

ADMISSION  
&  
EXAMINATION RULES  
&  
SYLLABUS

FOR

BACHELOR IN PHARMACY

**FACULTY OF PHARMACY**  
**JAMIA HAMDARD**  
(Deemed University)  
Hamdard Nagar, New Delhi - 110062

**ADMISSION & EXAMINATION RULES**  
**FOR**  
**BACHELOR IN PHARMACY**

# **JAMIA HAMDARD**

## **FACULTY OF PHARMACY**

### **ADMISSION & EXAMINATION RULES**

### **BACHELOR IN PHARMACY**

(Approved by the Standing Committee of the Academic Council in July 2004, to be effective from the Academic Session 2004-05 and applicable to all B. Pharm. students)

**1. Program:** Bachelor in Pharmacy (B. Pharm)

It shall be a fulltime regular course.

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

**2. Duration:** Four years

**3. Medium of Instruction and Examination:** English

**4. Eligibility for admission:** A candidate seeking admission to this course must have:

- a) Passed 10+2 examination from Central Board of Secondary Education, or any other examination recognized by Jamia Hamdard as equivalent thereto, with at least 50% marks in the aggregate of Physics, Chemistry and Biology subjects, and must have passed in each of these subjects.
- b) Qualified the admission test/interview conducted by Jamia Hamdard.
- c) Completed the age of 17 years on or before the first day of October of the year of admission.

Some seats are provided for those candidates who opt for an additional course in Unani Pharmacy. All such candidates will have to appear in all the subjects of Modern Pharmacy in addition to the additional papers in Unani Pharmacy (Urdu medium). On the successful completion of the course, these candidates will be entitled to award of degree in Modern Pharmacy and a separate certificate for Unani course. Proficiency in Urdu, comparable to Matric standard is essential for such candidates.

**5. Course structure:**

The numbers of hours of teaching in theory as well as practical in the various subjects of this course are listed below. The course contents are given in the syllabus.

S.No.	Subject	Course Code	Min. Teaching hrs.		Total
			Theory	Practical	
<b>Ist year</b>					
1.	Pharmaceutics-I (Introduction to Pharmacy)	BPH 01	50	100	150
2.	Pharmaceutics-II (Unit Operation)	BPH 02	50	100	150
3.	Pharmaceutics-III (Dispensing Pharmacy)	BPH 03	50	100	150
4.	Pharmaceutical Chemistry-I (Organic Chemistry)	BPH 04	50	100	150
5.	Pharmaceutical – II (Inorganic Medicinal & Pharmaceutical Chemistry)	BPH 05	50	100	150
6.	Pharmacognosy – I (Pharmaceutical Biology)	BPH 06	50	75	125
7.	Human Anatomy and Physiology	BPH 07	75	75	150
	<b>Total</b>		<b>375</b>	<b>650</b>	<b>1025</b>
	Unani Pharmacy	BU 01	15	-	15

<b>IInd year</b>					
8.	Pharmaceutical Maths & Biostatistics	BPH 08	50	-	50
9.	Pharmaceutics-IV (Pharmaceutical Microbiology)	BPH 09	50	100	150
10.	Pharmaceutics-V (Physical Pharmacy)	BPH 10	75	75	150
11.	Pharmaceutical Chemistry-III Pharmaceutical Analysis-I (Inorganic Chemistry)	BPH 11	50	100	150
12.	Pharmaceutical Chemistry-IV (Organic and Medicinal Chemistry including Heterocyclics)	BPH 12	50	100	150
13.	Pharmacognosy-II (General Pharmacognosy)	BPH 13	50	100	150
14.	Pathophysiology, Toxicology & Health Education	BPH 14	25	-	25
15.	Pharmacology-I	BPH 15	50	100	150
16.	Computer Application	BPH 16	25	25	50
	<b>Total</b>		<b>425</b>	<b>575</b>	<b>1000</b>
	Unani Pharmacy	BU 02	15	10	25

IIIrd year					
17.	Pharmaceutics-VI (Hospital & Clinical Pharmacy)	BPH 17	50	-	50
18.	Pharmaceutics – VII (Forensic Pharmacy & Ethics)	BPH 18	50	-	50
19.	Pharmaceutics-VIII (Pharmaceutical Formulations & Cosmetology)	BPH 19	50	75	125
20.	Pharmaceutical Chemistry-V (Pharmaceutical Analysis-II) (Physical Chemistry & Principles of Instrumental Analysis)	BPH 20	50	100	150
21.	Pharmaceutical Chemistry-VI (Medicinal Chemistry-I)	BPH 21	50	100	150
22.	Pharmaceutical Chemistry-VII (Chemistry of Natural Products)	BPH 22	50	100	150
23.	Pharmacognosy-III (Pharmacognosy and Phytochemistry)	BPH 23	50	75	125
24.	Pharmacology-II	BPH 24	50	100	150
25.	Biochemistry	BPH 25	50	100	150
	<b>Total</b>		<b>450</b>	<b>650</b>	<b>1100</b>
	Tour Report-Pharmacognosy			(2 wks.)	
	Unani Pharmacy	BU 03	15	10	25

IVth year					
26.	Pharmaceutical Biotechnology	BPH 26	25	-	25
27.	Pharmaceutics-IX (Pharmaceutical Management)	BPH 27	50	-	50
28.	Pharmaceutics-X (Biopharmaceutics & Pharmacokinetics)	BPH 28	50	100	150
29.	Pharmaceutics-XI (Pharmaceutical Technology)	BPH 29	50	100	150
30.	Pharmaceutical Chemistry-VIII (Pharmaceutical Analysis-III)	BPH 30	50	100	150
31.	Pharmaceutical Chemistry-IX (Medicinal Chemistry-II)	BPH 31	50	100	150
32.	Pharmacognosy-IV (Industrial Pharmacognosy)	BPH 32	50	100	150
33.	Pharmacology-III	BPH 33	50	100	150
	<b>Total</b>		<b>375</b>	<b>600</b>	<b>975</b>
	Tour report-Pharmaceutics			(2 wks.)	
	Unani Pharmacy	BU 04	12	8	20

#### 6. Scheme of Examination:

The distribution of marks for sessional in theory and practical work in different papers during the four years of study is detailed below. The duration of annual examination in theory as well as practical papers will be 3 hours. Unless specified otherwise.

S.No.	Year/Paper	Marks Theory			Marks Practical			Grand Total
		Annual	Sessional	Total	Annual	Sessional	Total	
<b>Ist year</b>								
1.	Pharmaceutics-I (Introduction to Pharmacy)	80	20	100	80	20	100	200
2.	Pharmaceutics-II (Unit Operation)	80	20	100	80	20	100	200
3.	Pharmaceutics-III (Dispensing Pharmacy)	80	20	100	80	20	100	200
4.	Pharmaceutical chemistry-I (Organic Chemistry)	80	20	100	#80	20	100	200
5.	Pharmaceutical Chemistry-I (Inorganic Medicinal & Pharmaceutical Chemistry)	80	20	100	#80	20	100	200
6.	Pharmacognosy-I (Pharmaceutical Biology)	80	20	100	80	20	100	200
7.	Human Anatomy & Physiology	80	20	100	80	20	100	200
	<b>Total</b>			<b>700</b>			<b>700</b>	<b>1400</b>
	Unani Pharmacy	80	20	100	-	-	-	100
# Duration of practical examination -4 hrs; For others -3 hrs.								
<b>IInd year</b>								
8.	Pharmaceutical Maths & Biostatistics	80	20	100	-	-	-	100
9.	Pharmaceutics-IV (Pharmaceutical Microbiology)	80	20	100	*80	20	100	200
10.	Pharmaceutics-V (Physical Pharmacy)	80	20	100	*80	20	100	200
11.	Pharmaceutical Chemistry- III (Inorganic Chemistry)	80	20	100	#80	20	100	200
12.	Pharmaceutical Chemistry- IV (Organic & Medicinal Chemistry)	80	20	100	#80	20	100	200
13.	Pharmacognosy-II (General Pharmacognosy)	80	20	100	80	20	100	200
14.	Pathophysiology, Toxicology & Health Education	80	20	100	-	-	-	100
15.	Pharmacology-I	80	20	100	*80	20	100	200
16.	Computer Applications	80	20	100	80	20	100	200
	<b>Total</b>			<b>900</b>			<b>700</b>	<b>1600</b>
	Unani Pharmacy	80	20	100	80	20	100	200
* Duration of practical exam. - 6 hrs; # Duration of practical exam. – 4 hrs; For others - 3 hrs.								

<b>IIIrd year</b>								
17.	Pharmaceutics-VI (Pharmacy Practice)	80	20	100	-	-	-	100
18.	Pharmaceutics-VII (Forensic Pharmacy & Ethics)	80	20	100	-	-	-	100
19.	Pharmaceutics-VII (Pharmaceutical Formulation & Cosmetology)	80	20	100	*80	20	100	200
20.	Pharmaceutical Chem. – V (Physical Chemistry & Principles of Instrumental Analysis)	80	20	100	*80	20	100	200
21.	Pharmaceutical Chemistry-VI (Medicinal Chemistry I)	80	20	100	*80	20	100	200
22.	Pharmaceutical Chemistry-VII (Natural Products Chemistry)	80	20	100	*80	20	100	200
23.	Pharmacognosy-III (Pharmacognosy and Phytochemistry)	80	20	100	*80	20	100	200
24.	Pharmacology-II	80	20	100	*80	20	100	200
25.	Biochemistry	80	20	100	80	20	100	200
	Tour Report – Pharmacognosy	-	-	-	-	-	25	25
	<b>Total</b>			<b>900</b>			<b>725</b>	<b>1625</b>
	Unani Pharmacy	80	20	100	80	20	100	200
*Duration of Practical Exams - 6 hrs., For others – 3 hrs.								
<b>IVth year</b>								
26.	Biotechnology	80	20	100	-	-	-	100
27.	Pharmaceutics-IX (Pharmaceutical Management)	80	20	100	-	-	-	100
28.	Pharmaceutics-X (Biopharmaceutics & Pharmacokinetics)	80	20	100	*80	20	100	200
29.	Pharmaceutics-XI (Pharmaceutical Technology)	80	20	100	*80	20	100	200
30.	Pharmaceutical Chemistry-VIII (Pharm. Analysis-III)	80	20	100	*80	20	100	200
31.	Pharmaceutical Chemistry – IX (Medicinal Chemistry)	80	20	100	*80	20	100	200
32.	Pharmacognosy-IV (Industrial Pharmacognosy)	80	20	100	*80	20	100	200
33.	Pharmacology – III	80	20	100	*80	20	100	200
	Tour Report Pharmaceutics	-	-	-	-	-	25	25
	<b>Total</b>			<b>800</b>	-	-	<b>625</b>	<b>1425</b>
	Unani Pharmacy	80	20	100	80	20	100	200

\* Duration of practical examination – 6 hrs.

### 7. Internal Assessment:

- a) For the purpose of awarding sessional marks, the performance of students shall be evaluated continuously on the basis of written tests/seminars/viva voce, etc. in each course. The respective teachers will give these.

- b) Each theory test will be of two hours duration. These will be conducted as per a schedule notified by the Dean, Faculty of pharmacy. The respective teachers will hold practical sessional tests in regular classes. Three tests (theory and practical) will be properly spaced in the three terms of the academic session.
- c) The marks obtained shall be notified in time by the respective teachers and answer books shown to the students, if they wish so. The sessional test answer books shall be retained in the Department till the end of the academic term.
- d) There shall be at least three tests for each course and the average of best two tests shall be taken to award the sessional marks. There will be no provision for special or additional internal assessment tests.
- e) A regular record of the marks for sessional tests conducted in an academic year shall be maintained by the teacher concerned/Head of Department for each student.
- f) The students shall maintained tour reports for assessment by the teachers conducting the tour.
- g) The final sessional marks shall be submitted by the teachers to the Head of the Department who shall forward the same to the registrar, within ten days of the last sessional test held. These shall also be displayed on the Notice Board of the Department/Faculty.

#### **8. Attendance:**

- a) All students must attend every lecture and practical class. However, to account for late joining or other such contingencies, the attendance requirement for appearing in the examinations shall be a minimum of 75% of the classes actually held.
- b) In order to maintain the attendance record of a particular course a roll call will be taken by the teacher in every scheduled lecture and practical class. For the purpose of attendance, every scheduled practical class will be counted as one attendance unit, irrespective of the number or contact hours.
- c) The teacher in charge will consolidate the attendance record for the lectures and practicals for each term. Attendance on account of participation in the prescribed function of NCC, NSS, Inter university sports, educational tours/field work shall be credited to aggregate, provided the attendance record, duly countersigned by the Officer in-charge, is sent to the Dean of Faculty within two weeks of the function/activity, etc.

- d) The statements of attendance of students shall be displayed on Department Notice Board at the close of each term as given in the University Calendar. A copy of the same shall be sent to the Head of Department/Office of Dean of Faculty for record. Notice displayed on Notice Board shall be deemed to be proper notification, and no individual notice shall be sent to students.
- e) If a student is found to be continuously absent from the classes without information for a period of 30 days, the teacher in charge shall report it to the Head of Department/Dean for striking off the name of such a student from rolls. Such a student may, however, apply for readmission within 15 days from the date of issue of the Notice of striking off the name. The request may be considered by the Dean for readmission. Such a student shall not be readmitted after the prescribed period. The readmission shall be effected on payment of prescribed readmission fees.
- f) A student with less than 75% attendance of the lectures and practicals separately in each subject/course in an academic year shall be detained from appearing in the Annual University examination. The Dean of Faculty concerned may consider application for the condonation of attendance upto 5% on account of sickness, provided the application for condonation of attendance, duly certified by a Registered Medical Practitioner/Public Hospital had been submitted within 5 days from the recovery from illness. Condonation of attendance on account of any other extenuating circumstances may also be considered, provided the request is duly supported by documentary evidence.
- g) A student detained on account of attendance will be readmitted to the same class in the next academic year on payments of current fees except Enrollment fee, Identity card fee and Security deposits.

#### **9. Eligibility for admission to examination:**

A student seeking admission to the examination to be held at the end of each academic year must have pursued a regular course of study for one academic year, and must have completed the prescribed attendance requirements. Further, a student admitted to any course must pass the first year examination within two academic years, and must complete the full course of study within prescribed span period of seven years.

#### **10. Annual and Supplementary examinations:**

- a) The annual and Supplementary examinations shall be held as per schedule given in the Academic Calendar of Jamia Hamdard. The Supplementary examinations may normally be held after 30 days from the declaration of results of the Annual examination.

- b) A candidate who fails to appear in the annual examination or having appeared in the Annual examination fails to pass in any subject(s) as prescribed for the examination, may be allowed to appear in the remaining subjects in the Supplementary examination.
- c) A candidate will be given a total number of three attempts, inclusive of the first attempt, to clear the papers in which he/she fails to qualify (irrespective of the number of such papers). In exceptionally hard cases, a student may be considered for grant of one last mercy chance.
- d) The Dean of the Faculty will examine application for mercy chance with proper justification and a written undertaking given by the student, and specific recommendations will be forwarded to the Registrar for getting approval of the competent authority. The undertaking would be to the effect that in case he/she does not clear the backlog in this final attempt, he/she will not have any further claim to continue the studies and that his/her name may be struck off the rolls.
- e) The duration of annual examination in theory as well as practical papers will be 3 hours, unless specified otherwise.
- f) Examiners shall examine students orally during the Practical examination and take cognizance of their performance when marking their papers.
- g) A student shall not be declared to have passed the examination unless he/she secures at least 50% marks in each of the subjects separately in the theory as well as practical examinations, including sessional marks. Each theory paper or practical examination shall be construed as a separate paper.
- h) Ten days vacation shall be given as preparatory holidays before the commencement of Annual Examinations.
- i) The candidates will retain the Internal Assessment of the previous examination, wherever applicable.

**11. Promotion to next class:**

- a) All students securing at least 50% marks in each of the subjects separately in the theory as well as practical examinations, including sessional marks, shall be promoted to the next year of study.

- b) A student who fails in *one or two* subjects (separately in theory and practicals), and secures at least 50% marks in the aggregate, may be provisionally promoted to the next higher class. However, such a student shall have to clear these subjects in the year to which thus promoted provisionally.
- c) A student who fails in more than two subjects will have to repeat the year of study and clear it within the prescribed span period.
- d) A student who has been promoted as per clause (b) above and fails to clear the backlog in the year to which promoted provisionally, will be required to rejoin the year to which the carried over papers belonged, as a regular student. He/she will be registered only in those subjects in which he/she could not secure the minimum pass marks of the last examination. For instance, if a student was provisionally promoted to II year with a carry over of two papers of I year, and he/she does not succeed in clearing the carry over papers of I year along with the regular papers of II year, he/she will have to join I year again and register only in the backlog papers.
- e) Promotion to the next higher class will be considered subject to rules relating to the maximum period of stay at the University, viz. passing the first year examination within two academic year, and successfully completing all the requirements of the programme of study within seven years from admission.

## **12. Classification of successful candidates:**

- a) The result of the successful candidate shall be classified at the end of the final year examination on the basis of the aggregate of all subjects, theory and practicals, secured by the candidate in the II to IV year examinations, as indicated below.

Ist Division:	60% and above
2 <sup>nd</sup> Division:	50%-59%

- b) Candidate securing 75% or above marks in any subject(s) and have passed in all the subjects in a year in first attempt shall be declared to have obtained Distinction in that subject(s).
- c) A student shall be eligible for award of Gold Medal subject to the following criteria.
- He/she has secured the highest marks in aggregate of examinations of all the years of the programme of study.
  - He/she has obtained a minimum of 60 per cent marks in the aggregate, as stated in (i) above.
  - He/she has passed all examination, including qualifying courses, if any, in first attempt.

### **13. Span Period:**

Students must pass the first year examination within two academic years, and must complete the full course of study within seven years from their admission to the first year of the course. However, exceptions to the 7 years rule may be made in the following cases:

A candidate who fails in only one subject in B. Pharm. IVth year Annual examination but has completed the maximum span period of 7 years, may be allowed to avail one more chance in the subject concerned, as a special case.

A candidate who qualifies in at least one subject but fails in half the number of subjects of B. Pharm. IVth year examination, but has completed the span period of 7 years, may be allowed readmission in B. Pharm. IVth year in the concerned subjects as a hard case. Such a student shall have to appear in sessional tests, practicals internal assessments in the concerned subject, and will be required to clear the backlog in the Annual and Supplementary examination.

# **SYLLABUS**

## **Bachelor of Pharmacy**

**FACULTY OF PHARMACY  
JAMIA HAMDARD**

# **B-PHARM IST YEAR**

## Paper BPH 01

### PHARMACEUTICS -I INTRODUCTION TO PHARMACY (THEORY) Total Teaching Hours: 50

#### 1. Pharmacy Profession

Pharmacy as a career, evaluation of pharmacy profession, earlier period, middle to modern ages. Introduction to Pharmacopoeias with special reference to Indian Pharmacopoeia, B.P., U.S.P. and International Pharmacopoeia.

#### 2. Metrology

Imperial, metric and S.I., weights and measures, interconversion

#### 3. Introduction to Dosage forms

Classification of solids, semisolids and liquid dosage forms, conventional and novel delivery systems.

#### 4. Pharmaceutical Additives

Diluents, vehicles, bases, solvents, organoleptic additives, surfactants, polymers and their applications.

#### 5. Size reduction and Size Separation

Definitions, principles of size reduction, objectives of size reduction, factors affecting size reduction; principles, laws and factors affecting energy requirements, different methods of size reduction, study of hammer mill, fluid energy mill and disintegrator. Various methods and equipments employed for size separation e. g., sieving, sedimentation, centrifugal elutriation, microscopic methods.

#### 6. Mixing and Homogenization

Theory of mixing: solid-solid, solid-liquid, liquid-liquid and semisolid mixing. Study of different types of mixers used in pharmaceuticals like planetary mixers, sigma mixers, turbo dispensers, double cone mixers, Colloid mill, Triple roller mill.

#### 7. Clarification and Filtration

Definitions, theory and factors affecting filtration, types of filter media, filter aids, and selection of filters. Equipments like gravity filter, pressure filter, vacuum filters, filter press, leaf filters, continuous rotary drum filter, edge filter, sand filter, membrane filters. Centrifugal type filters; batch, semi continuous & continuous type.

#### 8. Heat Processes

**Evaporation:** Factors affecting evaporation, study of evaporating stills and evaporating pans, heat transferring evaporators, vapor compression evaporators and evaporation under reduced pressure.

**Distillation:** Importance of distillation in Pharmacy, methods of distillation. Brief introduction to freeze drying, sublimation, desiccation and exsiccation, efflorescence and its importance.

#### 9. Extraction and Galenicals

Extraction processes and study of percolation and maceration and their modifications, their applications in the preparation of tinctures and extracts.

### PRACTICAL Total Hours 100

1. Preparation of following classes of products involving the use of calculations in metrology (at least 2 products from each category wherever applicable):  
Aromatic waters, injections, solutions, spirits, glycerine, syrups, elixirs, lotions, mucilages and liniments, suppositories, tablets, powders and capsules.
2. Study of one monograph from the latest edition of Indian Pharmacopoeia.
3. Demonstration of equipments (working procedure) for
  - i) Size Reduction and size separation
  - ii) Mixing and homogenization
  - iii) Clarification and filtration
  - iv) Evaporation
  - v) Distillation
  - vi) Percolation

#### Books Recommended:

1. Remington's Pharmaceutical Sciences (Latest Edition).
2. The Extra Pharmacopoeia-Martindale (Latest Edition).

3. S.J Carter: Tutorial Pharmacy
4. Cooper and Gunn's: Dispensing Pharmacy
5. N.K.Jain and S.N.Sharma: The theory and practice of Professional Pharmacy
6. Indian Pharmacopoeia (Latest Edition).

**Paper BPH 02**

**PHARMACEUTICS -II  
UNIT OPERATIONS (THEORY)**

**Total Teaching Hours: 50**

**1. Introduction**

Introduction to unit operation and pharmaceutical engineering. Concept and requirement, basic laws, materials and energy balances.

**2. Conveying of Solids**

Belt conveyors, chain conveyors, screw conveyors and pneumatic conveyors.

**3. Pharmaceutical Plant Construction**

Selection of materials for pharmaceutical plants, study of factors like physical, chemical, mechanical and economical. Suitability of different materials for different plants i.e. Ferrous metals -Cast iron, steel, stainless steel; Non-ferrous metals - copper and alloys, aluminum and alloys, lead, tin, silver, nickel and alloys, chromium, zinc; Non-metals glass, stoneware, slate brick, concrete, asbestos, plastics, rubber, timber, ceramics and enamel.

**Corrosion :** Types, causes, theories and methods of prevention of corrosion.

**4. Environmental Pollution and safety hazards**

Mechanical, chemical, electrical fire and dust hazards, safety requirements; fire extinguishers; accident records. Environment control and effluent treatment.

**5. Flow of fluids**

Fluid static and dynamics, basic equations, laws of conservation in fluid flow.

**Measurement of pressure:** Manometers, Types of flow, Reynold's number and its significance; distribution of velocities in a pipe; friction losses; pipe fittings and joints.

**Measurement of fluid flow:** Principle, and construction of venturimeter, orifice meter, pitot tube, weirs, Rota meter, and positive displacement meter - current meter and disc meter.

**Flow controls:** Plug cock, globe valves, gate valves, and water hammer, unidirectional valves, automatic regulating valve.

**Pumps:** Reciprocating pumps, positive displacement pumps, rotary pumps - volute and centrifugal pumps.

**Blowers**-Compressors, evacuators

**6. Heat transfer**

Modes of heat transfer; heat transfer coefficient; OHTC. Convection- concept of film overall coefficient, evaluation of individual film coefficient. Radiation - Stefan Boltzmann law; heating media, equipments, lagging. Fuels - solid, liquid, gases. Steam as heating medium - properties and uses of steam, steam traps, pressure reducing valve, steam heated heat exchanger, lagging, condensation, heating by electricity.

**7. Distillation**

Theory of distillation, vapor liquid equilibrium relationship, volatility and relative volatility, Azeotropic and zeotropic mixture, phase diagrams. Rectification and construction of columns; molecular distillation; steam distillation; enthalpy composition diagram and determination of number of theoretical plates; HETP.

**8. Refrigeration and Air Conditioning**

**Refrigeration:** Theory of refrigeration, refrigeration current cycle and equipments employed for large-scale refrigeration.

**Air conditioning:** Theory of air conditioning, application and types, humidification and dehumidification, cooling towers.

**Humidity:** Determination methods, methods of increasing and decreasing humidity. Application of humidity control in pharmaceutical industries.

### **9. Drying**

Theory of drying - principles, equilibrium moisture content, rate of drying; drying of dilute solutions and suspensions - drum dryer, spray dryer; drying of solids - convection type, tray dryer, tunnel dryer, rotary dryer, fluidized bed dryer, vacuum dryer, oven dryer, freeze dryer, radiant heat dryers. Automation in drying process.

### **10. Autoclave Process Control System**

Process variables, temperature, pressure, flow, level and vacuum and their measurements. Elements of automatic process control systems. Elements of computer aided manufacturing (CAM).

### **11. Crystallization**

Characterization of crystals and factors affecting them, supersaturation theory and its limitations, nucleation mechanisms, crystal growth, study of various types of crystallizer, tanks, agitated batch, Swenson Walker, single vacuum, circulating magma and crystal crystallizer, cacking of crystals and its prevention.

## **PRACTICALS**

**Total Hours: 100**

### **Experiments based upon theoretical portion preferably on the following**

1. Effect of thickness of filter media, hydrostatic pressure, size of filter media etc. on filtration rate.
2. Rate of drying, equilibrium moisture content, determination of factors affecting rate of drying.
3. Effect of number of balls and speed of ball mill on the grinding rate in ball mill.
4. Comparison of single stage and multiple stage extraction in solid-liquid extraction.
5. Study of Reynold's number and flow of fluids.
6. Estimation of overall heat transfer coefficient in distillation unit.
7. Determination of flow rate by Orifice and Venturimeters.
8. Calibration of pressure gauge with manometers.
9. Efficiency of a simple distillation unit and effect of insulating materials on the efficiency.
10. Determination of efficiency of a steam distillation unit.
11. Determination of humidity by Psychometric method and physical - method.
12. Determination of hardness of water.
13. Effect of driving fluids on efficiency of ejector pumps.
14. Calibration of rotameters.
15. Factors affecting liquid displacement in air lift pumps.
16. Freeze drying of a solution of antibiotic. Suspension of lacto - bacilli and evaluation.
17. Elementary engineering drawing, Drawing instruments and their uses, Lines, Lettering and dimensions. Orthographic projections, isometric projections, conversion of pictorial views into orthographic views.

### **Books Recommended:**

1. J.F.Richardson and J.M. Coulron: Chemical Engineering
2. Walter L. Badger and J.T. Banchero: Introduction to Chemical Engineering
3. Perry: Handbook of Chemical Engineering
4. Lauer & Heckmann: Chemical Engineering Techniques
5. Peters: Elementary Chemical Engineering
6. S.J. Carter: Tutorial Pharmacy
7. N.D.Bhatt: Elementary Engineering Drawing.

### **Paper BPH 03**

## **PHARMACEUTICS III DISPENSING PHARMACY (THEORY) Total Teaching Hours: 50**

### **1. Prescriptions**

Reading and understanding of prescriptions. Modern methods of prescribing and common Latin abbreviations.

## **2. Metrology**

Reducing and enlarging recipes; percentage calculations, % w/v, v/v, and w/w, alcohol dilutions, use of alligation methods; proof spirit, isotonic solutions, mEq units, displacement value of suppositories.

## **3. Posology**

Factors influencing dose. Calculations of doses on the basis of age, sex and surface area.

## **4. Powders**

Types of powders, their merits and demerits, classification of powders, compounding, storage and packaging of powders requiring special consideration like effervescent powders, bulk powders, dusting powders, insufflations, dentifrices and cachets.

## **5. Liquid Dosage forms**

Preparation, merits, demerits, solubility and methods of increasing solubility. Storage and packaging of liquid formulations for internal and external use.

## **6. Emulsions and Suspensions**

**Emulsions** – Definition, types and identification tests, merits and demerits, uses and classification of emulsifying agents and preparation and stability of emulsions.

**Suspensions** – Definition, types, merits and demerits, use of suspending agents, flocculated and deflocculated suspensions, formulation and stability of suspensions.

## **7. Semi-Solid Dosage forms**

**Ointments:** Classification of ointments and ointment bases. Factors governing selection of an ideal ointment base, preparation, packaging, labeling and storage of ointments.

**Pastes, Jellies, Poultices:** Formulation.

**Suppositories and Pessaries:** Types, suppositories bases, displacement value, preparation, packaging, labeling and storage.

## **8. Tablets**

Types of tablets, merits and demerits, preparation methods, equipments, storage, packaging and evaluation of tablets.

## **9. Capsules**

Hard and soft gelatin capsules, merits and demerits, preparation, storage, packaging and evaluation of capsules.

## **10. Sterile Dosage forms**

Definition, types, merits and demerits. Elementary study of the formulation characteristics of the following types: Injectable preparations, ophthalmic and ENT products, Total Parenteral Nutrition, dialysis fluids.

General requirements of sterile dosage forms. Handling, packaging, storage and dispensing of sterile dosage forms.

## **11. Introduction to Ayurvedic/Unani Tibb Dosage forms.**

## **12. Incompatibility in Prescriptions**

Physical, chemical and therapeutic incompatibility.

## **13. Labelling instructions and precautions while dispensing various dosage forms.**

### **PRACTICAL Total Hours 100**

#### **1. Student's Orientation**

Introduction to the laboratory equipment, weighing methodology, general instructions and handling of prescriptions, labeling instructions.

#### **2. Compounding and Dispensing of Prescriptions**

At least 50 prescriptions, representing the following classes of products, should be compounded and dispensed:

Powders, capsules, tablets, mixtures, emulsions, lotions and liniments, ointments, creams, pastes, suppositories, ENT preparations, incompatibilities, miscellaneous products

#### **3. Current Patent and Proprietary Products**

A study of current patent and proprietary products. Students should be trained in patient counseling by discussing specific problems in major classes of patent and proprietary products. Study of the following classes of patent and proprietary products, generic and selected brand names, indications; contraindications, adverse drug reactions, available dosage forms, dose and packing of (a) Antihypertensive drugs, (b) Antiamoebic drugs, (c) Antihistaminic, (d) Antiemetics, (e) Antacids and ulcer healing drugs,

(f) Anti-diarrhoeals and laxatives, (g) Respiratory drugs, (h) Antibiotics, (i) Analgesics and (j) Antipyretics.

#### 4. Prescription Reading:

Minimum of 20 prescriptions from the clinical practice

#### 5. Legal and Ethical aspects of Dispensing and compounding of prescriptions

The students should be trained about these aspects and evaluated by questionnaire.

#### Books Recommended:

1. Indian Pharmacopoeia, Govt. of India.
2. Remington's Pharmaceutical Sciences.
3. Nanda, Popli and Sharma: Current dispensing practices.
4. R.K.Khar and Pratibha Nand: Dispensing Pharmacy, CBS Publishers, Delhi.
5. A.K. Gupta and S.S. Bajaj: Introduction to Pharmaceutics-II, 2<sup>nd</sup> Edition, CBS Publishers, New Delhi.
6. Cooper and Gunn: Dispensing for pharmaceutical students, 12<sup>th</sup> Edition, CBS Publishers, Delhi.
7. B.M. Mittal: Textbook of Pharmaceutical Formulation, 4<sup>th</sup> Edition, Vallabh Prakashan, Delhi.
8. Merck Manual: [www.Merck.com/pubs/manual](http://www.Merck.com/pubs/manual).
9. Rx list internet: Drug Index: [www.Rxlist.com](http://www.Rxlist.com).
10. Virtual Library: Medicine-[www.ohsu.edu/clinweb/wwwvi](http://www.ohsu.edu/clinweb/wwwvi).
11. Drugs Today
12. MIMS/CIMS
13. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Vol.12,- Prescribing of Drugs - pp-443-464, Marcel Dekker Inc. New York.
14. Asgar Ali and A.D. Mahamuni: Pharmaceutics-II (Theory and Practise of Dispensing Pharmacy), Vallabh Prakashan, New Delhi.

#### Paper BPH 04

### PHARMACEUTICAL CHEMISTRY I ORGANIC CHEMISTRY (THEORY) Total Teaching Hours: 50

#### 1. Basic Principles and Concepts of Organic Chemistry

Polarity of bonds and molecules, dipole moment, resonance, inductive and electromeric effects, intra-molecular and intermolecular hydrogen bonding, acids and bases.

#### 2. Stereochemistry

Stereoisomerism, optical activity, enantiomers, Diastereomerism, mesostructures, specification of R and S, D and L configuration, racemic modification and resolution of racemic mixtures, conformational analysis, geometrical isomerism, its nature of formation, nomenclature of isomers and determination of configuration.

**Structure, nomenclature, preparation and reactions/properties of the following groups of compounds (including mechanism of reactions wherever necessary).**

#### 3. Aliphatic & Alicyclic Hydrocarbons

Alkanes, alkenes, alkynes, cycloalkanes, Bayer strain theory

#### 4. Alkyl Halides

SN<sup>1</sup> and SN<sup>2</sup> reaction mechanism and stereochemistry, Dehydrohalogenation of alkyl halides, E<sub>1</sub> and E<sub>2</sub> mechanism, chloroform, carbon tetrachloride, trichloroethylene and halothane.

#### 5. Aliphatic Alcohols

- (i) Primary, secondary and tertiary alcohol, methanol, ethanol, proof spirit, denatured alcohol, methylated spirit.
- (ii) Di and trihydric alcohols: glycols, glycerol, ethylene glycol, propylene glycol and dimercaprol.

#### 6. Ethers

Thioethers, divinyl ether, solvent ether, anaesthetic ether.

#### 7. Aldehydes and Ketones

Formaldehyde, acetaldehyde and their polymers, mechanism of aldol condensation, Claisen

condensation, Cannizzaro's reaction, Benzoin condensation, Perkin's condensation, Wittig reaction, Mannich reaction.

#### **8. Saturated Monocarboxylic Acids**

Formic acid, acetic acid and their derivatives, propionic acid, butyric acid, valeric acid, palmitic acid and stearic acid, ethyl nitrate, acylhalides, lactic acid, lactides, lactones and gluconic acid.

#### **9. Di and Tricarboxylic Acids**

Oxalic acid, malonic acid, succinic acid and their amide and imide derivatives, maleic acid and fumaric acid, malic acid, glutaric acid, tartaric acid, citric acid and adipic acid.

#### **10. Aliphatic amines and related compounds**

Alkylamines,  $\beta$ -hydroxy and  $\beta$ -alkylamines, diamines, urea and ureides, Hofmann's rearrangement, differentiation of 1°, 2° and 3° amines, dextropropoxyphene hydrochloride, cramiphen hydrochloride, dicyclamine hydrochloride, mustine hydrochloride, cyclamic acid, thiambutosine.

#### **11. Organometallic compounds**

Grignard's reagent their preparation and synthetic applications.

#### **12. Carbanions**

Reactions involving carbanions, malonic ester, synthesis of carboxylic acids, acetoacetic ester, synthesis of ketones, decarboxylation of  $\beta$ -ketoacids and malonic acids, direct and indirect alkylation of esters and ketones, alkylation of carbonyl compounds via enamines,  $\alpha$ ,  $\beta$ -unsaturated carbonyl compounds (conjugate addition) including Michael and Diels - Alder reaction.

### **PRACTICAL Total Hours: 100**

1. Lassaigne's test for nitrogen, sulphur and halogens.
2. Identification of organic compounds based on solubility and functional group test.
3. Performance of qualitative test for alkaloids, carbohydrates, glycosides, proteins and amino acids.
4. Test for identity of selected drugs: atropine, caffeine, quinine, glucose, sucrose, ascorbic acid, aspirin and paracetamol.

#### **Books Recommended**

1. R.T. Morrison and R.N. Boyd: Organic Chemistry, Allyn and Bacon Inc, Boston, USA.
2. I.L. Finar: Organic Chemistry, Vol.1, Ale English Language Book Society and Longman Group Limited, London.
3. J.B. Hendrickson, D.J. Cram and C.S. Hammond: Organic Chemistry, McGraw Hill, Kogakusha, Limited, Tokyo.
4. P. Sykes: A Guide books to mechanism in Organic Chemistry, Orient Longman, New Delhi.
5. L.M. Atherden: Bentley and Drivers - Textbook of Pharmaceutical Chemistry, Oxford University Press, Delhi.
6. A.A. Siddiqui & Mohd. Ali: Practical Pharmaceutical Chemistry, New Delhi.
7. S.N. Pandeya: A textbook of pharmaceutical organic chemistry (Mechanistic approach) Vol- I, S.G.Publishers, Varanasi.

#### **Paper BPH 05**

### **PHARMACEUTICAL CHEMISTRY II INORGANIC MEDICINAL PHARMACEUTICAL CHEMISTRY (THEORY) Total Teaching Hours: 50**

#### **1. Sources of impurities in pharmaceutical substances**

Importance of limit test and general principles and procedure for limit tests of chloride, sulphate, iron, arsenic, lead and heavy metals.

**The following topics will be treated covering an outline of methods of preparation, tests for identity, assay procedure and pharmaceutical uses of compounds covered under following headings:**

#### **2. Pharmaceutical aids and necessities**

Acids, bases, buffers, antioxidants, water and pharmaceutically acceptable glass.

### **3. Major intra and extra cellular electrolytes**

Major physiological ions, electrolytes used in replacement therapy, physiological acids-base balance, electrolytes used in acid-base therapy, electrolyte combination therapy.

### **4. Essential and trace ions**

Copper, zinc, iron, selenium, sulfur and iodine.

### **5. Gastrointestinal agents**

Acidifying agents, antacids, protective and absorbents, saline cathartics.

### **6. Radiopharmaceutical used in medicine**

Therapeutic application of isotopes, diagnostic application of isotopes.

### **7. Topical agents**

Antimicrobials and astringents.

### **8. Dental products**

Anticaries agents and dentifrices.

### **9. Miscellaneous Inorganic Pharmaceutical agents**

Inhalants; respiratory stimulants, expectorants and emetics, antidotes.

## **PRACTICAL**

**Total Hours: 100**

1. Limit tests for impurities in pharmacopoeial compounds.
2. Standardisation of sulphuric acid, hydrochloric acid, sodium hydroxide, potassium permanganate, sodium thiosulphate.
3. Quantitative analysis -assay of the following compounds will be done: solution of ammonia, boric acid, sodium bicarbonate, sodium carbonate, ferrous sulphate, strong and weak iodine solutions, copper sulphate, chlorinated lime, sodium chloride, ammonium chloride, sodium sulphate.

#### **Books Recommended**

1. L.M. Atherdon, Bentley and Drivers: Textbook of pharmaceutical chemistry, Oxford, University press, Delhi.
2. Pharmacopoeia of India, Govt. of India, Ministry of Health, Delhi.
3. J.H. Block, E. Roche, T.O. Soine and C. O. Wilson: Inorganic Medicinal and Pharmaceutical chemistry, Lee Febiger, Philadelphia. PA.
4. Roger's Inorganic Pharmaceutical Chemistry.
5. S.N. Pandeya: A Textbook of inorganic medicinal chemistry, S.G.Publishers, Varanasi.
6. M. Ali: Text book of Pharmaceutical Inorganic chemistry, CBS, New Delhi.

#### **Paper BPH 06**

## **PHARMACOGNOSY I**

### **PHARMACEUTICAL BIOLOGY (THEORY)**

**Total Teaching Hours: 50**

#### **1. Introductory Pharmacognosy**

Historical development, modern concept and scope of Pharmacognosy. Significance of Pharmacognosy in various systems of medicine viz; Ayurveda, Unani, Homeopathic, Siddha and Allopathic systems practiced in India.

#### **2. Classification of crude drugs**

Based on alphabetical, morphological, pharmacological, chemical and taxonomical methods, official and unofficial drugs, organized and unorganized drugs.

#### **3. Definition of drug**

Sources of crude drugs viz; Herbs, Animals, inorganic matter, plant tissue culture and marine sources. Role of herbal drugs in national economy.

#### **4. Cultivation of herbal drugs.**

Factors influencing variability in drug activity, type of soils, fertilizers, plant hormones and their applications, polyploidy, mutation and hybridization in medicinal plants.

#### **5. Production Factors**

Factors involved in the preparation of herbal drugs for market from cultivated and wild sources including collection, drying, storage and transport methods.

## 6. Study of morphological and histological characters of crude drugs

Ergastic cell inclusions, anatomical structures of bark, fruits, seeds and monocot and dicot stems, leaves and roots.

## 7. Phytoconstituents of medicinal importance

Introduction, classification and chemical tests of: Carbohydrates, polysaccharides, mono-, di- and tri-terpenes, steroids, saponins, glycosides, flavonoids, phenolic compounds, tannins, carotenoides, alkaloids, iridoides and amino acids.

## 8. Principles of plant classification

Diagnostic features and medicinal significance of important plants with special reference to:

- i) **Algae:** Rhodophyceae (Agar, Alginic acid, Diatoms, Carrageenan and Cetraria).
- ii) **Fungi:** Eumycetes (Ergot, Yeast, Mushrooms, Antibiotics, and Lycopodium).
- iii) **Gymnosperm:** Pinaceae (Turpentine, Colophony), Gnetaceae (Ephedra).
- iv) **Angiosperm:** Apocynaceae, Asteraceae, Convolvulaceae, Lamiaceae, Rubiaceae, Rutaceae, Solanaceae, Scrophulariaceae, Apiaceae, Leguminosae (Caesalpinaceae, Mimosaceae, Papilionaceae), Papaveraceae, Acanthaceae and Euphorbiaceae.
- v) **Pteridophytes:** Male fern.

## 9. Techniques in microscopy

Details of mountants, clearing agents, chemomicroscopic reagents.

### **PRACTICAL** **Total Hours: 75**

1. Microscopic preparation. Staining and surface preparation.
2. Microscopical studies of basic tissues, bark, stem (Dicot, Monocot), Root (Dicot, Monocot), seed, leaf, fruits, trichomes, stomata, calcium oxalate crystals, starch, phloem fibres.
3. General chemical tests for alkaloids, glycosides, tannins, resins and proteins.
4. Study of diagnostic characters of families mentioned in the theory.

### **Books Recommended**

1. T.E. Wallis: Textbook of Pharmacognosy C.B.S. Publishers, Delhi.
2. A.C. Dutta: Botany for Degree students, Oxford University Press, New Delhi.
3. Mohd. Ali: Text Book of Pharmacognosy, CBS, New Delhi.
4. P.K. Mukherjee: Quality Control of Herbal Drugs
5. C.K. Kokate, A.P. Purohit and S.B. Gokhle: Pharmacognosy
6. Jean Brunet: Pharmacognosy and Phytochemistry, Medicinal Plants
7. V.E., Tylor, L.R. Brady and S.B., Robbers: Pharmacognosy, K.M. Varghese Co. Bombay.
8. J.B. Harborne: Phytochemical Methods, Chapman and Halls, London.

### **Paper BPH 07**

### **HUMAN ANATOMY & PHYSIOLOGY (THEORY)** **Total Teaching Hours: 75**

#### **1. Introduction**

- i) Definition and scope of anatomy, physiology and related sciences. Anatomical terms in relation to parts of the body, system and organs.
- ii) Study of human skeleton.

#### **2. Cell**

- i) Structures and their functions.
- ii) Genetic control of cell function.

#### **3. Tissues of the Body**

- i) Types of tissues and their functions.
- ii) Physiology of muscle contraction.
- iii) Neuromuscular transmission.

#### **4. Membrane**

- i) General principles of membrane permeability transport.
- ii) Mechanisms and electrophysiology of membrane.

## **5. Nervous System**

- i) General anatomy and physiology of neurons, synapses, neurohumoral transmission.
- ii) Central nervous system, its various parts and their functions.
- iii) RAS, Limbic system, Physiology of sleep, CSF, Sensory and motor pathway.
- iv) Autonomic nervous system.
- v) Reflex arc, conditioned and unconditioned reflexes.

## **6. Cardiovascular System and Blood**

- i) Structures and functions of heart and blood vessels.
- ii) Heart sounds, ECG, Cardiac cycle, Blood pressure and its regulations.
- iii) Circulation (Pulmonary, Cerebral, Coronary, Placental and Foetal).
- iv) Lymphatic system.
- v) Blood composition and functions.
- vi) Blood groups, Rh factor, blood transfusion. (Immune mechanism).

## **7. Respiratory System**

- i) Gross anatomy of respiratory passages.
- ii) Regulation and mechanism of breathing and pulmonary function test.
- iii) Transportation of gases.
- iv) Hypoxia, Anoxia, Dyspnoea, artificial respiration.

## **8. Digestive System**

- i) Gross anatomy of the alimentary canal.
- ii) Physiology of digestion.
- iii) Liver and pancreas.

## **9. Endocrine System**

Introduction to endocrinology and general mechanisms of hormone action: Pituitary hormones, their physiological functions, their control by hypothalamus. Formation, secretion and regulation of thyroid hormones and their functions, diseases of the thyroid. Adrenocortical hormones, their chemistry, secretion, regulation and functions. Abnormalities of adrenocortical secretion. Pancreatic hormones and their metabolic effects and pathophysiology of diabetes mellitus. Parathormone and calcitonin and control of calcium metabolism.

## **10. Reproductive System**

- i) Structure and function of male & female reproductive organs.
- ii) Spermatogenesis.
- iii) Puberty, ovulation, menstrual cycle, reproductive cycles.
- iv) Pregnancy, lactation, menopause and sex hormones

## **11. Urinary System**

- i) General disposition of organs of excretory system.
- ii) Physiological consideration of urine formation and factors controlling it.
- iii) Micturition.
- iv) Regulation of body fluid constituents and their volumes.
- v) Acid-base physiology: Hydrogen ion production, body buffer systems (bicarbonate, phosphate, and proteins), respiratory and renal regulation of acid base balance, correction of acidosis and alkalosis.

## **12. Special Senses**

- i) Physiology of hearing, taste, smell and vision.
- ii) Structure and functions of skin.
- iii) Regulation of body temperature.

## **PRACTICAL** **Total Hours: 100**

### **1. Human Anatomy & Physiology**

- i) Study of human skeleton and bones.
- ii) Study of models of organs of various body systems.
- iii) Study of surgical instruments

### **2. Histology**

- i) Handling of microscope
- ii) Identification of various tissues

### **3. Haematology**

- i) Estimation of haemoglobin
- ii) Total RBC count
- iii) Total WBC count (TLC)
- iv) Differential leukocyte count (DLC)
- v) Platelets count
- vi) Determination of blood group and Rh factor.
- vii) Determination of ESR (demonstration)
- viii) Determination of blood clotting and bleeding time
- ix) Identification of plasmodium species in the human blood

### **4. Respiration**

Pulmonary function test using spirometer.

### **5. Nervous System**

Study of reflex action.

Recording of body temperature by various techniques.

Recording and interpretation of EEG.

### **6. Cardiovascular System**

Determination of blood pressure by palpatory and auscultating methods.

Recording ECG and its interpretation.

### **Books Recommended:**

#### **Theory**

1. Sujit K. Chaudhuri: Concise Medical Physiology.
2. C.C. Chatterjee: Human Physiology.
3. Kathleen J.W. Wilson Ross and Wilson: Anatomy and Physiology in Health and Illness
4. T.W.A. Glenister and Jean R.W. Ross: Anatomy and Physiology for Nurses
5. Arthur C. Guyton: Textbook of Medical Physiology.
6. Cyril A. Keele, Erie Neil, Norman Joels and Samson Wrights: Applied Physiology.

#### **Practical**

1. Shukant R. Apte: Experimental Physiology.
2. Ramesh K. Goyal, Natyar M. Patel and Shailesh A. Shah: Practical Anatomy, Physiology and Biochemistry.
3. Sir John Y. Dacie and S. M. Lewis: Practical Haematology.

# **B-PHARM IIND YEAR**

**PHARMACEUTICAL MATHS AND BIOSTATISTICS**  
**STATISTICS AND CALCULUS**  
**Total Teaching Hours:-50**

1. Condensation of the data collected; various forms of distribution tables.
2. Pictorial representation of frequency distribution in histograms and frequency polygons.
3. Measures of central tendency.
4. Measures of dispersion-range, mean deviation and standard deviation, coefficient of variation.
5. Significance tests-test of significance and chi-square test of significance.
6. Correlation between two variables.
7. Interpolation.
8. Probability.
9. Use of log-log graph.
10. Limits of algebraic functions.
11. Lim Sin  $\theta$ ; axioms on limits; of trig. Functions.
12. Differential coefficient of a function; derivatives of  $x^n$ ,  $N_0R$ .
13. Derivative formula of sum and difference of two functions generalizing it for more than two; derivative of product of two functions-generalizing it for the product of 3 functions; derivatives of quotient of two functions.
14. Derivative of trigonometrical functions and inverse functions.
15. Derivative by method of substitution.
16. Derivative of function of a function.
17. Derivative by method of substitution.
18. Parametric functions; implicit function; log. Differentiation.
19. Higher order derivatives.
20. Partial derivatives.
21. Total differentials and total derivatives, higher order, partial derivative.
22. Tangent and normal, velocity and acceleration.
23. Approximate values, maxima and minima.
24. Derivation of formulae of integration from derivative formula.
25. Integration of sum and difference of two functions.
26. Integration by substitution, integration by parts.
27. The relationship of integration to summation.
28. Definite integration, interpretation of definite integration, as an area, area of circle.
29. R and B (beta) functions.
30. Double integrals, S.S (x,y)  $dydx$  over a particular region and its interpretation.
31. Ordinary differential equations of the first order.
32. Linear differential equations with constant coefficient.
33. Simultaneous differential equations.

**Books Recommended**

1. Prasad: Differential Calculus.
2. Prasad: Integral Calculus.
3. Yule and Kendell: Statistics.
4. Croxton and Frerick: Statistics.
5. Ayers Mathematics and Stats for Students of Pharmacy.

## PHARMACEUTICS-IV

### PHARMACEUTICAL MICROBIOLOGY INCLUDING BIOLOGICAL PHARMACY (THEORY)

Total Teaching Hours: 50

#### 1. Introduction

History of microbiology, its branches and its importance, general microbiological techniques, identification, staining and enumeration. General classification of microorganisms and study of bacteria, moulds, yeasts, viruses and actinomycetes -nutrition, cultivation, isolation and identification. Effect of moisture, temperature, ion, light and pH on the growth of micro - organisms; bacteriological media; bacterial metabolism - EMP and TCA pathways. Salient features of common communicable disease producing microbes. Study of different types of phase microscopy, dark field microscopy and electron microscopy. Bacterial resistance.

#### 2. Immunology

Introduction, types of immunity, phagocytosis, antigens, antibodies, components; immune-systems humoral immunity, cellular immunity, privileged graft sites, graft host reaction; tolerance, immunogenetics; types of reactions and their application.

General method of the preparation of bacterial vaccines, toxoids, viral vaccine, rickettsial vaccines, anti-toxins, serum-immune blood derivatives and other products relative to immunity. Interferon. Preparation and standardization of immunological products, e.g., BCG vaccines, diphtheria toxoids, small pox vaccine, poliomyelitis vaccine, tetanus anti-toxin and diagnostic biologicals.

#### 3. Disinfection

Classification and mode of action of disinfectants, factors influencing disinfection, dynamics of disinfection; disinfectants, antiseptics and their evaluation.

#### 4. Sterilization methods and Principles

Methods of sterilization- Physical, chemical, heat, radiation, gaseous, filtration. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Examples of the materials sterilized by different methods, sterility indicators.

#### 5. Sterility testing of pharmaceutical products

Sterility testing of products according to IP, BP and USP. Sterility testing of parenteral products - solids, liquids, ophthalmic and other sterile products according to the I.P., B.P. and U.S.P. Sterility testing of sterile surgical devices, dressings, implants, absorbable, haemostats, surgical ligatures and sutures, surgical catgut .

#### 6. Aseptic Technique

Designing of aseptic area ,laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.

#### 7. Fermentation Technology

Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. Large scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, fungal diastase and dextran. A brief introduction to Recombinant DNA technology.

#### 8. Microbiological Standardization

Microbiological methods for standardization of antibiotics, vitamins and amino acids. Immunoassay. Assessment of a new antibiotic and testing of antimicrobial activity of a new substance.

#### 9. Microbial spoilage and preservation of Pharmaceutical products

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage, preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

#### 10. Control of microbial contamination during manufacture

General aspects-environmental cleanliness and hygiene, quality of starting materials, process design, quality control and documentation.

**PRACTICALS**  
**Total Hours 100**

**Exercises illustrating the course contents of theory including:**

1. Preparation of various types of culture media.
2. Studying of different laboratory equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes .
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Various staining methods-simple, Grams staining and acid fast staining.
5. Isolation of pure culture of micro-organisms by multiple streak plate technique
6. Evaluation of antiseptic and disinfectants e.g. RWC, FDA method and chick martin.
7. Sterility testing-different methods as per IP/BP/USP
8. Hanging drop slide preparation.
9. Biochemical reactions-starch hydrolysis, nitrate reduction, litmus milk test, gelatin liquefaction, carbohydrate metabolism.
10. Microbial viable count in a pharmaceutical product and total count of bacteria
11. Thermal death time determination.
12. Microbiological assay of antibiotics.
13. Isolation of an antibiotic producer.
14. Bacteriophage isolation and characteristics
15. Normal throat flora.
16. Studying of the environment micro flora and testing of aseptic area.
17. Antimicrobial activity of an unknown compound.
18. Microbiological standardization of raw materials.
19. Demonstration of slide preparations of various microorganisms.

**Books Recommended**

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
3. Gilbert S.Banker and Christopher T. Rhodes: Modern Pharmaceutics.
4. Remington's Pharmaceutical Sciences.
5. Pelczar and Reid: Microbiology.
6. Dawson and Mirne: Immunological and Blood products.
7. Rose: Industrial Microbiology.
8. Prescott and Dunn: Industrial Microbiology.
9. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9<sup>th</sup> ed. Japan
10. Cooper and Gunn's: Tutorial Pharmacy
11. Peppler: Microbial Technology.
12. I.P., B.P., U.S.P. - latest editions
13. Ananthnarayan : Text Book of Microbiology.
14. Edward: Fundamentals of Microbiology
15. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
16. PUBMED - on Internet (www.pubmed.com)

**Paper BPH 10**

**PHARMACEUTICS -V**  
**PHYSICAL PHARMACY (THEORY)**

**Total Teaching Hours: 75**

**1. Complexation and Drug action**

Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis, crystalline structure of complexes, thermodynamic treatment of stability constants, protein binding.

**2. Kinetic and Drug Stability**

Rates and orders of reactions, influence of temperature and other factors on reaction rates, decomposition and stabilization of medicinal agents, accelerated stability analysis.

### **3. Surface and interfacial phenomenon**

Surface and interfacial tension, surface free energy, measurement of surface and interfacial tension, spreading coefficient, complex films, adsorption phenomenon, adsorption at solid/liquid interface. Surface activity, general classification of surfactants, hydrophilic-lipophilic system, solubilization, factors affecting solubilization, mechanism of solubilization, pharmaceutical applications of solubilization, co-solubilization. Micelle formation, factors affecting micelle formation- determination of critical micelle concentration. Detergency, emulsification, wetting agent, foaming agent, antifoaming agent. Medicinal and pharmaceutical application of surfactants.

### **4. Buffers**

Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting tonicity.

### **5. Rheology**

Fundamentals of rheology- Introduction, types of flow, quantitative measurement of flow, mechanical models to illustrate viscoelasticity, thixotropy, measurement of thixotropy, thixotropy in formulations, rheology of disperse systems, application of rheology to pharmacy. Methods of measuring viscosity.

### **6. Micromeritics**

Introduction, importance in Pharmacy, fundamental properties of collection of particles like particle size, particle size distribution, particle shape, particle volume, particle number, surface area, methods for determining particle size, surface area and particle volume. Derived properties of loose powder, flow properties of powders, angle of repose, factors affecting flow of powders.

### **7. Coarse Dispersions**

Suspensions - Interfacial properties of suspended particles, settling in suspensions, formulation of suspension. Emulsions- theories of emulsification, physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions, phase equilibria and emulsion formulation.

### **8. Diffusion and Dissolution**

Steady state diffusion, procedures and apparatus, dissolution, drug release, diffusion principles in biologic systems, vapor sorption and transmission and thermodynamics of diffusion.

## **PRACTICALS**

### **Total Hours 75**

1. Preparation and properties of simple complexes.
2. Design, conduction and reporting of accelerated testing in studying chemical stabilization against hydrolytic decomposition of drugs.
3. Determination of surface and interfacial tension
4. Preparation and properties of colloids.
5. Viscosity determination of Newtonian and Non-Newtonian liquids by one point and multipoint viscometers.
6. Determination of HLB value of surfactant by saponification method.
7. Determination of HLB value by modified Griffin acacia emulsion method.
8. Determination of spreading coefficient of organic liquid by stalagamometer.
9. Determination of particle size by optical method.
10. Determination of particle size by sieving method and efficiency of screening operation.
11. Determination of particle size by sedimentation method using and Andraesson pipette.
12. Determination of flow properties of powder through the tube as a function of length of tube, diameter of orifice of tube and pressure head.
13. Experiments demonstrating the measurement of angle of repose of powders and the factors affecting.
14. Determination of CMC (Critical Micelle Concentration) of surfactants by surface tension methods.
15. Experiments demonstrating the usefulness of solubilizing agent in forming a clear liquid phase of two immiscible liquids (Ternary phase diagram) .
16. Qualitative and quantitative study of adsorption phenomenon.
17. Determination of bulk density of pharmaceutical solid.
18. Any other new experiment that can be included from time to time in support of the theoretical aspects of the course.

**Books Recommended:**

1. Martin: Physical Pharmacy, K.M.B. Varghese Co. Bombay.
2. A.T. Florence and D. Attwood W: Physiochemical principles of Pharmacy.
3. Shotton and Ridgeway: Physical Pharmaceutics.
4. Remingtons Pharmaceutical Sciences, Mark Publishing Co.
5. H.S. Beans, A.H. Beckett and J.E. Carless: Advances in Pharmaceutical Sciences, Vol. 1 to 4.
6. S.P. Agarwal, Rajesh Khanna: Physical Pharmacy, CBS Publishers, New Delhi.

**Paper BPH 11**

**PHARMACEUTICAL CHEMISTRY III  
PHARMACEUTICAL ANALYSIS -I  
INORGANIC CHEMISTRY (THEORY)  
Total Teaching Hours:-50**

**1. Introduction**

Significance of quantitative analysis in quality control, different techniques of analysis.

**2. Acid-base titrations**

Theories of acidimetry and alkalimetry, classification, direct titration of strong acids, weak acids, strong bases and weak bases.

Preparation and standardization of acids and bases. Some exercises related to the determination of acids & bases. Some official assay procedures, e.g., boric acid, hydrochloric acid, phosphoric acid, sodium hydroxide, calcium carbonate, ammonium hydroxide, nitric acid, sulfuric acid.

**3. Oxidation & reduction titrations**

Concepts of oxidation and reduction, redox reactions, strengths and equivalent weights of oxidizing and reducing agents, redox indicators, potassium permanganate titrations, iodometry and iodimetry, ceric ammonium sulphate titrations, potassium iodate titrations. Pharmaceutical applications, preparation and standardization of redox titrants, e.g., sodium thiosulphate. Some exercises related to determination of oxidizing and reducing agents in a given sample shall be covered.

**4. Precipitation titrations**

Preparation and standardization of titrants like silver nitrate, ammonium thiocyanate; titrations according to Mohr's and Volhard's methods, ammonium and potassium thiocyanate titrations, indicators, applications in pharmaceutical analysis, Fajan's method and Gaylussac's method.

**5. Diazotisation titrations**

Different conditions involved in diazotisation of different amines, end point determination and pharmaceutical analytical applications such as in the assay of sulfonamides.

**6 Gravimetric analysis**

Introduction, precipitation techniques, supersaturation, coprecipitation, digestion, washing of the precipitates, filtration, paper and crucibles, ignition, specific examples of Gravimetric estimations like barium as barium sulphate, aluminum as aluminum oxide, calcium as calcium oxalate, magnesium as magnesium pyrophosphate. Other organic precipitants.

**7. Non-aqueous titrations**

Theoretical considerations, scope and limitations, acid base equilibria in non-aqueous media, titration of weak bases, titration of weak acids. Pharmaceutical products should be selected for illustration e.g. ephedrine, methyl dopa and adrenaline acid tartarate.

**8. Complexometric titrations**

Types of Complexometric titrations, metal ion indicators, factors influencing the stability of complexes and applications e.g. calcium gluconate, bismuth carbonate, bismuth subnitrate, ligand's and determination of hardness of water.

**PRACTICAL  
Total Hours: -100**

**1. Acid base titrations**

Preparation and standardization of acids and bases, some exercises related to the determination of acids and bases separately and in mixture form. Some official assay procedures of boric acid, ascorbic acid shall also be covered.

## 2. Oxidation-reduction titration

Preparation and standardization of some redox titrants, e.g., potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to the determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving use of potassium iodate, potassium bromate, ceric ammonium sulphate shall be performed.

## 3. Precipitation titrations

Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohr's and Volhard's methods.

## 4. Gravimetric analysis

Determination of water of hydration, some exercises related to Gravimetric estimation of metal ions such as barium, magnesium and calcium shall be covered.

## 5. Diazotisation reaction

Assay of sulphonamides like wise any two official assays.

## 6. Complexometric titration

Any two official assays done by this method.

### Books Recommended

1. L.M. Atherden: Bentley and Driver's Text book of Pharmaceutical Chemistry, Oxford University Press, Delhi.
2. G.L. Jenlnds, J.E. Christian, G.P. Hager: Quantitative Pharmaceutical Chemistry, Mc- GrawHill Company, New York.
3. Pharmacopoeia of India, Govt. of India, Ministry of Health, Delhi.
4. Bassett, R.C. Denney, G.H. Jeffery, J. Mendham: Vogel's Textbook of quantitative Inorganic Analysis, The ELBS and Longman, London.
5. A.H. Beckett and J.B. Stenlake: Practical Pharmaceutical Chemistry, Vol I & II. The Athlone Press of the University of London.

### Paper BPH 12

**PHARMACEUTICAL CHEMISTRY IV  
ORGANIC CHEMISTRY (THEORY)  
INCLUDING HETEROCYCLIC AND MEDICINAL CHEMISTRY  
Total Teaching Hours: 50**

#### 1. Aromatic Compounds

Structure and resonance of benzene, aromatic character, mechanism of electrophilic aromatic substitution, orientation effects in electrophilic substitution, nucleophilic aromatic substitution.

#### 2. Preparation, properties and actions of

Phenols, sulphonic acids and derivatives, carboxylic acids, nitro compounds, amines, diazonium salts, aryl halides and ketones.

#### 3. Poly nuclear aromatic hydrocarbons

Naphthalene, phenanthrene and anthracene.

#### 4. Heterocyclic compounds

Study of fundamentals of heterocyclics, nomenclature, methods of synthesis and important chemical reactions of the following:

##### (i) Five -membered heterocycles

Furan, thiophene, pyrrole, thiazole, oxazole, imidazole, pyrazole, triazole and tetrazole.

##### (ii) Six-membered heterocycles

Pyridine, pyridazine, pyrimidine, pyrazine and pyrones.

##### (iii) Benz-fused heterocycles

Quinoline, isoquinoline, indole, acridines and xanthone.

#### 5. The following topic shall be treated covering outlines of synthetic procedures (of selected drugs), uses, and structure activity relationship including physicochemical, steric aspects and mode of action.

Vitamins, thyroid hormones and antithyroid drugs, coagulants and anticoagulants, expectorants and antitussives, antiseptics and disinfectants, diagnostic agents, hypoglycemic agents.

**PRACTICAL**  
**Total Hours: 100**

1. Identification of organic compounds and preparation of simple derivatives.
2. Synthesis based on *O*- and *N*-acetylation, nitration and bromination.

**Books Recommended**

1. R.T. Morrison and R.N. Boyd: Organic Chemistry, Allyn and Bacon Inc., Boston (USA).
2. I.L. Finar: Organic Chemistry, Vol. I & II, ELBS and Longman Group Ltd., London.
3. L.M. Atherden: Bentley and Driver's-Textbook of Pharmaceutical Chemistry, Oxford University Press, Delhi
4. F.G. Mann & B.C. Saunders: Practical Organic Chemistry, Longman, London and New York.
5. Vogel's Text Book of practical Organic Chemistry, Longman, London. New York.
6. S.N. Pandeya: A Textbook of Pharmaceutical Chemistry (Heterocyclics & Biomolecules) VoII, S.G.Publishers, Varanasi.

**Paper BPH 13**

**PHARMACOGNOSY II**  
**GENERAL PHARMACOGNOSY (THEORY)**  
**Total Teaching Hours:-50**

**1. Biosynthesis**

Formation of primary and secondary metabolites. Study of Calvin cycle, TCA cycle, Shikimic acid pathway, Embden-Maerhoef pathway, acetate hypothesis, isoprenoid pathway. Biosynthesis of carbohydrates, lipids and volatile oils.

**2. Toxic Drugs**

Study of Allergens, hallucinogens, narcotics, mycotoxins, toxic mushrooms and Indian toxic plants.

**3. Plant Products**

Introduction to plant bitters, sweeteners, health food, cosmetic and photosensitising agents.

**4. Quantitative microscopy**

Determination of stomatal index, stomatal number, palisade ratio, vein islet number, vein termination number, Lycopodium spore method. Micrometers and measurement of microscopic characters.

**5. Herbarium**

Preparation of herbarium sheets and their importance in authentication of plants.

**6. Pharmaceutical aids**

Biological sources, chemical test and microscopy of: Cotton, silk, wool regenerated fibres, asbestos, kaolin, prepared chalk, and kieselghur.

**7. Drugs of Animal origins**

Shellac, cochineal, cantharides, spermaceti, woolfat, lard, beeswax, honey, musk, lanolin, gelatin.

**8. Enzymes**

Biological sources, preparation, characters and uses of Diastase, Papain Bromelain, Ficin, Yeast, Pancreatin, Urokinase, Pepsin, Trypsin, Pencillinase, Hyaluronidase and Stryptokinase.

**9. Natural pesticides and Insecticides**

Tobacco, Pyrethrum, Cevadilla, Neem, RYANIA. Introduction to herbicides, fungicides, fumigants and rodenticides.

**PRACTICAL**  
**Total Hours:-75**

1. Identification through morphological, sensory and chemical characteristic of shellac, cochineal, cantharides, spermaceti, woolfat, lard, beeswax, honey, lanolin, gelatin, Yeast, Diastase, Papain, Bromelain, Cotton, Silk and Wool.
2. Quantitative microscopy of Vinca, Datura and Senna leaves.
3. Microscopic and chemical tests of the following powdered drugs:
  - i) Leaf: Senna, Datura

- ii) Stem: Ephedra
- iii) Root: Rauwolfia, Glycyrrhiza
- iv) Seed: Nux vomica, Plantago
- v) Bark: Cinchona, Cinnamon
- vi) Fruits: Fennel, Coriander
- vii) Wood: Quassia,
- viii) Rhizome: Ginger, Turmeric
- ix) Flowers: Clove.

#### **Books Recommended**

1. T.E. Wallis: Textbook of Pharmacognosy C.B.S. Publishers, Delhi.
2. S.S. Handa and M.K. Kaul: Supplement to Cultivation and utilization of Aromatic Plants, RRL, Jammu.
3. J.B. Harborne: Phytochemical Methods, Chapman and Halls, London.
4. C.K. Kokate, P.P. Purohit and S.B. Gokhle: Pharmacognosy, Nirali Prakshan, Pune.
5. Mohd. Ali: Textbook of Pharmacognosy, CBS Publishers, New Delhi.
6. P.K. Mukherjee: Quality Control of Herbal Drugs.
7. Betty P.rek W. Snowdon: Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS, New Delhi
8. Jean Brunet: Pharmacognosy and Phytochemistry, Medicinal Plants
9. V.E. Tylor, L.R. Brady and S.B. Robbers: Pharmacognosy, K.M. Varghese Co. Bombay.
10. The Wealth of India, Raw Materials, Vol. I-X, NISCAR.

#### **Paper BPH 14**

### **PATHOPHYSIOLOGY, TOXICOLOGY AND HEALTH EDUCATION (THEORY)**

**Total Teaching Hours: 25**

#### **1. General aspect of Pathophysiology –**

Atrophy, necrosis, pain, irritation, inflammation, shock, allergy

#### **2. Pathophysiology and Clinical Assessment**

- i) Disorders of cells and tissues - hypoplasia, hyperplasia, hypertrophy, metaplasia, neoplasia and general considerations.
- ii) Disorders of blood cells - leukopenia, leukemia, erythrocyte disorders (anemia polycythemia), hemorrhagic diseases (thrombocytopenia, fibrinogen deficiency, purpura)
- iii) Disorders of blood vessels and heart - atheroma, arteriosclerosis, aneurysms, thrombophlebitis, embolism, varicose veins, congestive cardiac failure, ischaemic heart disease, rheumatic heart diseases, arrhythmia, hypertension, Burger's disease.
- iv) Disorders of the respiratory tract - tonsillitis, bronchitis, bronchial asthma, emphysema, cough.
- v) Disorders of the digestive tract - gastritis, peptic ulcers, pancreatitis, cirrhosis of the liver, jaundice
- vi) Disorders of the urinary system - glomerulonephritis, renal calculi
- vii) Disorders of the nervous system and special senses - Epilepsy, hypoxia, dementia, Parkinsons' disease, chorea, Alzheimer's disease, migrain, depression, .schizophrenia
- viii) Disorders of the reproductive system - Impotency, infertility, cryptorchism
- ix) Disorders of bone, joints and cartilages - Osteoporosis, gout, arthritis, rickettes.
- x) Disorders of eye - glaucoma and cataract

#### **3. Toxicology**

- i) Definition, scope and its branches
- ii) Teratogenicity and Carcinogenicity
- iii) Toxicity of heavy metals and their antidotes
- iv) Management of poisoned patients

#### **4. Health Education**

- i) Spread and prevention of communicable disease- AIDS, sexually transmitted disease, small pox, measles, influenza, diphtheria, whooping cough, meningitis, tuberculosis, polio-myelitis, viral hepatitis, cholera, typhoid, diarrhea, amoebiasis, malaria, filariasis, rabies, tetanus, leprosy.
- ii) Control of population explosion, national family planning program means of contraception (mechanical, chemicals, surgical, Immunological, physical and physiological).

iii) Immunization – various vaccines, toxoids and their uses.

### **Books Recommended**

1. Kathleen J.W. Wilson: Anatomy and physiology in Health and Illness.
2. H.E.A. Mentz: Pathophysiology in Medical Science.
3. Thomas H. Kent, Michael N. Hart: Introduction to Human Disease.
4. Martha J. Miller: Pathophysiology- Principle of Disease.
5. Phillip J. Williams and James L. Burson: Industrial Toxicology.
6. P.K. Gupta and D.K. Salunkhe: Modern Toxicology.
7. B.C. Katzung: Basic and Clinical Pharmacology.
8. D.R. Lurance: Evaluation of Drug activities: Pharmacometrics, Vol.-I.
9. J.E. Park and K. Park: Textbook of Preventive and Social Medicine.
10. Yash Pal Bedi: A Handbook of Hygiene and Public Health.
11. Material published by Ministry of Health, Family Planning and Urban Development, (Department of Family Planning).

### **Paper BPH 15**

## **PHARMACOLOGY-I (THEORY)**

**Total Teaching Hours: 50**

### **1. General Pharmacology**

- i) Definition, scope and branches of pharmacology. Historical development with special reference to India.
- ii) Routes of drugs administration and drug delivery systems.
- iii) Dynamics of absorption, distribution and excretion of drugs.
- iv) Basic pharmacokinetic parameters employed in the use of drugs, their bioavailability and biotransformations, metabolizing enzymes as targets of drugs action (induction and inhibition).
- v) Mechanisms of drugs action, drug receptors and cellular signaling systems.
- vi) Drug antagonism and synergism.
- vii) Drug dependence and related conditions.
- viii) Adverse drug effects and their monitoring, Iatrogenic diseases.
- ix) Pharmacogenomics.

### **2. Pharmacology of Autonomic Nervous System**

- i) Cholinergic receptors, cholinergic drugs (parasympathomimetics, cholinomimetics, anticholinesterases).
- ii) Anticholinergic drugs.
- iii) Adrenoceptors, sympathomimetics, adrenoceptors blockers.
- iv) Drugs action on autonomic ganglia (ganglionic stimulants, ganglion blocking agents).
- v) Neuromuscular blocking agents and centrally acting muscle relaxants.

### **3. Autocoids**

- i) Histamine, Antihistaminics.
- ii) Serotonin, agonists and antagonists.
- iii) Arachidonic acid metabolites.
- iv) Renin Angiotensin Aldosterone System, Plasmakinins, VIP, neurotensin, substance P, PAF .

### **4. Drugs in Ocular Pharmacology**

- i) Mydriatic and miotic agents and drugs used in glaucoma.

## **PRACTICAL**

**Total Hours: 100**

1. Study of instruments used in experimental Pharmacology, smoking and fixing a kymograph.
2. Handling of laboratory animals.
3. Techniques of drug administrations in animals.
4. Influence of routes of administration of drugs on drug response.
5. Experiments on isolated tissue preparations.
  - i) To record CRC of acetylcholine using guinea pig ileum / rat intestine.

- ii) Determination of dose ratio.
  - iii) Study of competitive antagonism using acetylcholine and atropine.
  - iv) Potentiation of acetylcholine responses with anticholinesterases.
  - v) Determination of PD<sub>2</sub> value.
6. Study of drug absorption in vitro.
  7. Determination of intraocular pressure in rabbits.

#### **Books Recommended:**

##### **Theory**

1. C.R.Craig and R.E.Stitze: Modern Pharmacology.
2. Goodman Gilman's: The Pharmacological Basis of Therapeutics by Alfred Goodman Gilman, Theodore W.Rall, Alan S.Nies and Palmer Taylor.
3. D.R.Laurence and P.N.Bennett: Clinical Pharmacology.
4. K.D.Tripathi: Essentials of Medical Pharmacology.
5. R.S.Satoskar and S.D.Bhandarkar: Pharmacology and Pharmacotherapeutics.
6. H.P.Rang and M.M.Dale: Pharmacology.
7. James Crossland: Lewis's Pharmacology, revised.

##### **Practical**

1. Pharmacological experiments on isolated preparations by Edinburgh University, Pharmacology Staff, 1968.
2. U.K.Sheth, N.K. Dadkar and Usha G.Kamat: Selected topics in experimental pharmacology.
3. S.K.Kulkarni: Handbook of experimental Pharmacology.
4. M.N.Ghosh: Fundamental of Experimental Pharmacology.
5. Ian Kitchen: Textbook of invitro Pharmacology.
6. Robert A.Tumer: Screening methods in Pharmacology, Vol.1, edited.
7. F.S.K. Barar: Essentials of Pharmacotherapeutics.
8. K.K. Pillai, Experimental Pharmacology, CBS, New Delhi.

#### **Paper BPH 16**

### **COMPUTER APPLICATIONS**

**Total Teaching Hours: 25**

#### **1. Fundamentals of Computers**

Computers, its types and uses, computer generations, hardware, software, elements of a computer system.

Number Bases-Decimal, binary, octal, hexadecimal, data representation.

Storage devices - Primary memory, hard disk, floppy disk, CDROM.

Input and output devices.

#### **2. Operating System-DOS, Windows and Unix**

Operating system-definition, organization, functions, operations and types, history of DOS, Windows and UNIX operating systems, handling of drives, directories and files, commands-internal, external.

Program groups, items, icons, clipboard, folders, task swapping.

Major differences between DOS and UNIX operating systems

#### **3. Data Transmission and Networks**

Hardware and software components. Seven layer model. Bus, star and ring topologies.

#### **4. Programming**

High level languages, machine languages, syntax, semantics.

Program design aims - Stages in programming, flow charts.

#### **5. Programming Language 'C'**

Data types, constants, variables, arithmetic and relational expression, symbolic constants, input and output, increment and decrement operators, assignment statement, if-else, switch statements.

Loops-while, do-while, for-transfer statements, functions, header files, recursion, pointers and arrays, structures.

#### **6. Application Software**

Wordprocessing techniques, file manipulations and formatting, printing setups, mail-merge. Table

handling. Mathematical equations, graphs, picture handling and drawings.  
About spreadsheet programs, workbooks/worksheets, Formatting of sheets, Formulae and functions, graphs. Import and export of files/ data.  
Presentation Packages, slide designing, graphs. Import and export facilities.

### **PRACTICALS**

**Total Hours: 25**

MS Office—MS word. MS Excel. Powerpoint, DOS Comands.

#### **Books recommended**

1. Bryon S. Gottfried: McGraw Hill Book Co. (Schaum's Series) Programming with C.
2. E. Balagumswamy: Tata McGraw Hill Publishing Co., Programming in C.
3. John Sheeley and Roger Hunt: Computer Studies, First Course, Delhi: A.K. Wheeler & Co 1986.
4. R.J. Scidal, and M. L. Rubin (Ed.): Computer and Communications: Implications for Education. Academic press. 1977.
5. V. Rajaraman: Fundamental of Computers, II<sup>nd</sup> Edition, East Economy Edition.

# **B-PHARM IIIIRD YEAR**

**PHARMACEUTICS VI**  
**PHARMACY PRACTICE (THEORY)**  
**Total Teaching Hours: 50**

**Part I-Hospital Pharmacy**

**1. Status of health delivery systems in India**

Definition and role of hospitals in the health delivery systems. Types of hospitals.

**2. Hospital Pharmacy**

Definition, functions and objectives of hospital pharmacy, location, layout and flow chart of material and men, personnel and facilities required including equipments.

**3. Drug distribution system in Hospitals**

- i) Out patients
- ii) In patients: Detailed discussion of
  - (a) Unit dose dispensing
  - (b) Floor ward stock system and satellite pharmacy services
  - (c) Central sterile services, bed side pharmacy
- vi) Prepackaging.

**4. OTC Counter**

Its establishment, dispensing, personnel, space, equipment, apparatus and other facilities required to achieve safe, efficient and speedy dispensing of drugs.

**5. Maintenance of records of issue and use of narcotics and dangerous drugs, ward stock medicines and emergency drugs.**

**6. Medical Stores**

Objectives, layout facilities; procedures for procurement of drugs and supplies from medical stores depot, manufacturer, distributor, local market, procedure and limits of emergency purchase.

**7. Pharmacy Therapeutics Committee**

Constitution and functions of Pharmacy therapeutics committee, hospital formulary system and its organization, functions and composition.

**8. Drug Information service and drug information bulletin**

**9. Manufacturing of pharmaceuticals in hospitals**

**Sterile Manufacturing:** Large and small volume parenterals, facilities, requirements, layout, production planning, manpower requirements.

**Non-sterile manufacture:** Liquid orals, external bulk concentrates.

**10. Surgical instruments, hospital equipments and health accessories:** Nomenclature and uses.

**Part II-Clinical Pharmacy**

**11. Introduction to clinical pharmacy practice**

Definition and scope, common daily terminology used in the practice of medicine, functioning and working of clinical pharmacy unit, manpower requirements.

**12. Pharmacists and patient counseling including specific examples**

**13. Drug interactions of clinical important drugs**

Definition and Introduction, Mechanism of drug interactions, Drug - Drug Interactions with reference to Analgesics, Diuretics, Cardiovascular drugs, Gastrointestinal agents, Vitamins and Hypoglycemic drugs.

**14. Compliance to treatment and role of pharmacist**

Impact of diseases on drug action

**15. Drugs in clinical toxicity**

Introduction, general treatment of poisoning, systemic antidotes. Treatment of poisoning due to insecticides, heavy metals, narcotics, barbiturates, organophosphorous compounds

**16. Pharmaco-economics**

**Diseases:** Etiology, pathophysiology, manifestations and treatment of tuberculosis, hepatitis, rheumatoid arthritis, peptic ulcer, epilepsy, diabetes mellitus, atherosclerosis and hypertension.

**Books Recommended**

1. Remington's Pharmaceutical Sciences.

2. W.E Hassan: Hospital Pharmacy.
3. Heifindal et al: Clinical Pharmacy & Therapeutics.
4. Allwood and Fell: Hospital Pharmacy.
5. P.C. Dandiya, R.K. Khar and N. Gumbani: Pharmacist year Book CBS Publisher.
6. Pratibha Nand and R.K. Khar: Hospital & Clinical Pharmacy.

**Paper BPH 18**

**PHARMACEUTICS -VII  
FORENSIC PHARMACY AND ETHICS (THEORY)  
Total Teaching Hours: 50**

**1. Historical Background**

Drug legislation in India, Code of Ethics for Pharmacists.

**2. Drug Laws**

(A detailed study : Case study (actual/simulated) inclusive of recent amendments)

- i) Prevention of cruelty of animals act.
- ii) Pharmacy Act 1948.
- iii) Drugs and cosmetic Act 1940, Rules 1945.
- iv) Narcotic Drugs and Psychotropic Substances Act, and Rules there under.
- v) Drugs and Magic Remedies (Objectionable Advertisements) Act 1954.
- vi) Medicinal and Toilet Preparations (Excise Duties) Act 1955, Rules 1976.
- vii) Poison Act.
- viii) Factory Act.
- ix) Delhi shops and Establishment Act.
- x) Medical termination of pregnancy Act.
- xi) The Drug (price control) order.
- xii) The Insecticide Act.
- Xiii) Indian Patents Act as applicable to drugs and pharmaceuticals.
- xiv) AICTE Act, 1987.

**Books Recommended**

1. N. K. Jain: Pharmaceutical Jurisprudence
2. S. P. Aggarwal and R. Khanna: Pharmaceutical Jurisprudence, Tata Publishers.

**Paper BPH 19**

**PHARMACEUTICS -VIII  
PHARMACEUTICAL FORMULATION AND COSMETOLOGY (THEORY)  
Total Teaching Hours: 50**

**1. Preformulation studies**

- i) Study of physical properties of drugs like physical form, polymorphism, solubility, salt formation, dissolution and partitioning effects and their influence on formulation, stability and bioavailability of products.
- ii) Study of chemical properties like hydrolytic degradation, oxidation, racemization, decarboxylation, polymerization and their influence on formulation and stability of products. Drug substance - excipient interaction study.
- iii) Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulations.

**2. Validation**

Design, development and process validation methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets.

**3. Blood Products and Plasma Substitutes**

Classification of blood products; collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitute, ideal requirements and large scale preparation of dextran.

#### **4. Radio Pharmaceuticals**

Production of radiopharmaceuticals, radiation hazards, radiological safety, medical and pharmaceutical applications of radiopharmaceuticals.

#### **5. Raw materials used for Cosmetic preparations**

Surfactants, humectants, preservatives, herbal materials, perfumes, colors.

#### **6. Hair Care Products**

Introduction to hair structure, shampoos, hair conditioners, hair setting lotions, hair creams, hair bleaches and dyes.

#### **7. Skin Care Products**

Introduction to anatomy and physiology of skin, formulation of skin cleansers and moisturizers, sun screen products.

#### **8. Color Cosmetics**

Lipsticks and nail lacquers

#### **9. Dental Products:**

Dentifrices, tooth powder and tooth paste.

#### **10. Personal Hygiene Products**

Shaving soaps and creams, after shave preparations, antiperspirants and deodorants.

### **PRACTICALS**

**Total Hours 75**

#### **Preparation and quality control tests for:**

- i) Cold cream
- ii) Vanishing cream
- iii) Cleansing lotion and cream
- iv) Moisturizing cream
- v) Hair creams
- vi) Hair setting lotions
- vii) Shampoos
- viii) Hair colorants
- ix) Shaving creams
- x) Tooth powders
- xi) Tooth pastes
- xii) After shave lotions
- xiii) Other cosmetics
- xiv) Stability study of some formulations.

#### **Books Recommended**

1. G. S. Banker and C. T. Rhodes: Modern Pharmaceuticals, Second Edition, Volume 40, Marcel Dekker, Inc., New York, 1990.
2. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
3. M. E. Aulton: Pharmaceuticals, Science of Dosage Form Design.
4. Remington's Pharmaceutical Sciences.
5. E.A.Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
6. Javed Ali, Roop K. Khar and Alka Ahuja: Text book of Dosage Form Design, Birla Publications, 2004.
7. J. Swarbrick: Current concepts in the pharmaceutical Sciences: Dosage form. Design and Bioavailability, Lea and Febiger, Philadelphia, 1973.
8. L.Z. Benet: Biopharmaceutics as the basis for the design of drug products, In Drug Design.
9. A. Martin: Physical Pharmacy, Vargheese Publishing House, Mumbai, 1991.
10. B.M.Mittal, Textbook of Pharmaceutical formulation.
11. D.F.Williams and W.H.Schmitt: Chemistry and Technology of the cosmetics and Toileteries Industry.
12. Harry's Cosmetology
13. W.A.Poucher: Perfumes, Cosmetics and Soaps Vol. I, II and III Chapman and Hall London.
14. F.Y. Wells and H.Lubove: Cosmetics and the Skin, Reinhold Pub. New York.

**PHARMACEUTICAL CHEMISTRY-V**  
**PHARMACEUTICAL ANALYSIS II**  
**PHYSICAL CHEMISTRY & PRINCIPLES OF INSTRUMENTAL ANALYSIS**  
**(THEORY)**  
**Total Teaching Hours:-50**

**1. Ionisation and ionic equilibria**

Arrhenius theory, degree of ionisation and Ostwald dilution law, electrolyte and non electrolytes, Debye-Huckel theory, buffer solutions and preparation of pharmaceutical buffer solution, approximate calculation of buffer capacity excluding the derivation of Vanslykes equation of buffer capacity, buffers in pharmaceutical and biological systems, solubility products, hydrolysis of salts.

**2. Solutions**

Colligative properties (Lowering of vapour pressure and Raoult's Law, osmosis and osmotic pressure, measurement of osmotic pressure, pharmaceutical applications of osmosis, theories of semipermeable membranes, elevation of boiling point and its experimental determination, depression of freezing point and its determination). Distribution law and solvent extraction method.

**3. Catalysis:**

Homogeneous and heterogeneous catalysis, acid base catalysis, theories of catalysis, poisoning and applications of catalysis.

**4. Thermodynamics**

First law of thermodynamics, work done in expansion of gases, internal energy, enthalpy, heat capacity.

**5. Potentiometric analysis**

Electrodes and reference electrodes, potentials of galvanic cells, potentiometric acid-base titrations, potentiometric pH determination, precipitation and complexometric formation, oxidation-reduction titrations, applications in pharmacy.

**6. Conductometric analysis**

Definitions of units in conductometric titrations. Measurement of conductance, applications and conductance in non-aqueous solution.

**7. Aquametry**

Brief account of aquametry, physical and chemical methods for water determination, viz, Karl Fischer, spectrophotometric method, gas chromatographic and electrochemical methods.

**8. Spectrofluorimetry**

Fluorescence, spectrofluorimetry and analytical factors. Principles of turbidimetry, Instrumentation.

**9. Chromatography**

Fundamental principles of chromatography, adsorption, partition, column, paper, thin-layer chromatography, gas chromatography and electrophoresis.

**10. Polarimetry**

Principles and applications; polarization types of molecule analyzed; optical rotation; effects of concentration, wavelength, solvent, temperature on optical rotation; polarimeter, light source, sample cells.

**PRACTICAL**  
**Total Hours: 100**

Experiments based on surface tension, viscosity, partition coefficient, kinetics, solubility product, and critical solution temperature. Exercises involving polarimetry, refractometry and pH-determination.

**Books Recommended**

1. J.R. Barrante: Physical Chemistry of Life Sciences, Printeil.
2. K.J. Laidler: Physical Chemistry with Biological Applications, Benjamin.
3. S.C. Wallwork: Physical Chemistry for Students of Pharmacy and Biology, Longman.
4. L. M. Atherden: Bentley and Driver's-Textbook of Pharmaceutical Chemistry, Oxford University Press, Delhi.
5. A.J. Mce: Physical Chemistry, E.L. B.S., London.

6. H.H. Willard, L.L. Merritt and J.A. Dean: Instrumental Methods of Analysis, Van Nostrand Reinhold, New York.
7. Samuel Glasstone and David Lewis: Elements of Physical Chemistry, Macmillan Press, London.
8. A.H. Beckett and J.B. Staenlake: Practical Pharmaceutical Chemistry, Vol. I and II. The Athlone Press of the University of London.
9. K.A. Connors: A Textbook of Pharmaceutical Analysis, Wiley - Interscience, New York.

**Paper BPH 21**

**PHARMACEUTICAL CHEMISTRY VI  
MEDICINAL CHEMISTRY-I (THEORY)  
Total Teaching Hours: 50**

1. Principles of medicinal chemistry including drug absorption, metabolism, distribution and elimination.
2. Physico-Chemical properties of drugs in relation to biological activity.
3. Modern concepts of rational drug design: a brief introduction
4. The following topics shall be treated covering uses, structure activity relationship including physico-chemical and steric aspects and mode of action:
  - i) Drugs Affecting the Central Nervous System**  
General anesthetics, sedative-hypnotics, anticonvulsants, antipsychotics, anxiolytics, antidepressants, hallucinogens, antiparkinson agents, opiate analgesics, nonopiate analgesics, nonsteroidal anti-inflammatory agents.
  - ii) Drugs Affecting the Peripheral Nervous System**  
Local anesthetics, skeletal muscle relaxants.
  - iii) Drugs Affecting the Autonomic Nervous System**  
Adrenergic agents, antiadrenergic agents, cholinergic agents, anticholinergic and antispasmodic agents, histamine and antihistamines.
  - iv) Drugs Affecting the Kidney**  
Diuretics.
5. The outline of the synthetic procedure of the following drugs will also be covered: -
  - i) CNS acting agents:** Halothane, Methoxyfluorane, Thiopental sodium, Diazepam, Oxazepam, Phenobarbital, Glutethimide, Meprobamate, Chloral hydrate, Phenytoin, Trimethadione, Ethosuximide, Valproic acid, Diphenoxylate, Loperamide, Levallorphan, Levo-Propoxyphene, Mefenamic acid, Indomethacin, Ibuprofen, Naproxen, Acetaminophen, Phenylbutazone, Oxyphenbutazone, Aspirin, Diclofenac, Nimesulide, Probenecid, Allopurinol, Chlorpromazine, Perphenazine, Haloperidol, Risperidone, Molindine, Clozapine, Diazepam, Lorazepam, Oxazepam, Buspirone, Imipramine, Amitriptyline, Fluoxetine and Meclobemide.
  - ii) Drugs acting on peripheral nervous system:** Cocaine, Benzocaine, Lidocaine, Chlorphenesin, and Dantrolene Sodium.
  - iii) Drugs acting on autonomic nervous system:** Epinephrine, Norepinephrine, Ephedrine, Isoproterenol, Terbutaline, Naphazoline, Phenoxybenzamine, Phentolamine, Propranolol, Metoprolol, Acetylcholine, Methacholine, Bethanechol, Physostigmine, Pyridostigmine, Malathion, Clidinium Bromide, Dicyclomine, Benztropine, Diphenhydramine hydrochloride, Tripeleminamine, Pylamine, Pheniramine, Chlorpheniramine, Promethazine and Meclizine.
  - iv) Drugs acting on kidney:** Acetazolamide, Dichlorphenamide, Chlorthiazide, Chlorthalidone, Ethacrynic acid, Furosemide, Spironolactone, Triamterene and Amiloride.

**PRACTICAL  
Total Hours:100**

Synthesis of compounds of medicinal interest including synthesis involving two steps and synthesis of heterocyclic compounds.

### Books Recommended

1. M.E. Wolf: Burger's Medicinal Chemistry, John Wiley and Sons, New York.
2. R.F. Doerge, Wilson & Gisvold's: Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
3. W.O. Foye: Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
4. D. Lednicher and L.A. Mitschier: ALE Organic Chemistry of Drug synthesis Vol. 1, II & III John Wiley and Sons, New York.
5. S.N. Pandeya: A Textbook of Medicinal chemistry, Vol. I, S.G. Publishers, Varanasi.
6. Ashutosh Kar: Medicinal Chemistry, Wiley Eastern, Ltd., New Delhi.
7. I.L. Finar: Organic Chemistry Vol. II, The English Language Book Society, London.

### Paper BPH 22

#### PHARMACEUTICAL CHEMISTRY VII NATURAL PRODUCT CHEMISTRY (THEORY) Total Teaching Hours:-50

1. General methods of isolation of natural products, belonging to different groups.
2. **Carbohydrates**  
An account of the chemistry of mono, di- and polysaccharides: glucose, fructose, sucrose, maltose, lactose, cellulose, starch, glycogen, dextran and Chitin. Study of the naturally occurring glycosides (excluding cardiac glycosides) Indican, ruberythric acid, amygdalin, salicin, sinigrin and arbutin.
3. **Proteins and amino acids**  
Classification, general methods of preparation and properties of amino acids, general nature of proteins, classification of proteins, End group analysis, Basic idea regarding primary, secondary, tertiary and quaternary structure of protein.
4. **Terpenoids**  
Classification, isolation and structure determination of some important terpenoids: Limonene, pinene, cineole, menthol, menthone, camphor,  $\alpha$ -terpineol and citral.
5. **Alkaloids**  
Isolation, general methods of determination of structure, estimation of functional groups, structure elucidation and syntheses of some selected simple members, ephedrine, nicotine, atropine, cocaine, quinine, cinchonine, papaverine, morphine, reserpine.
6. **Xanthine bases**  
Introduction in relation to uric acid, isolation, structure determination and synthesis of caffeine, theophylline and theobromine.
7. Study of the chemistry of lipids (fats, oils and waxes), phospholipids.
8. Chemistry of Nucleic acid- Preliminary studies along with synthesis of purine and pyrimidine bases.

#### PRACTICAL Total Hours: 100

1. Analysis of fixed oils:., determination of acid value, saponification value, iodine value, ester value and hydroxyl value.
2. Isolation of a few naturally occurring compounds such as caffeine, from tea leaves.
3. Estimation of following organic groups: hydroxyl (alcoholic and phenolic), amino, carboxylic groups and acetyl group.

### Books Recommended

1. I.L. Finar: Organic Chemistry Vol.-I and II, The English Language Book Society, London.
2. Pharmacopoeia of India, Govt. of India, Ministry of Health, Delhi.
3. R.K. Bansal: Heterocyclic Chemistry, Wiley Eastern, New Delhi.
4. Joul Smith: Heterocyclic Chemistry, ELBS, London.

**PHARMACOGNOSY III**  
**PHARMACOGNOSY & PHYTOCHEMISTRY (THEORY)**  
**Total Teaching Hours:-50**

**1. Carbohydrates**

Biological sources, chemical constituents, adulterants and uses of:

Starches, Acacia gum, Tragacanth, Sterculia, Guar gum, Plantago, Pectin, Sodium alginate, Agar, Bael, Honey.

**2. Lipids**

Biological sources, chemical constituents, adulterants & uses of:

Arachis oil, castor oil, sesame oil, cotton seed oil, olive oil, chalmooogra oil, shark liver oil, cod liver oil, neem oil, kokum bitter, rice bran oil, guggul lipids.

**3. Tannins**

Biological sources, chemical constituents, chemical test and uses of: pale catechu, black catechu, Nutgalls, *Terminalia belerica*, *Terminalia chebula*, *Terminalia arjuna*.

**4. Volatile oils**

Biological sources, chemical constituents, adulterants and uses of:

Black pepper, Turpentine, Mentha, Coriander, Cardamom, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Cumin, Caraway, Dill, Spearmint, Clove, Anise, Star anise, Fennel, Nutmeg, Eucalyptus, Chenopodium, Ajowan, Sandal wood, Palmarosa, Gaultheria.

**5. Resinous drugs**

Classification, formation and chemical nature. Biological sources, chemical constituents, identification test, adulterants and uses of:

Benzoin, Peru balsam, Tolu balsam, Colophony, Myrrh, Asafoetida, Jalap, Colocynth, Ginger, Turmeric, Capsicum, Cannabis, Podophyllum.

**6. Glycosides**

Nature and classification. Biological sources, chemical constituents, adulterants and uses of:

Digitalis, strophanthus, squill, thevetia, oleander, cascara, aloe, rhubarb, senna, quassia, dioscorea, quillaia, glycyrrhiza, ginseng, gentian, senega, ruta, wild cherry, withania, Bitter almond. Biosynthesis of Cardiac and Anthraquinone glycoside.

**7. Alkaloids**

Biological sources, chemical constituents, adulterants and uses of:

Areca nut, Belladonna, Hyoscymus, Stramonium, Duboisia, Lobelia, Coca, Coffee, Tea, Cinchona, Opium, Ipecac, Nux vomica, Ergot, Rauwolfia, Physostigma, Vinca, Kurchi, Veratrum, Ephedra, Colchicum, Vasaca, Pilocarpus, Aconite, Solanum xanthocarpum. Biosynthesis of tropane, cinchona and opium alkaloids.

**PRACTICAL**  
**Total Hours: 75**

1. Identification of organised drugs studied in theory on the basis of morphological and sensory characters.

2. Microscopy of:

Datura, Thevetia, Quassia, , Cinchona, Ipecac, Nux vomica, Rauwolfia, Cinnamon, Caraway, Clove, Fennel, Aconite.

3. Chemical tests of:

Starches, Acacia gum, Tragacanth, Sterculia, Guar gum, Agar, Plantago, Sesame oil, Cotton seed oil, Pale catechu, Black catechu, Tannic acid, Clove, Cinnamon, Benzoin, Peru balsam, Tolu balsam, Colophony, Asafoetida, Aloe, Thevetia, Cinchona, Ipecac, Nux vomica, Ephedra, Colchicum.

4. Pharmacognosy tour for field collection of medicinal and aromatic plants. (2 Weeks)

5. Preparation of herbarium sheets and monograph on one of the collected plant during tour.

**Books Recommended:**

1. C.K. Kokate, P.P. Purohit and S.B. Gokhle: Pharmacognosy, Nirali Prakshan, Pune.
2. Mohd. Ali, Text Book of Pharmacognosy, CBS, New Delhi.
3. P.K. Mukherjee: Quality Control of Herbal Drugs

4. J.B.Harborne: Phytochemical Methods, Chapman and Halls, London.
5. Jean Brunet: Pharmacognosy and Phytochemistry, Medicinal Plants, Lavoisier Publishing, France.
6. S.S. Handa and M.K Kaul: Supplement to Cultivation and utilization of Medicinal Plants, RRL, Jammu.
7. S.S. Handa and M.K.Kaul: Supplement to Cultivation and utilization of Aromatic Plants, RRL, Jammu.
8. V.E.Tylor, L.R. Brady and S.B.Robbers: Pharmacognosy, K.M. Varghese Co., Bombay.

**Paper BPH 24**

**PHARMACOLOGY-II (THEORY)**

**Total Teaching Hours: 50**

**1. Drugs Acting on Central Nervous System**

- i) Synaptic transmission in the CNS.
- ii) General anaesthetics, Dissociative and neurolept- anaesthesia.
- iii) Hypnotics and sedatives.
- iv) Alcohol.
- v) Antiepileptics.
- vi) Psychopharmacological agent.
- vii) Antiparkinsonian drugs.
- viii) Non-steroidal analgesics, anti-inflammatory and anti-pyretic agents, drugs used in gout.
- ix) Narcotic analgesics, opiod poisoning and treatment.
- x) CNS stimulants and Nootropic agents.
- xi) Local anaesthetics.

**2. Drugs Acting on Cardiovascular System**

- i) Cardiac glycosides and positive inotropic agents.
- ii) Antiarrhythmic drugs.
- iii) Antihypertensive drugs.
- iv) Coronary vasodilators and drugs used in angina.
- v) Hypolipidemic drugs.
- vi) Fibrinolytic agents.
- vii) Nitric oxide.

**3. Drugs Acting on the Blood and Blood Forming Agents**

- i) Coagulants.
- ii) Anticoagulants.
- iii) Haematinics (iron, vitamin B12 and Folic acid).
- iv) Plasma expanders.

**4. Diuretics**

**5. Drugs Acting on Gastrointestinal System**

- i) Purgatives.
- ii) Antidiarrhoeal drugs.
- iii) Antacids and treatment of peptic ulcers.
- iv) Emetics and antiemetics.
- v) Prokinetic agents.

**6. Drugs Acting on Respiratory System**

- i) Expectorants.
- ii) Antitussive bronchodilators.
- iii) Drugs used in common cold.

**PRACTICAL**

**Total Hours: 100**

1. Stages of chloroform and ether anesthesia with and without premedication.
2. Study of phenobarbitone induced hypnosis (Demonstration).
3. Determination of analgesic activity (codeine/aspirin).
4. Study of anticonvulsant activity.

5. Study of local anesthetic activity.
  - i) Surface anesthesia activity on rabbits.
  - ii) Infiltration anesthesia using guinea pigs.
6. Identification of unknown drugs using rat ileum.
7. Seminars on the drugs studied in theory.

**Books Recommended:**

**Theory**

1. C.R.Craig and R.E.Stitzel: Modern Pharmacology
2. Theodore W.Rall, Alan S.Nies and Palmer Taylor: Goodman Gilman's : The Pharmacological Basis of Therapeutics by Alfred Goodman Gilman.
3. D.R.Laurence and P.N.Bennett: Clinical Pharmacology.
4. K.D.Tripathi: Essentials of Medical Pharmacology.
5. R.S.Satoskar and S.D.Bhandarkar: Pharmacology and Pharmacotherapeutics.
6. F.S.K. Barar: Essentials of Pharmacotherapeutics.
7. H.P.Rang and M.M.Dale: Pharmacology.
8. James Crossland: Lewis's Pharmacology, revised.

**Practical**

1. Pharmacological experiments on isolated preparations by Edinburgh University Pharmacology Staff, 1968.
2. Robert A.Turner and Peter Hebbom: Screening methods in Pharmacology, Vol.1 edited
3. S.K.Kulkarni: Handbook of experimental Pharmacology
4. M.N.Ghosh: Fundamentals of experimental pharmacology
5. Ian Kitchen: Text book of invitro Pharmacology
6. U.K.Sheth, N.K.Dadkar, Usha G.Kamat: Selected topics in Experimental Pharmacology
7. K. K. Pillai: Experimental Pharmacology, CBS, Delhi.

**Paper BPH 25**

**BIOCHEMISTRY (THEORY)**

**Total Teaching Hours: 50**

**1. Enzymes**

- i) Classification of enzymes.
- ii) General mechanisms of enzyme action.
- iii) Factors affecting the velocity of enzyme catalysed reaction.
- iv) Activators and inactivators of enzymatic reactions.
- v) Application of metabolic antagonism.

**2. Biological Oxidations**

- i) Oxidation-reduction chains in nature.
- ii) Oxidative phosphorylation.

**3. Metabolism of Carbohydrate**

- i) Anaerobic metabolism of Glucose.
- ii) Aerobic metabolism (Kreb's cycle).
- iii) HMP pathway.
- iv) Regulation of blood glucose concentration.
- v) Glycogenesis.
- vi) Glycogenolysis.
- vii) Gluconeogenesis.

**4. Metabolism of Lipids**

- i) Fatty acid metabolism.
- ii) Oxidation of fatty acids.
- iii) Biosynthesis of fatty acids.
- iv) Synthesis and degradation of triglycerides.
- v) Hormonal influence on the mobilisation of fat in adipose tissue.

vi) Ketosis.

#### **5. Metabolism of Proteins**

- i) Amino acid degradation and urea cycle.
- ii) Metabolism of tyrosine and Tryptophan.

#### **6. Protein Synthesis**

- i) Transmission and expression of genetic information.
- ii) DNA genetic role.
- iii) DNA Structure and replication.
- iv) RNA and transcription.
- v) Gene-protein relationship.
- vi) Control of Protein Synthesis.

#### **7. Metabolism of Nucleic Acids**

Metabolism of purines and pyrimidines.

#### **8. Metabolism of Inorganic Elements**

Calcium, Phosphorous, Magnesium, Trace elements.

#### **9. Basic Principles of Molecular Biology**

Gene cloning: Restriction endonuclease, Restriction sites, Cloning vectors, Antibiotic marker gene, Application of DNA recombinant technology, DNA library.

### **PRACTICAL**

**Total Hours: 50**

1. Estimation of glucose in blood.
2. Estimation of Liver glycogen.
3. Estimation of protein in Serum.
4. Determination of Creatinine and Creatine in blood and Urine.
5. Estimation of Chloride in Serum and Urine.
6. Estimation of Uric acid in Serum and Urine.
7. Determination of acid and alkaline phosphate.
8. Determination of SGOT and SGPT.
9. Determination of blood Cholesterol.
10. Estimation of RNA and DNA.
11. Determination of Serum bilirubin.
12. Electrophoretic separation of Serum proteins.
13. Fat determination in milk.

#### **Books Recommended**

##### **Theory**

1. Lubert Stryer: Biochemistry.
2. Abraham Mazur and Benjamin Harrow: Textbook of Biochemistry.
3. Albert L. Lehninger: Principles of Biochemistry.
4. R.W. McGilvery and Gerald Goldstein: Biochemistry - A functional approach.
5. H.G. Bray and Sybil P. James: Biochemistry for Medical Students.
6. John W. Suttle: Introduction to Biochemistry.
7. W. Martin, Peter A. Mayes, Victor, W. Rodwell: Harper's Review of Biochemistry.
8. Karlson P: Introduction to Modern Biochemistry.

##### **Practical**

1. Varun K. Malhotra: Practical Biochemistry for Students.
2. Harold Varley: Practical Clinical Biochemistry.
3. David T. Plummer: An Introduction to Practical Biochemistry.

# **B-PHARM IV TH YEAR**

## Paper BPH 26

### PHARMACEUTICAL BIOTECHNOLOGY (THEORY)

Total Teaching Hours: 50

#### 1. Genetic Engineering

- i) Brief introduction to biotechnology with reference to pharmaceutical sciences.
- ii) Basic principles of genetic engineering.
- iii) Recombinant DNA technology.
- iv) Application of genetic engineering in medicine.

#### 2. Plant Biotechnology

- i) Protoplast isolation, protoplast fusion, somatic hybridization, applications of protoplast fusion.
- ii) Methods of gene transfer in plants. Agrobacterium mediated, direct gene transfer methods, use of marker and reporter genes, selection.
- iii) Applications of transgenic plants.

#### 3. Animal Biotechnology

- i) Animal cell and tissue culture, media, transfection methods, application of transgenic animals.
- ii) Immunotechnology, Structure of immunoglobulins, vaccine development and immunization, Hybridoma and monoclonal antibodies.
- iii) Biopolymers and its types.
- iv) Applications of biopolymers.

#### 4. Industrial and Microbial Biotechnology

- i) Enzyme Biotechnology- Methods of enzyme immobilization, bioreactors, Application of immobilized enzymes.
- ii) Brief introduction to Protein Engineering.
- iii) Immunotoxin and Drug designing.
- iv) Use of microbes in industry. Isolating and culturing of microorganism, microbial transformation.

#### Books Recommended

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: (1998) ASM Press Washington D.C.
2. RA Goldshy et. al., : Kuby Immunology, (2001).
3. J.W. Goding: Monoclonal Antibodies, (1986).
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, (1973) CRC Press, Degrand, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) (1999) Blackwell Scientific Publication.
7. R.Endress: Plant Cell Biotechnology (1994) Springer-Verlag Berlin Heidelberg.

## Paper BPH 27

### PHARMACEUTICS IX

### PHARMACEUTICAL MANAGEMENT

Total Teaching Hours: 50

#### 1. Personnel Management and Industrial Relations

Objectives and functions of personnel department, employment and development of personnel. Industrial relations: problems of labor management relations, causes of industrial disputes, remedies, industrial dispute act, trade union grievance and grievance handling procedure, causes of grievances, need for grievance procedure, grievance redressal machinery.

#### 2. Motivation

Objectives, rules of motivation, motivation steps. Types of motivation, Financial and non-financial motivators. Theories of motivation: McGregor's Theory X and Y, Herzberg's time factor theory, McClelland's need for achievement theory, Vroom's expectancy theory, Behavioral theory, Employee-Centered approach.

#### 3. Communication

Importance, nature of communication, types of communication- oral vs. written, media of communication. Barriers to communication. Communication failure. Achieving effective communication.

#### **4. Purchasing and Store Keeping**

Objectives, organisation and responsibilities of purchasing department, methods and types of purchasing-centralised and decentralised purchasing. Types of stores, depot, location and layout of a store, problems and development.

#### **5. Materials management**

Materials handling, equipment, inventory management, economic ordering quantity, ABC analysis, value analysis, classification and codification of stores, obsolete, surplus and scrap management, lead time, inventory carrying costs, safety stock, solutions to problems relating to EOQ.

#### **6. Drug Supply**

Planning and management, supply process and its pitfalls, planning for drug supply, planning models, steps to develop a formulary, predicting drug requirements, procurement cycle and its methods, designing training programs to improve pharmaceutical logistics.

#### **7. Pharmaceutical Marketing**

Goals, theories of selling process, company market, systems, market and sale forecasting, market test method, statistical demand analysis, types of sales organizations, salesmanship, qualification of a salesman, channels of distribution advertising, presentation and analysis of statistical data. (charts, frequency distribution).

#### **8. Establishment of a pharmaceutical factory**

Choice of site, trends in location of a plant, plant facilities, layout of stores in an industry, layout of injectable unit or sterile area, tableting department and area requirement for each department.

#### **9. Production and Maintenance Management**

A brief exposure of various functions and objectives of production management, various activities of production management, production organization, productivity and wastivity. Objectives of maintenance management, probability distributions, reliability engineering, preventive maintenance and its benefits.

#### **Books Recommended**

1. Principles of Marketing, by Philips Kottler.
2. Personnel management and Industrial Relations, by R.S. Davar.
3. Personnel management, by Mamoria.
4. Materials management, by Gopalkrisnan, and R.K. Rajput.
5. Purchasing and Store Keeping, by D.R. Gupta, R.K. Rajput.
6. Managing Drug Supply: management sciences for health, by Borbon.
7. Pharmaceutical Marketing by Smith.
8. Establishment of a pharmaceutical factory, by S.P. Aganil.
9. Quantitative techniques for managerial decision making, by U.K. Srivastava and S.C. Sharma.
10. Marketing Management by Philips Kottler, Tenth Edition, Printice Hall of India Pvt. Ltd.
11. Marketing Strategy: A Global Perspective by Vernon R. Stauble The Dryden Press.
12. D.A. Whetton and K.S. Cameron , Developing Management Skills, New York: Harper Collins, 1995, 72-73.
13. Peter F. Drucker, Management: Tasks, Responsibilities, Practices, New York: Harper and Row, 1974, 523.
14. Stanley C.Hollander, The Wheel of Retailing, J. of Marketing, July 1960, pp 37-42.
15. Amber G. Rao and Peter B. Miller, Advertising/ Sales Response functions, J. of Advertising Research, April 1975, pp7-15.

#### **Paper BPH 28**

### **PHARMACEUTICS -X BIOPHARMACEUTICS AND PHARMACOKINETICS (THEORY) Total Teaching Hours: 50**

#### **A. Biopharmaceutics**

**1.** Introduction to biopharmaceutics, definition, historical development of the subject, fundamental principles, concepts and its role in formulation development and clinical setting.

#### **2. Drug Absorption**

Various mechanisms, factors affecting drug absorption-physicochemical, physiological and pharmaceutical.

### **3. Drug disposition**

Distribution in blood, plasma-protein binding, application of drug-protein binding.

### **4. Determination of bioavailability and bioequivalence:**

Measures of bioequivalence study and single dose bioequivalence study and relevant statistics, review of regulatory requirements for conducting bioequivalence study.

### **B. Pharmacokinetics**

5. Introduction to pharmacokinetics, importance in bioavailability and clinical practice. Concepts, definition and explanation of terminologies used.
6. Compartment models - concepts and their importance in the study of pharmacokinetics.
7. One compartment open model. Determination of pharmacokinetic parameters from plasma and urine data after i.v. injection and oral administration. Percent absorbed time plot and absorption rates based on one compartment model.
8. Two compartment open model, pharmacokinetics of single and multiple dose administration as applied to intravenous (rapid) and oral administration, intravenous transformation. Dosage adjustment in patients with and without renal failure.
9. Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance.
10. Extraction ratio, hepatic clearance, biliary excretion, extra hepatic circulation.
11. Non-Linear Pharmacokinetics with special reference to one compartment model after i.v. drug administration. Michaelis Menton equation. Detection of non-linearity (saturation mechanism).

## **PRACTICALS**

**Total Hours 100**

3. Establishment of standard curve of a drug substance.
4. Disintegration and Dissolution of peroral tablets.
5. Influence of vehicle on drug availability from topical dosage forms in-vitro.
6. Release of drug from suppository base.
7. Evaluation of antacid products, by acid neutralizing capacity and Rosset-Rice test methods.
8. Comparative in-vitro release rate studies of marketed formulations.
9. Determination of bioavailability of marketed formulations by plasma concentration method.
10. Determination of bioavailability of marketed formulations by urinary excretion method.
11. Drug release from capsules, effect of diluents etc.
12. Effect of protein binding by egg albumin; dialysis method.
13. Determination of pharmacokinetic parameters, determination and evaluation of bioavailability of drug administered by IV, IM and P.O.
14. Practice numericals based on the portions covered under theory syllabus.

### **Books Recommended**

1. J.G. Wagner: Text Book of Biopharmaceutics and Pharmacokinetics.
2. Shargel and Yu: Text Book of Biopharmaceutics and Pharmacokinetics (Prentice Hall).
3. Controlled drug bioavailability published by Wiley interscience.
4. Blanchard and Brodie: Principles and Perspective in drug bioavailability.
5. R.E. Notari: Biopharmaceutics and Pharmacokinetics.
6. Remington's Pharmaceutical Sciences.
7. Rowland and Tozer: Textbook of clinical Pharmacokinetics
8. J. Swarbrick: Current concepts in Pharmaceutical sciences and Biopharmaceutics
9. Javed Ali, Roop K. Khar and Alka Ahuja, TextBook of Biopharmaceutics and Pharmacokinetics, Birla Publication, 2001.
10. H.F. Lodish, and J.E. Rothman: The assembly of cell membranes Sci. Am. 240:48-63, 1979.
11. R.I. Oberle, G.L. Amidon: J. Pharmacok. and Biopharm., 15: 529-544, (1987).
12. A. Rubinstein, V.H.K. Li and J. R. Robinson: In Oral sustained release formulations, Design and Evaluation, NewYork, Pergman, 1988 chap 6.
13. A. Tsuji, Tamai: I Pharm. Res. Carrier mediated intestinal transport of drugs 13(7) 963-977 (1966).
14. J.P. Skelly, W.H. Barr: In Robinson, J.R. Lee, V.H.L. (eds) Controlled Drug Delivery, Fundamentals and applications 2<sup>nd</sup> eds. NewYork Macel Dekker, 1987.

15. P.G. Welling: Pharmacokinetic considerations of controlled release drug products. Drug Dev. Ind. Pharm. 9, 1185-1225 (1983).
16. S. Gardner: Bioequivalence requirements and in-vivo bioavailability procedures Fed. Reg, 42 :1651 (1977).

**Paper BPH 29**

**PHARMACEUTICS -XI  
PHARMACEUTICAL TECHNOLOGY (THEORY)**

**Total Teaching Hours: 50**

**1. Mixing**

Fluid mixing, mechanism and types of flow, equipments. Solids mixing, mixing mechanism, equipment.

**2. Capsules**

**Hard gelatin capsules:** Formulation of shell and contents, capsule production, filling operation and equipment employed.

**Soft gelatin capsules:** Manufacture, processing and quality control.

**3. Microencapsulation**

Importance and application, techniques, equipment employed.

**4. Tablets**

Production of tablets, additives and components, preparation of components for compression, forms of compressed tablets, evaluation.

**Tablet coating-**Sugar coating, film coating, air suspension coating, film defects.

**5. Measurement of tablet punch forces**

Transmission of forces through a powder. Distribution of forces within the powder mass, effect of pressure on the relative volume, adhesion and cohesion of particles strength of granules and tablets. Factors affecting the strength of tablets.

**6. Pharmaceutical aerosols**

Components, formulation, types of systems, manufacturing, operation of an aerosol package, quality control and testing, oral, inhalation, nasal and topical aerosols. Future developments.

**7. Controlled drug delivery system**

Introduction, terminology, drug targeting, design and fabrication of oral controlled release drug delivery system. Introduction to implantable and transdermal therapeutic system.

**8. Packaging technology**

Types of containers, materials used, closures, unit dose packaging, strip packaging materials, packaging of solid, parenterals, and ophthalmic dosage forms, stability aspects of packaging.

**9. Good manufacturing practices for pharmaceuticals**

Status and applicability of regulation, current good manufacturing practices in manufacturing, processing, packaging and holding of drugs, production and process controls, ISO 9000 certification.

**PRACTICALS**

**Total Hours 100**

1. Preparation of tablets by the following techniques:
  - a. Wet granulation (Aqueous).
  - b. Wet granulation (non-aqueous).
  - c. Dry granulation (Slugging).
2. Coating of tablets - sugar coating and film coating.
3. Strip packing of tablets.
4. Quality control of tablets.
5. Filling and sealing of hard capsules.
6. Quality control of capsules.
7. Preparation of sustained release dosage forms employing various techniques.
8. Preparation of an aerosol dosage form and its evaluation.
9. Preparation and evaluation of microcapsules by employing various techniques.
10. Any other experiments illustrative of the theory of syllabus.

### Books Recommended

1. L.Lachman, H. A. Liberman, and J. L. Kanig: Theory and practices of Industrial Pharmacy, 3<sup>rd</sup> Edition, 1986.
2. M. E. Aulton: Pharmaceutics: The science of dosage form design, ELBS publisher, 1988.
3. Robinson and Lee: Controlled drug delivery: Fundamentals and applications, 2<sup>nd</sup> Edition, Marcel Dekker, Inc., 1987.
4. J.S Warbrick: Novel drug delivery systems, Vol. 14
5. G.S. Banker and C.T.Rhodes: Modern Pharmaceutics, 2<sup>nd</sup> Edition, Marcel Dekker, 1990.
6. Remington's Pharmaceutical Sciences, 18<sup>th</sup> Edition, Mack Publishing Company, 1990.
7. Cooper and Gunn's Tutorial Pharmacy, 6<sup>th</sup> Edition, CBS Publishers and Distributors, 1999.
8. N. K. Jain: Advances in controlled and novel drug delivery system, 1<sup>st</sup> Edition, CBS Publishers and Distributors, 2001.
9. A. Kydonieus: Treatise on controlled drug delivery, Marcel Dekker, Inc., 1991.
10. H. A. Liberman, L. Lachman, and J. B. Schwartz: Pharmaceutical dosage forms: **Tablets**, Vol. 1,2 and 3, 2<sup>nd</sup> Edition Marcel Dekker, 1989.
11. L. Krowczynski: Extended release dosage forms, CRC press, Inc., Boca Raton, 1987.
12. A. L. Brody and K. S. Marsh: Encyclopedia of packaging technology, 2<sup>nd</sup> Edition, John Wiley and Sons Inc., 1997.
13. P. P. Sharma: How to practice GMPs, 2nd Edition, Vandana Publications, 1995.
14. J. Swarbrick, and J. C. Boylan: Encyclopedia of pharmaceutical Technology, Vol 118, Marcel Dekker, 1988.
15. World Health Organization's guidelines on good manufacturing practices and inspection (available at <http://www.who.int>)
16. "Controlled drug delivery" (available at NC State University's web sites <http://www5.bae.ncsu.edu>)
17. L.Lachman: Theory and practices of Industrial Pharmacy, 2nd Edition.
18. S. D. Bruck: Controlled drug delivery, Vol. I and II.

### Paper BPH 30

#### PHARMACEUTICAL CHEMISTRY-VIII PHARMACEUTICAL ANALYSIS III (THEORY) Total Teaching Hours:-50

##### 1. Advanced chromatographic techniques

Theory of ion exchange, type of exchangers, ion-exchange equilibria, ion-exchange separation, applications in pharmaceutical analysis. High performance liquid chromatography, HPTLC and instrumentation with reference to quantitative estimation of drugs and biopharmaceutical agents. Gas-TLC chromatography. Super critical fluid chromatography.

##### 2. Visible and ultraviolet absorption spectrophotometry

Principles of visual and UV absorption spectrophotometry, qualitative and quantitative analysis, Instrumentation.

##### 3. Nuclear Magnetic Resonance

An introduction to the theory of NMR, chemical shifts, spin spin coupling, NMR instrumentation, structure elucidation of simple organic compounds and qualitative analysis of drugs

##### 4. Infrared spectrophotometry

Origin of infrared spectra and regions, qualitative and quantitative analysis, instruments and applications.

##### 5. Mass spectrometry

Basic principles, instrumentation, the mass spectra, types of ion, determination of molecular formula, molecular weight, fragmentation, mass spectra of some simple molecules.

##### 6. Atomic absorption spectroscopy

Theory of absorption of radiant energy by atoms, equipment, and analytical applications.

##### 7. Flame photometry

Theory of emission spectra, equipment, and qualitative and quantitative applications with reference to flame photometry

## 8. Polarography

Introduction, theoretical consideration, organic polarography, dropping mercury electrode, basic principles of polarographic instruments, methods of analysis, experiments including amperometric titrations.

## 9. Different methods of analysis of following drugs related to functional group with particular reference to instrumental methods

- i) Antibiotics: Nalidixic acid, ciprofloxacin, tetracycline, and chloramphenicol.
- ii) Vitamins: Ascorbic acid, thiamine, vitamin A,
- iii) Barbiturates: Phenobarbitone.
- iv) Sulphonamides: Sulfanilamide, sulphadiazine, and dapsone.
- v) Steroids: Dexamethasone, prednisolone.

## PRACTICALS Total Hours 100

1. Experiments based on thin-layer and paper chromatography.
2. Analysis of as specified in Indian Pharmacopoeia.

### Books Recommended

1. L.G.Chatten: A Textbook of Pharmaceutical Chemistry, Vol. 1 and 11, Mareel Dekker, New York.
2. A.H. Beckett and J.B. Stenlake: Practical Pharmaceutical Chemistry, Vol I and II, Ale Athlone press of the University of London.
3. H.H.Willard, L.L.Merritt and J.A. Dean: Instrumental Methods of Analysis, Van Nostrand Reinbold, New York.
4. J.Basset, R.C. Denney, G.H. Jeffery and Medthan: Vogel's Textbook of Quantitative Inorganic Analysis including elementary instrumental analysis, The ELBS, and Longman.
5. K.A. Connors: A Text Book of Pharmaceutical Analysis Wiley-Interscience, New York. Quantitative pharmaceutical chemistry.
6. D.C. Garrat: Quantitative analysis of Drugs, Chapman & Hall, London.
7. R.M. Sliverstein, G.C. Bassier and J.C. Morrill: Spectroscopic identification of organic compounds- John Wiley & Sons, New York.
8. John R. Dyer: Application of absorption spectroscopy of organic compounds.

### Paper BPH 31

## PHARMACEUTICAL CHEMISTRY IX MEDICINAL CHEMISTRY II (THEORY) Total Teaching Hours:-50

**The following topics shall be treated covering uses, structure activity relationship including physicochemical and steric aspects and mode of action:**

### 1. Drugs affecting blood and the cardiovascular system

- i) Anticoagulants.
- ii) Antihyperlipidemics.
- iii) Cardiac glycosides.
- iv) Antihypertensive agents.
- v) Vasodilators.
- vi) Antiarrhythmics.

### 2. Vitamins (excluding the detailed study of constituents).

### 3. Steroids

Nomenclature, stereochemistry, classification, isolation methods, chemistry of cholesterol, diosgenin, stigmasterol, ergosterol, beta-sitosterol and steroidal alkaloids.

### 4. Hormones

- i) Sex Hormones And Analogs : Androgens and anabolic agents, estrogens and progestational agents (Oral Contraceptives).
- ii) Corticoids: Adrenocorticoids and glucocorticoids.
- iii) Prostaglandins.

## 5. Antiinfective and Antiinvasive Agents

- i) Antifungals.
- ii) Antiprotozoals.
- iii) Antimalarials.
- iv) Sulfonamides.
- v) Antibacterial quinolones.
- vi) Antibiotics.
- vii) Antiamoebic.
- viii) Antimycobacterial agents.
- ix) Anthelmintics.
- x) Antivirals.
- xi) Antineoplastic agents.

The outline of the synthetic procedure of the following drugs will also be covered

## 6. Cardiovascular Agents

MethylDopa, Clonidine, Verapamil, Captopril, Enalapril, Propranolol, Atenolol, Phenoxybenzamine, Phentolamine, Hydralazine, Minoxidil, Sodium Nitropruside, and Tocainide.

## 7. Antiamoebics

Metronidazole, Tinidazole and Diloxinide furoate.

## 8. Antitubercular

Isoniazid, Pyrazinamide, Ethambutol, and Rifampicin.

## 9. Antiviral

Amantadine, Idoxuridine and Ganciclovir.

## 10. Antihelmintic

Mebendazole, Thiabendazole and Niclosamide.

## 11. Antineoplastic

Thiotepa, Carmustine, Chlorambucil, Cyclophosphamide, and Mechlorethamine.

## 12. Antimalarials

Chloroquine, Primaquine, Proguanil, and Amodiaquine.

## 13. Antitrypanosomal

Pentamidine, Isothionate and Nifurtimox.

## 14. Antibiotics

Doxycycline, Chloramphenicol, Carbenicillin and Cephalexin.

## 15. Antifungals

Fluconazole, Tolnaftate and Clotrimazole.

## 16. Sulphonamides

Sulphacetamide, Sulphanilamide, Sulphadiazine and Sulphamethoxazole.

## 17. Steroids and Hormones

Diosgenin, Progesterone, Norethnodrel, Testosterone, Cortisone, Prednisolone, Triamcinolone, Diethylstilbestrol, Betamethasone, Aldosterone and Clomiphene.

## PRACTICALS

Total Hours 100

Two or three step synthesis of some compounds of medicinal interest.

### Books Recommended

1. M.E. Wolff: Burger's Medicinal Chemistry, John Wiley and Sons, New York.
2. R.F. Doerge, Wilson & Gisvold's: Text Book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
3. W.O. Foye: Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
4. S.N.Pandeya: A Textbook of medicinal chemistry, Vol.-II, S.G.Publishers, Varanasi.
5. A. Kar: Medicinal Chemistry, Wiley Eastern,- Limited Publishers, New Delhi.
6. D. Lednicer and L.A. Mitschlar, Organic Chemistry of Drug Synthesis, Vol. II, & III. John Willey and Sons, New York.
7. Vogel's: Text Book of Practical Organic Chemistry, ELBS & Longman, London, and New York.
8. F.G. Menn and B.C. Saunders: Practical Organic Chemistry, ELBS & Longman, London and New York.

**PHARMACOGNOSY IV**  
**INDUSTRIAL PHARMACOGNOSY (THEORY)**

**1. Isolation Techniques**

General methods used for the isolation and characterisation of alkaloids, lipids, glycosides, proteins, volatile oils, bioflavonoids, steroids, terpenoids and resins. Application of column, paper and thin layer chromatographic techniques for the isolation of phytopharmaceuticals.

**2. Phytopharmaceuticals**

Isolation, characterisation and estimation of:

Caffeine, Eugenol, Pectin, Solanine, Piperine, Tannic acid, Diosgenin, Hesperidine, Berberine, Calcium sennosides, Rutin, Glycyrrhizin, Menthol, Ephedrine, Quinine, Andrographolides, Gu ggul lipids and Katha industry in India.

**3. Plant Biotechnology**

Tissue culture, Nutritional requirements, Callus and suspension culture, production of secondary metabolites, viz. Shikonin and Taxol. Biotransformation, immobilisation of cells and enzymes. Gene transfer in plants, application of plant biotechnology.

**4. Methods of adulteration**

Deterioration of herbal drugs by insect. Evaluation of drugs by organoleptic, microscopic, physical, chemical and biological methods. WHO guidelines.

**5. Quality control and Standardization of herbal drugs**

Extractive values, ash values, chromatographic techniques (TLC, HPTLC and HPLC) for determination of chromatographic markers, spectroscopic techniques and assay methods. Determination of heavy metals in herbal preparation and alcohol contents in Aristas and bhasams. Quality control and rational use of herbal drugs as per WHO guidelines.

**6. Herbal formulations**

Principles involved in Ayurveda, Sidha, Unani, Chinese and Homeopathic systems of medicines, preparation of Ayurvedic formulations like Aristas, Asava, Ghutika, Tailia, Churna, Avaleha, Ghrita and Bhasms; Unani formulations like Majooms, Safoofs.

**7. Herbal cosmetics**

Shampoos (soapnut), Conditioners, (Amla, Henna, Hibiscus, Tea), Hair darkeners (Amla, Henna), Skin care (Aloe, Turmeric)

**8. Traditional herbal drugs**

Common names, sources, active constituents and uses of:

Punarnava (*Boerhavia diffusa*), Shankhpushpi (*Convolvulus microphylla*), Lehsun (*Allium sativum*), Guggul (*Commiphora mukul*), Kalmegh (*Andrographis peniculata*), Tulsi (*Ocimum sanctum*), Valerian (*Valerian officinalis*), Artemisia (*Artemisia annua*), Chirata (*Swertia chirata*), Asoka (*Saraca indica*), Saffron (*Crocus sativa*), Shilajit, Brahmi ( *Bacopa monnieri* and *Centella asiatica*), Salai (*Boswellia serrata*), Giloe (*Tinospora cordifolia*).

**9. Worldwide trade of crude drugs and volatile oils**

Plants based industries and research institutes. Intellectual Property Rights with special reference to phytoconstituents. Regulation pertaining to trade drugs.

**PRACTICALS**  
**Total Hours 100**

1. Isolation and TLC profile of volatile oils of:  
Eucalyptus, Cumin and Lemon grass.
2. Isolation of Starch, Lipids, Resins, Tannic acids, Sennosides and Quinine.
3. Isolation and TLC profile of Total alkaloids:  
Nux vomica, Rauwolfia, Cinchona, Tea, and Vinca.
4. Herbal formulation of Shampoos.
5. Preparation and evaluation of herbal drugs.
6. Morphology of traditional herbal drugs.

7. Determination of Moisture content, Ash value, Swelling factor, Extractive values and foreign organic matters in herbal formulations.
8. Estimation of Citral, Carvone, Cineole, Balsamic acid, Quinine and Anthraquinone glycosides.

#### **Books Recommended**

1. Jean Brunet: Pharmacognosy and Phytochemistry, Medicinal Plants, Lavoisier Publishing, France.
2. Kirtikar and Basu: Indian Medicinal Plants.
3. Indian Pharmacopoeia.
4. Ayurvedic Pharmacopoeia.
5. British Pharmacopoeia.
6. www.chemexil.gov.in
7. www.camag.com
8. C.K. Atal and B.M. Kapoor: Cultivation and Utilization of Medicinal & Aromatic Plants, RRL, Jammu.
9. J.B. Harborne: Phytochemical Methods, Chapman and Halls, London.
10. E. Stahl: Thin Layer Chromatography Springer, Verlag, Berlin.
11. The Wealth of India, Raw materials and Industrial Product, Vol. 1-10, NISCAIR, New Delhi.
12. C.K. Kokate, P.P. Purohit and S.B. Gokhle: Pharmacognosy, Nirali Prakshan, Pune.
13. V.E. Tylor, L.R. Brady and S.B. Robbers: Pharmacognosy, K.M. Varghese Co. Bombay.
14. S.B. Wagner Zgainsky: Plant Drug Analysis.
15. T.E. Wallis: Textbook of Pharmacognosy C.B.S. Publishers, Delhi.

#### **Paper BPH 33**

### **PHARMACOLOGY-III (THEORY)**

**Total Hours: 50**

#### **1. Chemotherapy**

- i) General principles of chemotherapy, General mechanism of action of chemotherapeutics agents.
- ii) Sulfonamides, Quinolones and other antibiotics ( $\beta$ -lactam antibiotic, aminoglycosides, macrolides, tetracyclines, chloramphenicol, polypeptides).
- iii) Antiprotozoal drugs.
- v) Antimalarials.
- vi) Antiamoebics.
- vii) Urinary antiseptics
- viii) Antifungal and antiviral drugs.
- ix) Anti-helminthics.
- x) Chemotherapy of tuberculosis and leprosy.
- xi) Chemotherapy of cancer.
- xii) Immunomodulators.

#### **2. Pharmacology of Endocrine System**

- i) Pituitary hormones.
- ii) Thyroid - antithyroid drugs.
- iii) Insulin, oral hypoglycemics and glucagons.
- iv) Adrenocortical steroids and their antagonists.
- v) Sex hormones, contraceptives and drugs used in infertility.
- vi) Drugs regulating calcium homoeostasis, bisphosphonates.

#### **3. Bioassays**

- i) General principles and methods of Bioassays.
- ii) Official methods of bioassay of:  
Insulin, Heparin, Oxytocin, Vasopressin, ACTH, Glucagon, Gonadotrophin.

#### **4. Evaluation of New Drugs**

- i) Acute, subacute and chronic toxicity tests.
- ii) Teratogenicity and Carcinogenicity.
- iii) Clinical trials.

#### **5. Vitamins**

**PRACTICALS**  
**Total Hours 100**

Bio-assay of following by using appropriate isolated tissue preparation: Acetylcholine, histamine, adrenaline, Oxytocin.

**Books Recommended**

**Theory**

1. C.R. Craig and R.E.Stitzel: Modern Pharmacology.
2. Goodman and Gilman's: The Pharmacological Basis of Therapeutics by Alfred Goodman Gilman, Theodore W.Rall, Alan Nies and Palmer Taylor.
3. D.R. Laurence and P.N.Bennett: Clinical Pharmacology.
4. K.D.Tripathi: Essentials of Medical Pharmacology.
5. R.S.Satoskar and S.D.Rhandarkar, Pharmacology and Pharmacotherapeutics.
6. F.S.K. Barar: Essentials of Pharmacotherapeutics.
7. H.P. Rang and M.M. Dale: Pharmacology.
8. James Crossland: Lewis's Pharmacology.
9. Pharmacopoeia of India.
10. British Pharmacopoeia .

**Practical**

1. U.K. Sheth, N.K. Dadkar, Usha G.Kamat: Selected topics in Experimental Pharmacology.
2. Pharmacological Experiments on isolated preparations, Edinburgh University Pharmacology Staff, 1968.
3. D.R.Laurence and A.L.Bacharach: Evaluation of drug activities : Pharmacometrics, Vol. 1.
4. Ian Kitchen: Textbook of in vitro pharmacology.
5. S.K. Kulkarni: Handbook of Experimental Pharmacology.
6. M.N. Ghosh: Fundamentals of Experimental Pharmacology.
7. K.K. Pillai, Experimental Pharmacology, CBS, Delhi.