

# **MASTER IN PHARMACY**

**Programme:** Master of Pharmacy ( M. Pharm) in the following subjects.

- i) Pharmaceutics
- ii) Pharmaceutical Chemistry
- iii) Pharmacology
- iv) Pharmacognosy

It shall be a full time regular course.

During an academic year, a candidate shall be enrolled only for one programme of study and shall not appear in any other examination of this or any other University.

**Duration :** Four semester which will be designated as under :

- Ist Semester - July-Dec.
- IInd Semester - Jan-June
- IIIrd Semester - July-Dec.
- IVth Semester - Jan-June

**Total Number of Seats:** 40 (10 Seats in each branch)

**Medium of instruction and examination:** English

**Eligibility of admission:** A candidate seeking admission to M. Pharm course must have:

- Passed Bachelor of Pharmacy from PCI recognised college and degree from recognized University by UGC Government of India.
- The selection of candidates will be made through the entrance test conducted by AAI DU.
- Preference will be given to GATE qualified candidates.

**Course Structure:** The course work shall be divided into four semesters. The course contents are given in the Syllabus

**Scheme of the Examination:** As per University rules. (Percentage system will be followed and 50% will be passing marks.)

**Course Fee:** Rs. 60,000 per Semester (For all four branches).

**Faculty Requirement for M. Pharm. Course (including B.pharm, D. Pharm)**

SNo.	Specialization	Total No. of Faculty Required			No. of Faculty Present			Additional Faculty Required		
		Professor	Reader	Lecturer	Professor	Reader	Lecturer	Professor	Reader	Lecturer
1.	Pharmaceutics	01	03	07	---	---	03	01	03	04
2.	Pharmaceutical Chemistry	01	03	07	---	01	03	01	02	04
3.	Pharmacology	01	03	07	---	---	03	01	03	04
4.	Pharmacognosy	01	03	07	---	---	02	01	03	05

### Requirement of Laboratory for M. Pharm.

<b>S.No.</b>	<b>Specialization</b>	<b>Total No. Laboratory Required</b>	<b>No. of Laboratory Existing in Department for M.Pharm.</b>	<b>Additional Lab required</b>
<b>1.</b>	<b>Pharmaceutics</b>	03	01	02
<b>2.</b>	<b>Pharmaceutical Chemistry</b>	02	01	01
<b>3.</b>	<b>Pharmacology</b>	02	01	01
<b>4.</b>	<b>Pharmacognosy</b>	02	01	01
<b>5.</b>	<b>Modern Analytical Technique (Common for all Specialization)</b>	02	01	01

\* Animal House, computer lab. and Advanced Machine room are mandatory.

**SOPHISTICATED INSTRUMENT REQUIRED FOR DIFFERENT  
SPECIALIZATION OF M. PHARM. COURSE**

<b>S.No.</b>	<b>Specialization</b>	<b>Instruments</b>
<b>1.</b>	<b>Pharmaceutics</b>	Multi-station tablet compression machine, Automated sampling dissolution apparatus (08 cylinders inbuilt), lyophilizer, ultracentrifuge (20,000 rpm), ultrasonicator, homosinizer, rotavapour, vacuum dryer, dehumidifier, satability study chamber, Tablet coating machine, Fluidized bed dryer, keshary chein apparatus, Tonometer.
<b>2.</b>	<b>Pharmaceutical Chemistry</b>	Discovery studio(ACCEERLYS LTD. software)
<b>3.</b>	<b>Pharmacology</b>	Plethysmograph, Cooling centrifuge, Shaking water bath, Passive avoidance test apparatus, Active avoidance test apparatus, Digital Glucometer, Deep freezer/ Liquid nitrogen cylinder, Biopac, .
<b>4.</b>	<b>Pharmacognosy</b>	Column, Binocular microscope.
<b>5.</b>	<b>Modern Analytical Technique (Common for all Specialization)</b>	HPLC, FTIR, HPTLC, rotavapour,

\* Urgent requirements were highlighted.

**CURRICULUM FOR FIRST YEAR MASTER OF PHARMACY  
(PHARMACEUTICS)  
Total Credits: 67**

FIRST YEAR		SEMESTER – I			
Course code	Course Title	L	T	P	Credits
PHA- 611	Modern Pharmaceutical Analytical Technique (Theory)	4	0	0	4
PHA- 612	Modern Pharmaceutical Analytical Technique (Practical)	0	0	8	4
MAS- 7	Biostatistics and Computer Application	3	0	0	3
PHA -711	Pharmaceutics – I (Advanced Pharmaceutics)(Theory)	3	0	0	3
PHA- 712	Pharmaceutics – I (Advanced Pharmaceutics)(Practical)	0	0	8	4
<b>Total Credits</b>					<b>18</b>

FIRST YEAR		SEMESTER – II			
Course code	Course Title	L	T	P	Credits
PHA – 721	Drug Regulatory Affair & Intellectual Property Right	3	0	0	3
PHA- 821	Pharmaceutics – II (Biopharmaceutics & Pharmacokinetics)(Theory)	3	0	0	3
PHA-822	Pharmaceutics –II(Biopharmaceutics & Pharmacokinetics)(Practical)	0	0	8	4
PHA- 823	Pharmaceutics – III (Advanced Drug Delivery Systems)(Theory)	3	0	0	3
PHA- 824	Pharmaceutics – III (Advanced Drug Delivery Systems)(Practical)	0	0	8	4
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – III			
Course code	Course Title	L	T	P	Credits
PHA- 780	Seminar	0	0	0	2
PHA- 781	Project Seminar	0	0	0	15
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – IV			
Course code	Course Title	L	T	P	Credits
PHA- 899	Thesis/ Project Work	0	0	0	15
<b>Total Credits</b>					<b>15</b>

**CURRICULUM FOR FIRST YEAR MASTER OF PHARMACY  
(PHARMACEUTICAL CHEMISTRY)**

**Total Credits: 66**

FIRST YEAR		SEMESTER – I			
Course code	Course Title	L	T	P	Credits
PHA – 611	Modern Pharmaceutical Analytical Technique (Theory)	4	0	0	4
PHA- 612	Modern Pharmaceutical Analytical Technique (Practical)	0	0	8	4
MAS- 7	Biostatistics and Computer Application	3	0	0	3
PHA- 713	Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Theory)	3	0	0	3
PHA- 714	Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Practical)	0	0	8	4
<b>Total Credits</b>					<b>18</b>

FIRST YEAR		SEMESTER – II			
Course code	Course Title	L	T	P	Credits
PHA- 721	Drug Regulatory Affairs & Intellectual Property Right	3	0	0	3
PHA- 825	Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Theory)	3	0	0	3
PHA-826	Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Practical)	0	0	8	4
PHA-827	Drug Design (Theory)	3	0	0	3
PHA-828	Chemistry of Natural Products	3	0	0	3
<b>Total Credits</b>					<b>16</b>

SECOND YEAR		SEMESTER – III			
Course code	Course Title	L	T	P	Credits
PHA- 780	Seminar	0	0	0	2
PHA- 781	Project Seminar	0	0	0	15
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – IV			
Course code	Course Title	L	T	P	Credits
PHA-899	Thesis/ Project Work	0	0	0	15

<b>Total Credits</b>	<b>15</b>
----------------------	-----------

**CURRICULUM FOR FIRST YEAR MASTER OF PHARMACY  
(PHARMACOLOGY)  
Total Credits: 67**

FIRST YEAR		SEMESTER – I			
Course code	Course Title	L	T	P	Credits
<b>PHA- 611</b>	Modern Pharmaceutical Analytical Technique (Theory)	4	0	0	4
<b>PHA- 612</b>	Modern Pharmaceutical Analytical Technique (Practical)	0	0	8	4
<b>MAS-7</b>	Biostatistics and Computer Application	3	0	0	3
<b>PHA- 715</b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Theory)	3	0	0	3
<b>PHA- 716</b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Practical)	0	0	8	4
<b>Total Credits</b>					<b>18</b>

FIRST YEAR		SEMESTER – II			
Course code	Course Title	L	T	P	Credits
<b>PHA- 721</b>	Drug Regulatory Affairs & Intellectual Property Rights	3	0	0	3
<b>PHA- 829</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Theory)	3	0	0	3
<b>PHA- 830</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Practical)	0	0	8	4
<b>PHA- 831</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Theory)	3	0	0	3
<b>PHA- 832</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Practical)	0	0	8	4
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – III			
Course code	Course Title	L	T	P	Credits
<b>PHA- 780</b>	Seminar	0	0	0	2
<b>PHA- 781</b>	Project Seminar	0	0	0	15
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – IV			
Course code	Course Title	L	T	P	Credits
PHA- 899	Thesis/ Project Work	0	0	0	15
<b>Total Credits</b>					<b>15</b>

**CURRICULUM FOR FIRST YEAR MASTER OF PHARMACY  
(PHARMACOGNOSY)  
Total Credits: 67**

FIRST YEAR		SEMESTER – I			
Course code	Course Title	L	T	P	Credits
PHA- 611	Modern Pharmaceutical Analytical Technique (Theory)	4	0	0	4
PHA-612	Modern Pharmaceutical Analytical Technique (Practical)	0	0	8	4
MAS - 7	Biostatistics and Computer Application	3	0	0	3
PHA-717	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) (Theory)	3	0	0	3
PHA- 718	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) (Theory)	0	0	8	4
<b>Total Credits</b>					<b>18</b>

FIRST YEAR		SEMESTER – II			
Course code	Course Title	L	T	P	Credits
PHA- 721	Drug Regulatory Affairs & Intellectual Property Rights	3	0	0	3
PHA- 833	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Theory)	3	0	0	3
PHA-834	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Practical)	0	0	8	4
PHA-835	Pharmacognosy & Phytochemistry- III (Theory)	3	0	0	3
PHA-836	Pharmacognosy & Phytochemistry- III (Practical)	0	0	8	4
<b>Total Credits</b>					<b>17</b>

SECOND YEAR		SEMESTER – III			
Course code	Course Title	L	T	P	Credits
PHA- 780	Seminar	0	0	0	2

PHA- 781	Project Seminar	0	0	0	15
<b>Total Credits</b>					<b>17</b>
SECOND YEAR			SEMESTER – IV		
<b>Course code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
PHA- 899	Thesis/ Project Work	0	0	0	15
<b>Total Credits</b>					<b>15</b>

## **MASTER OF PHARMACY**

*It is a two year course. It has four specializations*

### **(PHARMACEUTICAL CHEMISTRY)**

**Total Credits: 66**

#### **Semester I**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA – 611</b>	<i>Modern Pharmaceutical Analytical Technique (Theory)</i>	<b>4(4-0-0)</b>
<b>PHA- 612</b>	<i>Modern Pharmaceutical Analytical Technique (Practical)</i>	<b>4(0-0-8)</b>
<b>MAS- 7</b>	<i>Biostatistics and Computer Application</i>	<b>3(3-0-0)</b>
<b>PHA- 713</b>	<i>Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Theory)</i>	<b>3(3-0-0)</b>
<b>PHA- 714</b>	<i>Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Practical)</i>	<b>4(0-0-8)</b>

		18
--	--	----

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<i>PHA-721</i>	<i>Drug Regulatory Affairs &amp; Intellectual Property Right</i>	<b>3(3-0-0)</b>
<i>PHA-825</i>	<i>Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Theory)</i>	3(3-0-0)
<i>PHA-826</i>	<i>Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Practical)</i>	4(0-0-8)
<i>PHA-827</i>	<i>Drug Design (Theory)</i>	3(3-0-0)
<i>PHA-828</i>	<i>Chemistry of Natural Products</i>	3(3-0-0)
<i>Total Credits</i>		16

### Semester III

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA-780</b>	Seminar	<b>2(0-0-4)</b>
PHA-781	Project Seminar	15(0-0-30)
		17

### Semester IV

<b>Course</b>	<b>Course Title</b>	<b>Credits</b>
---------------	---------------------	----------------

<b>code</b>		
<b>PHA-899</b>	Thesis/ Project Work	<b>15(0-0-30)</b>
		<b>15</b>

**MASTER OF PHARMACY (PHARMACOLOGY)**

**Total Credits: 67**  
**Semester I**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b><i>PHA- 611</i></b>	<i>Modern Pharmaceutical Analytical Technique (Theory)</i>	<b>4(4-0-0)</b>
<b><i>PHA- 612</i></b>	<i>Modern Pharmaceutical Analytical Technique (Practical)</i>	<b>4(0-0-8)</b>
<b><i>MAS-7</i></b>	<i>Biostatistics and Computer Application</i>	<b>3(3-0-0)</b>
<b><i>PHA- 715</i></b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Theory)	<b>3(3-0-0)</b>
<b><i>PHA- 716</i></b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Practical)	<b>4(0-0-8)</b>
	<b>Total Credits</b>	<b>18</b>

**Semester II**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
--------------------	---------------------	----------------

<b>PHA-721</b>	<b>Drug Regulatory Affairs &amp; Intellectual Property Rights</b>	<b>3(3-0-0)</b>
<b>PHA- 829</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Theory)	<b>3(3-0-0)</b>
<b>PHA- 830</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Practical)	<b>4(0-0-8)</b>
<b>PHA-831</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Theory)	<b>3(3-0-0)</b>
<b>PHA-832</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Practical)	<b>4(0-0-8)</b>
	<b>Total Credits</b>	<b>17</b>

### **Semester III**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA-780</b>	<b>Seminar</b>	<b>2(0-0-4)</b>
<b>PHA- 781</b>	Project Seminar	<b>15(0-0-30)</b>
	<b>Total Credits</b>	<b>17</b>

### **Semester IV**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA- 899</b>	Thesis/ Project Work	<b>15(0-0-30)</b>

	Total Credits	15
--	---------------	----

## MASTER OF PHARMACY (PHARMACOGNOSY)

**Total Credits: 67**

### Semester I

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA- 611</b>	<i>Modern Pharmaceutical Analytical Technique (Theory)</i>	<b>4(4-0-0)</b>
<b>PHA-612</b>	<i>Modern Pharmaceutical Analytical Technique (Practical)</i>	<b>4(0-0-8)</b>
<b>MAS - 7</b>	<i>Biostatistics and Computer Application</i>	<b>3(3-0-0)</b>
<b>PHA-717</b>	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) <i>(Theory)</i>	<b>3(3-0-0)</b>
<b>PHA- 718</b>	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) <i>(Theory)</i>	<b>4(0-0-8)</b>
	<b>Total Credits</b>	<b>18</b>

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA-</b>	<b>Drug Regulatory Affairs &amp; Intellectual</b>	<b>3(3-0-</b>

<b>721</b>	<b>Property Rights</b>	<b>0)</b>
<b>PHA-833</b>	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Theory)	<b>3(3-0-0)</b>
<b>PHA-834</b>	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Practical)	<b>4(0-0-8)</b>
<b>PHA-835</b>	Pharmacognosy & Phytochemistry- III (Theory)	<b>3(3-0-0)</b>
<b>PHA-836</b>	Pharmacognosy & Phytochemistry- III (Practical)	<b>4(0-0-8)</b>
	<b>Total Credits</b>	<b>17</b>

### **Semester III**

<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
<b>PHA-780</b>	<b>Seminar</b>	<b>2(0-0-4)</b>
PHA- 781	Project Seminar	<b>15(0-0-30)</b>
	<b>Total Credits</b>	<b>17</b>
<b>Course code</b>	<b>Course Title</b>	<b>Credits</b>
PHA- 899	Thesis/ Project Work	<b>15(0-0-30)</b>
	<b>Total Credits</b>	<b>15</b>

# M. PHARM. PHARMACEUTICS

## SEMESTER –I

### MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

#### *THEORY*

**Course Code: PHA- 611**

**Credits- 04**

**(Theory 4 hrs/week)**

Principles of separation and applications of TLC. Column chromatography. Paper chromatography, Ion exchange chromatography, Counter current chromatography, G.C., DCCC, HPTLC & HPLC and electrophoresis.

#### **Infrared spectroscopy**

Introduction: The IR absorption process; the modes of vibration bond properties and absorption trends. The Hook's Law & calculations of frequencies for different types of bonds; coupled interactions; hydrogen bonding; radiation source, sample handling, qualitative and quantitative applications and introduction about FT-IR

#### **Ultraviolet spectroscopy :**

Introduction: The nature of electronic excitation, the origin of UV band structure; principle of absorption spectroscopy; Beer and Lambert's Law, Chromophore different types of transitions; shifts reagents effects of substituents; effect of conjugation' confirmations and geometry; calculation of Lamda maxima, effect of solvents, qualitative and quantitative applications

#### **Nuclear Magnetic Resonance spectroscopy :**

A. <sup>1</sup>H NMR Spectroscopy: Principle, Instrumentation techniques. Chemical equivalence, spin-spin coupling, The origin of spin-spin splitting, Pascal triangle, the coupling constant chemical shift reagents Pharm. application including interpretation of Proton-NMR spectra.

B. <sup>13</sup>C NMR Spectroscopy: Peak assignments, off resonance decoupling, selective proton decoupling, chemical shift equivalence, chemical shifts and spin coupling.

#### **Mass Spectrometry:**

Basic principle and theory involved, Instrumentation, types of ions, fragmentation, rearrangements; mass spectra of representative compounds, recognition of molecular ion peak, chemical ionization mass spectrometry, field desorption mass spectrometry, mass spectrometry, fast atom bombardment mass spectrometry.

#### **Thermal analysis:**

Introduction to various thermal methods of analysis, basic principle and theory; differential thermal analysis and differential scanning calorimetry and micro calorimetry. Different types of calorimeters and micro calorimeters.

**Pharmacological evaluation** of drugs in biological fluids: Bioassay.

**Microbiological assays.**

**Radioimmunoassays.**

**Quantitative microscopy** of herbal drugs. Lycopodium spore method, stomatal number, stomatal index, palisade ratio, vein-islet number, and vein-termination number.

### **BOOKS RECOMMENDED**

1. R.M.Silverstein, F.X.Webster, Spectrometric Identification of organic compounds, 6th ed. John Wiley & sons, New-York, 1998.
2. Remington, The science and practice of pharmacy, Mack publishing company. Easton Pennsylvania.
3. Organic Spectroscopy by Willam Kemp
4. E. Heftmann, A laboratory handbook of chromatography, New - York.
5. H.H.Willard, L.L.Merritt and J.A.Dean, Instrumental methods of analysis, Van Nostrend Reinhold, New York.
6. WWM. Wenland, Thermal analysis, John Willy and sons, New-York.
7. Principle of instrumental analysis, V ed. By Skoog, Holler-Niemen.
8. Modern analytical chemistry by David Harvey. (MC Graw-Hill international edition).

## **MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

### ***PRACTICALS***

**Course Code: PHA - 612**

**Credits- 04**

**(Practical 8 hrs/week)**

Practicals will be based on the topics mentioned in paper.

### **BIostatistics AND COMPUTER APPLICATION**

#### ***THEORY***

**Course Code: MAS-7**

**Credits- 03**

**(Theory 3 hrs/week)**

#### **BIostatistics**

1. A study of the following with reference to their applications in pharmacy and Biological Sciences.
2. Probability : Definition of laws of probability, probability distributions, properties of Normal, Binomial, Poison distributions, sampling distributions of mean and variance, standard error and fiducial limits.
3. Regression and correlation : Linear and curvilinear regressions, methods of least squares, correlation coefficients, rank correlation multiple regression.

4. Tests of significance : Testing hypotheses, errors of two kinds, power of test, test of significance based on normal distribution and t-test, test for significance of correlation coefficient.

F-test & Analysis of variance : 1-way, 2-way and 3-way classification.

5. Chi-square test of

(i) Variance of a normal population

(ii) Goodness of fit.

(iii) Independence in contingency tables.

Non-parametric tests, order statistics, sign test, run test, median test.

Design of experiments, Principles of randomization, replication and local control, completely randomized block and Latin square designs, factorial experiments, applications of the above designs in Pharmaceutical research.

6. Statistical quality control, process control, control charts, acceptance sampling- sampling plans.

## **COMPUTER**

1. Introduction to Computer : What is Computer, History of computers, Development & Respective generations, need to use computers, Types of computers hardware and software, Evolution and Generation of computer, basic computer organization, Number system, Storage devices- primary and secondary storage devices, **I/P** And **O/P** devices-printer, key board, scanner, punch card, mouse. Computer languages.

2. Operating System : Concept and evolution of Operating System, Batch Processing, Spooling, multi programming, Multiprocessing, time sharing, On line processing, real time processing, Virtual storage, OS-Controlled software, Introduction to DOS commands.

3. Computer Software: Software, Type of Software (Application, System) Development of software, Use of MS WORD, MS EXCEL, MS POWERPOINT etc.

4. Computer Networking & Internet: Computer Networking, Network Topologies, LAN, WAN, MAN etc. Introduction to INTERNET, Browser, URL, Search Engine, Mailing etc., Domain names, Protocols- Like, FTP, Web site, Modem, Introduction to HTML.

5. Application of Computer in Pharmacy

## **REFERENCES:**

1. Biostatistics by Alvin E.Lewis.

2. Introduction to probability & Statistics by Henry L.Alder & Edward B. Roessler.
3. Fundamentals of Applied Statistics by S.C.Gupta, V.K.Kapoor
4. Mathematics & Statistics for use in Pharmacy, Biology, Chemistry by Saunders & Flemming.
5. Practical Pharmacology by M.N.Ghosh.
6. Indian Pharmacopoeia & British Pharmacopoeia. 7. Remington's Pharmaceutical Sciences.

## PHARMACEUTICS -I

### (ADVANCED PHARMACEUTICS)

#### *THEORY*

**Course Code: PHA- 711**  
(Theory 3 hrs/week)

**Credits- 03**

**Preformulation studies:** goals of preformulation, preformulation parameters, methodology, solid state properties, solubility and partition coefficient, solubility and dissolution, modern concepts in rheology, drug excipient compatibility

**Packaging technology:** packaging materials, closures and containers units of dose packaging, blister packing, strip packing. Fda regulations, packs for tablets, capsules, ointments and aerosols.

**Scale-up techniques:** effect of scale up on formulation, process parameters like mixing, granulation, drying, compression, coating, packaging, stability, selection and evaluation of suitable equipments.

**Solid state properties:** crystal properties and polymorphism techniques for study of crystal properties; solid state stability, flow properties of powders, segregation and its importance.

**Theories of compaction and compression:** compression, consolidation strength of granules, compression and consolidation under high loads, effects of friction, distribution of forces in compaction, force volume relationships, heckel plots, compaction profiles, energy involved in compaction, strength of tablet, crushing strength, friability, lamination, instrumentation of tablet machines.

**Polymer science:** properties of polymers, thermodynamics of polymer solution, phase separation, polymers in solid state. Applications of polymers in pharmaceutical formulations.

**Process validation:** regulatory basis, validation of solid dosage forms, sterile products, liquid dosage forms. Process validation of raw materials, validation of analytical methods, equipment and process.

**Kinetics and drugs stability:** stability calculations, rate equation, kinetics of some decomposition, strategy of stability testing, methods of stabilization, methods of accelerated stability testing in dosage forms. Freeze thaw methods, centrifugal methods, temperature and humidity control.

**Books recommended:**

1. Liberman , h.a. & lachman, l., pharmaceutical dosages forms: tablets. Vol. I, ii and iii.
2. Avis, lachman i. & liberman h.a.: pharmaceutical dosages forms: parenteral medication vol. I and ii.
3. Turco, s. And king, r.f., sterile dosages forms, lea and febiger, philadelphia.
4. Remington's pharmaceutical sciences.
5. Martin, a.n., swarbrick, j & cammarata, a., physical pharmacy, lea and febiger, philadelphia.
6. Carstensen, j.t. Theory of pharmaceutical systems, academic press, new york and london.

## **PHARMACEUTICS -I**

**(ADVANCED PHARMACEUTICS)**

### ***PRACTICAL***

**Course Code: PHA- 712**  
**(Practical 8 hrs/week)**

**Credits- 04**

Practicals will be based on the topics mentioned in paper I.

## **SEMESTER- II**

**DRUG REGULATORY AFFAIRS & INTELLECTUAL PROPERTY RIGHTS**

### ***THEORY***

**Course Code: PHA- 721**

**Credits- 03**

**(Theory 3 hrs/week)**

1. W.H.O. certification scheme on the quality of pharmaceutical products.
2. Quality management in the drug industry: philosophy and essential elements.
3. Guidelines on the inspection of pharmaceutical manufacture and drug distribution channels. Page No. 7/43
4. Drugs Prices Control Order, 1995.
5. New Drug Policy, 1994.
6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.
7. General Principles of Intellectual Property: Copyright, Trademark  
Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on industry and patients, patent term and extension The Patents Act, 1970 – Salient features.
8. New Drug Application: Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials.
9. Industrial safety: Industrial hazards due to fire, chemicals, pharmaceuticals, radiation and accidents - mechanical and electrical equipments. Monitoring and prevention systems, Industrial effluent testing.
10. Stability Studies: ICH guidelines and WHO guidelines and stability protocols for dosage forms.

**REFERENCES :**

1. Quality Assurance of Pharmaceutics Vol I & II of WHO publications, 1999.
  2. GMPs by Mehra
  3. The Drugs and Cosmetic Act, 1940 by Vijay Mallik
  4. ISO 9000 and Total Quality Management by S.K.Ghosh
  5. How to Practice GMP by P.P.Sharma
  6. GMP of Pharmaceuticals by Willing and Stoker.
- Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## **PHARMACEUTICS -II**

**(BIOPHARMACEUTICS & PHARMACOKINETICS)**

### ***THEORY***

**Course Code: PHA - 821**

**Credits- 03**

**(Theory 3 hrs/week)**

**Transport of drugs through membranes and barriers other than gi tract :** buccal absorption , salivary excretion of drugs , excretion of drugs via sweat, excretion of drugs into milk, penetration of drugs into eye, transfer across placenta, passage of drugs into and out of

cerebrospinal and brain, measurement and interpretation of in vitro rates of dissolution. Intrinsic rates of dissolution, dissolution of drugs from solid dosage forms, various modern methods and models for testing dissolution rate, factors and kinetics of dissolution.

**Bioavailability and bioequivalence:** bioequivalence and its determination, study design for the assessment of bioavailability and bioequivalence, factors influencing bioavailability and bioequivalence, correlation of in vitro dissolution & in vivo bioavailability, statistical concepts in estimation of bioavailability and bioequivalence.

**Pharmacokinetics:** consideration of one, two and multiple compartment models on intravenous administration, intravenous infusion and first order absorption of single dose .

**Kinetic of multiple dosing:** dosage regimens, loading and maintenance doses, one and two compartment models on intravenous administration, and first order absorption of single dosing.

**Clinical pharmacokinetics:** concept, absorption, distribution and renal clearance and elimination, disposition and absorption kinetics, intravenous dose, constant i.v. Infusion, extravascular dose, metabolite kinetics.

therapeutic regimens- therapeutic response and toxicity, dosage regimens, clinical trial studies.

**Physiologic pharmacokinetic models:** concepts, physiologic pharmacokinetic models with binding blood flow - limited versus diffusion - limited model, applications and limitation of physiologic pharmacokinetic models, mean residence time (mrt), statistical moments theory, mean absorption time (mat), mean dissolution time (mdt).

**Non-linear pharmacokinetics:** recognition of non-linearity, one and two compartment open model with Michaelis-menton kinetics, determination of  $k_m$  and  $v_m$ , non-linear tissue binding constants.

#### **Books recommended:**

1. Gibaldi m., pharmacokinetics, marcel dekker inc. New york.
2. Abdou, h.m. Dissolution, bioavailability and bioequivalence, mack publishing co. Easton , pa
3. Smith, r.v. & stewart, j.t., text book of biopharmaceutical analysis, lea and febiger, philadelphia.
4. Wagner j.g.- fundamentals of clinical pharmacokinetics, drug intelligence pub. Hamilton.
5. Welling, p.g., tse, f.i.s. & dighe, s.v.(eds), pharmaceutical bioequivalence, marcel dekker inc., new york
6. Gibaldi, m., perrier, d.: pharmacokinetics, marcel dekker inc., new york
7. Rowland, m. & tozer, t. N., clinical pharmacokinetics-concept and applications , lea and febiger usa.
8. Shargel, l. & yu, abc.: applied biopharmaceutics & pharmacokinetics, appleton and lange, connecticut, usa.
9. Hotari, r.e., biopharmaceutics and clinical pharmacokinetics, marcel dekker inc., new york and basel.

## **PHARMACEUTICS -II**

**(BIOPHARMACEUTICS & PHARMACOKINETICS)**

***PRACTICAL***

**Course Code: PHA- 822**  
**(Practical 8 hrs/week)**

**Credits- 04**

Practicals Will Be Based On The Topics Mentioned In Paper.

**PHARMACEUTICS -III**

**(ADVANCED DRUG DELIVERY SYSTEMS)**

***THEORY***

**Course Code: PHA- 823**  
**(Theory 3 hrs/week)**

**Credits- 03**

Fundamentals of controlled release drug delivery influence of drug properties and routes of drug administration on the design of sustained and controlled release systems.

Pharmacokinetic/pharmacodynamic basis of drug delivery. Dosing considerations and bioavailability assessment. Regulatory assesment.

Design and fabrication of: oral controlled release drug delivery systems, parentral products, implantable products, transdermal therapeutic system, prodrugs as sustained chemical delivery systems.

Biochemical and molecular approach to controlled drug delivery: liposomes, niosomes, microspheres, resealed erythrocytes, nanoparticles, osmotic pumps

Targeted drug delivery: definition, concept, target-drug interactions, delivery systems.

Advances in controlled and novel drug delivery

**Book recommended:**

1. Robinson, j.r. & lee, v.h.i.,: controlled and novel drug delivery marcel dekker, new york and basel.
2. Jain, n.k.: controlled and novel drug delivery,cbs, new delhi.
3. Jain,n.k.advances in novel and controlled drug delivery.
4. Chien, y.w.: novel drug delivery systems, marcel dekker, new york and basel.
4. Roseman, t.j.: controlled release drug delivery ssystems, marcel dekker new york
5. Goldberg : targeted drugs.
6. Bruck, s.d., controlled drug delivery, vol. I & ii.
7. Juliano, r.l. : drug delivery systems.
8. Review articles published in various journals.

## **PHARMACEUTICS -III**

**(ADVANCED DRUG DELIVERY SYSTEMS)**

### ***PRACTICAL***

**Course Code: PHA- 824**

**Credits- 04**

**(Practical 8 hrs/week)**

PRACTICALS WILL BE BASED ON THE TOPICS MENTIONED IN PAPER.

## **SEMESTER- III**

### **SEMINAR**

**Course Code: PHA- 780**

**Credits- 02**

The seminar will be based on the topic other than the topic of the thesis/ project work

### **PROJECT SEMINAR**

**Course Code: PHA- 781**

**Credits- 15**

The seminar will be based on progress of the project work

## **SEMESTER- IV**

### **THESIS/ PROJECT WORK**

**Course Code: PHA- 899**

**Credits- 15**

Project Seminar and Viva-voce

# **M. PHARM. PHARMACEUTICAL CHEMISTRY**

## **SEMESTER –I**

### **MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

#### ***THEORY***

**Course Code: PHA- 611**  
**(Theory 4 hrs/week)**

**Credits- 04**

Principles of separation and applications of TLC. Column chromatography. Paper chromatography, Ion exchange chromatography, Counter current chromatography, G.C., DCCC, HPTLC & HPLC and electrophoresis.

**Infrared spectroscopy**

Introduction: The IR absorption process; the modes of vibration bond properties and absorption trends. The Hook's Law & calculations of frequencies for different types of bonds; coupled interactions; hydrogen bonding; radiation source, sample handling, qualitative and quantitative applications and introduction about FT-IR

### **Ultraviolet spectroscopy :**

Introduction: The nature of electronic excitation, the origin of UV band structure; principle of absorption spectroscopy; Beer and Lambert's Law, Chromophore different types of transitions; shifts reagents effects of substituents; effect of conjugation' confirmations and geometry; calculation of Lamda maxima, effect of solvents, qualitative and quantitative applications

### **Nuclear Magnetic Resonance spectroscopy :**

A. <sup>1</sup>H NMR Spectroscopy: Principle, Instrumentation techniques. Chemical equivalence, spin-spin coupling, The origin of spin-spin splitting, Pascal triangle, the coupling constant chemical shift reagents Pharm. application including interpretation of Proton-NMR spectra.

B. <sup>13</sup>C NMR Spectroscopy: Peak assignments, off resonance decoupling, selective proton decoupling, chemical shift equivalence, chemical shifts and spin coupling.

### **Mass Spectrometry:**

Basic principle and theory involved, Instrumentation, types of ions, fragmentation, rearrangements; mass spectra of representative compounds, recognition of molecular ion peak, chemical ionization mass spectrometry, field desorption mass spectrometry, mass spectrometry, fast atom bombardment mass spectrometry.

### **Thermal analysis:**

Introduction to various thermal methods of analysis, basic principle and theory; differential thermal analysis and differential scanning calorimetry and micro calorimetry. Different types of calorimeters and micro calorimeters.

**Pharmacological evaluation** of drugs in biological fluids: Bioassay.

**Microbiological assays.**

**Radioimmunoassays.**

**Quantitative microscopy** of herbal drugs. Lycopodium spore method, stomatal number, stomatal index, palisade ratio, vein-islet number, and vein-termination number.

### **BOOKS RECOMMENDED**

1. R.M.Silverstein, F.X.Webster, Spectrometric Identification of organic compounds, 6th ed. John Wiley & sons, New-York, 1998.
2. Remington, The science and practice of pharmacy, Mack publishing company. Easton Pennsylvania.
3. Organic Spectroscopy by Willam Kemp
4. E. Heftmann, A laboratory handbook of chromatography, New - York.
5. H.H.Willard, L.L.Merritt and J.A.Dean, Instrumental methods of analysis, Van Nostrend Reinhold, New York.
6. WWM. Wenland, Thermal analysis, John Willy and sons, New-York.
7. Principle of instrumental analysis, V ed. By Skoog, Holler-Niemen.
8. Modern analytical chemistry by David Harvey. (MC Graw-Hill international edition).

# MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

## *PRACTICALS*

**Course Code: PHA- 612**

**Credits- 04**

**(Practical 8 hrs/week)**

Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## **BIOSTATISTICS AND COMPUTER APPLICATION *THEORY***

**Course Code: MAS-7**

**Credits- 03**

**(Theory 3 hrs/week)**

### **BIOSTATISTICS**

1. A study of the following with reference to their applications in pharmacy and Biological Sciences.
2. Probability : Definition of laws of probability, probability distributions, properties of Normal, Binomial, Poisson distributions, sampling distributions of mean and variance, standard error and fiducial limits.
3. Regression and correlation : Linear and curvilinear regressions, methods of least squares, correlation coefficients, rank correlation multiple regression.
4. Tests of significance : Testing hypotheses, errors of two kinds, power of test, test of significance based on normal distribution and t-test, test for significance of correlation coefficient.  
F-test & Analysis of variance : 1-way, 2-way and 3-way classification.
5. Chi-square test of
  - (i) Variance of a normal population
  - (ii) Goodness of fit.
  - (iii) Independence in contingency tables.

Non-parametric tests, order statistics, sign test, run test, median test.

Design of experiments, Principles of randomization, replication and local control, completely randomized block and Latin square designs, factorial experiments, applications of the above designs in Pharmaceutical research.

6. Statistical quality control, process control, control charts, acceptance sampling- sampling plans.

### **COMPUTER**

1. Introduction to Computer : What is Computer, History of computers, Development & Respective generations, need to use computers, Types of computers hardware and software, Evolution and Generation of computer, basic computer organization, Number system, Storage devices- primary and secondary storage devices, **I/P** And **O/P** devices-printer, key board, scanner, punch card, mouse. Computer languages.
2. Operating System : Concept and evolution of Operating System, Batch Processing, Spooling, multi programming, Multiprocessing, time sharing, On line processing, real time processing, Virtual storage, OS-Controlled software, Introduction to DOS commands.
3. Computer Software: Software, Type of Software (Application, System) Development of software, Use of MS WORD, MS EXCEL, MS POWERPOINT etc.
4. Computer Networking & Internet: Computer Networking, Network Topologies, LAN, WAN, MAN etc. Introduction to INTERNET, Browser, URL, Search Engine, Mailing etc., Domain names, Protocols- Like, FTP, Web site, Modem, Introduction to HTML.
5. Application of Computer in Pharmacy

#### **REFERENCES:**

1. Biostatistics by Alvin E.Lewis.
2. Introduction to probability & Statistics by Henry L.Alder & Edward B. Roessler.
3. Fundamentals of Applied Statistics by S.C.Gupta, V.K.Kapoor
4. Mathematics & Statistics for use in Pharmacy, Biology, Chemistry by Saunders & Flemming.
5. Practical Pharmacology by M.N.Ghosh.
6. Indian Pharmacopoeia & British Pharmacopoeia. 7. Remington's Pharmaceutical Sciences.

## **PHARMACEUTICAL CHEMISTRY – I**

### **(Advanced Pharmaceutical Chemistry)**

#### ***THEORY***

**Course Code: PHA- 713**  
**(Theory 3 hrs/week)**

**Credits- 03**

### **1. Stereochemistry :**

i. Principles of stereochemistry including geometric isomerism, optical isomerism and conformational isomerism, Dynamic stereochemistry.

### **2. Mechanisms, stereochemistry and applications of following individual reactions:**

1. Hydrogenation
2. Reduction with metallic hydrides
3. Clemensen Reduction
4. Wolf Kishner reduction
5. Birch Reduction
6. Meerwein-Ponndorf reduction
7. Oppenauer oxidation
8. Free radical reaction
9. Allylic Bromination
10. Use of diazomethane and peracids in synthesis
11. Grignard Reaction
12. Pinacol and related rearrangements
13. Beckmann rearrangement and ozonolysis
14. Heck reaction
15. Sharpless oxidation
16. Suzuki coupling
17. Wittig Reaction

**3. Synthone approach:** Definition, terms and abbreviation, rules and guidelines used in synthesis of following drugs.

Rosiglitazone, Trimethoprim, Terfenadine, Ibuprofen, Fentanyl, Midazolam, Ciprofloxacin, Captopril, Diclofenac, Losartan

### **4. Green Chemistry:**

Water as solvent, ionic liquids, supercritical liquids, Supported reagents and catalysts, Solvent free reactions, activation by Microwave, Ultrasound etc.

## **PHARMACEUTICAL CHEMISTRY – I**

**(Advanced Pharmaceutical Chemistry )**

### **PRACTICAL**

**Course Code: PHA- 714**

**Credits- 04**

**(Practical 8 hrs/week)**

1. Experimental techniques – Fractional distillation, Vacuum distillation, Preparative chromatography- Column and TLC.
2. Synthesis of any five different heterocyclic compounds using reactions discussed under point 2 of theory syllabus.
3. Practical illustrations of any five reactions described in the point(2) of theory syllabus.
4. Principles, mechanism and techniques of stereo controlled synthesis of Nifedipine, Chlorzoxazone and Paracetamol.

5. Isolation of phytochemical principles (e.g. alkaloids, steroids) from natural origin.

***Recommended Books for Theory & Practical***

1. Sykes- A Guidebook to Mechanism in Organic Chemistry.
2. March- Advanced Organic Chemistry –Reaction Mechanisms.
3. Eliel- Stereochemistry of Carbon Compounds.
4. Alexander- Principles of Ionic Organic Reaction.
5. Surrey- Reaction in Organic Chemistry.
6. Hendrickson – Organic Chemistry.
7. Jerry March- Advanced Organic Chemistry.
8. Asymmetric Synthesis, Vol. 1-7, Ed. J. A. Morrison
9. Chirotechnology - R.A Sheldon.
10. Practical Organic Synthesis: A Student's Guide - Reinhart Keese, Martin Brändle, Trevor Toubé
11. Norman, Principles of Organic Chemistry, Carby and Sunberg, Organic Chemistry Part A & B.
12. Beuhler and Pearson – Organic Chemistry – Part A & B.
13. Mc Murry, Organic Chemistry.
14. M. Lancaster, Green Chemistry.
15. William M. Nelson, Green Solvents for Chemistry: Perspectives and Practice (Green Chemistry Series)
16. Named Organic Reaction, 2<sup>nd</sup> Ed, Thomas Laue and Andreas Plagens(Eds), John Wiley & Sons Ltd, England, 2005.
17. Alvisè Perosa, Fulvio Zecchini, Methods and Reagents for Green Chemistry: An Introduction
18. Daniel Lednicer-Organic Chemistry of Drug Synthesis (Vol. 1-7).
19. K.B.G. Torsell, Natural Products Chemistry, John Wiley and Sons, New York.
20. J.B. Harborne, Phytochemical Methods, Chapman and Hall, London

## **SEMESTER II**

### **DRUG REGULATORY AFFAIRS & INTELLECTUAL PROPERTY RIGHTS**

#### ***THEORY***

**Course Code: PHA- 721**

**Credits- 03**

**(Theory 3 hrs/week)**

1. W.H.O. certification scheme on the quality of pharmaceutical products.
2. Quality management in the drug industry: philosophy and essential elements.
3. Guidelines on the inspection of pharmaceutical manufacture and drug distribution channels. Page No. 7/43
4. Drugs Prices Control Order, 1995.
5. New Drug Policy, 1994.
6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.
7. General Principles of Intellectual Property: Copyright, Trademark

Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on industry and patients, patent term and extension The Patents Act, 1970 – Salient features.

**8. New Drug Application:** Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials.

**9. Industrial safety:** Industrial hazards due to fire, chemicals, pharmaceuticals, radiation and accidents - mechanical and electrical equipments. Monitoring and prevention systems, Industrial effluent testing.

**10. Stability Studies:** ICH guidelines and WHO guidelines and stability protocols for dosage forms.

#### **REFERENCES :**

1. Quality Assurance of Pharmaceutics Vol I & II of WHO publications, 1999.

2. GMPs by Mehra

3. The Drugs and Cosmetic Act, 1940 by Vijay Mallik

4. ISO 9000 and Total Quality Management by S.K.Ghosh

5. How to Practice GMP by P.P.Sharma

6. GMP of Pharmaceuticals by Willing and Stoker.

Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## **PHARMACEUTICAL CHEMISTRY – II**

### **(Advanced Medicinal Chemistry)**

#### ***THEORY***

**Course Code: PHA- 825**

**Credits- 03**

**(Theory 3 hrs/week)**

1. **Microorganism in drug development:** Microbial conversions of drugs like steroids, prostaglandins and antibiotics. These should include some biotechnology-oriented chapters like enzymes immobilization techniques.

2. **Molecular concept of drug receptor interactions.**

Advances in following classes of receptors and their drug ligands, Opioid, Dopamine, Adrenergic, Cholinergic, Histamine, 5-HT<sub>1A</sub>, GABA.

3. **Synthesis** of following drugs describing reaction conditions mechanism and strategies involved in the synthesis: Gefitinib, Cetrizine, Fexofenadine, Linezolid, Risperidone, Ziprasidone, Diazepam, Dapsone, Ethinyl estradiol, Vit. B, Diphenhydramine.

4. **Combinatorial chemistry:** solid phase synthesis, Different types of polymer supports, linkers, Strategies of library synthesis and characterization, High-Throughput

Screening in Drug Discovery

Solid phase strategies

a. General strategies and concepts

b. Specific implementation issues

i . Solid support

- ii Anchoring chemistry
- iii. Coupling chemistry
- iv. Protection schemes
- v. Analytical methods
- c. Solution phase analysis
- 5. **Gene therapy:** A brief introduction, concept with suitable examples, scope, techniques and application.
- 6. Brief introduction to QSAR and CADD.

## PHARMACEUTICAL CHEMISTRY – II

### (Advanced Medicinal Chemistry)

#### *Practical*

**Course Code: PHA-826**

**Credits- 04**

**(Practical: 8 hrs/week)**

1. Synthetic studies of any four drugs mentioned in the point (3) of the theory syllabus.
2. Determination of partition coefficient, refractive index & ionization constant of drugs using RPHPLC & RPTLC.
3. To perform a regression analysis of a series of bioactive compounds from a reputed scientific publication and develop a mathematical QSAR relationship with its complete interpretation. (This research paper should not have QSAR study).
4. Microwave assisted synthesis of any five compounds.

#### ***Books Recommended***

1. Foye: Principles of Medicinal Chemistry, 6<sup>th</sup>ed. (Lippincott).
2. Ariens: Medicinal Chemistry Series.
3. Ellis and West: Progress in Medicinal Chemistry Series.
4. Butterworthser: Progress in Medicinal Chemistry Series.
5. Burgers Medicinal chemistry-The Basis of Medicinal chemistry by Manfred E. Wolff part-I (John Wiley & Sons).
6. Medicinal chemistry – The Role of organic chemistry in drug research by S.M.Roberts and B.J.Price.
7. Vogel's Textbook of practical organic chemistry by Arthur I Vogel (ELBS and Lognman)
8. Organic Chemistry of Drug Design and Drug Action – R. B. Silverman
9. The Organic Chemistry of Drug Synthesis (1-7 volumes) by Daniel Lednicer & Laster A. Mitscher (John Wiley & Sons).
10. An Introduction to Organic Laboratory Manual by Pavia, Lampman and Chris.
11. Principles of Organic and Medicinal Chemistry – Munson.
12. Comprehensive Medicinal Chemistry – Hansch and Leo.
13. High-Throughput Screening in Drug Discovery Edited by Jorg Huser, Wiley

## DRUG DESIGN

### *THEORY*

**Course Code: PHA- 827**

**Credits- 03**

**(Theory 3 hrs/week)**

1. A general study of co-relation of physicochemical properties and stereochemistry and drug action. Isosterism and bio-isosterism as guides to structural variations, metabolite, antagonism and theory of drug action.
2. An overall treatment of various approaches to drug design including the method of variation, e.g. – Fibonacci search, Topliss tree, Craigs plot, Simplex methods, and Cluster analysis.
3. Quantitative Structure-Activity Relationships (QSAR) with detail coverage of Hansch's Liner method, Free and Wilson methods, mixed approached principal component analysis and application of above.
4. Drug design based on antagonism and enzyme inhibition.
5. Computer Aided Drug Design Basic concept of computational chemistry like Quantum Mechanics, molecular mechanics, Force fields, Energy minimization, conformational reaction, Molecular Dynamics. Liqand based drug design based on active site of receptor/enzyme. Indirect Drug Design – Analog approach, Pharmacophore mapping, Template forcing, Excluded volume & shape analysis, artificial intelligence methods.
6. Drug metabolism based drug design – Prodrugs design.

#### ***Books recommended***

1. Ariens-Drug Design, Vol. VII.
2. Smith-William-Introduction to the Principle of Drug Design.
3. Woodridge-Progress in Pharmaceutical Research.
4. Introduction to the Principles of Drug Design by John Smith & Hywel Williams (Wright PSG).
5. Guide to Chemical Basis of Drug Design by Alfred Burger (John Wiley & Sons)
6. Burgers Medicinal chemistry-The Basis of Medicinal chemistry by Manfred E. Wolff part-I (John Wiley & Sons).
7. Computer Assisted Drug Design By Edward. C. Olson (American Chemical Society, ACD symposium series 112).
8. Medicinal Chemistry – The Role of Organic Chemistry in Drug Research by S. M. Roberts and B. J. Price.
9. Principals of Medicinal Chemistry – Foye.
10. Comprehensive Medicinal Chemistry by Hansch & Leo, Vol. 4.

## CHEMISTRY OF NATURAL PRODUCT

### *THEORY*

1. Natural products as Leads for new pharmaceutical.
2. The natural products obtained from terrestrial and microbial sources will be discussed in the light of various degradative and synthetic approaches supported by spectral data. Important members representing the following classes of natural products shall be discussed.
3. **ALKALOIDS:** General introduction and classification, isolation and purification methods, general methods employed for determining the structure of alkaloids, constitution of morphine, reserpine and quinine.
4. **STEROIDS :** General introduction, stereochemistry, nomenclature and structure elucidation of sterols (cholesterol), sapogenin (diosgenin) and cardiac glycosides.
5. **AMINO ACIDS AND PEPTIDES, NUCLEIC ACIDS :** General introduction, synthesis of peptides and amino acids. End group analysis, structural features of Insulin, vasopressin and oxytocin, structural features of DNA & RNA.
6. **ANTIBIOTICS :** Classification of antibiotics, structural details of penicillins and tetracyclines, polypeptide antibiotics.
7. **FLAVONOIDS :** Detailed chemical account of rutin and quercetin.
8. **TRITERPENOIDS :** A general chemical treatment and structural elucidation of terpenoids
9. **COUMARINS:** General methods of isolation and purification and structural determination of Xanthotoxin and psoralene.
10. Marine products with therapeutic potential.

**Books Recommended**

1. I.L. Finar, Organic Chemistry, Vol.II, The English Language Books Society and Longman Group Limited.
2. G.A. Cordell, Introduction to Alkaloids, John Wiley and Sons, New York.
3. M.L. Wickery and B. Wickery, Secondary Plant Metabolism McMillan Press Ltd. London.
4. L.F. Fieser and M. Fieser, Steroids, Reinhold Publishing Co. New York.
5. K.B.G. Torsell, Natural Products Chemistry, John Wiley and Sons, New York.

6. J.B. Harborne, Phytochemical Methods, Chapman and Hall, London

7. Burger's Medicinal Chemistry and Drug Discovery, Vol. I. Principle and Practice, 5th, Edition, John Wiley Sons, New York.

## **SEMESTER- III**

### **SEMINAR**

**Course Code: PHA- 780**

**Credits- 02**

The seminar will be based on the topic other than the topic of the thesis/ project work

### **PROJECT SEMINAR**

**Course Code: PHA- 781**

**Credits- 15**

The seminar will be based on progress of the project work

## **SEMESTER- IV**

### **THESIS/ PROJECT WORK**

**Course Code: PHA- 899**

**Credits- 15**

Project Seminar and Viva-voce

# M. PHARM. PHARMACOLOGY

## SEMESTER –I

### MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

#### *THEORY*

**Course Code: PHA- 611**  
**(Theory 4 hrs/week)**

**Credits- 04**

Principles of separation and applications of TLC. Column chromatography. Paper chromatography, Ion exchange chromatography, Counter current chromatography, G.C., DCCC, HPTLC & HPLC and electrophoresis.

#### **Infrared spectroscopy**

Introduction: The IR absorption process; the modes of vibration bond properties and absorption trends. The Hook's Law & calculations of frequencies for different types of bonds; coupled interactions; hydrogen bonding; radiation source, sample handling, qualitative and quantitative applications and introduction about FT-IR

#### **Ultraviolet spectroscopy :**

Introduction: The nature of electronic excitation, the origin of UV band structure; principle of absorption spectroscopy; Beer and Lambert's Law, Chromophore different types of transitions; shifts reagents effects of substituents; effect of conjugation' confirmations and geometry; calculation of Lamda maxima, effect of solvents, qualitative and quantitative applications

#### **Nuclear Magnetic Resonance spectroscopy :**

- A. <sup>1</sup>H NMR Spectroscopy: Principle, Instrumentation techniques. Chemical equivalence, spin-spin coupling, The origin of spin-spin splitting, Pascal triangle, the coupling constant chemical shift reagents Pharm. application including interpretation of Proton-NMR spectra.
- B. <sup>13</sup>C NMR Spectroscopy: Peak assignments, off resonance decoupling, selective proton decoupling, chemical shift equivalence, chemical shifts and spin coupling.

**Mass Spectrometry:**

Basic principle and theory involved, Instrumentation, types of ions, fragmentation, rearrangements; mass spectra of representative compounds, recognition of molecular ion peak, chemical ionization mass spectrometry, field desorption mass spectrometry, mass spectrometry, fast atom bombardment mass spectrometry.

**Thermal analysis:**

Introduction to various thermal methods of analysis, basic principle and theory; differential thermal analysis and differential scanning calorimetry and micro calorimetry. Different types of calorimeters and micro calorimeters.

**Pharmacological evaluation** of drugs in biological fluids: Bioassay.

**Microbiological assays.**

**Radioimmunoassays.**

**Quantitative microscopy** of herbal drugs. Lycopodium spore method, stomatal number, stomatal index, palisade ratio, vein-islet number, and vein-termination number.

**BOOKS RECOMMENDED**

1. R.M.Silverstein, F.X.Webster, Spectrometric Identification of organic compounds, 6th ed. John Wiley & sons, New-York, 1998.
2. Remington, The science and practice of pharmacy, Mack publishing company. Easton Pennsylvania.
3. Organic Spectroscopy by Willam Kemp
4. E. Heftmann, A laboratory handbook of chromatography, New - York.
5. H.H.Willard, L.L.Merritt and J.A.Dean, Instrumental methods of analysis, Van Nostrend Reinhold, New York.
6. WWM. Wenland, Thermal analysis, John Willy and sons, New-York.
7. Principle of instrumental analysis, V ed. By Skoog, Holler-Niemen.
8. Modern analytical chemistry by David Harvey. (MC Graw-Hill international edition).

**MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

**PRACTICALS**

**Course Code: PHA - 612**

**Credits- 04**

**(Practical 8 hrs/week)**

Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## **BIOSTATISTICS AND COMPUTER APPLICATION THEORY**

**Course Code: MAS-7**  
**(Theory 3 hrs/week)**

**Credits- 03**

### **BIOSTATISTICS**

1. A study of the following with reference to their applications in pharmacy and Biological Sciences.
2. Probability : Definition of laws of probability, probability distributions, properties of Normal, Binomial, Poisson distributions, sampling distributions of mean and variance, standard error and fiducial limits.
3. Regression and correlation : Linear and curvilinear regressions, methods of least squares, correlation coefficients, rank correlation multiple regression.
4. Tests of significance : Testing hypotheses, errors of two kinds, power of test, test of significance based on normal distribution and t-test, test for significance of correlation coefficient.  
F-test & Analysis of variance : 1-way, 2-way and 3-way classification.
5. Chi-square test of
  - (i) Variance of a normal population
  - (ii) Goodness of fit.
  - (iii) Independence in contingency tables.

Non-parametric tests, order statistics, sign test, run test, median test.

Design of experiments, Principles of randomization, replication and local control, completely randomized block and Latin square designs, factorial experiments, applications of the above designs in Pharmaceutical research.

6. Statistical quality control, process control, control charts, acceptance sampling- sampling plans.

### **COMPUTER**

1. Introduction to Computer : What is Computer, History of computers, Development & Respective generations, need to use computers, Types of computers hardware and software, Evolution and Generation of computer, basic computer organization, Number system, Storage devices- primary and secondary storage devices, **I/P** And **O/P** devices-printer, key board, scanner, punch card, mouse. Computer languages.
2. Operating System : Concept and evolution of Operating System, Batch Processing, Spooling, multi programming, Multiprocessing, time sharing, On line processing, real time processing, Virtual storage, OS-Controlled software, Introduction to DOS commands.

3. Computer Software: Software, Type of Software (Application, System) Development of software, Use of MS WORD, MS EXCEL, MS POWERPOINT etc.
4. Computer Networking & Internet: Computer Networking, Network Topologies, LAN, WAN, MAN etc. Introduction to INTERNET, Browser, URL, Search Engine, Mailing etc., Domain names, Protocols- Like, FTP, Web site, Modem, Introduction to HTML.
5. Application of Computer in Pharmacy

#### **REFERENCES:**

1. Biostatistics by Alvin E.Lewis.
2. Introduction to probability & Statistics by Henry L.Alder & Edward B. Roessler.
3. Fundamentals of Applied Statistics by S.C.Gupta, V.K.Kapoor
4. Mathematics & Statistics for use in Pharmacy, Biology, Chemistry by Saunders & Flemming.
5. Practical Pharmacology by M.N.Ghosh.
6. Indian Pharmacopoeia & British Pharmacopoeia. 7. Remington's Pharmaceutical Sciences.

## **PHARMACOLOGY – I** **(BASIC PRINCIPLES OF DRUG THERAPY, AND CLINICAL PHARMACOLOGY)**

### ***THEORY***

**Course Code: PHA- 715**  
**(Theory 3 hrs/week)**

**Credits- 03**

**I. Definition, Scope, Organization and growth of Clinical Pharmacology,** Cellular Transduction Mechanisms, Clinical Pharmacokinetics, Monitoring of Drug Therapy, Adverse Drug Reactions, Patient Compliance, Pharmacogenetics, Paediatric and Geriatric Pharmacology, Drug Interactions, Drug Therapy during pregnancy and lactation.

**II. Drugs acting on the autonomic nervous system :**

**i) Neurotransmission :** The Autonomic and Somatic Motor Nervous System.

**ii) Muscarinic Receptor Agonists and Antagonists.**

**iii) Anticholinestrase Agents**

**iv) Agents acting at the neuromuscular junction and autonomic ganglia.**

v) Catecholamines, Sympathomimetic Drugs and adrenergic receptor antagonists, Ocular Pharmacology.

vi) 5-Hydroxy tryptamine (Serotonin) receptor agonists and antagonists.

### **III. Drugs acting on the Central Nervous System**

i) Neurotransmission and the Central Nervous System

ii) History and Principles of Anesthesiology

iii) General Anesthetics

iv) Local Anesthetics

v) Hypnotics , Sedatives and Ethanol

vi) Drugs and the treatment of Psychiatric Disorder : Psychosis, Anxiety : Depression and Mania

vii) Drugs Effective in the therapy of Epilepsy

viii) Drugs effective in the therapy of Migraine

ix) Treatment of Central Nervous system degenerative disorders

x) Opioid Analgesics and Antagonists

xi) Drug Addiction and Drug Abuse

### **IV. Autocoids : Drug Therapy of Inflammation**

i) Introduction

ii) Histamine, Bradykinin and their Antagonists

iii) Lipid- Derived Autocoids : Eicosanoids and platelet Activating factor

iv) Analgesic-Antipyretic and Anti-Inflammatory agents and Drugs employed in the treatment of Govt.

v) Drugs used in the treatment of Asthma.

### **V. Drugs effecting renal, blood and cardiovascular function :**

i) Diuretics

ii) Drugs used in the treatment of Myocardial Ischemia

iii) Antihypertensive agents and the drug therapy of hypertension.

iv) Pharmacological treatment of Heart Failure

v) Antiarrhythmic Drugs

vi) Drugs used in the treatment of Hyperlipoproteinemias

vii) Heamatopoietic Agents : Growth factors, Minerals and Vitamins

viii) Anti coagulant, thrombolytic and antiplatelet drugs.

### **BOOKS RECOMMENDED**

1. Modern Pharmacology by C.R. Craig and R.E. Stitzel

2. Goodman and Gilman's : The Pharmacological Basis of Therapeutics, edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S Nies, and Palmar Taylor

3. Clinical Pharmacology by D.R. Laurence and P.N. Benett

4. Essentials of Pharmacotherapeutics by F.S.K. Barar

5. Pharmacology by H.P. Rang and M.M. Dale

6. Lewis's Pharmacology revised by James Crossland

7. Oxford Textbook of Clinical Pharmacology and Drug Therapy by D.G. Grahame-Smith and J.K. Aronson.

## **PHARMACOLOGY – I**

### **(BASIC PRINCIPLES OF DRUG THERAPY, AND CLINICAL PHARMACOLOGY)**

## ***PRACTICAL***

**Course Code:PHA- 716**

**Credits- 04**

**(Practical 8 hrs/week)**

Pharmacological techniques employed in the study of various drugs.

## **SEMESTER-II**

### **DRUG REGULATORY AFFAIRS & INTELLECTUAL PROPERTY RIGHTS**

#### ***THEORY***

**Course Code: PHA- 721**

**Credits- 03**

**(Theory 3 hrs/week)**

1. W.H.O. certification scheme on the quality of pharmaceutical products.
2. Quality management in the drug industry: philosophy and essential elements.
3. Guidelines on the inspection of pharmaceutical manufacture and drug distribution channels. Page No. 7/43
4. Drugs Prices Control Order, 1995.
5. New Drug Policy, 1994.
6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.
7. General Principles of Intellectual Property: Copyright, Trademark  
Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on industry and patients, patent term and extension The Patents Act, 1970 – Salient features.
8. New Drug Application: Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials.
9. Industrial safety: Industrial hazards due to fire, chemicals, pharmaceuticals, radiation and accidents - mechanical and electrical equipments. Monitoring and prevention systems, Industrial effluent testing.
10. Stability Studies: ICH guidelines and WHO guidelines and stability protocols for dosage forms.

#### **REFERENCES :**

1. Quality Assurance of Pharmaceutics Vol I & II of WHO publications, 1999.
2. GMPs by Mehra
3. The Drugs and Cosmetic Act, 1940 by Vijay Mallik
4. ISO 9000 and Total Quality Management by S.K.Ghosh

5. How to Practice GMP by P.P.Sharma

6. GMP of Pharmaceuticals by Willing and Stoker.

Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## **PHARMACOLOGY – II** **(Recent advances and emerging Trends in Pharmacological Sciences)**

### *THEORY*

**Course Code: PHA- 829**

**Credits- 03**

**(Theory 3 hrs/week)**

#### **I. Digestive System**

- a) Pharmacotherapy of peptic ulcer, diarrhoea, constipation.
- b) Agents affecting gastrointestinal water, Flux and motility : Emesis and antiemetics; Bile acids and Pancreatic enzymes

#### **II. Therapy of Infectious diseases**

- a) General Principles, Antibacterial Drugs Sulphonamides, Quinolones, Penicillins, Cephalosporins, Tetracyclines, Chloramphenicol.
- b) Drugs used in the chemotherapy of Protozoal infections: Malaria
- c) Drugs used in the chemotherapy of Protozoal infections : Trypanosomiasis, Leishmaniasis, Amebiasis, Giardiasis, Trichomoniasis, and other Protozoal infections.
- d) Drugs used in the chemotherapy of Helminthiasis
- e) Drugs used in the chemotherapy of Leprosy, Tuberculosis, Fungal infections, Viral infections
- f) Drugs used in the Chemotherapy of Neoplastic diseases
- g) Immunomodulators : Immunosuppressive agents and Immunostimulants
- h) Newer Chemotherapeutic agents

#### **III. Hormones and Hormones Antagonists**

- a) Adenohypophyseal hormones and their Hypothalamic releasing factors.
- b) Hormones of Posterior pituitary
- c) Thyroid and Antithyroid drugs
- d) Estrogens and Progestins, Antifertility agents
- e) Androgens
- f) Adrenocorticotrophic hormones; Adrenocortical steroids and their synthetic analogs; Inhibitors of the synthesis and actions of adrenocortical hormones.
- g) Insulin, oral hypoglycemic agents and the Pharmacology of pancreatic hormones.
- h) Agents affecting Calcification and bone turnover:  
Calcium phosphate, parathyroid hormones, vitamin D, Calcitonin and other compounds.
- i) Vasopressin and other agents affecting the renal conservation of water.

#### **IV. Emerging Trends & Recent advances in:**

- a) Receptor and G-Protein
- b) Cyclic nucleotides
- c) TNF, Apoptosis
- d) Ion channel modulators
- e) Neurosteroids and Cannabinoids
- f) Nitric oxide
- g) ANF, Anti oxidants : Melatonin
- h) Chiral Pharmacology
- i) Gene therapy
- j) Neuropeptide, Substance P, Angiotensin II modulators.

**RECOMMENDED REFERENCE JOURNALS**

1. Annual Review Pharmacology and Toxicology
2. Drugs
3. Pharmacological Reviews
4. Trends in Pharmacological Sciences
5. Indian Journal of Physiology & Pharmacology
6. Indian Journal of Experimental Biology
7. Indian Journal of Pharmacology

**PHARMACOLOGY – II**  
**(Recent advances and emerging Trends in Pharmacological Sciences)**

*PRACTICAL*

**Course Code: PHA- 830**

**Credits- 04**

**(Practical 8 hrs/week)**

- a) Study of agonist and antagonist
- b) pD<sub>2</sub> Value
- c) pA<sub>2</sub> Value
- d) 5HT bioassay (Comparative, graphical, 4 point)
- e) Oxytocin bioassay (Graphical)
- f) Antagonist bioassay
- g) Ach bioassay (rat fundus)
- h) Histamine assay guinea pig ileum (Graphical & 4 point assay)
- i) Blind screening of drugs.

**Screening methods in Pharmacology:**

Screening of antipsychotics, antianxiety, nootropics, antidepressants, antiparkinson, antipileptics, analgesics, anti-inflammatory, antihypertensive, anti MI, anti ulcer, antidiabetic and antioxidants.

**(II)** Estimation of drugs in body fluids using modern analytical techniques.

**BOOKS RECOMMENDED**

1. Fundamentals of Experimental Pharmacology by M.N. Ghosh

2. Screening Methods in Pharmacology, Vol I & II, edited by Robert A. Turner and Peter Hebborn
3. Textbook of invitro Practical Pharmacology by Ian Kitchen
4. Evaluation of Drug Activities : Pharmacometrics, Vol I & II, edited by D.R. Laurence and A.L. Bacharah
5. Selected Topics in Experimental Pharmacology by U.K. Sheth, N.K. Dadkar and Usha G. Kamat
6. Pharmacological Experiments of Isolated preparations by Edinburgh University Pharmacology Staff, 1968
7. Analytical procedures for Therapeutics Drug Monitoring and Emergency Toxicology by Randall C. Baselt
8. Frontiers in Therapeutics Monitoring, edited by Gianni Tagnoni, Roberto Latini and William J. Jusko
9. Drug-Bioscreening Drug Evaluation Techniques in Pharmacology in Emmanuel B. Thompson
10. Fundamentals of Experimental Pharmacology by M.N. Ghosh, Scientific Book Agency, Calcutta (1984)
11. Pharmacological experiments in Intact preparations Edinburgh University Pharmacology Staff, Livingstone (1968).
12. Pharmacological Experiments on isolated preparations, Edinburgh University Pharmacology Staff, Livingstone (1968)
13. Handbook of Experimental Pharmacology by S.K. Kulkarni, Vallabh Parakashan Delhi, 3rd Edition (1999)
14. Screening Methods in Pharmacology by P. Turner, Vol. I & II, Academic Press, New York and London (1965)
15. Drug discovery and evaluation by H.G. Vogel and W.H. Vogel, Springer-Verlag, Berlin Heideleberg (1997)

## **PHARMACOLOGY – III**

### **(Pharmacological methods and Toxicology)**

#### *THEORY*

**Course Code:PHA- 831**  
**(Theory 3 hrs/week)**

**Credits- 03**

1. Principles of Pharmacological and Clinical Evaluation of drugs.
2. Pharmacological Techniques to evaluate drugs belonging to following categories.
  - a) Antipsychotics, antianxiety agents; nootropics; antidepressants, antiparkinsonian agents, antiepileptics, analgesics, anti-inflammatory agents, local anaesthetics.
  - b) Antihypertensives, antiarrhythmics, antiatherosclerotics, drugs for myocardial infarction.
  - c) Antiulcer drugs, antidiabetics, antitussives
  - d) Evaluation of antioxidants

- e) Transgenic animals, genetically prone animal models
- f) Anti cancer drugs
- g) In-vitro techniques
- h) Antifertility agents
- 3. Drug Toxicity, Safety Evaluation of new drugs
- 4. Regulations for Laboratory animal care and ethical requirements

**BOOKS RECOMMENDED**

- 1. Modern Pharmacology by C.R. Craig and R.E. Stitzel
- 2. Goodman and Gilman's : The Pharmacological Basis of Therapeutics edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S. Nies and Palmar Taylor
- 3. Clinical Pharmacology by D.R. Laurence and P.N. Benett
- 4. Essentials of Pharmactherapeutics by F.S.K. Barar
- 5. Pharmacology by H.P. Rang and M.M. Dale
- 6. Lewis's Pharmacology revised by James Crosslang
- 7. Oxfor Textbook of Clinical Pharmacology and Drug Therapy by D.G. Grahame Smith and J.K. Aronson
- 8. Vogel's Pharmacology

PHARMACOLOGY – III  
(Pharmacological methods and Toxicology)  
PRACTICAL

**Course Code :PHA- 832**  
**(Practical 8 hrs/week)**

**Credits- 04**

Practical will be based on the topic mention in Pharmacology-III theory

**SEMESTER- III**

**SEMINAR**

**Course Code: PHA- 780**

**Credits- 02**

The seminar will be based on the topic other than the topic of the thesis/ project work

**PROJECT SEMINAR**

**Course Code: PHA- 781**

**Credits- 15**

The seminar will be based on progress of the project work

**SEMESTER- IV**

**THESIS/ PROJECT WORK**

**Course Code: PHA- 899**

**Credits- 15**

Project Seminar and Viva-voce

# M. PHARM. PHARMACOGNOSY

## SEMESTER –I

### MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

#### *THEORY*

**Course Code: PHA- 611**

**Credits- 04**

**(Theory 4 hrs/week)**

Principles of separation and applications of TLC. Column chromatography. Paper chromatography, Ion exchange chromatography, Counter current chromatography, G.C., DCCC, HPTLC & HPLC and electrophoresis.

#### **Infrared spectroscopy**

Introduction: The IR absorption process; the modes of vibration bond properties and absorption trends. The Hook's Law & calculations of frequencies for different types of bonds; coupled interactions; hydrogen bonding; radiation source, sample handling, qualitative and quantitative applications and introduction about FT-IR

#### **Ultraviolet spectroscopy :**

Introduction: The nature of electronic excitation, the origin of UV band structure; principle of absorption spectroscopy; Beer and Lambert's Law, Chromophore different types of transitions; shifts reagents effects of substituents; effect of conjugation' confirmations and geometry; calculation of Lamda maxima, effect of solvents, qualitative and quantitative applications

#### **Nuclear Magnetic Resonance spectroscopy :**

A. <sup>1</sup>H NMR Spectroscopy: Principle, Instrumentation techniques. Chemical equivalence, spin-spin coupling, The origin of spin-spin splitting, Pascal triangle, the coupling constant chemical shift reagents Pharm. application including interpretation of Proton-NMR spectra.

B. <sup>13</sup>C NMR Spectroscopy: Peak assignments, off resonance decoupling, selective proton decoupling, chemical shift equivalence, chemical shifts and spin coupling.

#### **Mass Spectrometry:**

Basic principle and theory involved, Instrumentation, types of ions, fragmentation, rearrangements; mass spectra of representative compounds, recognition of molecular ion peak, chemical ionization mass spectrometry, field desorption mass spectrometry, mass spectrometry, fast atom bombardment mass spectrometry.

#### **Thermal analysis:**

Introduction to various thermal methods of analysis, basic principle and theory; differential thermal analysis and differential scanning calorimetry and micro calorimetry. Different types of calorimeters and micro calorimeters.

**Pharmacological evaluation** of drugs in biological fluids: Bioassay.

**Microbiological assays.**

**Radioimmunoassays.**

**Quantitative microscopy** of herbal drugs. Lycopodium spore method, stomatal number, stomatal index, palisade ratio, vein-islet number, and vein-termination number.

### **BOOKS RECOMMENDED**

1. R.M.Silverstein, F.X.Webster, Spectrometric Identification of organic compounds, 6th ed. John Wiley & sons, New-York, 1998.
2. Remington, The science and practice of pharmacy, Mack publishing company. Easton Pennsylvania.
3. Organic Spectroscopy by Willam Kemp
4. E. Heftmann, A laboratory handbook of chromatography, New - York.
5. H.H.Willard, L.L.Merritt and J.A.Dean, Instrumental methods of analysis, Van Nostrend Reinhold, New York.
6. WWM. Wenland, Thermal analysis, John Willy and sons, New-York.
7. Principle of instrumental analysis, V ed. By Skoog, Holler-Niemen.
8. Modern analytical chemistry by David Harvey. (MC Graw-Hill international edition).

## **MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

### *PRACTICALS*

**Course Code: PHA- 612**

**Credits- 04**

**(Practical 8 hrs/week)**

Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

### **BIostatISTICS AND COMPUTER APPLICATION THEORY**

**Course Code: MAS-7**

**Credits- 03**

**(Theory 3 hrs/week)**

### **BIostatISTICS**

1. A study of the following with reference to their applications in pharmacy and Biological Sciences.
2. Probability : Definition of laws of probability, probability distributions, properties of Normal, Binomial, Poison distributions, sampling distributions of mean and variance, standard error and fiducial limits.
3. Regression and correlation : Linear and curvilinear regressions, methods of least squares, correlation coefficients, rank correlation multiple regression.

4. Tests of significance : Testing hypotheses, errors of two kinds, power of test, test of significance based on normal distribution and t-test, test for significance of correlation coefficient.

F-test & Analysis of variance : 1-way, 2-way and 3-way classification.

5. Chi-square test of

(i) Variance of a normal population

(ii) Goodness of fit.

(iii) Independence in contingency tables.

Non-parametric tests, order statistics, sign test, run test, median test.

Design of experiments, Principles of randomization, replication and local control, completely randomized block and Latin square designs, factorial experiments, applications of the above designs in Pharmaceutical research.

6. Statistical quality control, process control, control charts, acceptance sampling- sampling plans.

## **COMPUTER**

1. Introduction to Computer : What is Computer, History of computers, Development & Respective generations, need to use computers, Types of computers hardware and software, Evolution and Generation of computer, basic computer organization, Number system, Storage devices- primary and secondary storage devices, **I/P** And **O/P** devices-printer, key board, scanner, punch card, mouse. Computer languages.

2. Operating System : Concept and evolution of Operating System, Batch Processing, Spooling, multi programming, Multiprocessing, time sharing, On line processing, real time processing, Virtual storage, OS-Controlled software, Introduction to DOS commands.

3. Computer Software: Software, Type of Software (Application, System) Development of software, Use of MS WORD, MS EXCEL, MS POWERPOINT etc.

4. Computer Networking & Internet: Computer Networking, Network Topologies, LAN, WAN, MAN etc. Introduction to INTERNET, Browser, URL, Search Engine, Mailing etc., Domain names, Protocols- Like, FTP, Web site, Modem, Introduction to HTML.

5. Application of Computer in Pharmacy

## **REFERENCES:**

1. Biostatistics by Alvin E.Lewis.

2. Introduction to probability & Statistics by Henry L.Alder & Edward B. Roessler.
3. Fundamentals of Applied Statistics by S.C.Gupta, V.K.Kapoor
4. Mathematics & Statistics for use in Pharmacy, Biology, Chemistry by Saunders & Flemming.
5. Practical Pharmacology by M.N.Ghosh.
6. Indian Pharmacopoeia & British Pharmacopoeia. 7. Remington's Pharmaceutical Sciences.

## **PHARMACOGNOSY & PHYTOCHEMISTRY- I** **(Advances in Pharmacognosy)**

### *THEORY*

**Course Code: PHA- PHA-717**  
**(Theory 3 hrs/week)**

**Credits- 03**

#### **1. General Introduction to Pharmacognosy**

Role of Pharmacognosy in the herbal industry.

Classification of herbal drugs with special reference to Chemotaxonomy.

#### **2. Commerce and quality control of herbal drugs**

International trade.

Quality control with reference to WHO guideline.

Common problems encountered maintenance of quality of crude drugs.

#### **3. General aspects of cultivation and collection**

Good practices in cultivation.

Plant growth regulators.

Weeds and pest control techniques.

Application of chromatographic techniques such as column, paper, TLC, HPTLC, GLC, HPLC and DCCC in the isolation and purification of phytopharmaceuticals.

**4. Good practices in collection** Preparation of herbarium specifications, use of flora and keys of plant identification, Microtomy and advanced histological techniques as applied to pharmacognostical specimen, pharmacognostical drawings and macro and micro photography. Quantitative microscopy as applied to drug evaluation and pollen grain analysis.

**5. Agrotechnology of medicinal plants** Ecotypic, Phenotypic and Genotypic Variability affecting phytopharmaceuticals. Prospects and economics and medicinal and aromatic plants in India. Cultivation methods developed in India for the following plants of commercial significance. Glycyrrhiza, Ipecac, Mentha, Poppy, Psyllium and Senna. Tropane alkaloid and steroid containing plants.

## **BOOKS RECOMMENDED**

1. Trease and Evans Pharmacognosy, W.C. Evans
2. Pharmacognosy, Varro E.Tyler, Lynn. R.Brady, James E.Robbers
3. Text Book of Pharmacognosy, T.E. Wallis, CBS Pub. Delhi.
4. Ramstad - Modern Pharmacognosy.
5. John - Dodds - Lorin - Experiments in Plant Tissue Culture.
6. CSIR- Cultivation and Utilization of Medicinal Plants.
7. Handa S.S. & Kaul. K.L. Supplement to cultivation & utilization of medicinal plants.
8. CSIR - Wealth of India, Raw Materials.
9. Bartz - Reinhard - Zenk - Plant Tissue Culture and its Biotechnical Applications.
10. Pharmacognosy, C.K. Kokate, A.P. Purohit, and S.B. Gokhale.
11. Quality Standards of Indian Medicinal Plants Vol-I, ICMR, New Delhi.
12. WHO guide lines for the quality control of Herbal plant materials.
13. The Practical evaluation of phytopharmaceutical by brain & turner.
14. Harborne - Comparative Biochemistry of Flavonoids.
15. Biological standardization by J.N.Barn, D.J.Finley and L.G. Good win.
16. Indian pharmacopoea, Indian Herbal Pharmacopoea and other pharmacopoeia.
17. Ayurvedic Formulary of India.
18. British Herbal Pharmacopoeia.
19. Screening methods of Pharmacology By Robert turner.

## **PHARMACOGNOSY & PHYTOCHEMISTRY- I (Advances in Pharmacognosy)**

### *PRACTICAL*

**Course Code: PHA-718**  
**(Practical 8 hrs/week)**

**Credits- 04**

Practicals will be based on the topics mentioned in paper I.

## **SEMESTER- II**

### **DRUG REGULATORY AFFAIRS & INTELLECTUAL PROPERTY RIGHTS**

#### *THEORY*

**Course Code: PHA-721**  
**(Theory 3 hrs/week)**

**Credits- 03**

1. W.H.O. certification scheme on the quality of pharmaceutical products.
2. Quality management in the drug industry: philosophy and essential elements.
3. Guidelines on the inspection of pharmaceutical manufacture and drug distribution channels. Page No. 7/43
4. Drugs Prices Control Order, 1995.
5. New Drug Policy, 1994.
6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.
7. General Principles of Intellectual Property: Copyright, Trademark  
Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on industry and patients, patent term and extension The Patents Act, 1970 – Salient features.
8. New Drug Application: Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials.
9. Industrial safety: Industrial hazards due to fire, chemicals, pharmaceuticals, radiation and accidents - mechanical and electrical equipments. Monitoring and prevention systems, Industrial effluent testing.
10. Stability Studies: ICH guidelines and WHO guidelines and stability protocols for dosage forms.

#### REFERENCES :

1. Quality Assurance of Pharmaceutics Vol I & II of WHO publications, 1999.
  2. GMPs by Mehra
  3. The Drugs and Cosmetic Act, 1940 by Vijay Mallik
  4. ISO 9000 and Total Quality Management by S.K.Ghosh
  5. How to Practice GMP by P.P.Sharma
  6. GMP of Pharmaceuticals by Willing and Stoker.
- Practicals based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

## PHARMACOGNOSY & PHYTOCHEMISTRY- II (Advanced Pharmacognosy)

### *THEORY*

**Course Code:PHA- 833**

**Credits- 03**

**(Theory 3 hrs/week)**

1. **Biogenesis of secondary metabolites:** Application of tracer techniques in evaluation of biogenetic pathways of secondary metabolites. Strategies to enhance secondary metabolite production through tissue culture techniques like-precursor feeding, elicitation, genetic manipulation, bioreactor techniques, biotransformation, etc.
2. **Chemotaxonomy of medicinal plants:** Introduction, principle of Chemotaxonomy, Role of secondary metabolites in chemotaxonomy, applications of chemotaxonomy in medical botany.

3. **Natural Product Drug Discovery:** *Natural products* used as colour pigments, excipients, biopolymers, photosensitizing agents, flavours, biofuels, Microbial conversion, aberrant synthesis, Herbal cosmetics
4. **Recent advances in Pharmacognosy:** With special reference to anticancer, antidiabetic, hepatoprotective, anti-inflammatory, hypo lipidaemic, immunomodulatory drugs.
5. **INDIAN SYSTEM OF MEDICINES:** Traditional and folk-lore preparation and there quality, safety, efficacy assessment.

### ***Reference Books***

1. Trease and Evans, Pharmacognosy, Saunders Company, London.
2. Tyler, Brady, and Robbers, Pharmacognosy, Lea Febiger, USA.
3. Wallis T. E., Text Book of Pharmacognosy, CBS publishers & distribution, Delhi.
4. Kokate, Purohit, Gokhale, Pharmacognosy, Nirali Prakashan, Pune.
5. Rangari V.D., Pharmacognosy & Phytochemistry, Vol I, II, Career Publication, Nashik.
6. Agrawal O.P., Chemistry of Organic Natural Product, Goel Publication House, UP.
7. E. Ramstad, Modern Pharmacognosy, Mc-graw hill Book Company.
8. Pridham J B, Swain T, Biosynthetic pathway in higher plants, Academic Press, New York.
9. Street H E, Tissue culture and plant science, Academic press, London.
10. Rainerat and Bajaj, plant tissue culture.
11. Shah and Quadry Text Book of Pharmacognosy.
12. Chopra, Indigenous drug of India.
13. Wealth of India.
14. Nadkarni, Material Medica.
15. Ayurvedic Pharmacopoeia.
16. Indian Pharmacopoeia.
17. British Pharmacopoeia.
18. Martindale Extra Pharmacopoeia.
19. Wagner, Plant drug analysis.

## **PHARMACOGNOSY & PHYTOCHEMISTRY- II** (Advanced Pharmacognosy)

### ***PRACTICAL***

**Course Code: PHA-834**  
**(Practical 8 hrs/week)**

**Credits- 04**

Practicals will be based on the topics mentioned in paper

## PHARMACOGNOSY & PHYTOCHEMISTRY- III

### *THEORY*

**Course Code: PHA- 835**

**Credits- 03**

**(Theory 3 hrs/week)**

1. **Genetics in Pharmacognosy:** Mutation, polyploidy, hybridization in relation to the improvement of vegetable drugs, Chemical races.
2. **Plant Biotechnology:** Cell/tissue culture technique, micro-propagation of medicinal and aromatic plants, germplasm storage, method of cell immobilization.
3. Recombinant DNA technology and its application with special reference to production of antibiotic and non antibiotic drug from lower plant.
4. Transgenic plant and its application
5. Phytopharmaceuticals: Anticancer, Ant diabetic, Anti-inflammatory, Cardiovascular, hepatoprotective.

### **Books Recommended**

1. The Wealth of India (Raw Materials) All Volumes, NISCOM, Delhi.
2. Evans WC (2002) Trease & Evans' Pharmacognosy, W.B. Saunders & Co., London.
3. Natural Products for Plants by Kaufmann, CRC Press New York.
4. Cultivation and Utilization of Medicinal & Aromatic Plants by C.K. Atal and B.M. Kapur, R.R.L. Jammu.

## PHARMACOGNOSY & PHYTOCHEMISTRY- III

### *PRACTICAL*

**Course Code: PHA- 836**

**Credits- 04**

**(Theory 8 hrs/week)**

Practicals will be based on the topics mentioned in paper III

## SEMESTER- III

### SEMINAR

**Course Code: PHA- 780**

**Credits- 02**

The seminar will be based on the topic other than the topic of the thesis/ project work

### **PROJECT SEMINAR**

**Course Code: PHA- 781**

**Credits- 15**

The seminar will be based on progress of the project work

### **SEMESTER- IV**

### **THESIS/ PROJECT WORK**

**Course Code: PHA- 899**

**Credits- 15**

Project Seminar and Viva-voce

### **CURRICULUM OF EXAMINATION (MASTER OF PHARMACY) (PHARMACEUTICS)**

#### **Semester I**

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 611</b>	Modern Pharmaceutical Analytical Technique (Theory)	<b>100</b>
<b>PHA- 612</b>	Modern Pharmaceutical Analytical Technique (Practical)	<b>100</b>

<b>MAS- 7</b>	Biostatistics and Computer Application	<b>100</b>
<b>PHA -711</b>	Pharmaceutics – I (Advanced Pharmaceutics)(Theory)	<b>100</b>
<b>PHA- 712</b>	Pharmaceutics – I (Advanced Pharmaceutics)(Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA – 721</b>	Drug Regulatory Affair & Intellectual Property Right	<b>100</b>
<b>PHA- 821</b>	Pharmaceutics – II (Biopharmaceutics & Pharmacokinetics)(Theory)	<b>100</b>
<b>PHA-822</b>	Pharmaceutics –II(Biopharmaceutics & Pharmacokinetics)(Practical)	<b>100</b>
<b>PHA- 823</b>	Pharmaceutics – III (Advanced Drug Delivery Systems)(Theory)	<b>100</b>
<b>PHA- 824</b>	Pharmaceutics – III (Advanced Drug Delivery Systems)(Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester –III

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 780</b>	Seminar	<b>100</b>
<b>PHA- 781</b>	Project Seminar	<b>200</b>
<b>Total</b>		<b>300</b>

### Semester IV

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 899</b>	Thesis/ Project Work	<b>200</b>
<b>Total</b>		<b>200</b>

## CURRICULUM FOR EXAMINATION (MASTER OF PHARMACY) (PHARMACEUTICAL CHEMISTRY)

### Semester - I

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA – 611</b>	Modern Pharmaceutical Analytical Technique (Theory)	<b>100</b>
<b>PHA- 612</b>	Modern Pharmaceutical Analytical Technique (Practical)	<b>100</b>

<b>MAS- 7</b>	Biostatistics and Computer Application	<b>100</b>
<b>PHA- 713</b>	Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Theory)	<b>100</b>
<b>PHA- 714</b>	Pharmaceutical Chemistry- I (Advanced Pharm. Chemistry) (Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 721</b>	Drug Regulatory Affairs & Intellectual Property Right	<b>100</b>
<b>PHA- 825</b>	Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Theory)	<b>100</b>
<b>PHA-826</b>	Pharmaceutical Chemistry- II (Advanced Medicinal Chemistry) (Practical)	<b>100</b>
<b>PHA-827</b>	Drug Design (Theory)	<b>100</b>
<b>PHA-828</b>	Chemistry of Natural Products	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester –III

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 780</b>	Seminar	<b>100</b>
<b>PHA- 781</b>	Project Seminar	<b>200</b>
<b>Total</b>		<b>300</b>

### Semester IV

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 899</b>	Thesis/ Project Work	<b>200</b>
<b>Total</b>		<b>200</b>

## CURRICULUM FOR EXAMINATION (MASTER OF PHARMACY) (PHARMACOLOGY)

### Semester I

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 611</b>	Modern Pharmaceutical Analytical Technique (Theory)	<b>100</b>
<b>PHA- 612</b>	Modern Pharmaceutical Analytical Technique (Practical)	<b>100</b>
<b>MAS-7</b>	Biostatistics and Computer Application	<b>100</b>

<b>PHA- 715</b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Theory)	<b>100</b>
<b>PHA- 716</b>	Pharmacology – I (Basic Principles Of Drug Therapy,And Clinical Pharmacology) (Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 721</b>	Drug Regulatory Affairs & Intellectual Property Rights	<b>100</b>
<b>PHA- 829</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Theory)	<b>100</b>
<b>PHA- 830</b>	Pharmacology – II (Recent Advances And Emerging Trends In Pharmacological Sciences) (Practical)	<b>100</b>
<b>PHA- 831</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Theory)	<b>100</b>
<b>PHA- 832</b>	Pharmacology – III (Pharmacological Methods And Toxicology) (Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester –III

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 780</b>	Seminar	<b>100</b>
<b>PHA- 781</b>	Project Seminar	<b>200</b>
<b>Total</b>		<b>300</b>

### Semester IV

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 899</b>	Thesis/ Project Work	<b>200</b>
<b>Total</b>		<b>200</b>

## CURRICULUM FOR EXAMINATION (MASTER OF PHARMACY) (PHARMACOGNOSY)

### Semester I

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 611</b>	Modern Pharmaceutical Analytical Technique (Theory)	<b>100</b>
<b>PHA-612</b>	Modern Pharmaceutical Analytical Technique (Practical)	<b>100</b>

<b>MAS - 7</b>	Biostatistics and Computer Application	<b>100</b>
<b>PHA-717</b>	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) (Theory)	<b>100</b>
<b>PHA- 718</b>	Pharmacognosy & phytochemistry- I (Advances in Pharmacognosy) (Theory)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester II

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 721</b>	Drug Regulatory Affairs & Intellectual Property Rights	<b>100</b>
<b>PHA- 833</b>	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Theory)	<b>100</b>
<b>PHA-834</b>	Pharmacognosy & Phytochemistry- II (Advanced Pharmacognosy) (Practical)	<b>100</b>
<b>PHA-835</b>	Pharmacognosy & Phytochemistry- III (Theory)	<b>100</b>
<b>PHA-836</b>	Pharmacognosy & Phytochemistry- III (Practical)	<b>100</b>
<b>Total</b>		<b>500</b>

### Semester -III

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 780</b>	Seminar	<b>100</b>
<b>PHA- 781</b>	Project Seminar	<b>200</b>
<b>Total</b>		<b>300</b>

### Semester IV

<b>Course code</b>	<b>Course Title</b>	<b>Marks</b>
<b>PHA- 899</b>	Thesis/ Project Work	<b>200</b>
<b>Total</b>		<b>200</b>