DEPARTMENT OF PHARMACEUTICAL SCIENCES
MAHARSHI DAYANAND UNIVERSITY, ROHTAK.

FACULTY OF PHARMACEUTICAL SCIENCES MEETING HELD ON 14-8-2010.

Proposed Syllabus for Pre Ph.D. Course

Teaching Load

	Theory	Practicals
Paper I -- Research Methodology	4 hrs / wk	6 hrs / wk
Paper – II (Communication Skills and Computer Applications)	4 hrs / wk	6 hrs / wk
Paper – III (Specialisation Paper)	4 hrs / wk	6 hrs / wk
Total	12 hrs / wk	18 hrs / wk

Distribution of Marks:

	Theory	Practicals
Paper I -- Research Methodology	50	100
Paper – II (Communication Skills)	50	
Paper – III (Specialisation Paper)	50	
Total	150	100

Duration of Examination:

	Theory	Practicals
Paper I -- Research Methodology	3 hrs	6 hrs * (common for Paper I, II & III)
Paper – II (Communication Skills)	3 hrs	
Paper – III (Specialisation Paper)	3 hrs	

NOTE :

1. There shall be a separate theory / practical examiner (one internal and one external) for each separate specializations (Pharmaceutics / Pharm. chemistry / Pharmacognosy / Pharmacology).
2. 30 % marks in each paper (theory and practicals separately) shall be reserved for internal assessment (sessional examination).
3. A candidate shall be declared pass if he/she obtains 50 % aggregate marks individually in each subject (sessional plus main examination taken together) (theory & practical separately) and 50 % marks in aggregate.

Paper I -- Research Methodology

Theory : (4 hrs / week)

1. Meaning, objectives and types of research. Research approaches
2. Research Methods – Library, Field and Laboratory methods.
3. Research Methodology and steps involved in a research process – formulating the research problem, extensive literature survey, developing the hypothesis, preparing the research design, determining sample design, collecting the data, execution of the project, analysis of data, hypothesis testing, generalizations and interpretation, and preparation of the report or presentation of the results.
4. Statistics: Introduction, its rule and usages; Collection, organization, graphics and pictorial representation of data, measures of central tendencies and dispersion, coefficient of variation. Probability: Basic concept; Common probability distribution related to normal distribution.
5. Sampling: Simple random and other sampling procedure. Distribution of sample mean and proportion. Estimation and Hypothesis testing: Point and interval estimation including fiducial limits. Concept of hypothesis testing and type of errors. Student –t and chi square tests. Sample size and power.

6. Correlation and regression: Graphical presentation of two continuous variables; Person's product moment correlation coefficient, its statistical significance. Multiple and partial correlation. Linear regression; Regression line, coefficient of determination, interval estimation and hypothesis testing for population slope. Introduction to multiple linear regression model.
7. Optimization techniques in experimentation.

Practicals : **(6 hrs / week)**

Study of the following instrumental techniques in Pharmaceutical Sciences :

High Performance Liquid Chromatography (HPLC), High Performance Thin Layer Chromatography (HPTLC), Gas Liquid Chromatography (GLC), Atomic absorption Spectroscopy (AAS), CHN analyzer, Thermo gravimetric analysis, Differential Scanning Calorimetry (DSC), Infrared spectroscopy, UV-Visible spectrometry, Particle size analyzer, Viscosity analysis, Karl Fischer Titration, Moisture analysis.

Paper-II Communication Skills and Computer Applications

Theory : (4 hrs / wk)

1. Basics of Communication skill.
2. Types of Scientific Communication.
3. Importance of publishing research paper.
4. Presenting and Publishing paper:
   a. Preliminaries, format, choosing Journal
   b. Title, Running Title
   c. Author : Single and Multi authorship
   d. Writing Abstract
   e. Selecting Keywords
   f. Introduction section
   g. Materials and Methods selection
   h. Result section
   i. Figures: Design Principles, Legends, table components, Graphs: Types, Style, Table v/sGraphs
   j. Discussion Section : Format, Grammar Style, Content
   k. Acknowledgements
   l. References : Different Styles
   m. Communication with the Editor, Handling Referees' Comments, Gallery Proofs
6. Writing Review Articles
7. Preparing Posters for Scientific Presentation
8. Preparing and Delivering of Oral Presentation
9. Writing Practical Reports
10. Avoiding Plagiarism
11. Research Grant Funding Agencies, Preparing for application to grant Providing agencies
12. Patent drafting and submission
13. Preparing documents for Technology Transfers, MoUs, confidentially Agreements
14. Detailed study of MS Word, MS Powerpoint, and MS Excel. Concepts of Internet and Primary search engines in research.

Reference Books:

1) Study and Communication Skills for the Biosciences by *Stuart Johnson and Jon Scott, Oxford* University Press
2) Write and Publish a Scientific Paper by *Robert A. Day* Oryx Press
3) Scientific Easy when you know how by *Jennifer Peat* BMJ Books
4) Research Projects and Research Proposals A Guide for Scientists Seeking Funding by *Paul G. Chapin* University Press

Practicals (6 hrs / wk):

Assignments on following should be provided by the guide to the student.
Assignments should include all the components mentioned below:

1. Exercise on writing research papers, preparing projects proposal for any of the funding agencies and preparing a power-point presentation for the made proposal.
2. Critical analysis of atleast 10 research papers of interest published in referred journals with respect to language, content, title, reference style, data, figures, tables, discussion etc. and preparing a report on the same.
3. Writing and submitting a review article related to doctoral research topic for an international journal.

Paper-III Specialisation Paper

Any candidate must opt for any one paper from either of the following four specializations :

1. Pharmaceutics
2. Pharmaceutical Chemistry
3. Pharmacognosy
4. Pharmacology

SPECILISATION: PHARMACEUTICS

(The candidate will choose any one title of paper from the four options available i.e., Quality Assurance in Pharmaceutical industries/ Regulatory Affairs/ Novel Drug Delivery Systems / Pharmaceutical technology)

Option I: Quality Assurance in Pharmaceutical Industries

Theory : (4 hrs / wk)

1. **Basic concepts of quality:** Quality objectives, Quality assurance and Total Quality management
2. **WHO GMPs: main principles for pharmaceutical products** (fundamentals of validation , DQ, IQ, PQ, Calibration of instruments, Validation of microbiological and analytical methods), GMPs for starting raw materials (Active pharmaceutical ingredients, pharmaceutical excipients), GMPs for specific pharmaceutical products (sterile, biological, investigational products for clinical trials, herbal medicines, radiopharmaceuticals), Guidelines for area classification and air handling units.
3. **Inspections and sampling operations of pharmaceutical products:** Inspection planning, inspection manual, inspection errors, sampling plans, sampling procedures in pharmaceutical industries.
4. **Statistical Quality Control:** Shewhart Control Charts and applications in quality control of pharmaceuticals, LCL, UCL, control limits etc.
5. **Quality of analytical methodologies:** Parameters for quality analysis (specificity, sensitivity, linearity, precision, accuracy, ruggedness and system suitability), stability indicating methods.
6. **Good Laboratory Practice (GLP):** General Provisions, Organizational Structure, Organization of Personnel, Facilities, sample control, Instrumentation, maintenance and Calibration of equipments, Standard Operating Procedures(SoPs), standard test procedures (STPs), product identification system, maintenance of records, reference standards, animal care

Practicals : (6 hrs / wk)

A number of practicals, based on above mentioned theory topics, should be conducted.

Option II : Regulatory Affairs

Theory : (4 hrs / wk)

1) **Overview of USFDA and Drug Develpoment** : Evolution of FDA, The FoodandDrug Administration Amendments Act of 2007, organizational structure
2) **CentralDrug Standard Control Organisation (CDSCO)** : Functions and responsibilities
3) **Investigational New Drug** : Need of an IND, Content and Format of an IND application, Submission of an IND, FDA review of IND.
4) **The New Drug Application** : Overview, Law regulations and Guidance, new drug development and approval, NDA development preclinical investigation, new drug application (phase I, phase II, phase IV and post marketing surveillance),contents of the NDA (chemistry, manufacturing, testing, packaging, labelling, controls, preclinical, clinical data), Human Pharmaco-kinetic and bioavailability testing requirements, Common technical document (CTD) for NDA, Submission, review and maintenance of NDA.
5) **Generic Drug Development** : Generic Drugs, Need of Generics, Birth of Generics: The Hatch Waxman Act of 1984, Abbreviated New Drug Application (ANDA), Similarity and comparison of NDA and ANDA application requirements, Format, submission to the FDA, Application review by the FDA, Application review by the FDA, Orange Book, Bioequivalence testing requirements, biowaivers, FDA Bioequivalence limits, Para certifications, FDA approval process.

Practicals : (6 hrs / wk)
A number of practicals, based on above mentioned theory topics, should be conducted.

Option III : Novel Drug Delivery Systems
Theory : (4 hrs / wk)

1. **Oral Controlled drug delivery systems** : Design and fabrication of diffusion controlled, dissolution controlled, osmotic, gastro-retentive delivery systems, biodegrable polymeric delivery systems. Controlled drug delivery polymers, roles of polymers in drug delivery, pharmacokinetic/ pharmacodynamic basis of oral controlled drug delivery.
2. **Miscellaneous forms of new drug delivery systems** : Design and fabrication of parentral, implantable, transdermal, intranasal, ocular, intra-vaginal, intra-uterine and other forms of drug delivery such as carrier or vector mediated delivery systems for biological macromolecules.
3. **Intelligent drug delivery systems** : Magnetically modulated, ultrasonically modulated, electrically regulated, photo-responsive, temperature sensitive, pH sensitive, inflammation responsive, glucose sensitive polymers, urea responsive delivery.
4. **Biochemical and molecular biology approaches to controlled drug delivery** : Microparticulate srug carriers, liposomes and stealth liposomes, microspheres, selective endocytosis of macromolecular drug cariers, antibodiesfor drug delivery, resealed erythrocytes, niosomes.
5. **Nanopharmaceuticals :** Methods of preparation, characterization and applications of nanoemlusion, nanoparticles and nanosuspensions.
6. **Regulatory considerations** in controlled drug delivery.

Practicals : (6 hrs / wk)
A number of practicals, based on above mentioned theory topics, should be conducted.

Option-IV : Pharmaceutical Technology
Theory: (4 hrs/wk)

1. **Preformulation Studies**: General considerations, significance and recent advances.
2. **Stability Studies**: General considerations, significance and ICH guidelines for carrying out stability studies.
3. **Dissolution Enhancement Techniques**: An overview and recent advances in various dissolution enhancement techniques such as solid dispersions, complexation, solubilization and nanoparticle technology etc.
4. **Solid Dosage Forms**: Formulation development, quality control and recent advances in tablets dosage forms.
5. **Parentral Dosage Forms :** Production of injectable grade water, Formulation development, quality control and recent advances in small volume and large volume parentrals.

Practicals: (6hrs/wk)
A number of practicals, based on above mentioned theory topics, should be conducted.

SPECIALIZATION : PHARMACEUTICAL CHEMISTRY

(The candidate will choose any one title of paper from the two options available i.e., Drug design / Advanced medicinal chemistry)

Option-I – Drug Design

THEORY **Lectures: 4 hrs / week**

1. **Drug Design:** Approaches to drug design, method of variation, biochemical and physiological approaches. Lead compound - Search & Optimization : Search of lead compound from natural products and other sources, selection of test compounds. Methods of lead optimization – synthesis of analogs, variation of substituents, extension of structure, ring versus chain structures, bioisosterism, ring contraction and expansion. Case study of Cimitidine and pantaprazole.
2. **Analogue based drug discovery –** Analogues as means of discovering new drugs, Drug likeliness and Analogue based drug discovery, Privileged Structures and Analogue-Based Drug Discovery.
3. **Quantitative structure activity relationship (QSAR):** Physicochemical parameters – hydrophobicity, electronic and steric parameters, Hansch analysis – Steps involved, Facts to be considered, Development of one-target and multi-target QSAR models in case of antimicrobial agents, Free-Wilson analysis, Craig plot, Topliss scheme, CoMFA analysis.

4. **Molecular modeling:** generation of 3D coordinates, sketch approach, conversion of 2D structures in 3D form, force fields, geometry optimization, energy minimization procedures. Quantum mechanical methods, conformational analysis, Pharmacophore identification, molecular modeling in 3D QSAR-CoMFA and related approaches.
5. **Prodrugs:** Objectives of Prodrug Design **–** increasing bioavailability, improving membrane permeability, prolonging activity, reducing side effects, removing undesirable properties. Prodrugs from different functional groups-carboxyl, amino, hydroxyl etc.

Practicals: **(6 hrs / week)**

Number of Practicals / assignments based on aforementioned theory.

RECOMMENDED READINGS :

1. Medicinal Chemistry — A molecular andBiochemical Approach, Thomas Nogrady and Donald F. Weaver
2. Medicinal Chemistry, A. Burger Vols. I to V
3. Principles of Medicinal Chemistry, W. O. Foye
4. The Organic Chemistry of the Drug Design and Drug Action, Richard B. Silverman
5. Goodman and Gilmans Text book of Pharmacology.
6. Wilson and Gisvolds Text book of Medicinal Chemistry

Option-II – Advanced medicinal chemistry

THEORY **Lectures: 4 hrs / week**

1. **Antiviral agents-** DNA & RNA viruses, viral replication, retroviruses, strategies to design anti-HIV drugs, antiviral drugs.
2. **Enzymes:** Enzymes as catalyst, Mechanisms of enzyme catalysis, Enzyme inhibition and inactivation, Drug resistance and drug synergism with special reference to enzymes, Reversible enzyme inhibitors with reference to development of ACE inhibitors and sulphonamides, Transition state analogs and multisubstrate analogs, slow-tight binding inhibitors with special reference to the development of statins.
3. **DNA-Interactive agents:** Introduction, DNA structure and properties, classes of drugs that interact with DNA, Reversible DNA binders, DNA alkylators, DNA strand breakers.
4. **Combinatorial chemistry:** solid phase synthesis, Solution phase synthesis, deconvolution techniques and applications of combinatorial chemistry.
5. **Antineoplastic agents**-molecular mechanism of cancer, oncogenes, alkylating agents, antimetabolites, antibiotics, natural products.; Drugs through microbial transformation.
6. **Nitric oxide-** interplay of NO & biological systems. NO biosynthesis and cytotoxicity, NO synthetase inhibitors and their therapeutic significance.

Practicals: **(6 hrs / week)**

Number of Practicals / assignments based on aforementioned theory.

RECOMMENDED READINGS :

1. Medicinal Chemistry — A molecular andBiochemical Approach, Thomas Nogrady and Donald F. Weaver
2. Medicinal Chemistry, A. Burger Vols. I to V
3. Principles of Medicinal Chemistry, W. O. Foye
4. The Organic Chemistry of the Drug Design and Drug Action, Richard B. Silverman
5. Goodman and Gilmans Text book of Pharmacology.
6. Wilson and Gisvolds Text book of Medicinal Chemistry

SPECIALIZATION : PHARMACOGNOSY

Theory : (4 hrs / wk)

1. **Extraction:** Different techniques adopted for the extraction of phytoconstituents like Maceration, percolation, sonication, soxhlet assisted extraction, ultrasound assisted extraction, super critical carbon dioxide extraction and SAP box.
2. **Quality control studies:** Methods involved in the standardization, quality control and safety studies of Herbal drugs and formulations.

3. **Biological Screening methods:** *In vitro* and *in vivo* Screening methods of herbal drugs and Formulations.
4. **Isolation, Purification and Analysis:** Recent advances in the various chromatographic techniques such as paper, column, UV, TLC, HPTLC, Preparative TLC, HPLC, GC and DCCC.
5. **Regulatory:** Regulatory requirements for manufacture and distribution of herbal formulations in India.

Practicals : (6 hrs / wk)

A number of practicals, based upon the above mentioned theory topics.

SPECIALIZATION : PHARMACOLOGY

(The candidate will choose any one title of paper from the two options available, i.e., Recent Trends in Pharmacological Sciences / Evaluation strategies for new drugs)

OPTION 1 : Recent trends in pharmacological sciences

Theory : (4 hrs / wk)

1. Pharmacokinetic Studies
   (Pre-clinical and Clinical)
   Membrane transporters and drug response
   a. ABC and SLC transporters
   b. Membrane transporters and adverse drug response
   c. Basic mechanisms of membrane transport
   d. Regulation of transporter expression by nuclear receptors
   e. ABC transporters involved in drug absorption, distribution and excretion
   f. Genetic variation in membrane transporters
   g. ABC transporters implications for clinical drug response
2. Drug Metabolism
3. Pharmacogenetics
4. Science of drug therapy

Practicals : (6 hrs / wk)

A number of practicals, based upon the above mentioned theory topics.

OPTION II : Evaluation strategies for new drugs

Theory : (4 hrs / wk)

1. Drug receptor interaction studies
2. Blind screening of drugs
3. Design of pharmacological screening
4. Clinical trials
5. Determination of inter-individual variation in response to drugs
6. Drug interactions
   -- Therapeutic index
   -- ADR
   -- Drug Toxicity, Schedule Y

Practicals : (6 hrs / wk)

A number of practicals, based upon the above mentioned theory topics.