial protocol for regulatory and ethical approval, testing of subject acceptance of clinical trials on herbal products and clinical investigator acceptance.

### Learning Outcome

Upon completion of this course the students will be able to:

**Approved by the Academic Council at its 17<sup>th</sup> Meeting held on 24.03.2021**

# **Course Structure of Ph.D. Course Work – Pharmacy**

## **Applicable from 2021 Onwards**

1. Appraise the regulations and ethical requirement for the usage of experimental animals.
2. Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
3. Describe the various newer screening methods involved in the drug discovery process
4. Appreciate and correlate the preclinical data to humans

### **Recommended Books (Latest edition):**

1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
2. Screening methods in Pharmacology by Robert Turner. A
3. Evaluation of drugs activities by Laurence and Bachrach
4. Methods in Pharmacology by Arnold Schwartz.
5. Fundamentals of experimental Pharmacology by M.N.Ghosh
6. Pharmacological experiment on intact preparations by Churchill Livingstone
7. Drug discovery and Evaluation by Vogel H.G.
8. Experimental Pharmacology by R.K.Goyal.
9. Preclinical evaluation of new drugs by S.K. Guta
10. Handbook of Experimental Pharmacology, SK.Kulkarni
11. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.
12. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK.
13. Screening Methods in Pharmacology, Robert A.Turner.
14. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.
15. Practical Manual of Experimental and Clinical Pharmacology by BikashMedhi (Author), Ajay Prakash (Author)

# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

Subject Code	PH748	Subject Title	Advance Drug Designing						
LTP	4:0:0	Credit	4	Subject Category	DE	Year	1 <sup>st</sup>	Semester	I

**Course Objective:** This course is designed to impart knowledge and skills necessary for drug discovery, drug designing, molecular modeling, docking studies & also knowledge on classification, mechanism of action of different classes of drugs.

### Unit I

Pharmaceutical Medicinal Chemistry General principles, Identification and study of targets for development of various therapeutic agents, rational approach for drug design, Computer aided drug design

### **UNIT-2**

Various targets of drug action and theory of drug action: agonist/antagonism and enzyme inhibition (IC<sub>50</sub>, EC<sub>50</sub> Concept)-An Overview. Correlation between physicochemical properties and drug action, establishing SAR and its analysis.

### **UNIT-3**

QSAR and brief introduction to various methods of QSAR, detailed study on HANSH LFER model, free wilson analysis. Methods of determining reaction mechanism (kinetic and non kinetic). Pharmacokinetics (ADME) in drug discovery.

### **UNIT-4**

Isosterism and bioisosterism as a guide to structural variation and prodrug design and its application in lead optimization.

### **UNIT-5**

Study of recently developed drugs and molecules in development pipeline, special emphasis on anticancer, antidiabetic, antihistaminic, antiviral, antimalarial, antibacterial, anti tubercularantiparkinsons, antihypertensive, antiarrhythmic, antianginal, antihyperlipidemic drugs.

**Learning Outcome:** Upon completion of this course it is expected that the scholars will able to learn principles of drug discovery, drug designing, molecular modeling, docking studies & also knowledge on classification, mechanism of action of different classes of drugs.

### **Books Recommended:**

#### **Recommended Books (Latest Editions)**

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.



# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

Subject Code	PH749	Subject Title	Modern Instrumental Techniques						
LTP	4:0:0	Credit	4	Subject Category	DE	Year	1 <sup>st</sup>	Semester	I

**Course Objective:** The course is designed to provide knowledge on various Modern Instrumental Techniques for Evaluation of APIs and Drug and structure elucidation of APIs and Drug Products

### Unit I

Principles, methods, interpretation of data and pharmaceutical applications of NMR spectroscopy; NMR solvents and their residual peaks, coupling constant, chemical shift, chemical environment, shielding and deshielding. <sup>1</sup>H NMR, <sup>13</sup>C NMR, correlation of structure with spectra: HMQC, HMBC, COSY, NOESY, NOE, DEPT, Explanation of spectra of some compounds and drugs.

### Unit II

Principles, methods, interpretation of data and pharmaceutical applications of UV-Visible spectroscopy. Energy levels and selection rules, Woodward-Fieser rules. Influence of substituent, ring size and strain on spectral characteristics; solvent effect; stereochemical effect; non-conjugated interactions; spectral correlation with structure.

### Unit III

Principles, methods, instrumentations, interpretation of data and pharmaceutical applications of mass spectrometry. Spectral interpretation with examples.

### Unit IV

Principles, methods, instrumentations, interpretation of data and pharmaceutical applications of IR spectroscopy. Spectral interpretation with examples.

### Unit V

Use of spectroscopic techniques such as IR, <sup>1</sup>H NMR, <sup>13</sup>C NMR, NOE, DEPT, HMQC, HMBC, COSY, NOESY, ESI-MS, HRMS and FAB mass for structural elucidation of selected drug molecules.

**Learning Outcome:** The research scholar will acquire a knowledge & basic concept of Modern Instrumental Techniques for Evaluation of APIs and Drug and structure elucidation of APIs and Drug Products

### **Books Recommended:**

1. Spectroscopy by Donald L Pavia, Gary M Lampman, George S Kriz, James A Vyvyan
2. Organic spectroscopy by William Kemp
3. Spectroscopic Methods in Organic Chemistry by Dudley H. Williams & Ian Fleming
4. Spectrometric Identification of Organic Compounds by Robert M. Silverstein, Francis X. Webster & David J. Kiemie
5. Applications of Absorption Spectroscopy of Organic Compounds by Dyer
6. Fundamentals of Molecular Spectroscopy by Colin N. Banwell & Elaine M. McCash

# Course Structure of Ph.D. Course Work – Pharmacy

## Applicable from 2021 Onwards

7. Spectroscopy by Pavia, Donald L. Lampman, Gary M. Kriz, George S.

Subject Code	PH750	Subject Title	Advance Synthetic Chemistry						
LTP	4:0:0	Credit	4	Subject Category	DE	Year	1 <sup>st</sup>	Semester	I

**Course Objective:** The subject provides basic concepts of organic chemistry reaction and its mechanism.

### Unit I

1. Stereochemistry and Conformation
2. Carbocations, Carbanions, Free Radicals, Carbenes, and Nitrenes

### Unit II

3. Aliphatic Substitution, Nucleophilic and Organometallic
4. Aromatic Substitution, Electrophilic
5. Aliphatic, Alkenyl, and Alkynyl Substitution, Electrophilic and Organometallic
6. Aromatic Substitution: Nucleophilic and Organometallic

### Unit III

7. Substitution Reactions: Radical
8. Addition to Carbon–Carbon Multiple Bonds
9. Addition to Carbon–Hetero Multiple Bonds

### Unit IV

10. Eliminations
11. Rearrangements

### Unit V

12. Retrosynthesis

**Learning Outcome:** Successfully completed this module research scholar will be able to:

- Understand a range of more sophisticated approaches to synthesis of complex organic molecules which includes the natural compound.
- Justify the selection of a reagent over another in terms of efficacy in relation to a particular synthetic problem.
- Predict reaction pathways and outcomes on the basis of mechanistic understanding.

### **Books Recommended:**

Advanced Organic Chemistry by J. March, John Wiley & Sons

## **Course Structure of Ph.D. Course Work – Pharmacy Applicable from 2021 Onwards**

<b>Subject Code</b>	<b>PH711</b>	<b>Subject Title</b>	<b>Seminar</b>						
<b>LTP</b>	<b>1:0:0</b>	<b>Credit</b>	1	<b>Subject Category</b>	DC	<b>Year</b>	<b>1<sup>st</sup></b>	<b>Semester</b>	I

1. Introduction, information retrieval systems.
2. Writing term papers and reports.
3. Organization of scientific material, thesis, dissertation and references.
4. Reading research papers.
5. Skill in oral presentation.

*Each research scholar has to present a seminar.*