Regulations and Syllabus

For

BACHELOR OF PHARMACY COURSE

(Applicable for the batches admitted from 2014-2015)

VINAYAKA MISSION'S RESEARCH FOUNDATION,

(Deemed to be University)

SALEM, INDIA

VINAYAKA MISSION'S RESEARCH FOUNDATION

(DEEMED TO BE UNIVERSITY),

VINAYAKA MISSION'S COLLEGE OF PHARMACY

Yercaud Main Road, Kondappanaickenpatty, Salem – 636 008

B.PHARMACY COURSE

INTRODUCTION

In exercise of the powers conferred by rule 9 of Memorandum of Association and Sec2 of chapter-V of Bye-laws of the Vinayaka Mission's Research Foundation-Deemed University, Salem, the Academic council of the University hereby makes the following regulations.

Short Title and Commencement

These regulations may be called "THE REGULATIONS FOR THE GRADUATE DEGREE IN BACHELOR OF PHARMACY OF THE VINAYAKA MISSION'S RESEARCH FOUNDATION – DEEMED UNIVERSITY".

These revised regulations shall come into force from the academic year 2014-2015 session. The regulations framed are subject to such modifications as may be approved by the Academic council from time to time.

Preamble

Degree education in Pharmacy in India was started with an aim to cater manpower for growing Pharmaceutical industry in India, for better health care to the patients and for the effective implementation of drug laws. With the vast growth of the Pharmaceutical industry and adaptation of modern technology in the production and standardization of drugs and formulations, demand for Pharmacy graduates increased and resulted in steep increase in the number of Pharmacy institutions imparting degree education.

Scope of Pharmacists

The options open to graduates in Pharmacy include Production and Quality control areas, administration and Management, Marketing, Research and Development, Medical detailing departments of Pharmaceutical industry, hospitals and in teaching. Some of them may opt to go for higher education in different branches of Pharmaceutical Sciences or Management. Few with entrepreneur ability may start production or repacking units or retail Pharmacy, departmental or chain stores while some may opt to go for bulk drug manufacturing, Ayurvedic and herbal formulations manufacturing or commercial analytical laboratories.

Programme Structure

The University is concerned with the breadth of the course content in a Pharmacy degree. It is essential that the student has to acquire a sufficient understanding of the scientific principles and techniques of the Pharmaceutical sciences, together with associated problem solving skills, to become, after appropriate experience in practice, a competent Pharmacist. The course should 2

enable the student to adapt to the new developments in Pharmacy and medicine, which will undoubtedly occur during his or her professional life. It should be integrated to provide the students with coordinated understanding, comprehensive knowledge and expertise in all aspects of the preparation, distribution, action and uses of drugs and medicines. It should also impart to students scientific rigours and discipline of mind.

The university considers that emphasis on the development of problem solving skills must be incorporated into the syllabus and teaching methods of the degree courses. Whilst the course should continue to be strongly based on science, adequate time must be devoted to teaching of topics relevant to the Pharmacist's future professional role. This may be achieved through close interaction with practice including the use of teacher practioners or joint appointees and also by incorporating elements of social and behavioural sciences.

For many reasons, it is not feasible to lay down a detailed course content and teaching syllabus. Future developments in Pharmacy and medicine will lead to constant revision of syllabus content which will be essential if Pharmacists are to be properly equipped by their academic training. Opinions will also vary from time to time on such matters as students contact hours and the balance between formal, didactic teaching and instruction by more participative seminars, tutorials and group work. Another factor that must be considered is the growing integration of the traditional Pharmaceutical subjects which brings with it variations in syllabus from University to University. The university being autonomous would use this flexibility to frame detailed syllabus within the framework of the guidelines.

Course Structure

Chemistry of Drugs and Other Constituents of Medicine and Biological Systems

The sources, structures and properties of chemical substances of natural and synthetic origin used in medicine, the chemical structure and relevant interactions of drugs in biological systems, including the principles of pharmacokinetics, analytical techniques, physical and chemical tests and other aspects of specifications for drugs.

Drug Formulations and Quality Standards

Physical, chemical and biological properties of materials; formulations and devices used to deliver biologically active molecule; bio-pharmaceutics and Pharmacokinetics in relation to drug absorption and disposition, formulation criteria and dosage requirements, formulation of medicines for administration to the body by different routes and to specific target sites; technical specifications for pharmaceutical excipients, including various principles of aseptic procedures and sterilization process; immunological products; radiopharmaceuticals; quality assurance of pharmaceutical products, packaging, good manufacturing practice, environmental control, pharmacopoeial and regulatory requirements.

Action and Uses of Drugs, Medicines and Other Products

Cell biology, human physiology, biochemistry, pathology and pathophysiology as a basis for the understanding of disease and of the pharmacology of drugs; biological methods of measurements of drug activity; chemical, physical, biochemical and biological aspects of the actions of drugs; immunological aspects of disease and chemotherapy, therapeutic uses and adverse reactions of drugs and medicines, their relevance to the treatment of humans. The existence and opportunities for misuse and abuse of drugs; drug dependence; principles of treatment of disease, focusing of the process of problem solving; therapeutics associated with clinical toxicology and epidemiology.

REGULATIONS

1. Qualification for Admission

a. Candidates who have passed two year P.U.C./P.D.C/H.S.C (10+2) examination or an equivalent examination of any approved Board or university with not less than 40% marks in aggregate in Physics, Chemistry and Mathematics or Biology (or) Physics, chemistry, botany and zoology.

b. Candidates belonging to scheduled castes / scheduled tribes, the minimum marks for admission shall 35% in lieu of 40 % for general category.

c. Candidates who have qualified D.Pharm should have aggregate of 50% of marks in the first and second year D.Pharm exam are eligible to join directly in II.B.Pharm

Other Criteria

Where the course content is not as prescribed for 10+2 education structure of the National committee, the candidate will have to undergo a period of one-year pre – professional training before admission to the pharmacy colleges.

a. The pre-professional examination with physics, chemistry and biology, after passing either the higher secondary school examination, of the pre-university or an equivalent examination. The pre professional examination shall include a practical test in these subjects.
b. The pre-university course, which was in vogue prior to the advent of the Higher secondary examination shall not be treated as equivalent to the Higher secondary examination (10+2) for purpose of eligibility and admission to the course.
c. Wherever the State Board/Body or appropriate authority have taken into account only the plus two level marks to determine the class of the candidate and issue the statement of marks accordingly, it alone would be taken into consideration.
d. Wherever the state board / body or appropriate authority have taken into account the marks obtained at the Plus One and Plus Two levels to determine the class of the candidate and the aggregate of the two examinations shall be taken into consideration.

e. Candidates who have studied abroad and have passed the equivalency of qualification as determined by the Association of Indian universities will form the guidelines to determine the eligibility and must have passed in the subjects of Physics, Chemistry, Biology (Botany/Zoology) up to 12th standard level with 50% marks aggregate and with pass in English language.

f. Any criteria not covered under the above provision, the ruling of the Eligibility Committee shall be adopted.

2. Age Limit

Should have completed the age of 17 years at the time of admission or would complete the said age on or before 31st December of the year of admission to first year B. Pharm course.

3. Eligibility Certificate

Candidates who have passed any qualifying examination other than the Higher Secondary course examination conducted by the Government of Tamilnadu shall obtain an eligibility certificate from the university by remitting the prescribed fees along with the application form before seeking admission to any one of the constituent Institution.

4. Registration

A candidate admitted to the course in any of the constituent colleges shall register with this university by remitting the prescribed fees along with the application form for registration duly filled in and forwarded to this university through the Head the Institution within the 90 days from the date of admission.

5. Duration of the Course

The course of study for B.Pharm shall extend over a period of four academic years and three academic years for those admitted to second B. Pharm directly. The curricula and syllabi for the course shall be prescribed from time to time.

6. Medium of Instruction and Examinations

Medium of Instruction and Examination shall be English

7. Working Days in an Academic Year

Each academic year shall consist of not less than 200 working days.

8. Course of Study

The course of study for B.Pharm I, II, III and IV year shall include the respective Theory & Practical subjects as given in Table - I, II, III and IV respectively. The number of hours to be devoted to each theory and practical subject in an academic year shall not be less than that shown in Table - I, II, III and IV.

9. Academic Work

A regular record of attendance both in Theory and Practical shall be maintained by the teaching staff of respective subjects.

10. Attendance Required for Admission to Examination

a. No candidate shall be permitted to appear for any one of the parts of B. Pharm. Examination unless he has attended the course in the subject for the prescribed period in the institution of this University and produces the necessary certificate of study, attendance, satisfactory conduct and progress from the Head of the Institution.

b. A candidate is required to put in minimum 80% of attendance in both theory and practical separately in each subject before admission to the examination.

c. A candidate lacking in the prescribed attendance and progress in any one subject in theory and practical shall not be permitted for admission to the entire examination in the first appearance.

11. Regulations for Condonation of Lack of Attendance.

Condonation of shortage of attendance upto a maximum of 10% in the prescribed eligible attendance for admission to an examination rests with the discretionary powers of the Vice – Chancellor. A candidate lacking in attendance should submit an application in the prescribed form and remit the stipulated fee, 15 days prior to the commencement of theory examination. The Head of the Department and Head of the institution should satisfy themselves on the reason of the candidate's request while forwarding the application with their endorsements to the Controller of Examinations, who would obtain the approval of the Vice-Chancellor for admission of the said candidate to the examination. No application would be considered if it is not forwarded through proper channel.

Application for condonation of lack of attendance shall be taken up for consideration on the following grounds:

1. Any illness afflicting the candidate. (The candidate should submit to the Head of the Institution a Medical Certificate from a registered Medical Practitioner soon after he returns to the Institution after treatment.)
2. Any unforeseen tragedy in the family. (The parent / Guardian should give in writing the reason for the ward's absence to the Head of the Institution).
3. Participation in NCC/NSS and other co-curricular activities representing the Institution or University. (The Head of the Institution should instruct the concerned officers in-charge of the student activities in their institution to endorse the leave)
4. Any other leave the Head of the Institution deems reasonable for condonation.

12. Internal Assessment Marks:

Theory: Three sessional examinations evenly spread during the academic year shall be conducted by the constituent colleges. The average marks of the best two examinations shall be computed out of a maximum of 30 marks and shall constitute the sessional award in theory. Provided further the colleges may conduct one special theory sessional examination towards the end of the academic session for those who might have missed any one of the regular sessional examination on genuine grounds.

Practical: Students are expected to perform the experiment listed in the respective syllabus. The number of experiments is also listed. Marks shall be awarded out of a maximum of 10 to each of the practical exercise and an average of those shall be computed out of maximum of 10 marks. In addition, three practical examinations evenly spread during each academic year shall be conducted. The average marks of the best of two practical examinations shall be computed out of a maximum of 20 marks. A total of 30 marks shall constitute the sessional award in practical.

The college shall maintain the sessional books of the students and the record of sessional award of the students. A regular record of both theory and practical class work and sessional examinations conducted in an institution imparting the course shall be maintained for each student in the institution. Marks shall be awarded as per the schemes given in Tables - V, VI, VII and VIII.

13. Eligibility to Appear for Annual University Examination

The candidates are required to score a minimum of 35% marks in each of the subjects (Theory and practicals separately) in the sessional examination to be eligible to appear for annual university examination in the respective subject.

14. University Examinations

1. Every year there shall be an examination to examine the students.

2. Each examination will be held twice every year. The first examination in a year shall be the annual examination and the second examination shall be supplementary examination.

3. The examinations shall be of written and practical (including oral nature) carrying maximum marks for each part of a subject as indicated in Tables - V, VI, VII and VIII.

15. Submission of Laboratory Record Note Books.

At the time of practical examination, each candidate shall submit to the Examiners the laboratory notebooks duly certified by the Head of the Department as a bonafide record of the work done by the candidate.

The candidate may be permitted at the discretion of examiners to refer to the Practical record book during the practical examination. No other materials, handwritten, cyclostyled or printed guides are allowed for reference during the practical examinations.

In respect of failed candidates the marks awarded for records at previous examinations will be carried over for the subsequent examination or the candidates shall have the option to improve his performance by submission of fresh records.

16. Criteria for Pass

a) Candidates who have secured a minimum of 50% marks in the Theory examination and 50 % marks in Practical (including oral) examination separately and an aggregate of 50% marks in theory, practical and sessional are declared to have passed in the subject (s).

b) The candidates who failed in one or more subjects (either Theory or Practical) shall have to appear in the subjects so failed in the subsequent examinations

17. Declaration of Class

Class shall be awarded at the end of I, II, III and final year of B.Pharm examination as shown below:

1) Distinction 75% and above
2) First Class 60% and above and less than 75%
3) Second class 50% and above and less than 60%

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 I to IV year examinations and completes the course in four years, as indicated below. I Class : 60% and above

II Class : 50%-59%

Candidate securing aggregate of 75% or above marks and have passed in all the subjects in a year in first attempt shall be declared to have obtained Distinction.

18. Conditions under which Candidates are Permitted to Proceed to Next Higher Class:

The Candidates are permitted to carry the any number of failed subjects to the next year.

19. Practical Training

A Practical training of 3 months at the end of third academic year in Dispensing / Community / Hospital Pharmacy or in a Pharmaceutical industry should be encouraged, which is optional.

20. Project Work

All the students must submit a short report on a project study undertaken in any of the following subjects:

a. Pharmaceutics.
b. Pharmaceutical Chemistry
c. Pharmacognosy
d. Pharmacology.
e. Pharmaceutical Analysis.
f. Pharmacy Practice.

The project shall be carried out under the guidance of a teacher in the college.

The project may be carried out either individually or in groups not exceeding 5 in number.

The project report shall be submitted in triplicate (typed copy not exceeding 50 pages)

The project will be evaluated by the examiner at the time of the practical examination appointed by the University.

The projects shall be evaluated by qualitative grading as Excellent / Good / Average.

The evaluation of the project report shall not be considered for the purpose of pass / class/ rank, but the grading shall be included in the Mark sheet of the Final B.Pharm course.

21. Award of Ranks

Ranks and Medals shall be awarded on the basis of aggregate of all the four university examinations. However, candidates who fail in one or more subjects during the B.Pharm course shall not be eligible for award of ranks.

Moreover, the candidates should have completed the B. Pharm course in minimum prescribed number of years, (four years) for the award of Ranks.

22. Award of Degree

Candidates who fulfill the requirements mentioned above will be eligible for award of degree during the ensuing convocation.

23. Duration for completion of the course of study

The duration for the completion of the course shall be fixed as double the actual duration of the course and the students have to pass within the said period, otherwise they have to get fresh Registration.

24. Revaluation / Retotalling of Answer Papers

There shall be provision for revaluation of the answer papers of the failed candidates in any examination. However, the candidates can also apply for retotalling.

25. Re-Admission after Break of Study

Candidate who seeks re-admission to the course after break of study has to get the approval from the university by paying a condonation fee.

No condonation is allowed for the candidate who has more than 2 years of break up period and he/she has to rejoin the course by paying the required fees.

Course of study

Table I: First year B.Pharm

Sl.No.	Subjects	Theory hours / week	Practical hours / week
1.1	Human Anatomy and Physiology	3	3
1.2	Pharmaceutical Organic Chemistry –I	3	3
1.3	Pharmaceutical Analysis	3	3
1.4	Biochemistry	3	3
1.5	Pharmacognosy	3	3
	Total number of Working hours	15	15
	Grand Total	**30 hours**	

Table II: Second year B.Pharm

Sl.No.	Subjects	Theory hours / week	Practical hours / week
2.1	Pharmaceutical Organic Chemistry- II	3	3
2.2	Physical Pharmaceutics	3	3
2.3	Industrial Pharmacognosy	3	3
2.4	Pharmaceutical Technology	3	3
2.5	Biostatistics and Computer Applications	3	3
	Total number of Working hours	15	15
	Grand Total	**30 hours**	

Table III: Third year B.Pharm

Sl.No.	Subjects	Theory hours / week	Practical hours / week
3.1	Medicinal Chemistry-I	3	3
3.2	Dispensing and Pharmaceutical Formulations	3	3
3.3	Pharmacology – I	3	3
3.4	Pharmacy Practice	3	3
3.5	Pharmaceutical Quality Assurance	3	-
3.6	Forensic Pharmacy	3	-
	Total number of Working hours	18	12
	Grand Total	**30 hours**	

Table IV: Fourth year B.Pharm

Sl.No.	Subjects	Theory hours / week	Practical hours / week
4.1	Pharmaceutical Biotechnology	3	3
4.2	Medicinal Chemistry-II	3	3
4.3	Industrial Pharmacy and Biopharmaceutics	3	3
4.4	Modern Methods of Pharmaceutical Analysis	3	3
4.5	Pharmacology – II	3	3
4.6	Pharmaceutical Marketing and Management	3	-
	Total number of Working hours	18	15
	Grand Total	**33 hours**	

Scheme of Study and Examination

Table V: First year B.Pharm course

Sl. No.	Subject	Theory Examination				Total marks	Practical Examination				Total marks
		Sessional		Annual			Sessional		Annual		
		Duration (Hrs)	Marks	Duration (Hrs)	Marks		Duration (Hrs)	Marks	Duration (Hrs)	Marks	
1.1	Human Anatomy and Physiology	2	30	03	70	100	3	30	4	70	100
1.2	Pharmaceutical Organic Chemistry –I	2	30	03	70	100	3	30	4	70	100
1.3	Pharmaceutical Analysis	2	30	03	70	100	3	30	4	70	100
1.4	Biochemistry	2	30	03	70	100	3	30	4	70	100
1.5	Pharmacognosy	2	30	03	70	100	3	30	4	70	100
	Total					**500**					**500**
	Grand total										**1000**

Table VI: Second year B.Pharm course

Sl. No.	Subject	Theory Examination				Total marks	Practical Examination				Total marks
		Sessional		Annual			Sessional		Annual		
		Duration (Hrs)	Marks	Duration (Hrs)	Marks		Duration (Hrs)	Marks	Duration (Hrs)	Marks	
2.1	Pharmaceutical Organic Chemistry- II	2	30	03	70	100	3	30	4	70	100
2.2	Physical Pharmaceutics	2	30	03	70	100	3	30	4	70	100
2.3	Industrial Pharmacognosy	2	30	03	70	100	3	30	4	70	100
2.4	Pharmaceutical Technology	2	30	03	70	100	3	30	4	70	100
2.5	Biostatistics and Computer Applications	2	30	03	70	100	3	30	4	70	100
	Total					**500**					**500**
	Grand total										**1000**

Table VII: Third year B.Pharm course

Sl. No.	Subject	Theory Examination				Total marks	Practical Examination				Total marks
		Sessional		Annual			Sessional		Annual		
		Duration (Hrs)	Marks	Duration (Hrs)	Marks		Duration (Hrs)	Marks	Duration (Hrs)	Marks	
3.1	Medicinal Chemistry-I	2	30	03	70	100	3	30	4	70	100
3.2	Dispensing and Pharmaceutical Formulations	2	30	03	70	100	3	30	4	70	100
3.3	Pharmacology – I	2	30	03	70	100	3	30	4	70	100
3.4	Pharmacy Practice	2	30	03	70	100	3	30	4	70	100
3.5	Pharmaceutical Quality Assurance	2	30	03	70	100	No Practical				
3.6	Forensic Pharmacy	2	30	03	70	100					
	Total					**600**					**400**
	Grand total										**1000**

Table VIII: Fourth year B.Pharm course

Sl. No.	Subject	Theory Examination				Total marks	Practical Examination				Total marks
		Sessional		Annual			Sessional		Annual		
		Duration (Hrs)	Marks	Duration (Hrs)	Marks		Duration (Hrs)	Marks	Duration (Hrs)	Marks	
4.1	Pharmaceutical Biotechnology	2	30	03	70	100	3	30	4	70	100
4.2	Medicinal Chemistry-II	2	30	03	70	100	3	30	4	70	100
4.3	Industrial Pharmacy and Biopharmaceutics	2	30	03	70	100	3	30	4	70	100
4.4	Modern Methods of Pharmaceutical Analysis	2	30	03	70	100	3	30	4	70	100
4.5	Pharmacology – II	2	30	03	70	100	3	30	4	70	100
4.6	Pharmaceutical Marketing and Management	2	30	03	70	100	No Practical				
	Total					**600**					**500**
	Grand total										**1100**

I.B.PHARMACY

1.1 HUMAN ANATOMY AND PHYSIOLOGY

THEORY **-75 Hrs**

Scope:

This course is designed to impart a fundamental knowledge on the structure and functions of the human body. It also helps in understanding both homeostasis mechanisms and homeostatic imbalances of various body systems. Since a medicament, which is produced by Pharmacist, is used to correct the deviation in human body it enhances the understanding of how the drugs act on the various body systems in correcting the disease state of the organs.

Objectives:

a. to describe the structure (gross and histology) and functions of various organs of the human body,
b. to describe the various homeostatic mechanisms and their imbalances of various systems,
c. to identity the various tissues and organs of the difference systems of the human body.
d. to perform the hematological tests and also record blood pressure, heart rate, pulse and Respiratory volumes,
e. to appreciate coordinated working pattern of different organs of each systems; and
f. to appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Lecture-wise Programme

1. Scope of anatomy, Physiology - Definitions of various terms used in anatomy -1 Hr

2. Structure of cell, its components and their functions, Normal cell cycle -3 Hrs

3. **Tissues**:
Epithelial, Connective, Muscular and Nervous tissue- their types and characteristics -3 Hrs

4. **Bones and Joints**:
Structure, composition and functions of the skeleton -classification of joints, types of movements of joints and disorders of joints (definitions). -5 Hrs

5. **Skeletal muscles :**
Structure of skeletal muscle, physiology of muscle contraction. Physiological properties of skeletal muscle and their disorders (definitions). Physiology of neuromuscular junction. -2 Hrs

6. Blood
Composition and functions of blood including their disorders. Blood grouping and its significance. Transfusion of blood. Mechanism of coagulation. Bleeding and clotting disorders. -6 Hrs

7. **Lymph :**
Lymph and lymphatic system - composition, formation, circulation. Spleen – its structure and functions, Disorders of lymphatic system (Definitions) -4 Hrs

8. Cardio Vascular system:
Anatomy and physiology of heart, blood vessels and blood circulation (pulmonary, coronary and systemic circulation) – cardiac cycle - heart rate, Blood pressure and its maintenance and regulation , ECG , heart sounds. Disorders of CVS (Definitions) -7 Hrs

9. Respiratory system.
Anatomy of respiratory tract, Mechanism of respiration and its regulation. Lung volumes and capacities. Physiology of respiration - transport of respiratory gases (oxygen and carbon dioxide), Disorders of Respiratory system (Definitions). Oxygen therapy and resuscitation -4 Hrs

10. Digestive system:
Anatomy and physiology of GIT, Anatomy and functions of accessory glands of GIT -liver, pancreas, and stomach, Digestion and absorption of carbohydrates, proteins and fats, gastro intestinal secretions and their regulations, movements of intestine. Disorders of digestive system (Definitions) -8 Hrs

11. Urinary system.
Anatomy and physiology of urinary system, physiology of urine formation, Renin angiotension system – Juxtaglomerular apparatus, acid - base balance. Disorders of urinary system (Definitions) -3 Hrs

12. Reproductive system.
Structure and function of Male and female reproductive systems, Sex hormones-physiology of menstruation, coitus and fertilization. Spermatogenesis and Oogenesis, – Pregnancy and parturition. Disorders of male and Female reproductive system (Definitions) -6 Hrs

13. Endocrine System.
Introduction, chemistry and actions of hormones, Basic anatomy and physiology of Pitutary, Thyroid, Para thyroid, Adrenals, Pancreas. Local hormones. Disorders of these glands. (Definitions) -6 Hrs

14. Central Nervous system.
Definition and classification of Nervous system . Anatomy ,physiology and functional areas of cerebrum Anatomy and physiology of cerebellum, mid brain. Thalamus, hypothalamus and Basal Ganglia . Spinal card : Structure and reflexes – mono poly planter, CSF, EEG, Cranial nerves –names and their functions. Disorders of CNS (Definitions) -10 Hrs

15. Autonomic Nervous system.
Anatomy, Physiology and Divisions of ANS. Motor and sensory pathways. Disorders of ANS (Definitions) -3 Hrs

16. Sense organs:
Physiology of Ear, Eye, Skin, Tongue and nose. Disorders of Sense organs (Definitions) -4 Hrs

PRACTICALS **-75 Hrs**

Experiments

1. Study of microscope .
2. Microscopic study of different tissues, organs.
3. General techniques for the collection of blood.
4. Determination of
   a. Bleeding time and clotting time.
   b. Hemoglobin content.
   c. Total RBC content.
   e. Total WBC content.
   f. Differential Leucocyte count(DLC).
   g. ESR.
   h. Blood grouping.
   i. Blood pressure.
   j. Pulse rate, heart rate, and Body temperature and Body Mass Index(BMI).
5. Identification of bones and points identification
6. Study of different systems and organs with the help of models and specimens.

RECOMMENDED BOOKS

1. Best & Tailor's "Physiological basis of Medical practice".
2. Guyton A.C. Hall J.E. Text book of Medical physiology.
3. Human Physiology. C.C. Chatterjee.
4. Anatomy and Physiology in Health and illness – Kathleen J.W.Wilson.
5. Seeley's Fundamental of Human Anatomy and Physiology by Cinnamman Van Putte, Latest edition, Tata Mc Graw hill, New Delhi.
6. Derasori and Gandhi's Elements of Human Anatomy, Physiology and Health Education by Goyal RK. Anitha A. Metha and Gaurang B.Shah, B.S. Shah Prakashan, Ahmedabad
7. Practical Anatomy and Physiology by Goyal RK. Natver M.Patel and Shailesh A.Shah. B.S. Shah Prakashan, Ahmedabad.
8. Tortora Gerard J and Nicholas. P Principles of anatomy and physiology publisher Harpercollins College, New York.
9. Samson Wright's Applied Physiology by Cyril A.Keek, Eric Neil and Norman joels.
10. A text book of Practical Physiology by V.G,.Ranade.
11. Fundamental of medical physiology by K. Sembuligam and Prema Sambulingam, Japee. Brothers, medical publishers Pvt, Ltd, New Delhi.
12. Human physiology by Chakkabarthi B.K. Gosh, H.M. and Sahana SM.The New book Stall Kolkatta, India.
13. Textbook of Practical Physiology by C.L.Ghai.
14. Practical workbook of Human Physiology by K.Srinageswari and Rajeev Sharma

1.2 PHARMACEUTICAL ORGANIC CHEMISTRY-I

THEORY **-75Hrs**

Scope: This subject consists of two sections. The organic chemistry section deals with classification and nomenclature of organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of compounds. The syllabus also emphasizes on mechanisms and orientation of reactions. The analytical chemistry section designed to enable the students to have fundamental knowledge of volumetric analysis and determination of impurities in Pharmaceuticals.

Objectives: Upon completion of the course the student shall be able to

- write the structure, name, type of isomerism of the organic compound
- write the reaction, name the reaction and understand orientation of reactions
- account for reactivity/stability of compounds,
- identify/confirm the organic compound
- know the principle of volumetric analysis of drugs.

Lecture wise programme

- General methods of preparation, General reactions of compounds marked* to be explained.
- To emphasize on definition, types/ classification, mechanisms, uses/applications, examples, differences .

Classification /Nomenclature/ Isomerism **-10Hrs**

1. Classification of organic Compounds
2. Common and IUPAC systems of Nomenclature of organic compounds
3. Structural Isomerisms in organic compounds

2.Alkanes*/Alkenes*/ Conjugated dienes* **-12Hrs**

a. SP_3 hybridization in alkanes, Halogenation of alkanes.

b. i. Stabilities of alkenes, SP_2 hybridization in alkenes,

ii. E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation, evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions.

iii. Ozonolysis, electrophilic addition reactions of- alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

c. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

3.Cyclo alkanes* **-3Hrs**

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings)

4.Alkyl halides* **-5Hrs**

a. SN_1 and SN_2 reactions-kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions

b. Nucleophilic substitution versus elimination reactions

5.Benzene and its derivatives **-10Hrs**

a. Analytical/ synthetic/ other evidences in the derivation of structure of benzene. Orbital picture, resonance in benzene, aromatic characters, Huckel's rule

Reactions of benzene – nitration, sulphonation, halogenation- reactivity, friedel crafts alkylation-reactivity, limitations, friedel crafts acylation.

Substituents,effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reactions

b.Aryl halides **-10Hrs**

Nomenclature, General methods of preparation, General reactions of - Aryl halides,Nucleophilic aromatic substitution reactions (Bimolecular nucleophilic substitution and Benzene-mechanisms), effect of substituents on reactivity towards nucleophilic aromatic substitution reactions

c. Phenols and Alcohols - **-7Hrs**

Nomenclature, General methods of preparation, General reactions, Acidity of - phenols, effect of substituents on acidity

d. Amines **-5Hrs**

Nomenclature,General methods of preparation, General reactions,

Basicity of - aromatic amines, effect of substituents on basicity, comparision with aliphatic saturated amines, synthetic uses of diazonium salts.

e.Carbonyl compounds* (Aldehydes and ketones) **-5Hrs**

Electromeric effect, aldol condensation, crossed aldol condensation, cannizaro reaction, crossed cannizaro reaction, benzoin condensation, perkin condensation, Knoevenagel reaction, reformatsky reaction.

f.Carboxylic acids and derivatives* **-3Hrs**

Acidity of carboxylic acids, effect of substituents on acidity, inductive effect.

6.Polynuclear hydrocarbons -5Hrs

Synthesis , reactions and medicinal uses of of following compounds/ derivatives - Naphthalene, Phenanthrene, Anthracene. Diphenylmethane and Triphenylmethane

Practical: -75 Hrs Experiments

1. Systematic qualitative analysis of unknown organic compound/s for preliminary tests.
2. Systematic qualitative analysis of unknown organic compound/s for functional group (for preliminary / Lassaigns / solubility / functional group tests)

   Following classes of compounds may be analyzed

   Phenols, amide/ urea, carbohydrate, amine, carboxylic acid, aldehyde, ketone, alcohol, carboxylic acid ester, hydrocarbon, halo hydrocarbon, nitro compound, anilide.
3. Preparation of organic drugs or intermediate involving one-step reaction (at least 16 compounds).
4. Determination of Melting point, Boiling Point of organic compounds including mixed Melting Point technology.
5. Introduction to the use of stereo models.

   a. Methane b. Ethane c. Acetylene d. Ketone e. Benzene.(Students may be asked to prepare the ball and stick stereo models by using China clay and Plastic sticks individually and they have to explain the formation of bonds and bond angles, bond lengths etc).

Recommended Books

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. A.H.Beckett & J.B. Stenlake's -Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
6. Text Book of Quantitative Inorganic analysis by Vogel
7. Bentely and Driver's Textbook of Pharmaceutical chemistry
8. Analytical chemistry principles by John H. Kennedy.
9. I.P.1985 ,1996, 2008 Govt. of India, Ministry of Health
10. Practical Organic Chemistry by Mann and Saunders.
11. Vogel’s text book of Practical Organic Chemistry
12. Advanced Practical organic chemistry by N.K.Vishnoi.
13. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

1.3 PHARMACEUTICAL ANALYSIS

THEORY **-75 Hrs**

Scope: This subject deals with application of analytical procedure used to determine purity, safety & quality of drugs and chemicals. The analytical chemistry section designed to enable the students to have fundamental knowledge of volumetric analysis and determination of impurities in Pharmaceuticals.

Objectives: Upon completion of the course the student shall be able to

- know the principle of volumetric analysis of drugs.
- know the detection of impurities
- know the limit test of pharmacopoeial substances.
- know the quantitative determination of drugs.

Lecture-wise Programme

-8 **Hrs**

Introduction: Pharmaceutical analysis, Significance of quantitative analysis in quality control Importance of quality control, computation of analytical results, significant figure, concept of error precision, accuracy standard deviation, normal distribution curve, calibration of analytical equipments, , methods of expressing concentrations, primary standard, secondary standard.

Impurities: **-6 Hrs**

Source and effect of impurities in pharmacopoeial substances, importance of limit test, general principle and procedures for limit test, limit test for chloride, sulphate, Iron, Arsenic, Lead and heavy metals.

Fundamentals of volumetric analysis: -5 **Hrs**

Theories of Acid-Base indicators and methods of expressing concentrations. Primary and secondary standard. Preparation and standardization of various molar/normal solutions like oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate, iodine and ceric ammonium sulphate solution. **-15Hrs**

1.Neutralization titrations- Acid – Base concepts, relative strength of acids and bases. Ionization, law of mass action, common ion effect, ionic product of water, pH, Henderson-

Hesselbalch equation, buffer solutions, theory of indicator, neutralization curves, choice of indicators, mixed and universal indicators, titration of polyprotic system (Mixture of acids), determination of carbonates and Bicarbonates titration. -4 **Hrs**

2.Non-aqueous titration: Theoretical basis, types of solvents, scope, limitations, preparation and standardisation of titrant solutions, titration of weak acid, weak bases, and indicators. Standardisation of perchloric acid, Lithium and sodium methoxide, Tetrabutyl ammonium hydroxide. **-8 Hrs**

3.Precipitation titrations: Principles of precipitation titrations, solubility product, effect of acids, temperature and solvent upon the solubility of precipitate. Argentimetric titration. Mercurimetric titration and titration involving ammonium or potassium thiocyanate. Barium sulphate, adsorption indicators, Gaylussac method, Mohr's method. Volhard's method and Fajan's method.

-5 Hrs

4.Complexometric titrations: Complexation, Chelation, Werner's co-ordination number, stability of complexes, titration curves, importance of buffer, types of complexometric titration, methods of end point detection. PM indicators, masking and demasking agents.

-8 Hrs

5.Oxidation – Reduction titrations: concepts of oxidation – reduction reactions, standard oxidation potential, Nernst equation, theory of redox titrations, redox indicators, titrations involving Ceric ammonium sulphate, Potassium permanganate, Titanous chloride, sodium – 2-6 dichlorophenol indophenol and Iodimetry and Iodometry. Preparation standardisation and titration.

-10 Hrs

7.Gravimetric analysis: Basic concepts, precipitation techniques, co-precipitation, post-precipitation. Various steps involved in gravimetric analysis. Pharmaceutical application eg. Determination of Barium sulphate as Barium chromate, calcium as calcium oxalates. Magnesium as Magnesium pyrophosphate, organic precipitants.

-6 Hrs

8.Miscellaneous methods: 1. Diazotization 2. Kjeldhal method of nitrogen estimation 3. Oxygen flask combustion 4. Gasometry and 5. Analysis of oils, fats and waxes

PRACTICALS **-75 Hrs**

1. Standardisation of analytical weights and calibration of volumetric apparatus.
2. Preparation and standardisation of volumetric solutions and assay of official compounds involving
3. Acidimetry,
4. Alkalimetry, (including Non-aqueous titrimetry)
5. Permanganametry,
6. Ceriometry,
7. Iodimetry,
8. Iodometry,
9. gravimetry and
10. complexometry.
11. At least 10 primary standard solution to be prepared and used for 10 different assays strictly as per **Indian Pharmacopoeia '96**.

Recommended Books:

1. Practical Pharmaceutical chemistry by A.H.Beckette and J.B.Stenlake.
2. Quantitative analysis by V. Alexevev.
3. A textbook of quantitative analysis by A.L.Vogel.
4. Indian Pharmacopoeia ‘ 96.
5. Principles of physical chemistry by B.R.Puri, L.R.Sharma and M.S.Pathania.
6. Physical pharmaceutics by Dr.R. Manavalan and C. Ramaswamy.

1.4 BIOCHEMISTRY

THEORY **-75 Hrs**

Scope of the Subject:

Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the present course is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions, which can help to understand the mechanism of the drug action and fundamental changes occur in diseases.

Objectives of biochemistry:

- Upon completion of course student shall able to
- Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- Understand the metabolism of nutrient molecules in physiological and pathological conditions.
- Understand the genetic organization of mammalian genome, functions of DNA and RNA in protein synthesis.
- Understand the principles of organ functions tests and their clinical significances.

Lecture wise programme: -

1.**Bioenergetics :**

Digestion, absorption and metabolism of carbohydrates, proteins and nucleoprotein.The concept of free energy. Determination of change in free energy from equilibrium constant and reduction potential ,TCA cycle and its biological significance, energetics of the TCA cycle. -15 Hrs

2.Biochemical organization of the cell and transport process across cell membrane. -3 Hrs

3.**Enzymes :**

Nomenclature, Enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, coenzymes significance and clinical importance of enzymes. -4 Hrs

4. **Carbohydrates:**

Classification and their properties. Starch, glycogen, dextrin, insulin, cellulose. Metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. Role of sugar nucleotide in nucleotide biosynthesis and pentose phosphate pathway. -5 Hrs

5. **Lipids;**

Classification and properties, study of sterols, essential fatty acids, ecosanoids, phospholipids, sphingolipds, oxidation of fatty acids, Q,Q - oxidation. Biosynthesis of ketone bodies.

-5 Hrs

6. **Proteins& Amino acid:**

Classification and properties, biosynthesis of amino acids, proteins, Essential amino acids, Metabolism of amino acids and protein synthesis. -6 Hrs

7.**Macromolecules :**

Physical and chemical properties of structures of Heamoglobin, immunoglobulins, nucleoprotein. -6 Hrs

8. **Vitamins:**

Classification and their properties, occurrence, functions, requirements, deficiency manifestations, role of vitamins as coenzyme. -6 Hrs

9. **Hormones:**

Chemical nature and properties, biochemical functions of hormones. -5 Hrs

10. **Nucleic acid and genetics:**

Brief introduction of genetic organization of the mammalian genome, genetic code, nucleic acids and structure of DNA and RNA, biosynthesis of DNA and its replication, mutation, mutagenesis, carcinogenesis. Biosynthesis of RNA structure of t- RNA, brief account of genetic engineering. -5 Hrs

11. **Metabolism of Nitrogen containing monomers:**

Nitrogen balance, Porphyrin biosynthesis, formation of bile pigments, hyperbilurubinmia, purine biosynthesis, pyrimidine biosynthesis. -4 Hrs

12. **Minerals:**

Metabolism: Functions and properties of minerals, including metabolism – calcium phosphorous, magnesium, iron, sodium, potassium and other trace elements. -4 Hrs

13. **Nutrition:**

Principles and nutritional significance of carbohydrates, lipids and proteins and major food stuffs.Functional tests of liver and Kidney. Elementary basis of biochemical mode of action of drugs, liposomal Benz oxidation, Biochemistry of urine and blood. -4 Hrs

14. **Regulation of gene expression:** Positive and Negative regulations, in the view of different concepts and chimericgenes -3 Hrs

PRACTICALS **-75 Hrs**

Title of the experiment

1. Qualitative analysis of carbohydrate
2. Qualitative analysis of protein.
3. Qualitative analysis of fats.
4. Qualitative analysis of abnormal constituents of urine.
5. Qualitative analysis of milk.
6. Preparation of standard buffer (citrate, Phosphate carbonate) and measurement of pH.
7. Separation of amino acids by two-dimensional paper chromatography and gel electrophoresis.
8. Separation of lipids by TLC.
9. Quantitative estimation of amino acids.
10. Quantitative estimation of proteins.
11. Identification of C-terminal amino acids of proteins.
12. Isolation of casein from milk.
13. Isolation and assay of glycogen from the liver and skeletal muscle or rats.
14. Isolation and determination of DNA
15. Isolation and determination of RNA
16. Estimation of blood glucose.
17. Enzymatic hydrolysis of glycogen by Q and Q amylase.
18. Acid hydrolysis and action of salivary amylase on starch.
19. Estimation of chloride in urine.
20. Estimation of protein in blood.
21. Estimation of SGPT activity in serum.
22. Estimation of blood cholesterol.
23. Estimation of ammonia in urine.
24. Estimation of creatinine in urine.
25. Estimation of SGOT activity in serum.

Recommended Books:

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry.
3. Biochemistry by Stryer
4. Textbook of Biochemistry by Rama Rao.
5. Textbook of Biochemistry by Deb.
6. Practical biochemistry by R.C.Gupta and S.Bhargavan.
7. Introduction of practical Biochemistry by David Plummer.
8. Practical Biochemistry for Medical students by Rajagopal & Ramakrishna.
9. Handbook of practical Biochemistry by V.K.Malhotra.

1.5 PHARMACOGNOSY

THEORY **-75 Hrs**

Scope: To learn and understand the cultivation and production of crude drugs and their usefulness.

Objectives: Upon completion of the course, the student shall be able to

Know the advantages in the cultivation and production of drugs

Know the evaluation techniques for the herbal drugs.

Lecture-wise Programme

1. Definition, History, present status, future scope & Development of Pharmacognosy -2 Hrs
2. Classification of crude drugs: Alphabetical, Morphological, chemical, taxonomical, pharmacological and chemotaxonomy -5 Hrs
3. Cultivation, collection, processing & storage of crude drugs -10 Hrs
   - General principle of cultivation & collection of crude drugs
   - Advantages & disadvantages of cultivation
   - Factors influencing cultivation of medicinal plants, Soil & soil fertility
   - Plant hormones & their applications.
   - Polyploidy, mutation and hybridization with special reference to medicinal plants
   - Collection of crude drugs
   - Processing, storage & preservation of crude drugs.
4. **Quality Control of Crude Drugs:** Different method of Adulteration of crude drugs and their evaluation by using various methods like Organoleptic, Microscopic, Physical, Chemical, Biological and Quantitative microscopy -4 Hrs
5. Conservation of medicinal plants -2 Hrs
6. Detailed study of the following crude drugs with specific emphasis on source, cultivation, collection, preparation, storage, diagnostic characters applicable, constituents, chemical tests, substitutes, adulterants and uses. -35 Hrs
   a. **Carbohydrates & their derived products:** Agar, Gum Acacia, Gum tragacanth, Honey, Isapghol, Bael, Pectin & starch
   b. **Tannins:** Black Catechu, Myrobalan, Pale catechu and Arjuna.
   c. **Lipids:** Castor oil, Wool fat, Bees wax, Cod liver oil, Olive oil, Sesame oil and Chaulmoogra oil

d. **Proteins:** Gelatin and spirulina

e. **Volatile oils:** Mentha, Coriander, Cinnamon, Clove, Fennel,Cardamom, Lemon grass oil, Sandal wood, Garlic

f. **Saponins:** Dioscorea, Gokhru, Liquorice, Ginseng, Centella

g. **Cardio active sterols:** Digitalis, Squill, Stropanthus

h. **Anthraquinones:** Aloes, Senna, and Rhubarb

i. **Alkaloids:** Areca, Lobelia, Belladonna, Berberis, Datura, Opium, Ergot, Rauwolfia, Adathoda, Pilocarpus,Kurchi, Punarnava, Sankupusphi, Ephedra

j. **Resins:** Guggul, Garcinia,Balsam of Tolu, Benzoin, Balsum of Peru, Asafoetida, Turmeric, Ginger and Shellac

7. **Tumor inhibitors:** Taxol, Vinca and Podophyllum -5 Hrs
8. **Anti hepatotoxic and oral hypoglycemic agents:** Phyllanthus & Gymnema -4 Hrs
9. **Plant fibers used as surgical dressings:** Cotton, Jute, Flax, silk, wool and rayon. Sutures – surgical catguts and ligatures -5 Hrs
10. **Pharmaceutical aids:** Talc, Bentonite, Kaolin, Kieselguhr -3 Hrs

Practical: -75 Hrs

1. Identification of crude drugs cited in theory (entire condition) by Morphological characters
2. Microscopical studies of some selected drugs mentioned in theory, Datura, senna, vinca, cinchona, cinnamon, clove, nuxvomica, ephedra, coriander, fennel and ginger
3. Microscopical studies of some powdered drugs of single or mixture of two components cinchona & cinnamon, coriander & fennel, senna & datura.
4. Identification of unorganized drugs mentioned in theory by Morphological characters & chemical tests.
5. Microscopical measurements of cells & cell contents: Phloem fibres and starch grains
6. Distillation of volatile oils
7. Determination of foaming index
8. Determination of moisture content of crude drugs

Recommended Books

1. Pharmacognosy: V.E.Tyler. Lynn. R. Brady, James E. Robgers.

2. Text book of Pharmacognosy by T.E.Wallis.

3. Study of crude drugs by Iyenger.

4. Powder crude drugs by Iyenger

5. Chemistry of organic natural products vol. I and II by O.P. Agarwal.

6. Practical pharmaceutical chemistry by Backett and Stanlake

7. Indian herbal pharmacopoeia and British herbal pharmacopoeia

8. Anatomy of crude drugs by M.A. Iyengar

9. Text book of Pharmacognosy –Ed.3-C.K. Kokate.

10. Pharmacognosy Pharmacobiotechnology- James Bobbers, Marilyn K, Speedice & V E.Tylor.

II.B. PHARMACY

2.1 PHARMACEUTICAL ORGANIC CHEMISTRY- II

THEORY **-75 Hrs**

Scope: The subject deals with structure, stability and reactivity of organic compounds. It emphasizes on mechanisms and orientation of reactions. The syllabus includes physical properties of organic compounds and named reactions. This course also deals with stereo chemical aspects of organic compounds and stereo chemical reactions.

Objectives: Upon completion of the course the student shall be able to

- write the structure, name, the type of isomerism of the organic compound
- write the reaction, name the reaction and understand orientation of reactions
- know and account for stability/reactivity/orientation

Lecture wise programme:

1. Stereochemistry: -20 Hrs

a) Optical isomerism:

Stereoisomerism, definition Tetrahedral carbon, Chirality, absolute configurations, RL rotation, sequence rule, Conventions used in stereochemistry, Lexicon of elements of symmetry, Racemic modifications and properties, Resolution of racemic modifications. Conformational analysis. Walden inversion, Stereomutation, Asymmetric synthesis, sterospecific and stero selective synthesis.

b) Geometrical isomerism:

Nature, rotation about a carbon-carbon double bond. Modern theory of double bonds, Nomenclature of isomers, Determination of configuration, stereochemistry of cyclic compounds.

c) Stereochemistry of Biphenyl compounds and Nitrogen compounds:

Walden Inversion, Nature, factors affecting, Mechanism of Asymmetric synthesis, Configuration of Biphenyl Molecule, optical activity, hybridization of orbitals. Stereochemistry of Nitrogen compounds, Amines and Oximes.

Nucleophillic aromatic substitution, α, β -unstaturated carbonyl compounds, conservation of orbital symmetry and rules, electrocyclic, cycloaddition and sigmatropic reactions, Neighbouring group effects, catalysis by transition metal complexes, stereoselective and stereospecific reactions, new organic reagents used in drug synthesis.

2. Reactions of synthetic importance -12 Hrs

Catalytic hydrogenation, dehydrogenation, Metalhydride reduction, Reduction with hydrazine and its derivatives, Birch reduction, clemmensen reduction, Meerwin Pondroff reduction, Oxidation with perchloric acid, leadtetraacetate, Mercuric acetate and selenium Oxide, Beckmann rearrangement, schmidt rearrangement, Darzen reaction.

3.Heterocyclic Chemistry -12 Hrs

Classification of Heterocyclic compounds, nature and nomenclature, Preparation and important reactions of pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole, pyridine, pyrimidine, indole, quinoline, isoquinoline, acridine, phenothiazine, azepines, Diazepines, Quinolones and Quinarlones.

Chemistry of Biomolecules of Pharmaceutical Importance: -16 Hrs

Alkaloids: Classification, general methods of structural elucidation, chemistry and pharmacological activity of

i)Atropine and related compounds

ii)Quinine and quinidine

iii)Reserpine

iv)Morphine and related compounds

v)Papavarine

vi)Ephedrine

vii)Ergot

viii)Vinca alkaloids

ix)xanthine alkaloids

Glycosides: - 5 Hrs

Basic ring system, nomenclature and stereo chemistry of steroid nucleus, chemistry of Digitoxin, Digoxin, Lanatosides, Diosgenin and Sarasapogenin, hecogenin, sennosides.

Vitamins: -5 Hrs

Chemistry and medical pharmaceutical uses of Vitamin A, D, E, K, B_1, B_2, B_6, B_{12}, C and Folic acid.

Terpenoids: -5 Hrs

Classification, general methods of determining the structure, chemistry and uses of Citral, Menthol, Thymol, Camphor, Alpha-terpineol, alpha-pinene

PRACTICALS **-75 Hrs**

I.Preparation of homocyclic compounds. (Students to prepare Minimum of six homocyclic compounds listed below)

1. 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
2. Benzoic acid/Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
3. 1- Phenyl azo -2- napthol from aniline by diazotization and coupling reactions

II. Preparation of heterocyclic compounds. (Students to prepare Minimum of Five heterocyclic compounds listed below or any other heterocyclic compounds)

1. Benzimidazole from ortho phenylene diamine.
2. 2,3–diphenyl quinoxaline from benzil
3. Benzotriazole from ortho phenylene diamine by diazotization.
4. 2-phenyl indole from acetophenone.
5. 3-methyl 1-phenyl pyrazol-5-one from ethylacetoacetate

III. Qualitative analysis of mixture of organic compounds containing 2 compounds – methods of separation and analysis.

IV. Determination of number of functional groups

Recommended Books:

1. Organic chemistry by I.L Finar
2. Organic chemistry by Morrison and Boyd.
3. Reactions and reagents by O.P. Agarwal.
4. Advanced Organic chemistry by Jerry March
5. Stereochemistry of carbon compounds by E.L.Eliel.
6. Roberts JD and Caserio M.C- Basic principles of organic chemistry WA Benjamin Inc. New York.
7. Stereochemistry by Potapov.
8. Singh Harkishan and Kapoor.V.K, Organic Chemistry, Vallabh Prakashan, Delhi.
9. Vogel A1. A text book of practical organic chemistry the English language book society and Lognman group limited, London.
10. Advanced practical organic chemistry by N.K.Vishnoi.

2.2 PHYSICAL PHARMACEUTICS

THEORY **-75 Hrs**

Scope: The course deals with the various physical, physicochemical properties and principle involved in formulations of dosage forms. Theory and practical components of the subject help the student to get a better insight in to various areas of formulation research and development and stability studies of pharmaceuticals.

Objectives: Upon the completion of the course student shall be able to

Understand various physicochemical properties of drug molecules in the designing the dosage form

Know the principles of chemical kinetics & to use them in assigning expiry date for formulation

Demonstrate use of physicochemical properties in evaluation of dosage forms.

Appreciate physicochemical properties of drug molecules in formulation research and development

Lecture wise programme:

1. **Physical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations & applications. -5 Hrs

2. **Colloids.**
   Introduction, types of colloidal systems, optical properties of colloid, kinetic properties of colloids, electric properties of colloids, solubilisation. -9 Hrs

3. **Coarse Dispersions.**
   Suspensions, interfacial properties of suspended particles. Setting in suspensions, formulation of suspensions, emulsions and theories of emulsification. Physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions, phase equilibria and emulsion formulation, special emulsion system, semi solids and gels.
   -12 Hrs

4. **Surface & Interfacial Phenomenon.**
   Liquid interfaces, adsorption at liquid interfaces, adsorption at solid interfaces, Electrical properties of interfaces, surface tension and its determination, classification of surfactants. -9 Hrs

5. **Kinetics.**
   Rates and orders of reaction, influence of temperature and other factors on rates, decomposition and stabilization of medical agents, kinetics in the solid state, accelerated stability analysis, kinetics of drug transport in vivo. -10 Hrs

6. **Micromeritics.**
   Particle size and size distribution, methods of determining particle size, particle shape and surface area, methods of determining surface area, pore size, derived properties of powders -8 Hrs

7. Rheology.

Viscosity, newtonian and non newtonian fluids, thixotropy and its application, Rheology of disperse system, viscomters. -5 Hrs

8. Complexation & Protein Binding.

Metal-complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, complexation and drug action, crystalline structure of complexes, thermodynamic treatment of stability constants. -10 Hrs

9. Thermodynamics

Thermodynamics first, second, third law of thermodynamics. Free energy functions and applications. Internal energy–open, closed and isolated systems, Isothermal, adiabatic and reversible process. Enthalpy, entropy, criteria of spontaneity and equilibrium.

-7 Hrs

PRACTICALS -75 Hrs

1. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. Determination of surface/ interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
4. Study of rheological properties of various types of systems using different viscometers.
5. Studies of different types of colloids and their properties.
6. Preparation of various types of suspensions and determination of their sedimentation parameters.
7. Preparation and stability studies of emulsions.
8. Studies on different types of complexes and determination of their stability constants.
9. Determination of half-life, rate constant and order of reaction.
10. To study the influence of various factors on the rate of reaction.
11. Accelerated stability testing, shelf-life determination and expiration dating of Pharmaceuticals.
12. Preparation of Pharmaceutical buffers and determination of buffer capacity.
13. Experiments involving tonicity adjustments.
14. Determination of partition co-efficient of iodine distributed between carbon tetra chloride and water.
15. Effect of addition of salt on the solubility of pharmaceutical substances.
16. Effect of changing pH on the solubility of pharmaceutical substances.
17. Effect of co-solvent on the solubility of pharmaceutical substances.
18. Effect of surfactant on the solubility of pharmaceutical substances.

RECOMMENDED BOOKS:

1. Physical Pharmacy by Martin.
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper & Gunn.
4. Stocklosam .J. Pharmaceutical calculation, Lea & Febiger, Philadelphia.
5. Liberman H.A. Riogor MM and Banker G,8, Pharmaceutical dosage forms, Dispense systems, Vols 12,2 Marcel Dekker Inc. NY.
6. Liberman HA, Lachman C & Schwarly SB Pharmaceutical Dosage forms, Tablets Vol. 1-3, Marcel Dekker Inc.
7. Physical Pharmaceutics by R.Manavalan and C.Ramasamy.

2.3 INDUSTRIAL PHARMACOGNOSY

THEORY **-75 Hrs**

Scope: To learn and understand the techniques involved in the herbal drug, cosmetic preparation and their standardization

Objectives: Upon completion of the course, the student shall be able to

know the modern extraction techniques, characterization and identification of the herbal drugs

understand the preparation and development of herbal drugs as per GMP guidelines

Lecture-wise Programme

1. Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs -11 Hrs
   a. Introduction to plant biochemistry with special reference to basic metabolic pathways.
   b. Introduction to biogenesis of secondary metabolites like Atropine, Ergotamine, Morphine and Steroidal glycosides
   c. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.
2. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India -3 Hrs
3. Industrial production and estimation of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Tropane alkaloids, Curcumin,Rutin, Phyllanthin,

   Asiaticoside, Andrographolides and Gymnemic acid -10 Hrs 4. Herbal formulation development and standardization -10 Hrs
   a. Preparation, stability testing of Herbal extracts and formulations
   b. Role of Herbs in Cosmetics

      Hair care preparation - Henna, Amla & Hibiscus

      Skin Care preparation – Aloe vera, Turmeric & Sandal wood

   c. Neutraceuticals
5. WHO Guidelines for the assessment of Herbal Medicine and Cosmetics -3 Hrs

6. a. Basic principles involved in the alternative system of medicine viz. Ayurveda, Siddha, Unani and Homeopathy -10 Hrs b. Preparation and standardization of Ayurvedic formulations i.e. Aristas, Asawas, Ghutika,Churna, Leha and Bhasma.

7. **Plant Toxins and adverse drug reactions:** Natural allergens, Hallucinogens, Teratogens -6 Hrs

8. **Plant tissue culture:** Historical development, nutritional requirements, growth and their maintenance, applications of plant tissue culture and types of cultures related to cell suspension culture, callus culture, hairy root culture and protoplast culture -10 Hrs

9. **Enzyme Biotechnology** -10 Hrs

   Introduction, general methods of isolation, purification and application of immobilized enzymes.

   Biological sources, methods of preparation, chemical nature and uses of:

   a. Papain b. Pepsin c. Trypsin d. Pancreatin e. Asparaginase and f. Urokinase

10. a.Herb-Drug interaction -2 Hrs

    b. Edible Vaccine

Practical: -75 Hrs

1. Exercise involving isolation of active principles
   a. Caffeine - from tea dust.
   b. Curcumin from turmeric
   c. Piperine from Pepper
   d. Hespiridin from orange peel
   e. Citric acid from Lemon
   f. Casein from milk
   g. Starch from potato
2. Separation of amino acids by Paper chromatography
3. TLC analysis of extracts

4. Determination of
    a. Moisture content (Loss on drying)
    b. Extractive values
    c. Ash values
    d. Swelling factors
5. Preparation and standardization of Ayurvedic formulations
6. Preparation of herbal cosmetics
7. Demonstration of experiments in column chromatography
8. Demonstration of experiments in plant tissue culture

Recommended Books

1. Pharmacognosy by Trease and Evans 14th and 15th edition.
2. Pharmacognosy Pharmacobiotechnology- James Bobbers, Marilyn K, Speedice & V.E. Tylor.
3. Herbal Drug Industry R.D.Chowdary.
4. The formulation and preparation of cosmetic, fragrances and flavours.
5. Remington's Pharmaceutical sciences.
6. WHO Guidelines – website http:/www/who.int/druginformation
7. Standardization of botanicals.
8. Quality Control Herbal Drugs - Pulok K.Mukherjee.
9. Pharmacognosy and Phytochemistry I edition, vol- l &II by Vinod. D. Rangari
10. Practical Pharmacognosy, III edition, C.K. Kokate.

2.4 PHARMACEUTICAL TECHNOLOGY

THEORY **-75 Hrs**

Scope: This course is designed to impart a fundamental knowledge on the art and science of various machines and their handling in pharmaceutical industry. This course focuses on various topics like unit operations, material handling, pharma plant construction, corrosion, industrial pollution etc.

Objectives: Upon completion of the course student shall be able

1. To know various unit operations used in Pharmaceutical Industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various tests to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical Industries

Lecture wise programme:

1. **Material of Pharmaceutical plant construction**: General study of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass. -4 Hrs

2. **Industrial Hazards and safety precautions**: Mechanical, chemical, electrical, fire and dust hazards, industrial dermatitis, accident records etc., safety measures in pharmaceutical plants -4 Hrs

3. **Fluid flow**: Types of flow, Reynold's number, viscosity, concept of boundary layer, basic equations of fluid low, valves, flow meters, manometers and measurement of flow and pressure. -4 Hrs

4. **Filtration and centrifugation**: Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, meta filter, etc. Factors affecting filtration. Mathematical problems on filtration, optimum cleaning cycle in batch filters,. Principles of centrifugation, industrial centrifugal filters and their application. -8 Hrs

5. **Crystallization**: characteristics of crystals like purity, size, shape, geometry, habit, forms size and factors affecting them, solubility curves and calculation of yields. Material and heat balances around Swenson Walker Crystallizer. Supersaturation theory and its limitations, Nucleation mechanisms, crystal growth, study of various types of Crystallizer. Caking of crystals and its prevention. Numerical problems on yields. -9 Hrs

6. **Refrigeration and air conditioning**: Principal and applications of refrigeration and air conditioning. -5 Hrs

7. **Heat transfer:** Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam electrical energy, steam pressure, boiler capacity and mathematical problems on heat transfer. -4 Hrs

8. **Evaporation**: Basic concept of phase equilibrium, factor affecting evaporation, type of evaporators, film evaporators, single and multiple effect evaporators, mathematical problems on evaporation. -6 Hrs

9. **Distillation**: General theory applied to binary mixtures, boiling point and equilibrium diagrams and Raoults law. Constant boiling mixtures (Azeotropes). Rectification, construction of rectifying columns. Simple distillation, Steam distillation, Flash distillation, Molecular distillation and Extractive distillation and its applications. -7 Hrs

10. **Drying:** Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and types of dryers, used in pharmaceutical industries and special drying methods. Mathematical problems on drying. -8 Hrs

11. **Size reduction**: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill etc. -6 Hrs

12. **Size separation:**
Standards Sieves, IP grade powder. Different modes of size separation, Types of screening equipments, Sieves, Sieve shaker, sedimentation tanks, cyclone separator, elutriation tank, Air separator, Bag filter and particle size distribution. -6 Hrs

13. **Mixing**: Theory of mixing, solid- solid, solid- liquid and liquid – liquid-mixing equipments. -4 Hrs

PRACTICALS -75 Hrs

1. Effect of particle size analysis
2. Evaluation of particle size distribution
3. Determination of moisture content and loss on drying
4. To determine the overall heat transfer co-efficient
5. Construction of drying curves (for calcium carbonate and starch)
6. Size reduction: to verify the laws of size reduction using ball mill.
7. Measurement of dew point
8. Effect of density on mixing
9. Experiment to illustrate solid / solid mixing
10. Determination of mixing efficiency using different types of mixtures.
11. Determination of effect of mixer on globular size of castor oil emulsion.
12. Experiments to demonstrate applications of centrifugation.
13. Experiments to illustrate the influence of various parameters on the time of drying.

RECOMMENDED BOOKS:

1. Introduction to chemical engineering by Walter L Badger.
2. Cooper &Gunn's Tutorial Pharmacy.
3. Theory and practice of Industrial Pharmacy by Lachman.
4. Refrigeration and Air conditioning by L. Ballaney.
5. Remington's The science and Practice of Pharmacy, Mack Publishing Co. Easton, Pernsybrania.
6. MaCabe WL and Smith J.C. Unit operations of Chemical Engineering McGraw Hill international Book Co., London.
7. Parry RH & Chilton CH Chemical Engineers Handbook, McGraw Kogakusha Ltd.,
8. Pharmaceutical engineering practical manual (unit operations) by Sudhakare Reddy published by Pharma books syndicate.
9. Pharmaceutical engineering: Principles and practice, C.V.S. Subramanyam, 2^{nd} edition, 2006, Vallabh Prakashan, Delhi.

2.5 BIOSTATISTICS AND COMPUTER APPLICATIONS.

THEORY - 75 Hrs

SCOPE: This subject deals with the introduction to computers, M.S. Word, M.S. Excel, Computer graphics, operating system, softwares, Net-work, Internet, Computer application in clinical studies. Biostatistics deals with the Frequency distribution, Graphics, Measures of central tendency, Correlation, Regression, Probability theory, Sampling technique, Sample, Parameter, Statistics, Students t-test and Pharmaceutical examples.

OBJECTIVES: Upon completion of the course the student shall be able to

- know the operation of M.S. Word, M.S. Excel, M.S. Access
- know the various application of computers in pharmacy
- know the various statistical technique to solve statistical problems
- solve statistical problems by using Excel
- appreciate various applications of software packages in Pharmacy
- Appreciate statistical techniques in solving the problems.

LECTURE WISE PROGRAMME:

BIOSTATISTICS

1. Scope of statistical methods of Medicine and Pharmacy. - 1 Hrs
2. Collection of Data. - 3 Hrs
3. Frequency distribution : - 4 Hrs
4. Measure of central tendency. - 4 Hrs
5. Theory of sampling - 3 Hrs
6. Statistical inference - 4 Hrs
7. Regression and correlation. - 5 Hrs
8. Probabilities. - 4 Hrs

COMPUTER APPLICATIONS

1. Computers:
   - 1.1 Introduction to computers: Basic components of computers, types of computer, characteristics, hardware aspects of computer. - 2 Hrs
   - 1.2 Operating systems: Definitions, types of operating systems, MS-DOS, UNIX, LINUX. Memories: RAM, ROM, secondary memory. - 6 Hrs
   - 1.3 Languages of computer:
     Introduction to programming languages.
     Overview of C-Introduction-Character set– C Token Keyword, flowchart and Identifier's-Assigning values to variables–Defining symbolic constants–

Arithmetic, Relational, Logical, Assignment, conditional, Bitwise, special Increment and decrement operators- Reading and writing a character. -12Hrs
Decision making and Branching:- Decision making with IF statements (Simple IF statement, IF–ELSE statement, Nesting of IF., ELSE, the ELSE, IF ladder)– Switch statement. - 5 Hrs
Decision making and looping:- which statement-the DO statement–FOR Statement. Arrays–String handling functions-user defined functions. - 5 Hrs

1.4 Computer Packages: MS Office – MS Word, MS Excel MS Power Point – Advantages and use. - 4 Hrs

1.5 Introduction to computer networks: Definition, LAN, WAN, Advantages, Internet world wide web. - 5 Hrs

1.6 Computer Graphics: Definition, Displays, devices, Graphical input and output devices, Multimedia–definition and application. - 4 Hrs

1.7 Computer applications in Pharmaceutical and clinical studies. - 2 Hrs

PRACTICALS **-75Hrs**

Exercises based on the following are to be dealt:

1. Computer operating systems like Unix, MS DOS, etc
2. Simple program in C
3. MS Office (MS-Word, MS-Excel, MS-Access, MS-Power point).

RECOMMENDED BOOKS:

1. Statistical methods by S. P. Gupta.
2. Statistics by Sancheti D.C., Kapoor V. K., Sultan Chand and Son's
3. E. Balagurusamy- Programming in ANSI-C Tata Mc. Graw Hill-1997.
4. Byron Gottfield-Programming with C.
5. C.Nellai Kannan-MS-Office.
6. Hunt N and Shelly J., Computers and cormmonsense, Prentice-Hall of India, New Delhi.
7. Popst and Perrum, Computer aided drug design, Academic Press, New York.
8. Writh, Systematic programming an introduction, prentice hall Englewood Cliff's New Jersy.
9. Tanen Baum, computer networks.
10. Rajaraman – FORTRAN.

III.B. PHARMACY

3.1 MEDICINAL CHEMISTRY-I

THEORY **-75 Hrs**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasis on chemical synthesis of important drugs under each class.

Objectives:
Upon completion of the course the student shall be able to

- understand the chemistry of drugs with respect to their pharmacological activity.
- understand the drug metabolic pathways, adverse effect and therapeutic value of drugs.
- know the Structural Activity Relationship of different class of drugs.
- write the chemical synthesis of some drugs

Lecture-wise Programme

1.Basic Principles of Medicinal Chemistry:
A)History and development of medicinal chemistry.
Drug Metabolism:

General pathways of drug metabolism (different types of reaction in phase - I and phase -II with examples), factors affecting drug metabolism including stereochemical aspects, significance of drug metabolism in medicinal chemistry. -3Hrs

B) Drug latentiation and prodrugs :

I) Basic concepts and application of prodrug design. -3 Hrs

II) Study of classification, mechanism of action (biochemical and molecular basis) structure activity relationship including stereochemical aspects, physiochemical properties and synthesis of selected drugs only (representative model drugs and marked with asterisk mark only) on the following categories of drugs.

1.Drug acting on CNS:

A.General anesthetics: Halothane*, Methoxyflurane*, Enflurane, Sevoflurane, Methohexital sodium*, Thiamylal sodium*, Thiopental sodium, Etomidate, Ketamine hydrochloride*

-4 Hrs.

B)Anxiolytics, Sedatives and Hypnotics: Chlordiazepoxide*, Diazepam*, Oxazepam, Chlorazepate dipotassium*, Prazepam*, Lorazepam, Halazepam, Flurazepam, Alprazolam, Barbital*, Phenobarbital, Mephobarbital, Talbutal*, Secobarbital, Triclofos sodium*. -4 Hrs

C)Antipsychotics: Chloropromazine hydrochloride*, Triflupromazine, Thioridazine, hydrochloride, Mesoridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate*, Trifluoperazine hydrochloride, Chloprothixene, Thiothixene, Lexapine succinate, Clozepine*, Haloperidol, Droperidol, Risoperidone. -4 Hrs

D)Anticonvulsants or antiepileptics: Phenytoin*, Barbiturates, Mephenytoin, Ethotoin, Trimethadione*, Paramethadione, Phensuximide, Ethosuximide*, Phenacemide, Carbamazepine*, Primidone*, Valproic acid* and Clonazepam*. -3 Hrs

E)CNS Stimulants and Psychedelics: Nikethamide*, Doxapram hydrochloride*, Dextroamphetamine sulphate*, Pentylene tetrazole, Phenelzine sulpahte, Tranylcypromine sulphate*, Pargyline hydrochloride, Amitriptyline hydrochloride*, Imipramine hydrochloride*, Desipramine hydrochloride, Doxepin hydrochloride*, Psilocybin and Psilocyn, Mescaline, Phenyclidine (PCP) tetrachydrocannabinol (THC). -5 Hrs

Drugs acting on ANS

a)Adrenergic Neurotransmittors: Structure and physiochemical properties, Biosynthesis and metabolism. -3 Hrs

Hydroxyamphetamine, Propylhexadine, Metorminal, Naphazoline, Tetrahydrazoline, Oxymetazoline, Xylometazoline. -4 Hrs

c)Adrenergic Antagonists: Tolazoline*, Phentolamine*, Phenoxybenzamine, Prazosin, Tetrazosin, Doxazosin, Ergotamine, Methysergide, Propranolol*, Dicloroisoproterenol, Practolol, Metibranolol, Acebutolol*, Atenolol*, Betaxolol, Bisoprolol, Esmolol, Metoprolol*, Labeatolol, Carvedilol. -4 Hrs

d)Cholinergic receptors drugs and related agents: Cholinergic receptors, Biochemical effects of muscarinic receptor stimulation. Cholinergic neurochemistry, stereochemistry of cholinergics. Acetylcholine*, Carbachol*, Bethanechol, Methacholine, Pilocarpine, Physostigmine,

Neostigmine, Pyridostigmine*, Edrophonium chloride, Ambenonium chloride, Pralidoxime chloride, Isofluorphate, Echothiophate iodide, Parathion, Malathion. -4 Hrs

e)Cholinergic blocking agents: Atropine sulphate, Hyoscyamine sulphate, Scpolamine hydrogen bromide, Homatropoine hydrogen bromide*, Ipratropium, bromide*, Tropicamide*, Cyclopentolate hydrochloride*, Clindinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Biperiden hydrochloride, Procylidine hydrochloride*, Isopropamide iodide. -4 Hrs

f)Ganglionic blocking agents and Neuromuscular blockers: Nicotine, Trimethaphan camsylate, Mecamylamine hydrochlroide*, Tubocurarine chloride, Mectrocurine iodide, Galamine triethiodide*, Decamethonium bromide*, Pancuronium bromide. -3 Hrs

g)Local Anestheics: Cocaine, Hexycaine, Meprylcaine, Cyclomethycaine, Piperocaine, Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate, Lignocaine*, Meprivacaine, Prilocaine, Etidocaine, Phenacaine, Diperodon, Dibucaine*, Dyclonine. -3 Hrs

Diuretics: Acetazolamide*, Dichlorphenamide, Chlorthiazide*, Hydrochlorthiazide*, Furosemide*, Bumetamide, Ethacrynicacid, Spironolactone, Triamterene*, Amiloride*, Mannitol. -3 Hrs

Antihistaminic agents: H1, H2, And H3 Receptors. Termination of histamine action, Diphenhydramine hydrochloride*, Dimenhydrinate, Bromodiphenhydramine hydrochlroide*, Doxylamine Succinate*, Carbinoxamine maleate*, Clemastine fumarate*, Diphenylphyraline hydrochloride, Tripelennamine hydrochloride*, Pyrilamine maleate*, Cyclizine hydrochloride*, Chlorcyclizine hydrochloride*, Meclizine hydrochloride*, Buclizine hydrochloride, Pheniramine maleate, Chlorpheniramine malaete, Triprolidine hydrochloride*, Phenindamine tartrate*, Promathazine hydrochloride*, Trimeprazine tartrate, Methdilazine hydrochlroide*, Cyproheptadine hydrochloride*, Azatadien maleate, Astemizole, Loratadine, Citrizine, Acrivastine Cromolyn sodium, Cimetidine*, Famotidine, Ranitidine, Nizatidine, Omeprazole, Lansoprazole. -8 Hrs

Prostaglandins and other Eicosanoid: Eicosanoid, Biosynthesis, Drug action medicated by eicosanoids, Design of eicosanoids drugs, eicosanoids approved for human clinical use. -2 Hrs

Analgesics, antipyretics and anti-inflammatory drugs.

Morphine and related drugs: Morphine sulphate, Codeine phosphate, Hydromorphone hydrochloride, Oxymorphonehydrochloride, Apomorphine hydrochloride, Meperidine hydrochloride*, Alphaprodine hydrochloride, Anilierdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Levophanol tartrate, Pentazocaine nalorphine hydrochloride, Lavellorphan tartrate, Naloxone hydrochloride, -4 Hrs

Antitussives : Noscapine, Dextromethorphan hydrogen bromide, Benzonatate. -2 Hrs

Anti-inflammatory agents: Sodium salicylate, Aspirin, Indomethacin*, Sulindac, Salsalate*, Tolmethin sodium, Zomipirac sodium, Diclofenac sodium, Ibuprofen*, Naproxen*, Fluribiprofen, Piroxicam*, Acetaminophen, Phenylbutazone*, Oxyphenbutamine. -5 Hrs

PRACTICALS **-75 Hrs**

I) Synthesis of selected compounds from the course content (10 drugs)

II) Monograph analysis of selected drugs from course content

1. Phenobarbitone
2. Caffine
3. Theophylline
4. Furosemide

III) Assay of Selected drugs from course content prescribed as per I.P or B.P.

1. Assay of Ibuprofen by alkalimetry
2. Assay of Aspirin by alkalimetry
3. Assay of Diclofenac by alkalimetry
4. Assay of Analgin by Iodimetry
5. Assay of Paracetamol by Iodimetry
6. Assay of Phenobarbitone by non aqueous titrimetry
7. Assay of Chlorpromazine by cerrimetry
8. Assay of Atropin by alkalimetry
9. Assay of Frusemide by alkalimetry
10. Assay of Chlorpheniramine by non aqueous titrimetry

RECOMMENDED BOOKS:

1. Burger's medicinal chemistry Vol I to IV.
2. Remington's pharmaceutical sciences 20th edition.
3. Ashutoshkar's medicinal chemistry.
4. Medicinal chemistry by Kadam Vol I and II.
5. Medicinal chemistry W.A.Foye.
6. Medicinal chemistry Wilson and Giswold.

3.2 DISPENSING AND PHARMACEUTICAL FORMULATIONS

THEORY -75 Hrs

Scope: This course is designed to impart a fundamental knowledge on the art and science of formulating different dosage forms. It prepares the students for most basics of the applied filed of pharmacy.

Objectives: Upon the completion of the course the student should be able to:

- Know the formulation aspects of different dosage forms
- Do different pharmaceutical calculation involved in formulation
- Formulate different types of dosage forms
- Appreciate the importance of good formulation for effectiveness

Lecture-wise Programme

1. **Prescription**: Handling of prescription, source of errors in prescription, care required in dispensing procedures including labeling of dispensed products. General dispensing procedures including labeling of dispensed products. - 4 Hrs

2. **Pharmaceutical calculations**: Latin terms used in prescription, posology, factors determining doses of drugs, calculation of doses for infants, adults and elderly patients; Enlarging and reducing recipes, percentage solutions, alligation, alcohol dilution, proof spirit, isotonic solutions. -5 Hrs

3. **Incompatibility**: Physical, chemical and therapeutic incompatibilities- definition, reasons and corrections of incompatibilities, role of pharmacist in overcoming such incompatibilities in prescriptions. -12 Hrs

4. Development of Indian Pharmacopoeia and introduction to other pharmacopoeias such as B.P, U.S.P., European Pharmacopoeia, extra pharmacopoeia and Indian national formulary. -3 Hrs

5. **Liquids:** Solutions, syrups, dry syrups, Elixirs, spirits, aromatic waters, liquids for external use –lotions, liniments, ear drops, throat paints, gargles, eye drops, glycerines, collodions.

   Definitions, general formulation, manufacturing procedures. Uses of official and other products in common use. -10 Hrs

6. **Semisolids**: Ointments, creams, pastes, jellies, definitions, bases, general formulations, manufacturing procedures. Uses of official and other products in common use. -10 Hrs

7. **Suppositories**: ideal requirements, bases, manufacturing procedures and uses of official and other important products. -7 Hrs

8. **Powders:** Advantages and limitations as dosage form, manufacturing procedure and equipments, special care and problems in manufacturing powders, powders of I.P and their uses, effervescent granules and salts and their specific uses. -10 Hrs

9. **Pharmaceutical aerosols:** Definition, propellants, general formulation, manufacturing and packaging. -4 Hrs

10. **Extraction and Galenical products**: Principle and method of extraction, preparations of infusion, tinctures, dry and soft liquid extracts. -10 Hrs

PRACTICALS: -75 Hrs

Solutions

1. Chloroform water
2. Camphor water
3. Aqueous Iodine solution
4. Strong Iodine solution
5. Cresol with soap solution
6. Strong ammonium acetate solution
7. Chlorinated lime and boric acid solution
8. Surgical solution of chlorinated soda IP55

Syrups

9. Syrup IP
10. Codeine phosphate syrup

Throat paint

11. Compound Iodine paint

Lotions

12. Calamine lotion
13. Benzyl benzoate lotion

Liniment

14. Turpentine liniment
15. Camphor liniment

Gargle

16. Potassium permanganate gargle

Powders

17. Compound effervescence powder
18. Dusting powder

Ointments

19. Simple ointment
20. Sulphur ointment
21. Emulsifying ointment
22. Compound benzoic acid ointment

Suppositories

23. Zinc oxide suppository
24. Iodoform suppository

Incompatabilities

25. Physical incompatabilities
26. Chemical incompatabilities
27. Therapeutic incompatabilities

Recommended Books

1. Ansel H.C., Introduction to Pharmaceutical dosage forms, K.M.Vaghese & Co, Bombay.
2. Aulton M.E., Pharmaceutics-The science of Dosage form design, ELBS/Churchil Livingstone.
3. Carter S.J., Cooper and Gunn's Dispensing for Pharmaceutical Students, CBS publishers, Delhi.
4. Carter S.J. Cooper and Gunn's Tutorial Pharmacy CBS Publishers, Delhi.
5. Remington's The science and practice of Pharmacy, Mack Publishing Co, Easton, Pernsybrania.
6. Lea and Febiger Pharmaceutical Dosage form and Drug delivery systems, Philadelphia.
7. Stoklosa MJ Pharmaceutical calculation, Lea & Febiger, Philadelphia.
8. Indian Pharmacopoeia 1966, 1985 published by The Controller of Publications, Delhi.
9. Latest editions of IP, BP, USP, Extra pharmacopoeia, Merk index and British pharmaceutical codex

3.3 PHARMACOLOGY - I

THEORY **-75 Hrs**

Scope: This subject will provide an opportunity for the student to learn about the drug with regard to classification , pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject, apart from general pharmacology, drugs acting on autonomic nerve system, central nervous system, cardiovascular system, respiratory system, free radicals and anti-oxidants , principles of toxicology, renal system will be taught.

Objectives:

a. to understand the pharmacological aspects of drugs falling under the above mentioned chapters;
b. to handle and carry out the animal experiments ;
c. to appreciate the importance of pharmacology subject as a basis of therapeutics ; and
d. to correlate and apply the knowledge therapeutically.

Lecture-wise Programme

1. **General Pharmacology**: -22 Hrs

a. Introduction, definitions and scope of Pharmacology
b. Sources of drugs and dosage forms
c. Routes of administration of drugs.
d. Pharmacokinetics (absorption, distribution, metabolism and excretion)
e. Pharmaco dynamics
f. Combined effect of drugs
g. Factors modifying drug effects
h. Pharmacogenetics and Pharmacogenomics
i. Dose response relationship, Structure activity relationship
j. Adverse drug reactions
k. Drugs interactions
l. Drug therapy during pregnancy and lactation
m. Drug therapy for neonates, infants, children and elderly.
n. Discovery and development of new drugs

2. Pharmacology of Peripheral Nervous system : -10 Hrs

a. Neurohumoral transmission (autonomic and Somatic Nervous system)
b. Cholinergic and anticholinergic drugs
c. Adrenergic and antiadrenergic drugs
d. Ganglionic stimulants and blocking agents.
e. Neuromuscular blocking agents
f. Local anaesthetic agents
g. Ocular pharmacology
h. Drugs used in myasthenia gravis .
i. Neuromuscular blocking agents.

3. Pharmacology of Central Nervous systems: -20 Hrs

a. Neurohumoral transmission in the C.N.S.
b. General anaesthetics.
c. Alcohols
d. Sedatives, hypnotics
e. Psychopharmacological agents – anti-psychotics, anti-anxiety agents, antidepressants, antimanics and hallucinogens and Nootropics, centrally acting muscles relaxants .
f. Anti – epileptic drugs.
g. Drugs used in Neurodegenerative disorders
h. Analgesics, antipyretics, anti-inflammatory and anti-gout drugs.
i. Narcotic analgesics and antagonists.
j. Analeptics.
k. Drug addition and Drug Abuse.

4. Pharmacology of Cardiovascular System. -10 Hrs

a. Cardiotonics
b. Antihypertensive drugs.
c. Antianginal and vasodilator drugs
d. Antiarrhythmic drugs.
e. Antihyperlipedemic drugs.
f. Drugs used in the therapy of shock.

5. Drugs acting on urinary system. -2 Hrs

a. Fluid and electrolyte balance.
b. Diuretics and anti-diuretics.

6. Drugs acting on the Respiratory system: -5 Hrs

a. Anti- asthmatic drugs including bronchodilators.
b. Anti-tussives and expectorants.
c. Respiratory stimulants.
d. Mucolytics and Nasal decongesants

7. Principles of Toxicology -6 Hrs

a. Definitions of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorus and atropine poisoning .
b. Heavy metals and their antagonists.
c. Definition for acute and subacute and chronic toxicity studies .

PRACTICALS **-75 Hrs**

Experiments

1. Experimental Pharmacology - Definition, Aims and in-*vivo* studies, Commonly used laboratory animals and their handling commonly used instruments in in-*vivo* studies. Some common and standard techniques. Bleeding and Intravenous injection, Intragastric administration.
2. Experiments on central nervous system
   a. CNS Stimulants and depressants
   b. General anasthetics
   c. Local anesthetics
   d. Analgesics
   e. Anti-convulsant drugs
   f. Catatonics and Anti Catatonics
   g. Hypnotics
   i. Anti-Anxiety agents
   j. Muscles Relaxants
   k. Anti-inflammatory activity
3. Effects of autonomic drugs on Rabbit's eye.
4. Statistical calculations in pharmacology.
   a. Students 't' test.
   b. ANOVA
5. Experiments based on computer models like expharm CD.

RECOMMENDED BOOKS:

1. Rang MP Dale MM Reter JM-Pharmacology.
2. Pharmacology and Therapeutics - Satoskar.
3. Kulkarni S.K. Hand book of Experimental Pharmacology.
4. Essentials of medical Pharmacology by K.D. Tripatdi
5. Essentials of pharmocotherapeutics by F.S.K. Barar.
6. Basic and clinical pharmacology by Bortren G. Katzung
7. Understanding Pharmacology and physiological approaches by Reilani Grajeda.
8. Derasari and Gandhi's Elements of Pharmacology by R.K. Goyal , Anitha A.Mehta B.S.Shed Prakasam, Ahmedabed
9. Principles of Pharmacology- HL Sharma & KK Sharma
10. Goodman and Gillmans, The Pharmacological basis of therapeutics by I.G. Hardman ad Lee E. Limbard, M.c. Graw hill, health profession Dvn.
11. Pharmacology by H.P.Rang, M.M.Dale, J.M. Ritter, Churchill living stone.
12. Lewis's Pharmacology by J.Crosslard , Churchill living stone
13. Modern Pharmacology by Craig CR and Stizel RR Little Brown and compag.
14. Clinical Pharmacology by Laurance DR and Bennet PN Churchill living stone
15. Pharmacology, Lippincott's illustrated Revision by Mycek M.J. Gertner DB, and perper MM, Lippincott company, Philadarphia
16. Chronopharmacology cellular and biomedical Interaction by B.Lammer
17. Topics of Molecular Pharmacology I & II – By Nurger and Roberts.
18. Principles of Pharmacology by Paul. L. Chapman and Hall.
19. Pharmacotherapy: A Pathological approach by Diprio.
20. Gupta P.K. and Salunkhe D.K. Moder Toxicology Vol I, II, III.

3.4 PHARMACY PRACTICE

THEORY **-75 Hrs**

Scope: This course is designed to impart basic knowledge and skills that are required for the practice of pharmacy in both hospital and community settings.

Objectives: Upon completion of this course it is expected that students shall be able to

understand the various drug distribution system

handle the prescriptions and manage community pharmacies

understand the elements of pharmaceutical care and provide comprehensive patient care services

understand the concept and practice of the quality use of medicines

summarize the therapeutic approach for management of various diseases including reference to the latest available evidence.

Lecture-wise Programme

A) Hospital & Community Pharmacy **-25 Hrs**

Hospital and its organization: Definition and classification of hospital - Primary, secondary and tertiary hospitals; organizational structure and functions of a hospital. -2 Hrs **Hospital pharmacy and its organization:** Definition, organizational structure and functions of hospital pharmacy. -2 Hrs
Pharmacy and therapeutic committee (PTC): Composition and functions of pharmacy and therapeutics committee -1 Hr **Budget preparation and implementation -**1 Hr

Hospital formulary (HF): Definition, content, preparation and revision of hospital formulary -2 Hrs

Drug store management and inventory control -5 Hrs

- Organization of drug store, types of materials, stocked and storage conditions
- Purchase and inventory control, purchase order, procurement and stocking
- Methods in inventory control

Drug distribution system in a hospital -3 Hrs

- Types of drug distribution systems, charging policy and labeling.
- Dispensing of controlled drugs.

Community Pharmacy: -7 Hrs

Organization and structure of retail and wholesale drug store, types and design of drug store, legal requirements for establishment and maintenance of a drug store, dispensing of proprietary products, maintenance of records of retail and wholesale, finance, staff and infrastructure requirements.

Prescribed medication order: Interpretation and legal requirements -1 Hr

Over the counter (OTC) sales: Rational use of common OTC medications (vitamins, tonics, iron preparations, analgesics, NSAIDS, cough mixtures, anti-diarrheal preparations) -1 Hr

B) Clinical Pharmacy **-25 Hrs**

Introduction to Clinical Pharmacy: Definition, concept, scenario of clinical pharmacy and pharmaceutical care. -3 Hrs

Daily activities of a clinical pharmacist: Ward round participation, drug therapy monitoring (medicines review), treatment chart review, clinical review, pharmacist intervention, adverse drug reaction management, drug and poison information service, patient medication history and patient medication counseling. -8 Hrs

Drug information services: Drug information centre, drug information resources, answering drug information query. -3 Hrs

Adverse drug reaction (ADR): Definition, types, predisposing factors, detection, reporting, management and prevention of ADR, role of pharmacist in the management of ADR. -3 Hrs

Medication adherence: Causes of medication non- adherence; pharmacist role in the medication adherence; monitoring of patient medication adherence. -1 Hr

Medication errors: Definition, types, categories, sources and management of medication errors. -2 Hrs

Therapeutic drug monitoring (TDM): Definition, need for TDM and factors influencing TDM -1 Hr

Clinical Trials: Definition, various phases, designs and conduct of clinical trials -4 Hrs

C) Therapeutics **-25 Hrs**

Basic pathophysiology and pharmacotherapy of the following disorders

Cardiovascular system: Hypertension and myocardial infarction -4 Hrs

Respiratory System: Asthma -2 Hrs

Renal System: Acute Renal Failure -2 Hrs

Endocrine System: Diabetes -2 Hrs

Nervous System: Epilepsy and stroke -4 Hrs

Gastrointestinal System: Peptic ulcer disease -2 Hrs

Disease of bones and joints: Rheumatoid arthritis -2 Hrs

Infectious Diseases: Guideline for rational use of antibiotics, Tuberculosis, Malaria, Pneumonia, Urinary tract infection -7 Hrs

PRACTICALS **-75 Hrs**

1. Drug information queries.
2. Patient medication counseling
3. Assessment of drug interactions in the given prescriptions.
4. Case presentation about the most common diseases covered in therapeutics.
5. Inventory control

A maximum of 20 experiments may be conducted covering the above areas of pharmacy practice.

Recommended Books

1. Hospital Pharmacy by William E. Hassan.
2. A textbook of Hospital Pharmacy by S.H. Merchant and J.S. Quadry.
3. Clinical Pharmacy and Hospital Drug Management by David H Lawson and R Michael E. Richards.
4. Clinical Pharmacy by Tipnis Bajaj.
5. A textbook of Clinical Pharmacy Practice- essential concepts and skills by Dr. G. Parthasarathi, Nyfort-Hansen Karin, Milap Nahata.
6. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc (latest edition)
7. Health Education and Community Pharmacy by Parmar N.S., CBS publishers.
8. Pathologic basis of disease : Robbins SL, W.B. Saunders publication
9. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication
10. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication
11. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA, Williams and Wilkins Publication
12. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.

3.5 PHARMACEUTICAL QUALITY ASSURANCE (Theory)

THEORY **-75Hrs**

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It covers the important aspects like GMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to

understand the GMP aspects in a pharmaceutical industry appreciate the importance of documentation understand the scope of quality certifications applicable to pharmaceutical industries understand the responsibilities of QA & QC departments

Lecture wise programme

1. Definition - Quality control and Quality assurance, concept and philosophy of TQM, GMP, ICH, Brief study of ICH common technical documents – Q1-Q11, Quality by design, six sigma concept, ISO 9000 & 14000. -8 Hrs

2. Organization and personnel: Personnel responsibilities, training, hygiene and personal records. -4 Hrs

3. Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. -5 Hrs

4. Equipments and raw materials: Equipments selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. -7 Hrs

5. Quality control test for containers, closers, caps and secondary packing materials. -6 Hrs

6. Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records. -8 Hrs

7. Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. -4 Hrs

8. Warehousing: Good warehousing practice, materials management. -4 Hrs

9. Responsibilities of quality control laboratory- GLP, Standard test procedures, protocols for clinical and non - clinical testing and control on animal houses. Application of computers in quality control and quality assurance laboratory. -10 Hrs

10. Calibration and Validation: Introduction and general principles, Calibration and Validation of analytical equipments, Analytical method Validation. -3 Hrs

11. NABL certification and licensing and accreditation procedure for drug industry. Patent regime and intellectual property rights. - 8 Hrs

12. Regulatory affairs: Regulatory aspects in India, US-FDA and European commissions. GATT policy. -8 Hrs

Recommended Books

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications .
4. A guide to total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marshell Deckker Series
9. ICH guidelines, ISO 9000
10. Dr. A. Pillani – The Drugs and Cosmetics Act.

3.6 FORENSIC PHARMACY (Theory)

THEORY **- 75 Hrs**

1. **Definition and scope of Forensic pharmacy**: Pharmacist's role in drug treatment drug usage, pharmacist as a member of health care team. - 8 Hrs

2. **Pharmaceutical legislation in India**: Historical development of pharmaceutical education in India and its present status, Professional ethics in Pharmacy practice, legal ethical responsibilities of Pharmacists. - 8 Hrs

3. **A detailed study and the understanding** of the various act and rules (as last amended) governing the Pharmaceutical Profession in India.

a.	Pharmacy Act.	-5 Hrs
b.	Drugs and cosmetics act 1940 and Rules 1945.	-20 Hrs
c.	Narcotics and psychotropic substances Act.	-3 Hrs
d.	Drugs and magic remedies (Objectionable advertisements) Act 1955.	- 2 Hrs
e.	Poisons Act and Rules.	-2 Hrs
f.	New drug policy 1986.	-2 Hrs
g.	Medicinal & Toilet preparations (excise duties) Act & Rules.	-3 Hrs
h.	Shops and Establishment Act.	-3 Hrs
i.	Essential commodities Act.	-2 Hrs
j.	Drugs (Price control) order.	-2 Hrs
k.	Medical termination of pregnancy Act.	-2 Hrs
l.	Prevention of cruelty of animal Act.	-2 Hr
m.	Insecticide Act.	-2 Hrs
n.	Sales promotion employees (Condition of service) Act.	-3 Hrs
o.	Patents act.	-3 Hrs
p.	Prevention of Food Adulteration act 1945 & Rules 1955	-3 Hrs

RECOMMENDED BOOKS :

1. Handbook of Labour laws by B.K.Bahr
2. Factories act by government of India publications.
3. Drugs and Pharmacy laws in India By H.K.Bharathi
4. Drugs and cosmetics act/rules by govt. of India publications.
5. Medicinal and toilet preparations act 1955 by Govt. of India Publications.
6. Laws of drugs by S.N. Katju.
7. Forensic Pharmacy & Ethics by S.C.Mahajan.
8. Laws relating to Drugs and Cosmetics by P.L.Malik.
9. Handbook of Drugs law M.L.Mehra
10. Forensic Pharmacy and Ethics By Mehta.
11. Text book of Forensic Pharmacy by M.M.Mithal.
12. Forensic Pharmacy by B.Suresh.
13. Forensic Pharmacy by B.S.Kuchekar.
14. Narcotic drugs and Psychotropic substances Act by Govt. of India Publications.
15. Drug control by P.K.Dutta.
16. The drugs and Cosmetics Act & Rules by The India Drug Manufacturers Association. Publication.
17. Dangerous Drugs Act 1930 by Govt. of India publications.
18. Drugs and Magic remedies act by Govt. of India Publications.

IV.B.PHARMACY

4.1 PHARMACEUTICAL BIOTECHNOLOGY

THEORY - 75 Hrs

SCOPE: This paper has been designed to provide the advanced knowledge to the Pharmacy students in valuable areas of advanced Biotechnology which plays a crucial role in determining its future use and applications in medicine, drug discovery and in pharmaceutical industry. It also emphasize the study of microbiological and biotechnological processes, its modern technology aspects to useful products and to correct the alternative ways to prevent the occurrence and the treatment of disease related to microorganisms and techniques.

OBJECTIVES: Upon completion of the subject student shall be able to

understand methods of identification, cultivation and preservation of various microorganisms

understand Genetic engineering applications in relation to production of pharmaceuticals know the importance of immunological reactions and preparations of immunological products

do sterilization of various equipments / products and bacterial sensitivity testing against antibiotics and disinfectants.

appreciate the use of microorganisms in fermentation technology.

Lecture-wise Programme

1. MICROBIOLOGY – PRINCIPLES & PRACTICE:

a. Scope of Microbiology, Microbes of Medicinal interest, microbes and diseases. -3 Hrs

b. Classification of microbes namely bacteria, fungi, virus, protozoa and Helminthes. Their Morphology, cell organelles and its functions. Methods of isolation and identification of bacteria with emphasis to staining techniques and biochemical reactions. Bacterial counting methods. -5 Hrs

c. Growth and cultivation of bacteria, fungi and virus in different culture media. Their nutritional requirements and environmental factors affecting their growth. -4 Hrs

d. Detailed study of different methods of sterilization including their merits and demerits. Sterilization methods of all pharmaceutical products. Detailed study of sterility testing of different pharmaceutical preparation. -2 Hrs

e. Disinfection – study of disinfectants, antiseptics, fungicidal and virucidal agents. Factors affecting their action and evaluation of bactericidal, bacteriostatic, virucidal activities, evaluation of preservatives in pharmaceutical preparations. -3 Hrs

f. Principles and methods of different microbiological assays including sensitivity testing with references to antibiotics and vitamins. -4 Hrs

2. Microbial Biotechnology.

a. Microbial genetics includes transformation, transduction, conjugation, transposable elements. -5 Hrs

b. Microbial biotransformation, introduction, types of reactions mediated by microorganisms, biotransformation of steroids and production of single cell protein. -4 Hrs

3. Immunology and immuno Biotechnology:

a. Introduction, types of immunity, antigens and paptens, Antigen – antibody reactions, complement systems, structure and functions of MHC, antigen recognition and presentation, hypersensitivity response, immuno stimulation and suppression, Anti-immune disorders. -5 Hrs

b. Immunization – Definition, types preparation, standardization and application of official vaccines, containerization, storage conditions and stability of official vaccines. -5 Hrs

c. Hybridoma technology- Introduction, techniques for production of monoclonal antibodies. Application of Monoclonal antibodies in Clinical diagnosis and Pharmaceutical research. -5 Hrs

d. Immuno blotting techniques such as Elisa, Western blot, Southern blot and Northern blot. -3 Hrs

4. Molecular Biology and Genetic engineering.

a. Introduction to molecular biology, structure of DNA and RNA, replication, translation and translation processes. -3 Hrs

b. Study of cloning vectors, Restriction endonucleus, cloning strategies and gene expression. -4 Hrs

c. Application of recombinant DNA technology and genetic engineering. Production of below mentioned using above techniques.

i) Regulatory protein - Interferons.
ii) Vaccines - Hepatitis – B.
iii) Hormones – Insulin.

-3 Hrs

5. Bioprocess technology.

a. Basic principles of fermentation, isolation and screening of industrial important microbes. -3 Hrs

b. Study, design and operation of fermenter, study of different parameters. -2 Hrs

c. Bioprocess of following metabolites
i) Organic solvents – Alcohol.
ii) Organic acids - Citric acid.
iii) Antibiotics – penicillin, Griseofulvin, Cephalosporin or 2 only.
iv) Vitamins – Vit B_{12}
v) Amino acids – Glutamic acid. -3 Hrs

6. Enzyme biotechnology.

Enzyme–Introduction, classification, and uses. Techniques of immobilization application, production of Amylase, Protease, streptokinase, Penicillinase by immobilization technique. -6 Hrs

7. Study of Infectious disease:

Typhoid, Malaria, Tuberculosis, Hepatitis and HIV. -3 Hrs

PRACTICALS -75 Hrs

Microscopy:

1. Microscopic examination of stained preparation.
2. Microbial examination of living bacterial preparation.
3. The microscopic measurement of microorganism.

Cultivation techniques and isolation:

4. Preparation of various types of culture media.
5. Sub culturing of different microorganism in different methods like Slants, Stabs. Culture plates and Isolation of pure cultures by streak plate preparation by simple and multiple streaking.

Staining methods

6. Simple staining, gram staining, acid fast staining, spore staining, capsule staining, flagella staining.

Minimum inhibition concentration of antibiotics*

7. By serial dilution and gradient plate techniques.

Microbial assays*

8. Microbial assay of antibiotics and vitamins by one level and two level assays.

Standard qualitative analysis of water.

9. Presumptive test: Determination of the most probable number of coliform bacteria, confirmed test and completed test.

Motility studies:

10. Motility studies on microorganism by hanging drop technique.

Evaluation of disinfectants.

11. Phenol co-efficient test.

Molecular Biology and Biotechnology.

12. Isolation of plasmid and agarose electrophoresis*.
13. Isolation and estimation of DNA by spectroscopy*.
14. Isolation and estimation of RNA by spectroscopy*.
15. Isolation and estimation of protein by spectroscopy*.
16. Sterility of testing for pharmaceuticals* (Powders, liquids).
17. Immobilization of whole cells.

* Refers to major experiment to be given (at least one) compulsorily during the university practical experiments.

Recommended Books:

1. Microbiology by Pelczar, Reid and Chan.
2. Essential and applications of mirobilogy by Judy Kandal.
3. Microbial Genetics by David Freifeider.
4. General microbiology by R.Y.Stainer.
5. Microbiology by Prescott.
6. Textbook of Microbiology by Anathanarayanan and Panicker.
7. Immunology by Weir.
8. Immunology by Ivan Roit.
9. Microbiology – A laboratory manual by James G. Cappuchino.
10. Laboratory microbiology by L. Jack Bradshaw.
11. Practical Medical Microbiology by Marchie & MC Cartiney.
12. Pharmaceutical Microbiology by Hugo and Russel.
13. Textbook of Biotechnology by Vyas and Dixit,.
14. Textbook of Biotechnology by R.C.Dubey.
15. Principles of Gene manipulation by S.B. Primrose.
16. Textbook of fermentation technology by Stanbury.
17. Industrial Microbiology by L.E. Casida.
18. Biochemical engineering by Webb and Steel.
19. Microbial technology by Peppler Vol. I and II.
20. Genes V and VI by Benjamin Lewin.

4.2 MEDICINAL CHEMISTRY-II

THEORY **-75Hrs**

Scope: This subject medicinal chemistry; is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of drug design, which include quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry, and Computer aided drug design (CADD). The subject concentrates on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR) and their therapeutic uses of drugs. The syllabus also emphasises on synthesis of important drugs.

Objectives: Upon completion of the course student shall be able to
appreciate the importance of drug design and understand the different modern techniques of drug design.

- understand the chemistry of drugs with respect to their biological activity.
- know the metabolism, adverse effect and therapeutic value of drugs.
- appreciate the SAR of important class of drug.

Lecture-wise Programme

1. Introduction to Drug Design

1.1 Principles Of Drug Design:
Traditional analog QSAR and mechanism based approaches. A brief introduction to graph theory, application of quantum mechanics, computer aided drug designing CADD and molecular modeling. -3 Hrs

1.2 Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis. -3 Hrs

2.Classification mode of action (biochemical and molecular basis wherever applicable) structure activity relationship including physicochemical and stereo chemical properties and synthesis and synthetic procedures for selected drugs (representative model drugs marked with asterisk only) on the following categories of drugs.

Anti infective agents:

a.Local Anti-Infective Agents: Ethyl alcohol, Isopropyl alcohol, Formaldehyde, Sodium glutaraldehyde solution, Liquefied phenol, Hexachlorophene*, Eugenol, Hexyl resorcinol, Anthralin, Hydrous benzoylperoxide, Halazone*, Benzalkonium Chloride*, Methybenzethorium chloride*, Cetylpyridinium chloride, Chlorhexidine gluconate*, Gentian violet, Methylene blue Thiomersal , Methyl paraban, Sodium benzoate. -4 Hrs

b.Anti Fungal Agents: Clotrimazole, Econoazole nitrate, Butoconazaole, Sulconazole nitrate*, Oxyconazole nitrate*, Tioconozole, Miconazole*, Ketoconazole*, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*, Cyclopiroxolamine, Amphotericin- B, Nystatin, Natamycin, Griseofulvin. -4 Hrs

c.Synthetic Antibacterial Agents: Nalidixic Acid*, Cinoxacin, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Furazolidine, Nitrofurantoin*, Methanamine. -3 Hrs

d.Antitubercular Agents: INH*, Ehionamide, Pyrazinamide, Aminosalicylic acid*, Rifampin, Rifabutin, Cyloserin*, Sterile Capreomycin sulphate. -2 Hrs

e.Antiprotazoal Agents: Metronidazole*, Diloxanide*, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine, Dimercaprol*.. -2 Hrs

f.Anthelmintics: Piperazine salts*,. DEC*, Thiabendazole*, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. -2 Hrs

g.Antiscabious And Antipedicular Agents: Benzyl Benzoate*, Lindane* (Gamaxene) Crotamiton*, Permethrin -2 Hrs

Sulphonamides and sulphones:

Historical development, chemistry and nomenclature, reducing crystallurea by lowering Pk_a, synergism of sulfonamides and folate reductase inhibitors, Sulphamethizole*, Sulfisoxazole, Sulphamethizine, Sulfacetamide sodium*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, mixed sulfonamides, Mefenide acetate, Silver sulfadiazine*, sulfasalazine, Dapsone*, Solapsone. -4 Hrs

Antimalarials:

History and development of Quinine sulphate, Chloroquine phosphate*, Hydroxy chloroquine sulphate, Amodiaquine hydrochloride*, Primaquine phosphate, Quinacrine hydrochloride, Mefloquine, Pyrimethamine, Trimethoprim, Cycloguanil pamoate, Sulfadoxine.

-4 Hrs

Antibiotics:

History background, current status of

a. Penicillins and cephalosporins.
b. Aminoglycosides
c. Tetracyclines

d. Macrolides
e. Lincomycines
f. Polypeptides
g. Unclassified antibiotics.
Chloramphenicol* and its prodrugs Novobiocin sodium, Mupirocin.
-12 Hrs

Antiviral agents:

Amantadine Hydrochloride, Rimantadine Hydrochloride Idoxuridine trifluride, Vidarabin*, Acyclovir*, Ganciolovir, Forscarnet sodium, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Ribavirin, Saquinovir, Indinavir, Ritonavir. -5 Hrs

Antienoplastic agents:

Meclorethamine, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa, Procarbazine, Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine, Dactinomycin, Daunorubicin hydrochloride Doxorubicin hydrochloride, Idarubicin hydrochloride, Bleomycin sulphate, Mitomycin, Plicamycin, Etoposide, Vinblastin sulphate, Vincristin Sulphate, Cisplatin, Hydroxy urea, Pipobroman, Mitotane, Fromostanolone propionate. -4 Hrs

Drugs acting on CVS:

A.Antianginal Vasodilators And Cardiotonics: Amylnitrate, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrate*, Verapamil, Dilitizam hydrochloride, Nifedipine, Amilodipine, Bepridil hydrochloride, Felodipine, Nicardipine, Dipyridamole, Digoxin, Digitoxin, Deslanoside. -3 Hrs

B.Antiarrythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Lidocaine hydrochloride, Phenytoin Sodium. -2 Hrs

C.Antihypertensive Agents: Captropril, Lisinopril, Enlapril, Benzapril hydrochloride, Quinapril hydrochloride, Reserpine, Guanethidine monosulphate*, Methyldopate hydrochloride*, Clonidine hydrochloride, Hydralazine hydrochloride, Sodium nitroprusside, Diazoxide, Minoxidil. -3 Hrs

D.Antihyperlipidemic agents: Clofibrate, Dextrothyroxine sodium, Cholestyramine resin, Niacin, Probucol. -2 Hrs

E.Anticoaglants and antithrombolytics: Protamine sulphate, Dicoumarol, Warfarin sodium, Anisindione. -1 Hr

Hormones and related drugs:

a. Insulin and its preparation, hypoglycemic agents.
b. Synthetic hypoglycemic agents.
c. Oxytocin and vasopressin.
d. Thyroid and antithyroid drugs.

-4 Hrs

Steroids and related drugs:

Glucocorticoids, Mineralocorticoids, Oestrogens, Progestrogens, Androgens, Chemistry of natural hormones, and synthetic derivatives including contraceptives.

-3 Hrs

Diagnostic drugs and reagents:

Congo Red, Evans Blue, Methacholine Chloride, Erythrosine Sodium, Benzyl Psenicilloyl poly lysine, Locetamide acid, Lodipamide meglumine, Tyropanoate sodium, Pentagastrin, Phenol sulphophthalein, Indocyanin Green, Fluorescein sodium, Bentiromite, Diatrizoic acid, Lotalamic acid, Propyl iodone. -3 Hrs

PRACTICALS -75 Hrs

1. Synthesis of selected drugs from course content involving two or more steps of synthesis and studying spectral analysis of drugs synthesized (at least 8 drugs).
2. Establishing the pharmacopoeial standards of drugs synthesized.
3. Determination of partition co efficient, dissociation constant and molar refractivity of compounds for QSAR analysis (at least 3 experiments).
4. Assay of medicinal compounds
5. Preparation of medicinally important compounds or intermediates by Microwave irradiation technique
6. Monograph analysis of selected drugs from course content

RECOMMENDED BOOKS:

1. Burger's medicinal chemistry Vol I to IV.
2. Remington's pharmaceutical sciences 20th edition.
3. Ashutoshkar's medicinal chemistry.
4. Medicinal chemistry by Kadam Vol I and II.
5. Medicinal chemistry W.A.Foye.
6. Medicinal chemistry Wilson and Gisvold.

4.3 INDUSTRIAL PHARMACY AND BIOPHARMACEUTICS

THEORY **-75 Hrs**

Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Objectives: Upon completion of the course the student shall be able to

know the various pharmaceutical dosage forms and their manufacturing techniques.

know various considerations in development of pharmaceutical dosage forms

formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

Lecture-wise Programme

1. Preformulation studies:

a. Study of physical properties of drugs like physical form, particle size, shape density, wetting, dielectric constant, solubility, dissolution, organoleptic properties and their effect on formulation, stability and bioavailability.

b. Study of chemical properties of drugs like hydrolysis, oxidation, reduction racemization, polymerisation, etc and their influence on formulation and stability of products.

c. Stability studies: Basic concept and objectives of stability study. Importance of accelerated stability study, effect of various environmental / processing on stability of the formulation and techniques for stabilization of products against the same. Regulatory requirements related to stability testing with emphasis on ICH guidelines, matrixing / bracketing techniques, climate zone, impurities in stability studies, photostability testing, etc., -7 Hrs

2. Capsules:

Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, method 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. -8 Hrs

3. Micro-encapsulation:

Types of microcapsules, importance of microencapsulation in pharmacy, microencapsulation by phase separation, co-acervation, multi orifice, spray drying, spray congealing, polymerisation complex emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules. -7 Hrs

4. 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. -15 Hrs

5. Parenteral Products:

a) Preformulation factors, routes of administration, water for injection, pyrogenicity, non aqueous vehicles, isotonicity and methods of its adjustment.

b) Formulation details, containers and closures and selection.

c) Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophillization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.

d) Aseptic Techniques –source of contamination and methods of prevention, Design of aseptic area, Laminar flow bench services and maintenance. -10 Hrs

6. Packaging of Pharmaceuticals

Desirable features and a detailed study of different type of pharmaceutical containers and closures (Glass, plastics and rubbers) including their merits and demerits. Selection and evaluation of pharmaceuticals packaging materials. -3 Hrs

7. Prolonged action pharmaceuticals:

Benefits, limitations, oral products, terminology, drug elimination rate, types and construction of products, evaluation, parenteral products absorption and evaluation. -4 Hrs

8. Novel Drug delivery systems:

Transdermal delivery systems, osmotic drug delivery systems, liposome. -6 Hrs

9. Biopharmaceutics and Pharmacokinetics

a. Biopharmaceutics: Rate of drug absorption after administration, drug concentration in blood, biological factor in drug absorption, physico-chemical factors, dosage from consideration for gastrointestinal absorption, drug distribution, site seeking, drug elimination.

b. Pharmacokinetics: Compartment models, A brief study of parameters like biological half life, apparent volume of distribution renal clearance, total body clearance, absorption and elimination rate constants, significance of the data.

c. Bioavailability and bioequivalency testing: Definitions, dosage form dissolution rate, bioequivalence testing.

-15 Hrs

PRACTICALS **-75 Hrs**

Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products like powders, capsules, tablets, parenterals, micro capsules etc. Evaluation of materials used in pharmaceutical packaging.

1. Pre-formulation protocols
2. Preparation of paracetamol tablets I.P 250 mg
3. Preparation of calcium gluconate tablets I.P.250 mg
4. Hardness test for tablets
5. Disintegration test for tablets
6. Friability test for tablets
7. Weight variation test for tablets
8. Dissolution test for tablets
9. Hydrolytic resistance test
10. Sterility test
11. Preparation of effervescent granules.
12. Preparation of Dextrose injection I.P. 5% w/v
13. Preparation of Sodium chloride injection I.P. 0.9% w/v
14. Preparation of Dextrose and sodium chloride injection I.P
15. Preparation of Compound sodium lactate injection I.P
16. Preparation of HPMC film for transdermal patch.
17. Preparation of ethyl cellulose film as rate controlling membrane for transdermal patch
18. Preparation of salbutamol sulphate film for transdermal patch
19. Preparation of Aspirin microspheres
20. Preparation of Diclofenac sodium microspheres
21. Determination of pharmacokinetic parameters
22. Determine *IN-VITRO* bioequivalence studies of different forms of marketed paracetamol tablets.
23. Determine the effect of granule size on disintegration and dissolution profile of Ibuprofen

Recommended Books

1. Pharmaceutical Dosage forms: Parenteral medications Vol.I & II by Liberman & Lachman
2. Pharmaceutical Dosage forms: Tablets Vol-3by Liberman & Lachman
3. Pharmaceutical Dosage forms: Disperse systems by Liberman & Lachman Vol.I
4. Remingtons Pharmaceutical Sciences.
5. Modern Pharmaceutics by Banker & Gilberts.
6. Theory and Practice of Industrial Pharmacy by Lachman
7. Hard Capsules by Ridgway. K. Pharmaceutical Press. London.
8. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi.
9. Novel Drug Delivery systems by Y.W. Chein.
10. Biopharmaceutics and Pharmacokinetics an Introduction by Robert E. Nofain.

4.4 MODERN METHODS OF PHARMACEUTICAL ANALYSIS

THEORY -75 Hrs Scope: This subject is designed to impart a fundamental knowledge on the testing of drugs by various instrumental methods of analysis. This focuses on various modern instruments that are used for testing the purity of drugs in various dosage forms. This course also gives knowledge about modern instruments that are used for drug testing like NMR, IR, Mass, HPLC, HPTLC etc, **Objectives:** Upon completion of the course the student shall be able to

- know the principle and applications of instrumentation
- understand the components and working of various analytical instruments.
- understand the different modern techniques of drug analysis.
- appreciate the advantages of instrumental methods of drug analysis

Lecture wise programme:

1.UV/Visible spectroscopy - 10 Hrs

1.1Theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert's law, Derivation and deviations, Applications of Beer law to single and multi component systems, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors- Barrier layer cell, Photo tube, Photomultiplier tube, Silicon Photodiode.

Applications - Spectrophotometric titrations, Measurement of equilibrium constant and rate constant.

1.2 IR spectroscopy – -4Hrs

Introduction, Fundamental modes of vibrations in poly atomic molecules. Sample handling, Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors – Golay cell, Bolometer, Thermocouple, Thermister, Pyrroelectric detector. Structure - frequency correlation with examples.

1.3 Atomic absorption spectroscopy – 2Hrs

Introduction, Theory, instrumentation, and applications.

2. 2.1. **Fluorimetry -3Hrs**

Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching. Instrumentation and applications

2.2. **Flame emission spectroscopy -3 Hrs**

Introduction, Theory, Instrumentation, Interferences and applications .

3.Nephelometry and Turbidimetry **-2Hrs**

Theory, Instrumentation and applications

4.NMR Spectroscopy **-5Hrs**

Principles, Instrumentation and applications

5.Mass Spectroscopy **-4Hrs**

Principles, Fragmentation, Instrumentation, applications.

Introduction to MALDI and ICPMS

6 X- Ray diffraction studies **-3 Hrs**

Introduction, diffraction methods and applications

7. Thermal Methods of Analysis: **-2Hrs**

Theory, Instrumentation and applications of Differential Scanning Calorimetry (DSC)

8. Chromatography

8.1. Adsorption and partition column chromatography **-4 Hrs**

Methodology, advantages, disadvantages and applications

8.2. Thin layer chromatography **-4Hrs**

Introduction, Principle, Methodology, Stahl's triangle, Rf values, advantages, disadvantages and applications

8.3. High Performance Thin Layer Chromatography (HPTLC) **-2Hrs**

Introduction, instrumentation, advantages, application

8.4. Paper chromatography -2**Hrs**

Introduction, Principle, Methodology, developmental techniques, advantages, disadvantages, applications.

8.5. Ion exchange chromatography -3**Hrs**

Introduction, Definition, classification, ion exchange resins, properties, mechanism of ion exchange process, Factors affecting ion exchange, methodology, applications.

8.6. High Performance Liquid Chromatography (HPLC) -4Hrs Introduction, theory, instrumentation, advantages and applications. Introduction to UPLC and super critical fluid chromatography

8.7. Gas Chromatography **-4Hrs**

Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

8.8. Electrophoresis **-3Hrs**

Principle of separation, classification, equipment for moving boundary electrophoresis, gel, paper electrophoresis and applications

8.9. Gel Filtration Chromatography **-2Hrs**

Introduction, technique, factors affecting, Applications.

9. Electro chemical methods of analysis **-4Hrs**

9.1. Conductometry - Introduction, Conductivity cell, Conductometric titrations, applications.

9.2. Potentiometry – Electrochemical cell, construction and working of reference and indicator electrodes, methods to determine end point of titration.

10.Quality assurance

A. Calibration and validation of following Instruments **-5Hrs**

UV-Visible spectrophotometer, pH meter, HPLC, Electronic balance, Conductivity meter, IR spectrophotometer, Fluorimeter, Flame Photometer

B. Introduction to analytical method development

PRACTICALS **-75** Hrs

1. Chromatographic analysis of some Pharmaceutical products like
    a. Separation & identification of amino acids by paper chromatography.
    b. Separation & identification of alkaloids by TLC
    c. Separation & identification of amino acid by TLC

2.Exercises involving Nephelo-tubidimeter, colorimeter, spectrophotometer,flame photometer, pH meter and florimeter, conductometric, potentiometric titrations like

a. Potentiometric titration of HCl with NaOH
b. Estimation of Quinine sulphate by fluorimetry
c. Estimation of riboflavin by fluorimetry
d. Study of quenching effects in fluorimetry
e. Determination of absorption maxima of a compound
f. Determination of primary amines by colorimetric method
g. Colorimetric estimation of Sulpha drugs.

h. Determination of Ibuprofen and Paracetamol by simultaneous equation method
i. Determination of Chloride and Sulphate by Nepheloturbidometry
j. Determination of Sodium/Potassium by flame photometry
k. IR interpretation of drug samples with different functional groups
l. Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.

RECOMMENDED BOOKS:

1. Instrumental methods of analysis by Hobarth Willard, Lynne L Merritt and John A Dean, 7th edition, CBC publishers, New Delhi.
2. Kennith A Connors, A Text Book of Pharmaceutical Analysis, 3rd edition, John Wiley and sons, New york (1982)
3. William Kemp, Spectroscopical methods, ELBS.
4. Indian Pharmacopoeia.
5. United States Pharmacopoeia.
6. British Pharmacopoeia.
7. Higuchi T and Hanssen E.B., Text Book of Pharmaceutical Analysis, A Wiley Interscience Publications.
8. Instrumental methods of chemical analysis by Gurudeep Chatwal and Sham Anand, Himalaya publishing house, 2002.
9. Instrumental methods of chemical analysis by B. K. Sharma, 10th edition, GOEL publishing house, 2002.
10. Principles of instrumental analysis by Doglas A Skoog, F. James Holler, 5th edition, Eastern press, Bangalore, 1998
11. Practical pharmaceutical chemistry by Beckett A. H. and Stenlake J. B., 4th edition, CBS publishers, New Delhi, 1997
12. Spectrometric identification of organic compounds by Robert M Silverstein, G. Clayton and Terence C. Morill, 6th edition, John Wiley and Sons, 2004
13. Quantitative analysis of drugs in Pharmaceutical formulation – P. D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.

4.5 PHARMACOLOGY – II

THEORY **-75 Hrs**

Scope: This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject bioassay, drug acting on GIT, Endocrine system, Chemotherapeutic agents, drugs acting on the Hemopoietic, system, Autocoids, Chronopharmacology, Clinical pharmacology, Immunopharmacology

Pharmacoepidemiology and Pharmaco-economics, Stem cell therapy , Genetherapy,

monoclonal antibodies taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

Objectives:

a. to understand the pharmacological aspects of drugs falling under the above mentioned chapters.
b. to carry out the animal experiments confidently
c. to appreciate the importance of pharmacology subject as a basis of therapeutics and
d. to correlate and apply the knowledge therapeutically.

Lecture-wise Programme

1. Bioassay : **-6 Hrs**

Definition, principles, merits, demerits, methods. Bioassay of adrenalin, oxytocin, ADH, Ach, Histamine, digitalis, d-Tubocurarine, Insulin, ACTH.

2. Drugs acting on the Gastrointestinal Tract : **-10 Hrs**

a. Antacids, anti-secretory and Anti ulcer drugs.
b. Laxatives and antidiarrhoel drugs.
c. Appetite stimulants and suppressants.
d. Emetics and anti-emetics.
e. Digestants, bitters, carminatives.
f. Sialogogues and cholagogue.
g. Anti - spasmodics

3. Pharmacology of Endocrine system : **-12 Hrs**

a. Basic concepts in endocrine pharmacology.
b. Hypothalamic and pitutary hormones.
c. Thyroid hormones and anti-thyroid drugs, parathormone, Calcitonin and Vitamin D.
d. Insulin, oral hypoglycaemic agents & glucagon.
e. ACTH and corticosteroids

f. Androgens and anabolic steroids.
g. Estrogens, progesterone and oral contraceptives.
h. Drugs acting on the uterus.
i. Drugs for erectile dysfunction.

4. Chemotherapy : -25 Hrs

a. General principles of chemotherapy.
b. Sulfonamides and Cotrimoxazole.
c. Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, Erythromycin, Quinolones and Miscellaneous antibiotics.
d. Chemotherapy of tuberculosis, leprosy, malaria, amoebiosis, giardiasis, filariasis, leishmeniasis, trypnasomiasis, helmenthiasis, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases including AIDS.
e. Chemotherapy of malignancy.

5. Drugs acting on the Hemopoietic system. -5 Hrs

a. Hematinics.
b. Coagulants and anticoagulants, vitamin K and hemostatic agents.
c. Fibrinolytic and anti-platelet drugs.
d. Blood plasma volume expanders.
e. Haemopoietic growth factors .

6. Autocoids : -6 Hrs

a. Histamine, 5HT and their antagonists.
b. Prostaglandins, Thromboxanes and Leukotrienes and their antagonists .
c. Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.

7. **Chronopharmacology -2 Hrs**

Definition-rhythms and cycles. Biological clocks and their significance leading to chronotherapy.

8. Clinical Pharmacology. -2 Hrs

Definition, Clinical trials, design of clinical trials and testing of drugs in humans.

9. Immunopharmacology -3 Hrs

Definition, Immunostimulants, Immunosuppressants and Anti-AIDS drugs.

10. Gene therapy -2 Hrs

Definition, rectors - Techniques, applications.

11. Monoclonal antibodies -2 Hrs

Definition, production, purification. Recombinant monoclonal antibodies, monoclonal antibody therapy – problems with monoclonal antibody therapy.

PRACTICALS **-75 Hrs**

Experiments

1. Experimental Pharmacology - Definition Aims *IN- VITRO* studies
2. Study of Physiological salt solutions used in experimental pharmacology
3. Anaesthetics used in animal studies
4. Procedures for rendering animal unconscious.
5. Commonly used instruments in in vitro studies.
6. Experiments on isolated preparation
   a. DRC of Ach using rat ileum preparation.
   b.Effect of Neostigmine on DRC of Ach using rat ileum preparation.
   c. PA_2 value of Atropine using Ach as an agonist on rat ileum preparation.
   d. DRC of Ach using rat colon preparation
   e. Effect of Neostigmine on DRC of Ach using rat colon preparation.
   f. PA_2 value of Atropine using Ach as an agonist on rat colon preparation.
   g. DRC of Histamine using guinea pig ileum
   h. PA_2 value of chlorpheniramine maleate using guinae pig ileum.
   i. Estimation of the strength of the test sample of agonist /drug (eg Ach, Histamine, 5HT, oxytocin etc) using suitable isolated muscle preparations employing, matching, bracketing, three point, four point methods of Bioassay .
   j. To record the DRC of 5HT on rat fundus preparation.
   k. To record the DRC of noraderenaline on rat anococcygues muscle preparation.
7. Pharmacology of Gastro Intestinal tract
   a. To study the antiulcer activity of drugs using pylorus ligated rats.
8. Estimation of bio availability parameters

   Viz AUC, Tmax, kel from blood and urine sample in human volunteers or in laboratory animals.
9. Evaluation of the anticoagulant effect of drugs by subaqueous tail bleeding time in rodents.
10. Evaluation of antidiabetic activity of oral hypoglycaemic agents in diabetic rodents.

RECOMMENDED BOOKS:

1. Ghosh MN, Fundamentals of Experimental Pharmacology, Scientific Book Agency Calcutta.
2. Katzung, B.G., Basic and Clinical Pharmacology, Prenticwe Hall, International.
3. Pharmacology and Therapeutics - Satoskar.
4. Kulkarni S.K. Hand book of Experimental Pharmacology.
5. Essential of medical pharmacology and T.D. Tripatdi
6. Derasari and Gandhi's Elements of Pharmacology by Goyal , R.K. Anitha A. Mehta, Balarame A and Mahesh D. Bunande, B.S. Shah Prakashan, Ahmedabad
7. Chronopharmacology cellular and Biomedical interactions by B.Lammar, 2005, (latest edition) , Marcel publications, New York.
8. Essentials of Pharmacotherapeutics by F.S.K. Barar, latest Edition, 2009, S. Chand & /company , New Delhi.
9. Principles of Pharmacology- HL Sharma and KK Sharma.
10. Craig CR., and Stitzel RR, Modern Pharmacology, Little Brown and Company, 1994.
11. Laurence, DR, and Bennet PN, Clinical Pharmacology, Churchil Livingstone.
12. Mycek MJ gertnet SB and Perper MM, Pharmacology Lippincott's Illustrated Reviews, Lippincott Company, Philadelphia.
13. Rang MP Dale MM Reter JM-Pharmacology.
14. Topics of Molecular Pharmacology I & II – By Nurger and Roberts.
15. Goodman and Gillmans, The Pharmacological basis of therapeutics.
16. Principles of Pharmacology by Paul, L. Chapman and Hall.
17. Pharmacotherapy: A Pathological approaches by diprio

4.6 PHARMACEUTICAL MARKETING AND MANAGEMENT (Theory)

Theory: **-75 Hrs**

Scope: This course gives the general management principles and pharmaceutical marketing systems, different types of market & marketing authorization and competitive practices in pharmaceutical industries. Marketing aspect covers types of market, principles of marketing and pharmaceutical product. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Objectives: Upon completion of the course the student shall be able to

- know pharmaceutical market systems
- understand marketing mix and marketing communications
- understand the basic principles of management sciences
- appreciate the importance of marketing in product promotion.
- Communicate effectively (Verbal and Non Verbal)
- Effectively Manage the team as a team player
- Manage the time effectively
- Develop Leadership Qualities and Essentials

Lecture-wise Programme

1 Marketing: **-11 Hrs**

a. The meaning and scope of marketing

b. The pharmaceutical market: Quantitative and qualitative aspects, size and composition of the market, demographic descriptions and socio-psychological characteristics of the consumer, market segmentation.

c. Analyzing the market - Role of market research

d. Consumer profile – Motivation and prescribing habbits of the physician, patients choice of physician and retail pharmacist

2. The pharmaceutical product **-6 Hrs**

a. Market consideration in product development, marketing mix, product life cycle (PLC), effects of different elements of marketing mix at different stages of PLC, product classification, product planning, product differentiation, modification of existing product.

b. New product development-All stages from the new product idea to the stage of marketing the developed product (bulk drug and formulations).

c. Branding-concept of brand, different types of brand, importance and reasons for branding, packaging.

3. Competitive practice in the pharmaceutical industry **-4 Hrs**

a. Patent laws, Trademark laws

b. Codification of various of drug store; Pricing of materials

4. Distribution **-4 Hrs**

a. The wholesaler-His role in distribution of pharmaceutical services offered to the manufacturer and the retailer, advantages and disadvantages of distribution through wholesaler

b. The retailer-Classification of retail institutions, advantages and disadvantages of retail institutions, the hospital as retail outlet.

5. Promotions -4 Hrs a. Different types of promotion-Advertising, Direct mail, Professionals, Journals, Sampling, Retailing, Medical exhibition, Public relations

b. Professional sales representatives (PSR)-Duties of PSR, Purpose of detailing, selection and training, compensation and future prospects of PSR

6. Management: **-10 Hrs**

a. Concepts of management, principles of management, objectives of management, manager-role and types

b. Primary functions of management – planning, organizing, staffing, directing, controlling, motivation, entrepreneurship development

c. Secondary functions of management – decision-making, leadership, innovation, delegation of authority/responsibility

7. Inventory control **- 4 Hrs**

Objectives and importance, modern techniques like ABC, VED analysis, the lead time, inventory carrying cost, safety stock, minimum and maximum stock levels, EOQ method, Scrap and surplus disposal.

8. Time Management
-8 Hrs

Value of Time; How to Track the action items; Goal setting; Using SMART Objective concept; Goals, Tasks, Sub Tasks; Resource Management; Mile Stone, Mapping and Gantt chart application

9. Preparing for an Interview **-10 Hrs**

Creating an Effective CV (Objective Setting, Skills, how to prepare the content, Describing Self, Summarizing the Education and Self, Selling your Experience, Deciding on looks, Getting it Right); Define the purpose of the interview; Preparation of STP, PDCA; Improving the delegation; Dress Code and Code of Conduct; Do's and Don'ts; Style of communication; Attitude Vs Skills; Confidence Vs arrogance

10. Motivations **-14 Hrs**

Analyzing Motivation

Definition of Motivation, Understanding Behavior, Recognizing the Needs, Human Brain and Human Psychology

Building Up

Assessment of Attitude, Being Good for Many, Improving Communication, Creating No Blame Culture, Winning Cooperation and Encouraging Initiatives.

Getting the Best from People

Motivating People; Motivating Self; Group Motivation; Dealing with De-motivated Individuals; Apprising Effectively; Evaluating each Jobs; Encouraging the staff; Empowering the staff; Building the Career; Rewarding achievement; Recognizing Excellence; Moving To change; Rewarding Exceptional Performance; Keeping motivation high; Tool for finding out how good an individual is a motivator.

Communications Skills:

Oral and written communications; Electronic communication; Discussions and meetings outcome as a communication; Presentation and Group discussion; Postures during the presentation or one to one meeting; Appraisals of staff by a Manager; Meetings Vs Structured meetings; Components of Meetings and Meeting Outcome; Communication skills in pharmacy practice

Recommended Books

1. Heinz Weihrich, Harold Koontz: Management: A global Perspective, McGraw Hill International Edition, Tenth edition.
2. S.V.R. Subba Rao, Pharmaceutical Marketing in India, Asian Institute of Pharmaceutical Marketing, Hyderabad, 1998 edition.
3. Mickey C. Smith, Principles of Pharmaceutical Marketing, CBS publishers and distributors, New Delhi, 3rd edition.
4. C.V.S. Subrahmanyam. Pharmaceutical production and management, Vallabh Prakashan publisher, New Delhi, 2005.
5. Peter F. Drucker, Management-tasks, responsibilities, practices. Allied Publishers Pvt Ltd., Mumbai, 2003.
6. Mickey C. Smith, Pharmaceutical Marketing in the 21st Century, pharmaceutical product press, New York, USA, 1996
7. Sachin Itkar, Pharmaceutical Management, Nirali Prakashan Publishers, Pune, 2007.
8. Inspired, Organized & Effective! by Darrin Salle (Feb 8, 2012).
9. Creating Successful CV - Simon Howard
10. How to Delegate – Robert Heller, DK Publication
11. Appraising Staff – Ken Langdon, Christina Osborne
12. Motivating People – Robert Heller
13. 18 Minutes: Find Your Focus, Master Distraction and Get the Right Things Done
14. Senn Delaney Leadership and Team
15. Say Goodbye to Chaos - Organize Your Life: This Ultimate Guide of Organizing Tips will Teach You How to Get Organized and How to Stay Organized [Kindle Edition] Edward V. Lewis, Blue Sheep Books
16. Steven Coveys - 8th Habit
17. The Seven habits of Highly Effective People by Stephen Covey
18. Communicating: A Social and Career Focus - Andrew D. Wolvin
19. Interpersonal Communication: Everyday Encounters (Wadsworth Series in Communication Studies)
20. The 80-20 Principle by Richard Koch
21. Mind Gym
22. The One Minute Manager Meets: The Monkey by Ken Blanchard