SYLLABUS AND CURRICULAM

OF B.PHARM.(Ay)

KERALA UNIVERSITY OF HEALTH SCIENCES
Regulations for the four –Year B. Pharm (Ay) Degree Course

1. Aims and Objectives of Bachelor of Pharmacy (Ayurveda)

The Course has been planned in such a manner that the students completing it, are capable of meeting different requirements of both manufacturing and consumer sector of Ayurvedic drugs. For manufacturing sector they will be in a position to take care of classical methods of drug manufacturing, drug selection, standardization, quality control, drug store management and other manufacturing requirements. For consuming sector they will be qualified persons for drug dispensing and other related activities.

Since they are also expected to provide service towards globalization perspective, it is imperative that they should have sound knowledge of both Ayurvedic and modern drug manufacturing techniques.

The main aim of this course is neither to produce graduates who can be Ayurvedic Physician nor experts for manufacturing. Allopathic drugs, but to produce qualified technologist who have the capacity of producing high quality Ayurvedic drugs by employing traditional techniques and also to control and maintain the quality.

Objective and scope.

To train specialized personnel.

- To be an expert in manufacturing of Ayurvedic formulations.
- To identify, collect and process the raw materials used in Ayurvedic drugs, and formulations.
- To be conversant with modern drugs manufacturing techniques including G.M.P, G.L.P. etc.
- To control and maintain the quality of Ayurvedic drugs.
- To be conversant with modern drug presentation techniques.
- To be conversant with drugs and cosmetics act and regulations.
2. Title of the programme

The programme shall be called the Bachelor of Pharmacy (Ayurveda) - (B. Pharm. (Ay.)

3. Background for starting the course.

Gujarat Ayurveda University, Jamnagar – WHO recognized Statutory Universities is the pioneer in Establishing the Course B.Pharm(Ayu) in the year 1999 with the aim of producing experts in the field of Ayurveda Manufacturing.

In the present scenario of globalization and commercialization of Ayurvedic products it become mandatory that the products produce should comply the safety, purity and quality protocols. Quality control and standardization of Ayurvedic product become need of the time. For manufacturing the standard product and to ensure the quality and safety it become necessary that technical persons are required. Considering this, the idea of starting a course B.Pharm(Ayu) emerged. Kerala being the land of Ayurveda recognized the need of personals who can par with the above mentioned scope and objectives. Parassinikkadavu Ayurveda Medical College, Kannur, Kerala took the pioneer step in Establishing the new course from the Academic year 2005-06 under Kannur University.

4. Eligibility for admission

A candidate who has undergone any of the following courses and passed the examination with 50% marks in the aggregate of optional subjects.

A) 1. Pre degree examination of the University of Kerala with Physics, Chemistry and Biology as optional subjects.

2. Higher secondary examination of Govt. of Kerala with Physics, Chemistry and Biology as optional subjects.

3. Any other examination with Physics, Chemistry and Biology as optional subjects approved as equivalent to any of the above examination by the Kannur University.

5. Duration of the course.

The course of study for B. Pharm (Ay) shall extend over a period of four academic years. Each academic year consists of not less than 200 working days.
6. **Medium of instruction.**

Medium of instruction shall be English

7. **Attendance**

A candidate is required to put in at least 80% of attendance in theory and practical subjects separately in a recognized institution approved by and affiliated to the Kannur University.

8. **Course of study**

The course of study for B.Pharm (Ay) I, II, III and final year shall include the respective theory and practical subjects as given below.

**FIRST B.PHARM (Ay)**

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject</th>
<th>Hours theory per week</th>
<th>Hours for practical per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Basic Principles of Ayurveda &amp; Sanskrit</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>1-2</td>
<td>Sareera Vijnanam</td>
<td>4 (2+2)</td>
<td>3</td>
</tr>
<tr>
<td>1-3</td>
<td>Pharmaceutical Chemistry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1-4</td>
<td>Pharmaceutical Analysis I</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1.5</td>
<td>Pharmaceutical Biology</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>1-6</td>
<td>Basic Electronics and Computer Applications</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total no. of hours/week</strong></td>
<td><strong>18</strong></td>
<td><strong>18</strong></td>
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## SECOND B.PHARM (Ay)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours theory per week</th>
<th>Hours for practical per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>Dravyaguna Vijnanam I</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2-2</td>
<td>Dravyaguna Vijnanam II</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2-3</td>
<td>Physical pharmacy</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2-4</td>
<td>Pharmaceutical Engineering</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2-5</td>
<td>Pharmacognosy I</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2-6</td>
<td>Biochemistry and Patho Physiology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2-7</td>
<td>Pharmaceutical Jurisprudence</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>Total no. hours / week</strong></td>
<td><strong>18</strong></td>
<td><strong>18</strong></td>
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<tr>
<td>Subject Code</td>
<td>Subject</td>
<td>Hours theory per week</td>
<td>Hours for practical per week</td>
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<tr>
<td>3-1</td>
<td>Rasasastra I</td>
<td>3</td>
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<tr>
<td>3-2</td>
<td>Bhaishayja kalpana I</td>
<td>3</td>
<td>3</td>
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<tr>
<td>3-3</td>
<td>Chemistry of Natural products</td>
<td>2</td>
<td>3</td>
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<tr>
<td>3-4</td>
<td>Pharmaceutical Microbiology &amp; Biotechnology</td>
<td>2</td>
<td>3</td>
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<tr>
<td>3-5</td>
<td>Pharmacology I</td>
<td>2</td>
<td>3</td>
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<tr>
<td>3-6</td>
<td>Pharmacognosy II</td>
<td>2</td>
<td>3</td>
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<td>3-7</td>
<td>Industrial Pharmacy I</td>
<td>2</td>
<td>3</td>
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<tr>
<td></td>
<td>Total no. of hours/week</td>
<td>16</td>
<td>21</td>
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### FOURTH B.PHARM. (Ay)

<table>
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<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours theory per week</th>
<th>Hours for practical per week</th>
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</thead>
<tbody>
<tr>
<td>4-1</td>
<td>Rasasasthra – II</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4-2</td>
<td>Bhaishajyakalpana –II</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4-3</td>
<td>Pharmaceutical analysis II</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4-4</td>
<td>Pharmacology II</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4-5</td>
<td>Industrial Pharmacy II</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>4-6</td>
<td>Pharmaceutical Industrial Management</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>Total No. of Hrs./ wk</strong></td>
<td><strong>18</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

After the completion of IV year examination the students should undergo compulsory practical Industrial training for a period of 2 months.
Note:- Duration of theory examination of each subject will be 3 hours and of practical examination will be 4 hours.

9. Minimum for a pass.

No candidate shall be declared to have passed in any subject, unless he/she obtains.

1. 45% marks in the University Examination and 50% marks in the total for theory (aggregate of University Examination Marks, Sessional mark and Viva mark) and

2. 45% mark in the University Examination and 50% marks in the total for practical (aggregate of University examination mark and sessional marks).

10. Sessional marks.

A. Theory: Three sessional examinations (evently spared) shall be conducted during the academic year. The average marks of best two examinations shall be computed out of a maximum of 40 marks and constitute the sessional in theory.

B. Practical: Students are expected to perform the number of experiments listed in respective syllabus. Students are required to maintain practical records for each of the practical subjects and should be produced at the time of examination. Marks shall be awarded out of maximum of 10 to each of the practical exercises and an average of those shall be computed out of a maximum of 40 marks. While awarding the sessional marks for practical experiments, the following consideration should be taken into account.

Marks for practical experiments shall be awarded on the basis of:

- Preparedness of the candidate.
- Manipulative skill
- Results
- Knowledge of the experiments and
- Viva-voce

A regular record of theory and practical sessional marks shall be maintained for each student in the institution. The remaining 10 marks of practical sessional mark will be on the basis of a practical sessional examination conducted at the end of the academic year.
Candidates who have registered for the university examination of a class will be eligible for promotion to the next higher class. But he/she will be eligible to appear for the examination of the higher class only after passing in all subjects in the lower class.

**ELIGIBILITY TO GET PROMOTION TO THE HIGHER CLASS**

The students became eligible to appear to the final year examination only after passing first year, second year, third year B.Pharm(Ay). They will be allowed to complete the course.

**IMPROVEMENT OF SESSIONAL MARKS**

Candidates who could not pass an examination can improve the sessional marks in theory of the subject in which he/she failed. For improving the sessional marks, two sessional examinations will be conducted and their average will be taken into account. Such improvement is allowed for a maximum of two times for a particular subject.

Candidates who have secured the minimum required for a pass in a subject shall be exempted from appearing of subsequent examination in such subject. A subject includes both theory & practical.

**ELIGIBILITY TO GET PROMOTION TO THE HIGHER CLASS**

The students became eligible to appear to the final year examination only after passing first year, second year, third year B.Pharm(Ay). They will be allowed to complete the course.

**11. Award of class and Distinction**

Distinction – 75% and above of the aggregate of each subject.

Class shall be awarded for I B.Pharm (Ay)/ II B.Pharm (Ay)/ III B.Pharm (Ay).

**EXAMINATIONS AS SHOWN BELOW.**

1. First class - 60% and above of the total aggregate of the examination.

2. Second class - 50% and above but less than 60% of the total aggregate of the examination.

For calculation of the class in Final Year Examination the aggregate of the marks of First, Second, Third and Final Year B.Pharm will be considered.

**12. Practical Training**
Every candidate shall undergo practical training in a GMP Certified Ayurvedic Manufacturing Unit attached to an Ayurvedic College recognized by any University of India, recognized by Kannur University or Pharmaceutical Co-operation of Kerala and Imcops Adayar. The Pharmaceutical Company should have GMP certified manufacturing unit having not less than 2000 Sq. feet area. The annual vacation period after Second Year, Third year or Final Year may be utilized for this. B.Pharm(Ay) Degree will be awarded only after the training certificate from the training institute, of having undergone the training successfully is forwarded to the University by the Principal of the college.

13. Award of ranks
Ranks and medals shall be awarded on the aggregate of all the four University Examinations. Candidates who fail in one or more subjects during the B.Pharm(Ay) course shall not be eligible for award of ranks.

Moreover the candidate should have completed the B.Pharm (Ay) course in prescribed (minimum) number of years.

14. Industrial Tour
Students of Third B.Pharm(Ay) course may visit several manufacturing houses or National Research Laboratories as supplement to the academic training and submit a report to the satisfaction of the Head of Institution.

15. Project work
Each candidate studying in the Final B.Pharm(Ay) class will carry out a project work in any branch of Pharmaceutical Sciences. The project work is intended to initiate the student into research work and the candidate is expected to conduct literature survey, analysis of data etc. under the supervision of a teacher. At the end of the year, the project work is certified by the supervising teacher of the institution will be submitted to the Head of Institution will constitute a panel of Professor/ Reader comprising one member each from Rasasastra, Bhaishaja Kalpana and Dravya guna Dept. The panel will evaluate the project work on the basis of seminars and / or Viva – Voce and marks will be sent to the University by the Head of the Institution. There is no minimum mark for a pass in the project work.
16. Approval Of Institution Conducting The Course Of Study

The regular course for B.Pharm shall be conducted by an institution approved and affiliated to Kannur University. The approval and affiliation will be granted only if adequate arrangements for teaching in regards to building, laboratories, library, equipments and staff pattern as laid down by the regulations of All India Council for Technical Education and Central Council of Indian Medicine available.

DEPARTMENTS

Pharmaceutical Chemistry

Pharmaceutical Analysis

Pharmacognosy

Pharmaceutics

Pharmacology

Rasasastra & Bhaishajyakalpana

Dravyaguna

ELIGIBILITY CRITERIA

Pharmaceutical Chemistry - M.Pharm(Ayu), M.Pharm (Pharmaceutical Chemistry )

Pharmaceutical Analysis - M.Pharm(Ayu), M.Pharm (Pharmaceutical Analysis ) M.D. (RS & BK)

Pharmacognosy - M.Pharm(Ayu)

Pharmaceutics - M.Pharm(Ayu), M.Pharm (Pharmaceutics) M.D. (RS & BK)

Pharmacology - M.Pharm(Ayu), M.Pharm (Pharmacology) M.D. (RS & BK)

Rasasastra & Bhaishajyakalpana - MD (RS & BK) , M.Pharm(Ay)

Dravyaguna - MD(Dravyaguna), M.Pharm(Ay)
**1:1 BASIC PRINCIPLES OF AYURVEDA & SANSKRIT**

Avataranakrama of Ayurveda


**BASIC KNOWLEDGE OF SANSKRIT**

I - Sabdamanjari – Sidharoopam

1. The alphabet - Classification of letters
2. The usage of cases
3. Sabdaroopa
   a. Ajantha Pullinga, Napusakalinga and streelinga
      ii) ‘Phalam’, ‘Madhu’
      iii) ‘Rema’, ‘Mathi’, ‘Nadee’
   b) Halantha
      ‘Rajan’, ‘Mahat’, ‘Pums’
   C. Pronoun
      ‘Ushmad’, ‘Asmad’, ‘Tat’

II. Conjugation of verbs
   a) Brief introduction of ‘Dashalakaras’ with reference to present, past and future.
   b) Dhathu roopa

III. Translation of simple sentences from Sanskrit to Malayalam and vice versa

IV. Sandhi, Avyaya and voice be taught with the appropriate textual context.

V. Sree Ramodantham – Balakandam

VI. Twenty lines of Sbhashitha related with Ayurveda – First chapter of vaidyakeeya subhashitham

REFERENCE

1. Ashtangahrudaya soothrasthanam I – Sanskrit

2. Sabdamanjari, Sidharoopam – R.S. Vadhyar

3. First Chapter of vaidyakeeya subhashitham – Chaukamba publication
1:2: SAREERA VIJNANAM

SAREERA RACHANA VIJNANAM

1. Sareerupakrama, Sareera Sastra Paribhasha, Abhinivrithi sareera, Garbha sareera, Pramana Sareera.
3. Marma Sareera
4. Kosta and Asaya sareera, grandhi sareera, Kala sareera, twak Sareera.
5. Uttamangeeya nadee samsthana sareera, Thantra sareera,
6. Comprehensive study of following system.
   Nervous system, Respiratory system, Cardiovascular system, Gastro intestinal, Genito Urinary System, Endocrine system.

Practicals
Demonstration and Identification and surface anatomy of soft organs bones with in the limits of prescribed theory topics.

References :
1. Relevant portions from Bruhatraya - Sareera stana
2. Human Anatomy Vol I, II and III – B.D. Chaurasya
3. Human Anatomy, Tortora

SAREERA KRIYA VIJNANAM

1. Concepts of following Physiological factors with its definition, constitution, classification and functions.
   Dosha, Dhatu, Mala, Srothas, Upadhatu, Ojas, Siradhamani, Indriya, Prakruthi.
2. Comprehensive study of following systems.
   Nervous system, Respiratory system, Cardiovascular system, Digestive System, Geneto Urinary Endocrine system, Reproductive system.
3. Physiology of Special senses.

Practicals
Routine examination of Blood and Urine.
1. Atomic and molecular structure
   Molecular orbitals, SP3, SP2 and SP hybridization. Ionic bond, covalent bond, multiple bond, polarity of bond, hydrogen bond.

2. Alkanes, Alkenes and Alkynes.
   a) Nomenclature
   b) General methods of preparation and reactions of alkanes, alkenes and alkynes (Emphasis on mechanism).
   c) Free radical substitution of alkane and mechanism.
   d) Carbonium ions – formation, stability and electrophilic addition mechanism.
   e) Inductive effect and hyper conjugation.

3. Alicyclic compounds.

4. Aromatic Hydrocarbons
   a. Structure of benzene including (Kedule and Dewar structures)
      - aromatic character, resonance theory.
   b. Electrophilic aromatic substitution. Friedal craft’s alklylation and acylation. Activating and deactivating groups and orientation in nitration, halogenation and sulphonation. Effect of orientation of substitution, steric effects.

5. Alkyl halides and Aryl halides.
   Their general methods of preparation and reactions.
6. Alcohols and Phenols.


7. Carbonyl compounds (aldehydes and ketones)

Structure and nomenclature: General methods of preparation and reaction. Nucleophilic addition, reaction, oxidation and reduction, carbonation, aldol condensation, Cannizzaroan departing reactions.
Identification and characterisation of aldehydes and ketones.

8. Carboxylic acids.

Mono and dicarboxylic acids. Nomenclature, different methods of preparation and reactions. Acidity and effect of substitution on acidity. Conversion to acid chlorides, anhydrides, amides and esters and reactions of these.

9. Nitro compounds.

General methods of preparation and reactions.

10. Amines and Diazonium salts.


11. Spectroscopic analysis of organic compounds.

An elementary study of UV, IR and NMR spectra and their applications in the study of structure of above mentioned class.
PRACTICAL WORK

Identification of simple organic compounds by systematic qualitative analysis based on tests for elements and functional groups, solubility, melting or boiling point and preparations of derivative.

Preparation of at least 10 organic compounds of pharmaceutical importance involving processes like hydrolysis, oxidation, reduction, halogenation, nitration, sulphonation, accelerations, esterification etc.

PHARMACEUTICAL CHEMISTRY – INORGANIC.

a) Metals and minerals occurrence properties, reactions and important compounds of Iron, Calcium, Aluminum, Copper, Gold, Silver, Mercury, Arsenic, Sulfur, Magnesium, Zinc, sodium and potassium.

b) Ammonium chloride – preparation, assay and uses.

c) Borax – preparation, assay and uses.

d) Reactivity of metal

e) Limit test for arsenic, chloride, iron and heavy metals.

f) Pre-pharmaceutical processing of metals and minerals.

Practicals

Relevant practicals of the above
1:4 PHARMACEUTICAL ANALYSIS

Theory

1. Significance of quantitative analysis in quality control, different techniques of analysis, Preliminaries and definitions, significant figures, Rules for retaining significant digits, Types of errors, Mean deviation, standard deviation, statistical treatment of small data sets, selection of sample, precision and accuracy, fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.

2. Acid Base titrations: Acid base concepts, Role of solvent, mass action, Common – ion effect, Ionic products of water, \( \text{pH} \), hydrolysis oil salts, Henderson – Hossolbach equation, Buffer solutions, Neutralization curves, Acid – base indicators, theory of indicators, mixed indicators, polyprotic system, polyamine and amine acid systems, Amine acid titration, applications in assay of \( \text{H}_3\text{PO}_4 \), \( \text{NaOH} \), \( \text{Caco}_3 \), etc.

3. Oxidation Reduction Titrations: Concepts of oxidation and reduction, Redox reactions, strengths and equivalent weights of oxidizing and reducing agents, theory of redox titrations, redox indicators, call representations, measurement of electrode potential, Oxidation – reduction curves, iodimetry and iodometry, titrations involving Ceric sulphate, potassium iodate, potassium bromate, potassium permanganate, titanous chloride and sodium 2, 6-dichlorophenol Indophenol.

Precipitations titrations: Precipitation reactions, Solubility products, Effect of acids, temperature and solvent upon the solubility of a precipitate. Argenometric titrations and titrations involving Ammonium or potassium thiocyanate nitrate, and barium sulphate indicators, Gay Lussac method; Mehr’s method, Volhard’s method and Fajan’s method.

4. Gravimetric analysis: Precipitation techniques, solubility products; the colloidal state, Supersaturation co-precipitation post- precipitation, Digestional washing of the precipitate, Filtration, Filter papers and crucibles, ignition, thermo-gravimetric curves, specific examples
like barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitents.

5. Theoretical considerations, and application in drug analysis and quality control of the following analytical techniques will be discussed.

6. Non–aqueous titrations

7. Complexometric titrations

8. Miscellaneous methods of analysis such as: Diazotisation titrations, Kjoldahl method of nitrogen estimation, Ksri Fischer titration, Oxygen flask combustion, gasometry.

Practicals

6 hrs/week

The students should be influenced by the main analytical tools through demonstrations. They should have a clear understanding of a typical analytical balance, the requirement of a good balance, weights, care and use of balance, methods of weighing and errors in weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

1. Standardisation of analytical weights and calibrating of volumetric apparatus.

2. Acid Base Titrations:

Preparation and Standardization of acid bases; some exercises related with determination of acids and bases separately or in mixture form, some official essay procedures eg. Boric acid should also be covered.

3. Oxidation reduction Titrations:

Preparation and standardization of some redox titrants eg. Potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc. Some exercises relate to determination of oxidizing and reducing agents in the simple shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titaneous chloride, sodium 2, 6 – dichlorophenol indophenol, and ceric ammonium sulphate.
4. Precipitation Titrations:

Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, Titrations according to Mohr’s, Volhard’s and Fajen’s methods.

5. Gravimetric Analysis:

Preparations of gooch crucible for filtration and use of standared glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.
Section A  50 marks

Botany

1. Method of classification of plant kingdom with brief account of plant nomenclature and taxonomy.
2. General morphology and anatomy of plants with special reference to flowers, fruits, roots, leaves, stem (bark, wood), seed.
3. Classification of plant and study of the following families with special reference to medicinally important plants:
   - Ranunculaceae
   - Menispermaceae
   - Cruciferae
   - Cappardidaceae
   - Malvaceae
   - Rutaceae
   - Leguminosae (Pappilonaceae, Caesalpinaceae, Mimosae)
   - Umbelliferaceae
   - Compositae
   - Apocynaceae
   - Solanaceae
   - Convolvulaceae
   - Euphorbiaceae
   - Liliaceae
   - Zingiberaceae
4. Structure of typical plant cell and its important inclusions. Structure and function of some important plant tissues like parenchyma, Sclerenchyma, xylem, Phloem. Etc.

**PRACTICAL**

1. Care Use and type of microscope.
2. Morphology of plants and plant parts indicated in theory.
3. Plant tissues like parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem etc.
5. Epidermal structure of leaf with special reference to stomata and trichomes.
6. Cell contents like starch grains, Calcium oxalate and calcium carbonate crystals.
7. Preparation of 25 herbariums belonging to the families mentioned in Theory.

**Section B ZOOLOGY 50 marks**

1. Animal Kingdom – general information and classification with brief account of binomial nomenclature.
2. Invertebrates: Characteristics features and Ayurvedic importance of animals of different species as sources of drugs.
3. Protozoa (Plasmodim, Leishmanias, Malarial Parasites, Trynmosoma, Entamoeba, Giardia, Trichomonas Porifera (Sponges), Coelenterates (Corals),
4. Parasitic Nematodes (Taenia solium, Fasciola hepatica, Ascaris), Host Parasite relationships.
5. Annelida (Earthworm & Leech), Arthropoda (Honey bee etc.), Mollusca, (Snails, Cuttle fish)
6. Chordata: Medicinal importance of animals belonging to classes mentioned below.

Pieces: Fishes & Fish oil

Amphibia: Frogs & Toads

Reptilia: Snake & Snake venom, Tortoise & Turtle shell.

Aves: Peacock, Hen

Mammals: Cow, Musk deer, Goat, Civet cat etc.

**Study of raw materials of drugs of animal origin:**

- Milk and its products
- Skin products
- Organ products
- Glandular secretions & Bile
- Animal secretion
- Ectodermal outgrowth (nail, horns, shell etc)
- Excretory / Coprophagous products as medicine from medicated animals.

**PRACTICAL:**

Demonstration of preserved specimens, charts & Identification of medicinally useful animals (Invertebrates & Chordates) with systematic approach.
1:6 BASIC ELECTRONICS AND COMPUTER APPLICATIONS

Theory

1. Basic Electronics: Semiconductors, p-n function diode, LEO photodiode and its uses Rectifiers (half wave, full wave, with filters)

2. Computers: 2-1 Introduction to computers.
   - History of computer development and respective generation:
   - Abacus, Napier, Bonar, Slide rule, PASCAL’S calculator. Need to use computers, applications in pharmacy and in general.
   - Computer classification: Mainframe, Mini and Micro Computers, comparison of Analogue & digital computers, Hardware and software, calculator and computer.
   - Operating system: Introduction to types of operating systems, UNIX, MS-DOS, etc.
   - RAM, Virtual Memory etc.
   - Types of languages: Conventional languages, their advantages, limitations, C, PASCAL, FORTRAN, Programming of these languages.
   - Introduction to Computer Networks: Architecture of seven layers of communications.
   - Introduction to Data Structure: Like Queuess, list, trees, binary trees algorithms, flow charts, structured systems, analysis and development, Ingress –SQL, Gateways etc. Statistics, methodologics.
Basic languages: Constants and variables: character set, constants, variables, Naming the variable, getting dates into memory, LET, INPUT, READ, DATA, Print statement.


Printer control: Coma and semicolon control, the TAB function, PRIINT, LPRINT. Functions and subroutines: User defined functions, subroutines, subscripted variables.

Computer Graphics

Computer application in pharmaceutical and clinical studies.

MS- Office

Relevant modification

Practicals

Exercises based on the following area to be dealt

1. Computer operating systems like UNIX, Ms-dos, etc
2. Programming of languages –C,
3. MS Office
2:1 DRAVYA GUNA VIGNANAM I

1. Dravya guna sastra lekshana, sapta padartha, Dravya lekshana, pancha bhoutika, dravya pradhanyata.

2. Dravya Vargeekaranam.
   Chetana – achetana, Karya Karana, Yonibheda, Prabhava bhedha, Soumyagneya, Rasa skandhas, Vanaspatika Vargeekarana.


5. Adhara of Dravya namakarana and paryay Vachi.

### 2:2 DRAVYA GUNA VIJNANAM II

I. Detailed study of the following drugs

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<thead>
<tr>
<th>1. Agaru</th>
<th>23. Karanja</th>
<th>45. Tuvaraka</th>
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<td>2. Agni mandha</td>
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<td>3. Ajamoda</td>
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<td>10. Asoka</td>
<td>32. Kirata tikta</td>
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<td>15. Udumbara</td>
<td>37. Kusta</td>
<td>59. Taleesa</td>
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<td>20. Kandakari</td>
<td>42. Gokshura</td>
<td>64. Nagakesara</td>
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<td>22. Kampillaka</td>
<td>44. Tulasi</td>
<td>66. Nirgundee</td>
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II. NON-DETAILED STUDY OF 100 PLANTS

1. Atasi
2. Amlavetasa
3. Ashmantaka
4. Amaravalli
5. Akshota
6. Akarakarabha
7. Akhurparni
8. Amra
9. Amragandhi
10. Avrtaki
11. Ingudi
12. Indravaruni
13. Irimeda
14. Ishwari
15. Upakunchika
16. Erandakarkati
17. Kaukushta
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III. Janthava dravya parichaya and its guna karma jnanam

IV. Guna karma jnanam of annapana upayoogi dravya


PRACTICALS

Relevant practicals of the above
2:3 PHYSICAL PHARMACY

Theory

1. Solubility and Distribution Phenomena


2. Diffusion and Dissolution.


3. Surface and interfacial Phenomena:


4. Colloids

   Introduction – types of colloidal systems optical properties, kinetic properties of colloids – solubilisation, Electrical properties of colloids.

5. Coarse dispersions


6. Rheology :

7. Kinetics


8. Micrometrics


9. Introduction of Polymer Science

Polymer solutions – molecular weight averages- Molecular weight determination from solution viscosity – Thickening Properties – Gel formation, conservation, Microencapsulation – pharmaceutical applications- Future trends in pharmaceutical and Biomedical uses.

Practicals

1. Determination of interfacial properties – surface tension – CMC power of surfactants

2. Experiments of viscosity – effect of viscosity on sedimentation rate.

3. Determination of rate of reaction.

4. Particle size distribution analysis and determination of particle size.

5. Study of suspensions by controlling flocculations and stability evaluation.


7. Study colloids: Preparation and stability study with addition of electrolytes.

8. Study of emulsions: stability and globule analysis.

9. Experiments pertaining to other theory chapters.
1. Fluid mechanics:
   Fluid statics – Mano meters.
   Fluid dynamics – Types of flow, Reynold’s number, viscosity, concept of boundary layer, basic equations of fluid flow, valves, Flow meters.

2. Material handling.
   Liquid handling - Different types of pumps, Reciprocating, rotary, centrifugal and diaphragm pumps.
   Gas handling - Various types of fans, blowers and compressors.
   Solid handling – Storage bins, hoppers and conveyers.

3. Heat transfer.
   Sources and uses of heat in pharmacy
   Conduction – Fourier’s Law of heat conduction through variable area like Pipes, Spheres etc.
   Convection – Natural and forced convection. Flow of heat through liquids and equation for rate of heat transfer, concept of individual film coefficient, overall heat transfer coefficient, log mean temperature difference.
   Radiation – Kirchoff’s Law, Stefan Beltzman Law, Black body, Gray body, Net heat transfer between two non black bodies by radiation

4. Mechanical separations.
   a. Filtration and centrifugation.
      Theory of filtration, Filter media, filter aids, industrial filters including filter press, filter leaf, rotary filter, edge filter etc.
Principles of Centrifugation – Industrial centrifugal filters and centrifugal sedimenters.

b. Size Reduction and size separation:

Definition, objectives of size reduction, factors effecting size reduction, laws governing energy and power requirements of a mill, types of mills including ball mill, hammer mill, fluid energy mill etc.

5. Evaporation


6. Distillation.


7. Drying


8. Humidification

Basic concepts and definition. Wet bulb and adiabatic saturation temperature, Humidity chart and measurement of humidity. Equipments for dehumidification operations.

9. Crystallization

Principles of crystallization, nucleation mechanism and crystal growth, study of various types of crystallizers, tank, agitated batch, Swenson Walker, vacuum, circulating magma and crystal crystalizer, caking of crystals and its prevention.
10. Mixing

Theory of mixing, mixers for powders, pastes and liquids.

11. Material of construction

General study of composition corrosion, resistant, properties and applications of the materials of construction with special reference to stainless steel and glass.

12. Industrial hazards and safety precautions

Mechanical, Chemical, Electrical, life and dust hazards, Industrial dermatitis, accident records etc.

13. Automatic process Control Systems:

Practicals

1. Determination of rate of filtration and study of factors affecting filtration including filter aids.

2. Determination of humidity – use of dry bulb and wet bulb thermometers and psychrometric charts.

3. Determination of overall heat transfer coefficients.

4. Experiments based on simple steam and azeotropic distillation equilibrium moisture content.

5. Screen analysis of powders.

Theory

1. Methods of classification of plants.

2. General structure and life history of insects like mosquito, housefly, mites and silkworm.

3. Definition, history, scope and development of pharmacognosy.

4. Sources of drugs: Biological, marine, mineral and plant tissue cultures as sources of drugs.

5. Classification of drugs: E.g. alphabetical, morphological, taxonomical, chemical and pharmacological.

6. Cultivation, collection, processing and storage of crude drugs:
   Factors influencing cultivation of medical plants. Types of soils and fertilizers of common use, pest management and natural pest control agents plant hormone and their applications, Polyploidy, Mutation and hybridization with reference to medical plants.

11. Quality control of crude drugs:
    Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods.

12. An introduction to active constituents of drugs:
    Their isolation, classification and properties.

13. Systematic pharmacognostic study of following:
    a) Carbohydrates and derived products: Agar, Guar gum, Acacia, Honey, Isobagol, Pectin, Starch, Sterculia and Tragacanth.
b) Lipids: Bees wax, castor oil, cocoa butter, Cod – Liver oil, hydnocarpus oil, kokum butter, hard, Linseed oil, Rice- bran oil, shark liver oil and wool fat.

14. Study of drugs containing reins and resin combinations:

   Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrha, Asafoetida, balsam of Tolu, balsam of Peru, Benzoin, Turmeric, Ginger.

15. Study of tannins and tannin containing drugs like Cambiar, black catechu, gall and myrobalan.

16. Volatile Oils:

   General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, Cinnamon, Cassia, Lemon Peel, orange peel, Lemon grass, Citronslle, Caraway, Dill, spearmint, Clove, Fennel, Nutmeg, Eucaluptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria, Sandal wood.

17. Phytochemical screening.

   a. Preparation of extracts.

   b. Screening of alkaloids, saponins, cardenolides and bufadienolides, flavenoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, aminoacids in plant extracts.

18. Study of fibers used in pharmacy such as cotten, silk, wool nylon, glass wool, polyester and asbestoses.

19. Study of pharmaceutical acids like talc, diatomite, kaolin, bentonite, gelatin and natural colors.
1. Microscopic measurements of cells and cell contents: starch grains, calcium oxalate crystals and phloem fibres.

2. Determination of leaf constants such as stomatal index, stomatal number, vein–islet number, vein termination number and palisade ratio.

3. Identification of crude drugs belonging to carbohydrates and lipids.

4. Preparation of herbarium sheets.

5. Identification of crude drugs mentioned in theory.

6. Study of fibres and pharmaceutical acids.

7. Microscopic studies of 7–selected crude drugs and their powders mentioned under the category of volatile oils in theory and their chemical tests.

8. General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.
2:6 BIOCHEMISTRY AND PATHO PHYSIOLOGY

Theory

1. Biochemical organization of the cell and transport processes across cell membrane.

2. The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.


5. Carbohydrates metabolism: Conversion of polysaccharide to glucose 1-phosphate, Glycolysis and fermentation and their regulation, Gluconeogenesis and glycogenolysis metabolism of galactose and galactosomia, Role of sugar nucleotides in biosynthesis, and pentosephosphatic pathway.

6. The Citric Acid Cycle: Significance reactions and energetic of the cycle Amphibolic role of the cycle and Glyoxalic acid cycle.

7. Lipid Metabolism: Oxidation of fatty acids, β-oxidation & energetic α-oxidation, γ-oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of ketone bodies and their utililization, control of lipid metabolism, Essential fatty acids & Gicosanoids (Prostaglandins, thromboxanes). Phospholides and Spingolipides.
8. Biological oxidation reduction Redox- potential enzymes and co-enzymes involved in oxidation reduction & its control, The respiratory chain, its role in energy capture and its control, energetic of oxidative phosphorylation, Inhibitors of repertory chain and oxidative phosphorylation, mechanism of oxidative phosphorylation.


10. Metabolism of ammonia and Nitrogen Containing Monomeres.

11. Nitrogen balance, Biosynthesis of amino acids, catabolism of amino acids, conversion of amino acids to specialized products, Assimilation ammonia, Urea cycle, metabolic disorders of Urea cycle, Metabolism biosynthesis, Purine nucleotide inter conversion, Purine biosynthesis, and formation of deoxyribonucleotides.

12. Biosynthesis of Nucleic Acids: Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA, and its replication, Mutation, Physical & Chemical mutagenesis carcenogenesis, DNA repair mechanism, Biosynthesis of RNA.

13. Regulation of gene expression.


Pathophysiology

1. Basic Principles of cell injury and adaptation

2. Basic Mechanism involved in the process of inflammation and repair.

Alternations in vascular permeability and blood flow, migration of WBC, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.

3. Patho Physiology of Common Diseases.

Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania, hypertension, angina, CCF, arteriosclerosis, myocardial infarction, diabetes, peptic ulcer, asthma, ulcerative colitis, hepatic disorders, acute and chronic renal failure, tuberculosis, urinary tract infections, sexually transmitted diseases, anemia and common types of neoplasams – wherever applicable the molecular basis should be discussed.

**Practicals**

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of $\text{pH}$.
2. Titration curve for amino acids.
3. Separation of amino acids by two-dimensional paper chromatography and gel electrophoresis.
4. The separation of lipids by TLC.
5. Separation of serum proteins by electrophoresis cellulose acetate.
6. Quantitative estimation of amino acids
8. The identification of $c$-terminal amino acids of protein
9. The determination of glucose by means of the enzymes glucose oxidase.
10. The isolation and essay of glycogen from the liver and skeletal muscle of rats.
12. The isolation and determination of RNA and DNA.
1. Definition and scope of Forensic pharmacy. Pharmacists role in drug treatment and drug usage. Pharmacist as a member of the Health Care Scheme.


3. Drugs and Cosmetic Act 1940.
   General study of the drugs and Cosmetic Act and rules there under. Study of the terms “Drugs” and “cosmetics”-Definitions, Provisions applicable to import, sale and manufacture of drugs of Ayurvedic drugs . Qualification, duties and responsibilities of Drug inspectors, sampling procedure, requirements and formalities for establishing manufacturing units, distribution houses, retail shops.
   Important schedules applicable to their establishment.
   Study of Schedule X and Y.
   Detail study of schedules relating to Ayurvedic drugs –Schedule E (1),Schedule T


Brief study of the following Acts.

   b. Factories Act 1948.
e. States shops & Establishment Act 1948.
f. Insecticides Act 1968.
g. Minimum Wages Act 1948.
h. AICTE Act 1987.

9. Assignments.

Topics, Trade names, Combination, Preparation , Banned drugs, Bannable drugs, newly introduced and out dated drugs. Drug tragedies, Committee reports on drug accidents, important case decisions published in drug cases relating to various topics covered in the subjects.
3:1: RASA SASTRA I


2. Rasa sala nirmana, Yantra – musha- puda – paribhasha jnanam..


4. Standardisation and quality control techniques metals and mineral preparations

Practicals

1. Identification of Rasa drugs.

2. Preparation of various rasa drugs – Sodhana, Marana.

3. Standardisation and quality testing of various dosage forms
3:2. BHAISHAJYA KALPANA I

1. History of development of Bhaishajya kalpana.
   Adharabhoo-da Sidhantha, Bhesha-jagara and its niyamas.

2. Yantras used for Bhaishajya Kalpana.
   Mana paribhasha, Ardra- Sushka dravya sangrahana niyamas. Saveeryavadhi.

3. Preparation of Ayaskriti Arka, Avaleha

4. Study of
   shnodaka – Oushada Yusha – Oushadha Sidha paneeya – Mamsarasa – Kalka –
   Kwatha – Ksharakalpana – Ksheerapaka – Khalweeya rasa – Guggulu kalpana –
   Gudika – Choorna – Dhoopana– Dhoopapana – Pramadhya – Phanda – Malahara

5. Preparation of various Kwathas, Swarasas.


7. Sodhana of various drugs.

8 Swarasa -Vasa Swarasa,Tulasi Swarasa

   Kalka – Lasuna Kalka
   Kwatha- Rasna Panchakam, Rasnairandadi, Padoladi, Nagaradi
   Punaranavastaka-Sahacharadi__Astavarga

Others----Elaneer Kuzhambu, Kurinji Kuzhambu, Ajamamsarasayana, Kooshmanda
rasayana__Chavanaprasta, Manibhadragula, Vilwadigulika, Avipathy choorna, Taleesa
patradi__Vaiswanara__Ashtachoorna, Saptamrita Lauha, Phalavarti, Dasangadhoopa.

**Practicals**

Preparation of various, Kwathas, Gudikas, Choornas Rasayanas, their
Standardization and quality testing.
3.3. CHEMISTRY OF NATURAL PRODUCTS

**Theory**

The following topics will be discussed with special reference to official natural produce and allied semi synthetic derivatives.

1. Discussion of naturally occurring biomolecules of the following types with the special references to their configuration.
   - Stereochmistry Biological importance (carbohydrates, Hormones, steroids, vitamins, and Alkaloids)

2. Carbohydrates of higher plant origin of pharmaceutical importance.
   - Classification, nomenclature, method of preparation structure, characterisation, general reaction of identification of amyloam, amylopectin, cyclo dextrines, cellulose derives, rhamnose, cymarose, deoxy sugars, gentobios – steraptase, sterptobiose.

3. Peptides and proteins, properties, simple and derived proteins, conjugated proteins, a study of their chemical nature, reactions.
   - Elementary study of nucleic proteins, nucleosides, nucleotides and nucleic acids of pharmaceutical/ biological importance.

4. Alkaloids
   - General Extraction, general methods of determination of a structure, classification and chemical nature and medicinal uses of official alkaloids, structural elucidation and synthesis of ephedrine, Atropine.

5. Enzymes: Definition, classification, Enzymatic activity in biological and industrial applications.
5. Vitamins
Classification, study of chemical nature of vitamins efficily in I.P. constitution and synthesis of Thiamine, Riboflavin, Ascorbic acid and Vit .D.

4. Steroids
Nomenclature, test for steroids, methods of isolation, structural features, chemistry of cholesterol, irradiation products and chemistry of ergosterol, chemistry of stiomasterol, Lanesterol and chemistry of bile acids/ salts.

5. Hormones
1. Estrogens, interrelationship of estrone, estradiol, estrial, constitution of estrone, synthesis and preparation and medicinal uses of synthetic nonsteroidal estrogenic compounds, eg. Bonzosterol hexosterol, diepesterol, stilbesterol, chlortrianisane.

2. Progestrones : Skeletal structure and synthesis of Progestrones, progesterone derivatives used as oral contraceptives.

3. Androgens : Skeletal structure and synthesis of testosterone and synthetic anabolic steroids.

4. Adrenal Cortex hormones: Classification, chemical nature of cortisone, hydrocortisone, synthesis of cortisone from naturally occurring sapogenine, skeletal structure of important synthetic, corticosteroid analogues such as predinisone, predinisolone, fluromethylone, betamethasone and dexamethasone, prodnisolone, fluromethylone, betamethasone and dexamethasone of and triamecinalone, structure, activity, relationship with their medicinal uses.

5. General introduction of protienaceous, hormones eg: Insulin, oxytocin, vasopressin and their biological importance and chemistry of thyroxin.

6. Saponin
Chemical nature, test for sapogenins, structure and uses of diosgenin, sarsopogenine.

7. Prostaglandins

A preliminary discussion, introduction on the nature of these compounds and their biological importance.

8. Glycosides

Definition, introduction, structural elucidation, test, chemistry and synthesis of Amyodalin.

A general study of cardiac glycosides of digitalis purpurea and lanata, strophanthus and squill with the importance of a glycine and glycone part with their SAR.


Constitution and synthesis of uric acid and caffeine, interrelationship of caffeine, theophylline, theobromine and their medicinal importance.

10. Terpences

Introduction, basic isoprene rule, classification – mono, di, tri, sequi terpens, structure and constitution of geranial camphor, alpha – terpineal, structure and interrelationship of limenone, dipentene and alpha – terpenol, terpone hydrate, cineol and carvone, constitution of menthol and thymol.

Synthesis of iones (Alpha and Beta)

11. Carotenoids

Introduction, source, occurrence, skeletal structure of carotenes, conversion of Beta-carotene and Vitamin A. Constitution and synthesis of Vitamin A.
PRACTICALS

1. Degradation of Natural products – atleast 4 compounds.

2. Test for purity of some official compounds belonging to the class of natural products, atleast five compounds of the pharmacopoeia.

3. Assay of pure natural products and finished preparations source materials and finished preparations of I.P. atleast 10 preparations.

4. Qualititative analysis of natural products – identification of 10 unknown compounds to be practiced.

5. Enzyme catalized simple reactions, dehyderylation, hydroxylation, methylation, demethylation (Selected simple eg)
a) Microbiology

Theory

1. Introduction to the scope of microbiology
2. Structure of bacterial cell.
3. Classification of microbes and their taxonomy, Actinomycetes bacteria, ricketssiae, spirochaetes viruses and Fungi.
4. Identification of Microbes stains and types of staining techniques, electron microscopy.
5. Nutrition, cultivation, isolation of bacteria, actinomycetes, fungi, viruses, etc.
6. Microbial genetics and variations.
7. Control of microbes by physical and chemical methods.
   a. Disinfection, factors influencing disinfectants, Dynamics of Disinfectants and antiseptic and their evaluation.
   b. Sterilization, different methods, validation of sterilization methods & equipments.
8. Sterility testing of all pharmaceutical products.
9. Immunity, Primary and secondary defensive mechanism of body, microbial resistance, interferon.
10. Microbial assays of antibiotics, Vitamins & amino acids.
b) Biotechnology

Theory

1. Immunology and immunological preparations

Principles antigens and haptens, immune system, cellular, humoral immunity, immunological tolerance, antigen – antibody reactions and their applications.

Hypersensitivity, Active and passive immunization, vaccines, their preparations, standardization and storage.

2. Genetic Recombination

Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications. Development of bridoma for monoclonal antibodies, study of drugs produced by biotechnology such as Activase, Humulin, Humstrop, HB etc.

3. Antibiotics.

Historical development of antibiotics, Antimicrobial spectrum and methods used for standardization. Screening of soil for organisms producing antibiotics, fermentere, its design, control of different parameters, isolation of mutants, factors influencing rate of mutation, design of fermentation processes. Extraction of fermentation products with special references to pencillins, streptomycins, tetracycline and vitamin B12.

4. Microbial Transformation

5. Enzyme immobilization.

Techniques of immobilization of enzyme: Factors affecting enzyme kinetics, study of enzymes such as hyalureidase, pencillinase, streptokinase and streptodernase, amylase and proteasas etc. Immobilization of bacteria and plant cells.

**Practicals**

Experiments devised to prepare various types of culture media, sub culturing of common aerobic and anaerobic bacteria, a fungus and yeast, various staining methods, various sterilization techniques and their validation of sterilizing techniques, evaluation of antiseptic and disinfectants, testing the sterility of pharmaceutical products as per I.P requirements. Microbial assay of antibiotics and vitamins etc.
3.5: PHARMACOLOGY

**Theory**

1. General Pharmacology.
   a. Introduction
      
      History of pharmacology, definitions of Therapeutics, Posology, Pharmacokinetics, Pharmacodynamics, toxicology, sources of drugs.
   b. Routes of drug administration and factors influencing the effect of drugs.
   c. Pharmacokinetics
      
      Adsorption of drugs, distribution and storage of drugs in the body
      Biotransformation of drugs, extraction of drugs.
   d. Pharmacodynamics
      
   e. Toxicology
      
      General study of toxicology with special reference to acute, sub acute and chronic toxicity, various types of toxicity, poisoning by the various drugs and measures to overcome them.
   f. Development of new drugs
      
      Evaluation in animals, toxicity studies, evaluation in humans.
   g. Bio assays.
Principles of bioassays, different types of bioassays, bioassays of insulin, digitalis, adrenaline, acetylcholine, histamine, oxytocine, d-tubocurarine.

Radio immune assay

Principles and applications

h. Drug dependence

Habituation, addiction, treatment.

II. Pharmacology of the following drugs with emphasis on Classification.

   Mechanism of action.

   Pharmacokinetics.

   Adverse effects.

   Contra indications.

   Drug interactions.

   Clinical uses.

   Preparation and dosages.

A. Drugs acting on automatic nervous system and somatic nervous system.

   Neuro humeral transmissions and receptors.

   Adrenorgic drugs and adrenergic blocking drugs.

   Cholinergic drugs, antimuscarine drugs, anticholine.

   Esterases, ganglionic stimulants and blockers,

   Neuro muscular blocking drugs.

B. Drugs acting on eye.

   Mydriatics, Miotics and drugs used in glaucoma.

C. 1. Hormones

   Pituitary hormones, thyroid and antithyroid hormones and drugs, estrogen and progesterone, androgene and anabolic steroids, adrenocortico steroid hormones.
2. Fertility control and oral contraceptives.

D. Antacids and their antagonistics.
   Histamine.
   Antihistamines.
   5 – hydroxy tryptamine.
   Anti- 5- hydroxy tryptamines.
   Angiotensins, Kinins, Enkephalins, prostaglandins and other polypeptides.
   Allergy and allergens.

E. Immunosuppressants and Immunostimulants.

F. Pharmacology of Vitamins.

G. Heavy metal and heavy metal antagonists.

H. Enzymes in therapy – Hyaluronidase, alpha chymotrypsin, L- Asparaginase, digestive enzymes – pepsin, pepain, diastase.

I. Drugs acting on uterus.

J. Drugs affecting respiratory system.
   Antitussives.
   Antiasthmatics.
   Therapeutic gases.
   Oxygen, Helium, Carbondioxide, water vapour.

Practicals

1. Study of various apparatus, physiological solution and recording devices used in experimental pharmacology.

2. some common and standard techniques – Bleeding and intravenous injection, intra gastric administration, procedures for rando rendering animals unconscious – stunning of rodents, pithing of frogs, chemical euthanasia.

4. To study the dose – response relationship of Acetylcholine on rectus abdominis muscle.

5. To study the dose – response relationship of histamine on guinea pig ileum.

6. To study the dose – response relationship of noradrenaline on rat anococygeus muscle preparation.

7. To study the action of mydriatics and mictics on rabbit eye.

8. To study the effect of hepatic microsomal enzyme inducers and inhibitors in the pentobarbton sleeping time in mice and rats.

9. Test for undue toxicity.

10. Determination of LD- 50 in mice.

11. To demonstrate hydrolysis of acetylcholine by serum choline esterase (frog rectum)

12. To demonstrate the potentiation of aceticholine action by anticholine esterase agent (frog rectum)

13. To demonstrate the inhibition of acetyl choline action by d- tubocurarine (frog rectum)

14. Effect of drugs on perfused frog heart- cardiac stimulants – adrenaline, Atropine, Ca\(^{2+}\) cardiac depressants – acetylcholine, propranolol, K\(^{+}\).

15. To study the effect of drugs on normal and hypodynamic frog heart.

16. Determination of the concentrations of sulphacetamide in the blood of rabbits after injection by various routes.
Theory

1. Study of the biological sources, cultivation, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides:
   (i) Saponins liquorices, ginseng, dioscorea, sarsaparilla, and senagas.
   (ii) Cardioactive sterols: Digitalis, squill, strophanthus and thevetia.
   (iii) Anthraquinone cathartics: Aloe, senna, rhubarb and cascara.
   (iv) Others: Psoralea, Ammi majus, Ammi visinaga, gentian, saffron, chirata, quassia.

2. Studies of traditional drugs, common vernacular names,
   b. Botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulation of following indigenous drugs.


3. The holistic concept of drug administration in traditional systems of medicine. Introduction to Ayurvedic preparations like Arishtas, Asvas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas.
6. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs:
   a. Pyridine piperidine: Tobacco, areca and lobelia.
   b. Tropane: belladonna, hyosayamus, datura, dubosia, coca and Withania.
   c. Quineline and isoquinoline: Cinchona, ipecacaunha.
   d. Indole: ergot, rawolfia, catharanthus, nux-vomica and phystigma.
   e. Imidazole: Pilocarpus.
   f. Steroidal, Veratrum and Kurchi.
   g. Alkaloidal amine: Ephedra and colchicum
   h. Glycoalkaloids: Solanum
   i. Purines: Coffea, Tea and Coca.

7. Role of medicinal and aromatic plants in national economy.

8. Biological sources, preparation, identification tests and uses of the following enzymes. Diastase, Papain, Pepsin, Trypsin and Pancreatin.


11. Introduction classification and study of different. Chromatographic methods and their applications in evaluation of herbal drugs.
Practicals

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important glycoside containing crude drugs is outlined above. Study of powdered drugs.
3. Standardization of some traditional drug formulations.
4. Identification of crude drugs listed above.
5. Microscopic study of characters of 8 – selected drugs given in theory in entire and powdered form.
7. Chromatographic studies of some herbal constituents.
3. 7 INDUSTRIAL PHARMACY

Theory

1. Powders
   - Advantages and limitations, manufacturing procedures and equipments, special care and problems in manufacturing powder and granules.

2. Internally administered solution – Diffusible and indiffusible solids

3. Tablets
   a) Formulation of different types of tablets, granulation technology on large scale by various techniques, physics of tablets making different types of tablet compression machinery and the equipments employed, evaluation of tablets.
   b) Coating of tablets:
      Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process, evaluation of coated tablets.

4. Capsules
   Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, methods of capsule filling, soft gelatin capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.

5. Liquid dosage forms
   Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilisers, colors, flavors and others, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.
6 Semisolid dosage forms:

Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selections. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging.

7 Extraction and galenical products:

Principles and methods of extraction, preparation of infusion, tinctures, dry, soft liquid extracts.

8 Pharmaceutical aerosols:

Definitions, Propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications

9 Micro encapsulation:

Types of microcapsules, importance of micro encapsulations in pharmacy, micro encapsulation by phase separation co-acervation multi orifice, spray drying, spray congealing, polymerization complex emulsion air suspension technique, coating pan and other techniques, evaluation of micro capsules

10 Preservatives used in pharmaceutical formulations

**Practical Training**

Practical training in relevant theory topics.
4:1 RASASASTRA II


3. Different varieties of important Rasa Yogas and its Pareekshana vidhis.

4. Preparations of Rasamanikya, Ananda bhairavarasa, Ichabhedirasa, Lokanadharasa, Hridayarnavarasa, Lekshmivilasarasa, Vasantha kusumakara rasa, Chinthamani rasa, Amritarnava rasa, Hams pottalirasa, Maha taleswara rasa, Swasakudara rasa, Hinguleswara rasa, Vatagajamgusa rasa, sarwanga sunthara rasa, Talakeswara rasa, Vata vidwamsana rasa

4. Standardisation and quality control techniques metals and mineral preparations

**Practicals**

1. Preparations of various herbo-mineral preparations.

2. Standardization and quality testing of prepared medicines.
1. Snehabheda Snehapaka Vidhi, Sneha Moorchana, Snehapaka lekshana,
   Niyama, Prayoga Vidhi, Matra, Upayoga Kala – Jatyadi grita, Sukumaragritha,
   Brahmi grita, Narayana taila, Murivenna, Bhoonaga taila.
2. Sandhana Kalpana – Madya – Asava – Arista – varuni – sura – surasava- suktas-
   Kanjika – Tushodaka – seedhu – Souveera Kalpanas., Arjunarista, Asokarista,
   Takrarista, Dasamoolarista, Draksharishta, Aravinda sava, Kumaryasava,
   Chandanasava.
3. Pathya Kalpana – Anna, Kadvara, Kambalika, Krisara, Takralpana, Yavagoo,
   Peya, Manda, Vilepi, Ragasheuda, Vatoyoudana, Vesavara, Yoosha Kalpana,
   Lepa nirmana and prayoga. Sata dhouta- Sahasradhouta gritha nirmana.
4. Malahara, Upanaha and Sikdha taila nirmana.
5. Drava, Anjana, Aschyotana, Vidalaka, Tarpana, putapaka, Gandoosha, Kabala,
   Mukhakalpa, Nasya, Pradhamana, Dhumapana, Kalpanas.
6. Study of different Preparations
   Ksheera shadpalagrita, Gulgulutikta grita ,Panchagavyagrita ,Jatyadi grita
   ,Ksheerabala taila ,Anutaila ,Asanavilwadi taila ,Karpasastyadi taila ,Gandhka
   taila ,Guggulu Marichadi taila
4:3 PHARMACEUTICAL ANALYSIS

Theory


B. Separation techniques:

1. Chromatography: Fundamental principles of chromatography adsorption, column, paper, liquid & high pressure liquid chromatography. Application, of the above techniques in pharmaceutical analysis.
   1. Electrophoresis.
   2. Gel filtration.

C. General treatment of the theory & application of the following optical & electrical instrument methods in pharmaceutical analysis.

   c. Nephalometry & Turbidimetry.
   d. Flame Photometry: A discussion about the various instruments & pharmaceutical applications.
   e. Atomic absorption spectrophotometry: Principles & applications to pharmaceutical analysis.
   f. NMR Spectroscopy: Principles & applications to pharmaceutical analysis.
   g. Mass Spectroscopy: Principles & applications to pharmaceutical analysis.
Polarography :- Introduction, theoretical considerations, organic polarography, dropping mercury electrode, basic principles of polarographic instrumentation, polarographic methods of analysis, pharmaceutical applications. Amperometric titrations.

Flurimetry :- Fluorescence, flurimetry & spectroflurimetry, analytical factors & applications.

Polarimetry :- Theory, instrumentation & applications.

Thermal analysis of Raw materials and dosage forms:- Differential scanning colorimetric and thermogravimetry.

D Good Manufacturing Practises (GMP) as per WHO, Good laboratory practices (GLP),

Practical Work -

- Standardization of various Ayurvedic dosage forms and proprietary medicines – churna, kashaya, aveleha. Asava –arista. Malahara, vati, gutika, taila & ghrita, bhasmas etc

- Chromatographic study of various formulations

Books recommended


4. Quantitative inorganic analysis. A.I.Vogel.

5. Instrumental methods of analysis, Willards.

6. Quantitative pharmaceutical chemistry, Jenkins et al.


8. Remington’s pharmaceutical Sciences.
9. Official books like I.P., B.P. etc.

10. The Ayurveda Formulary of India.

11. The Ayurveda Pharmacopeia of India.
The Pharmacology of the following groups of drugs with emphasis on,

Classification, Mechanism of action, Pharmacokinetics, Pharmacodynamics, Adverse effects, Drug interactions, Contraindications, Clinical uses, Preparations and dosages.

I. Drugs acting on central nervous system


II. Local anaesthetics

III. Drugs acting on the gastro-intestinal tract.

Appetisers, digestants, carminatives, appetite suppressants, Emetics, anti-emetic, antidiarrhoeals. Cathartics, Antacids, Drugs used in the treatment of peptic ulcer.

IV. Drugs affecting renal function

Metabolism of sodium, potassium, hydrogen ions and water, Diuretics and antidiuretics.

V. Cardiovascular drugs

Cardiac glycosides, Antiarrhythmic drugs, Vasodilators and antianginal drugs, Antiatherosclerotic drugs, Anti hypertensive drugs.

VI. Drugs acting on the blood and blood forming organs

- Drugs effective in Iron deficiency anaemia
- Drugs Effective in megaloblastic anaemia, aplastic anaemia.
- Drugs affecting coagulation of blood – coagulants, anticoagulants, thrombolytic agents, drugs affecting platelet function.
VII. Chemotherapy

- History, bacterial resistance, mode of action of antimicrobials
- Sulphonamides, quinolones, Penicillin’s, Cephalospopins, Tetracyclines, Chloramphenicol, Polypeptide antibiotics, Macrolide antibiotics, Aminoglycoside antibiotics.

- Chemotherapy of fungal infections

- Chemotherapy of viral infections

- Chemotherapy of leprosy and tuberculosis

- Chemotherapy of malaria

- Chemotherapy of protozoal infections, leishmaniasis, Giardiasis, Trichomoniasis, Trypanosomiasis, Balantidiasis.

- Chemotherapy of helminthiasis.

- Antineoplastic agents

- Antiseptic and Disinfectants

- Sclerosing, melanising and demenalising agents, drugs used in skin diseases.

Practical work

1. Study of local anesthetic property of procaine and lignocaine by

   - Surface anesthesia (Corneal Reflex – rabbit)
   
   - Infiltration anesthesia (Gunea pig)
   
   - Plesxes anesthesia (Lumbar plexes of frog)

2. Study of analgesic activity

3. Method of measuring motor activity

4. Actophotometer method

5. Ciliary movements and modification by drugs (frog)
6. Effect of drugs on isolated frog heart and identification of their mode of action.

7. Effect of drugs on isolated rabbit intestine and identification of their mode of action.

8. Effect of drugs on isolated rat fundus.

9. Effect of oxytocin on rat uterus.

10. To study the diuretic activity of a compound in rats.

11. Test for pyrogens.

12. Drugs acting on blood vessels.

13. Effect of drugs on the blood pressure of anaesthetized dog, rat, cat demonstration.

14. Bioassay of Acetylcholine (Frog rectus)

15. Bioassay of histamine in guineapig ileum.

4:5 INDUSTRIAL PHARMACY

**Theory**

1. Cosmetology and cosmetic preparations:

   Fundamental of cosmetic science, structures and functions of skin and hair, dentifrice and manicure preparations like nail polish, lipsticks, eyelashes, baby care products etc.

2. Suppositories:

   Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

3. Ophthalmic Preparations:

   Requirements, formulations, methods of preparation containers, evaluation.

4. Basic knowledge of parenteral dosage forms

4. Surgical products.

   Definitions, primary wound dressing, absorbents, surgical cotton, surgical gauses etc.. Bandages, adhesive tape, protective cellulosic hemostatics, official dressings, absorbable and non-absorbable sutures, ligatures and catguts. Medical prosthetics and organ replacement materials.

5. Sustained release formulation

6. Novel drug delivery system

7. Piolet plant scale up

8. Preformulations

9. Packaging of pharmaceutical products:

   Packaging components, types specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.

10. Stability Studies of pharmaceutical formulations.

**Practicals**

Practicals relevant to the theory topics.
4:6: PHARMACEUTICAL INDUSTRIAL
MANAGEMENT

1. Accountancy


2. Economics


Inland and foreign trade – Procedure for export and import of goods – international trade.

Principles of insurance – general fire, and marine insurance.

3. Pharmaceutical marketing


4. Salesmanship

Principles of sales promotion, advertising ethics of sales – merchantising – literature detailing.

5. Market research

Recruitment, training, evaluation, compensation – consumer redressal.


Principles of management: Coordination, communication, motivation, decision-making, leadership – innovation creativity – delegation of authority responsibility, record keeping.

Identification of key points: Maximum thrust for development and perfection


7. Factory organization and management
