

**THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY
CHENNAI-600 032**



**REGULATIONS AND SYLLABUS
B. PHARMACY DEGREE COURSE
2009-2010**

**THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY
CHENNAI – 600 032**

B. PHARMACY COURSE

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**THE TAMIL NADU Dr. M. G. R. MEDICAL UNIVERSITY,
CHENNAI-600 032.**

REGULATIONS OF THE UNIVERSITY

In exercise of the powers conferred by section 44 of The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Act, 1987 (Tamil Nadu Act 37 of 1987), The Standing Academic Board of The Tamil Nadu Dr. M.G.R. Medical University, Chennai hereby makes the following regulations.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called “**THE REGULATIONS FOR THE B.PHARMACY DEGREE COURSE OF THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI**”.

They shall come into force from the Academic Year 2009-2010.

The Regulations framed is subject to modifications from time to time by the Standing Academic Board.

1. ELIGIBILITY FOR ADMISSION :

a.) Candidates belonging to all categories except Scheduled Castes / Scheduled Tribes for admission to the B. Pharmacy course must have obtained individual pass marks in Physics, Chemistry, Biology or Botany & Zoology or Mathematics both in theory and practical with a minimum of 35% marks. Not less than 50% aggregate marks in the above subjects is mandatory at the qualifying examination (Academic Stream) after a period of 12 years of study i.e.10 + 2 pattern of education.

b.) Candidates belonging to Scheduled Castes / Scheduled Tribes must have obtained individual pass marks in Physics, Chemistry, Biology or Botany & Zoology (or) Mathematics both in Theory & Practical with a minimum of 35% marks and with not less than 40% aggregate marks in the above subjects.

c.) A pass in English with a minimum of 35% marks is mandatory for all categories for admission to the course.

(OR)

d.) Candidates qualified in the Diploma in Pharmacy examination conducted by the Board of Examinations of the Government of Tamil Nadu or any other Board of any other State recognized as equivalent thereto by the authority of this University.

3. OTHER CRITERIA

a.) 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.

b.) 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 the aggregate of the two examinations shall be taken into consideration.

c.) Candidates who have studied abroad and have passed the equivalency 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 or Mathematics in 12th Standard Level with 50% marks aggregate and with pass in English language. It is mandatory that the Candidate gets 35% marks in English and individual pass marks with a minimum of 35% in Physics, Chemistry, Biology or Botany and Zoology or Mathematics.

d.) Regarding any criteria not covered under the above provisions, the ruling of the Eligibility Committee / BOS-Pharmacy / SAB / GC regulations shall be adopted.

Minimum Eligibility mark and also admission procedure for NRI Quota seats in Self – Financing College. ** (G.O.(Ms.) No.137 Health & Family Welfare Department, dated 14.8.2006).

- (1) The marks fixed as indicated below shall be adopted as minimum eligibility marks for admission to B.Pharmacy course under NRI Quota in Self-Financing Colleges.
 - () The candidates must pass Physics, Chemistry, Biology (Botany and Zoology) and English individually and obtain minimum of 50% of marks taken together in Physics, Chemistry and Biology in the qualifying examination.
 - (i) For SC/ST students – 40% of the marks as stated above.
- (2) The following guidelines shall be followed for admission to NRI Students in Self Financing Colleges:-
 - (i) Admission to the NRI seats may be made on the basis of the marks in the qualifying examination.
 - (ii) The candidates who are seeking admission under NRI Quota are exempted from appearing for the Tamil Nadu Professional Courses Entrance Examination.
 - (iii) NRI financially supporting the candidate must be a blood relation such as

Father / Mother / Brother / Sister / Uncle / Aunt only.

(iv) Applicants for admission under NRI Quota shall not have completed 21 years of age on the 1st of July of the respective academic year.

(v.) Candidate must furnish the Xerox copies of the following supporting documents:-

- a) NRI Status Certificate of the financial supporter issued by the Embassy of respective Country under their seal.
- b) NRI Bank Account Pass Book of the financial supporter.
- c) Passport of the Financial Supporter.
- d) Nativity Certificate of the Financial Supporter.
- c) Evidence of payment of Development Charges in USD(\$)

(**32nd S.A.B. dated 21.12.2006.)

4. NATIONAL OPEN SCHOOL QUALIFICATION:

Candidates who have passed the Secondary School examination of National Open School with Minimum 5 subjects with any of the following group of subjects.

n. English, Physics, Chemistry, Botany, Zoology.

o. English, Physics, Chemistry, Biology and any other language.

(To be read along with Qualification for Admission under Regulations)

5. VOCATIONAL COURSE:

As per the orders of Government issued in G.O. Ms.No.186, and Family Welfare Department dated 25.03.1996, the students who have passed Vocational Higher Secondary Course of Kerala are not eligible for admission to the course.

6. RE-APPEARANCE OF FAILED CANDIDATES

Candidates who have passed the failed subjects in the qualifying examination in two opportunities from the first appearance are eligible for admission to the first B. Pharm Course.

7. QUALIFICATION FOR ADMISSION INTO DIRECT II YEAR B. PHARMACY COURSE

- a) Should have aggregate of 50% marks in the First and Second year D. Pharmacy Examination with a pass in HSC or equivalent with Physics, Chemistry and Biology (Botany & Zoology) or Mathematics.

OR

- b) Minimum qualifying marks in 10+2 examination as per Regulation (1a) above with pass in two year D. Pharmacy course.

8. AGE LIMIT FOR ADMISSION:

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 the first year B.Pharm course.

9. PHYSICAL FITNESS CERTIFICATE:

Every candidate before admission to the course shall submit to the Principal of the Institution a Certificate of Medical Fitness from an authorized Medical Officer that the candidate is physically fit to undergo the academic course and does not suffer from any disability or contagious disease.

10. ELIGIBILITY CERTIFICATE :

The candidate who have passed any qualifying examination other than the Higher Secondary Course Examination conducted by the Government of Tamil Nadu shall obtain an Eligibility Certificate from the University by remitting the prescribed fees along with the filled in Application Form (which can be downloaded from the University website (www.tnmmu.ac.in), Mark sheet, Transfer Certificate and other relevant documents required by the University before seeking admission to any one of the affiliated Institutions.

The candidates should obtain the Eligibility Certificate before admission. Due to some unavoidable reason; if the candidate got admission only on the last day of the cut-off date, then the candidate shall directly go and join the college without Eligibility Certificate. The institution, shall admit such candidates without Eligibility Certificate with a condition that the Eligibility Certificate should be produced within 15 days.

The candidates should apply to the University directly for Eligibility Certificate and the institutions; need not apply on behalf of the candidate. (31st S.A.B. date 28.07.2006).

11. WEBSITE AS VOLUNTARY BLOOD DONORS:

The University opened a Website for Voluntary Blood Donors to motivate some sort of social service among the students which will be useful, not only for the students but also for general public.

Hence every candidate should submit his / her Blood Group (Certificate from a competent person), contact number, willingness to donate the blood during emergencies in the prescribed proforma at the time registration which shall be made available in the website for Voluntary Blood Donors.

12. CUT-OFF DATE FOR ADMISSION TO EXAMINATION:

The Candidates admitted up to 30th September shall be registered to take up their 1st year examination during August of the next year. All kinds of admissions shall be completed on or before 30th September of the academic year. There shall not be any admissions after 30th September even if seats are vacant.

13. REGISTRATION :

A candidate admitted in the B. Pharmacy Degree Course in any one of the affiliated Institutions of this University shall register his / her name in the prescribed application form for registration duly filled along with the prescribed fee and a declaration in the format, (as in Annexure) to The Deputy Controller of Examinations in Pharmacy, through the affiliated Institution within 60 days from the Cut-off date prescribed for B. Pharmacy Degree course for admission.

19. DURATION OF THE COURSE :

20 (four) academic years (Non-Semester).

20. COMMENCEMENT OF THE COURSE :

From 1st August of the academic year.

21. CURRICULUM :

The Curriculum and the syllabi for the course shall be as prescribed by the University from time to time.

17. MEDIUM OF INSTRUCTION :

English shall be the medium of instruction for all the subjects of study for examinations of the B. Pharmacy Degree course.

1. WORKING DAYS IN THE ACADEMIC YEAR :

From the academic year 2009-2010 onwards each academic year shall consist of not less than 220 working days.

1. ATTENDANCE REQUIRED FOR ADMISSION TO EXAMINATIONS :

- . No candidate shall be permitted to appear in any one of the part of B.Pharm Examinations, unless he / she has attended the course in the subject for the prescribed period in an affiliated Institution recognized by this University and produces the necessary certificate of study attendance, satisfactory conduct and progress from the Head of the institution.
- a. A candidate is required to put in a minimum of 80% of attendance in both theory and practical separately in each subject before admission to the examination for all the years of study in B. Pharmacy degree course of this University.

- b. 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.

20. INTERNAL ASSESSMENT:

The following procedure shall be adopted for the candidates admitted during the academic year 2009-10:

A minimum of four written examinations shall be conducted in each subject during an academic year and the average marks of three best performances shall be taken into consideration for award of sessional marks.

A minimum of three practical examinations shall be conducted in each subject during an academic year and an average of two best performances shall be taken into consideration for award of sessional marks.

A failed candidate in any subject should be provided an opportunity to improve his sessional marks by conducting a minimum of two examinations in theory and practical separately and the average may be considered for improvement.

The Internal Assessment marks (both in written and practical taken together) should be submitted to the University endorsed by the Head of the Institution 15 days prior to the commencement of the theory Examinations.

A Candidate to be eligible for appearing to the University examination should have appeared for the internal assessment examination conducted by the institution and secure a minimum of 35% of marks in internal assessment.

21. SUBJECTS OF STUDY:

FIRST B.PHARM:

27. Pharmaceutical Inorganic Chemistry
28. Pharmaceutical Organic Chemistry
29. Anatomy, Physiology & Health Education
30. Bio-Chemistry
31. Biostatistics and Computer Applications

SECOND B. PHARM

1. Physical Pharmaceutics
2. Pharmaceutical Analysis and Physical Chemistry
3. Advanced Pharmaceutical Organic Chemistry
4. Pharmaceutical Technology
5. Pharmacy Practice and Pathophysiology

THIRD B. PHARM

1. Pharmacognosy and Phyto-Chemistry
2. Medicinal Chemistry –I
3. Pharmaceutical Dosage Forms and Cosmetic Technology
4. Pharmacology-I
5. Hospital & Clinical Pharmacy
6. Pharmaceutical Biotechnology

FOURTH B. PHARM

1. Formulative Pharmacy and Bio-Pharmaceutics
2. Advanced Pharmacognosy
3. Pharmacology-II
4. Modern Methods of Pharmaceutical Analysis
5. Medicinal Chemistry-II
6. Pharmaceutical Jurisprudence and Pharmacy Business Management

(37th S.A.B. Meeting held on 10-6-09)

The Internal Assessment should consist of the following points of evaluation:-

Theory

Practical / Clinical

Viva Voce

22. COMMENCEMENT OF EXAMINATION:-

Regular Examinations will commence from 1st August and supplementary Examinations will commence from 1st February.

If the date of commencement of the examination falls on Saturday, Sunday or declared Public Holidays, the examination shall begin on the next working day.

23. QUESTION PATTERN:

The uniform mark system for all subjects in B.Pharmacy is:

Theory – 100 Marks (80 Marks - Written and 20 Marks - IA)

80 Marks (Theory)

Essay 2 x 20 Marks = 40 Marks

Short Notes 6 x 5 Marks = 30 Marks

Short Answer Questions 5 x 2 Marks = 10 Marks

Choices are given

2/3

6/8

5/7

80 Marks

Practicals – 100 Marks (70 Marks for the University exam and 30 Marks as detailed below)

15 Marks – IA

5 Marks – Record Marks

10 Marks – Oral Marks

This will be implemented from August 2010 examinations for all the regulations. (37th Standing Academic Board Meeting held on 10.6.09)

Question paper pattern for:

- ii) Biostatistics and Computer Applications (PGL – III) ,
- iii) Pharmaceutical Analysis and Physical Chemistry (PC – III),
- iv) Advanced Pharmaceutical Organic Chemistry (APOC & CNP-PC-IV),
- v) Pharmacy Practice and Pathophysiology (P-III)
- vi) Pharmaceutical Jurisprudence and Pharmacy Business Management (PGL-IV):

Question Papers divided as **Part I and Part II** each carrying 40 Marks.

Section A		<u>Choices are given</u>
One Essay Question (out of 2)	1 x 20 Marks = 20 Marks	1/2
Short Notes (4 x 5)	3 x 5 Marks = 15 Marks	3/5
Short Answer Questions	2 x 2.5 Marks = 5 Marks	2/3

40 Marks		

Section B		<u>Choices are given</u>
One Essay Question (out of 2)	1 x 20 Marks = 20 Marks	1/2
Short Notes (4 x 5)	3 x 5 Marks = 15 Marks	3/5
Short Answer Questions	2 x 2.5 Marks = 5 Marks	2/3

40 Marks		

(As per the 37th Standing Academic Board Meeting held on 10.6.09).

1. CARRY OVER OF FAILED SUBJECTS:

Break System in the Under-Graduate Program (B.Pharmacy) will be followed from the academic year 2009-2010 onwards. The I and II year subjects should be passed before entering into the final year. The candidates can carry over only two subjects of III year to the final year. If the candidate fails in more than two subjects of the III year, it is a break. Before writing the final year examination, all the subjects of III year should be completed. (38th S.A.B. Meeting held on 19.11.09).

2. SUBMISSION OF LABORATORY RECORD NOTE BOOKS :

At the time of practical examination, each candidate shall submit to the Examiners his/ her laboratory note books duly certified by the Head of the Department as a bona-fide record of the work done by the candidate.

The practical record shall be evaluated by the concerned Subject staff of the Department (Internal Evaluator) and the practical record marks shall be submitted to the University 15 days prior to the commencement of the theory Examinations.

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

26. MINIMUM MARKS FOR A PASS

50% of marks in the University Theory examination.

50% of marks in the University Practical examination.

50% of marks in aggregate in Theory, Practical, I.A. & Oral.

1. EXEMPTION FROM THE RE-EXAMINATION IN A SUBJECT:-

- a) Candidates who have failed in the examination but obtained pass marks in any subject shall be exempted from reappearing in that subject.
- b) Failed candidates who are not permitted to the next phase of study are also required to put in a minimum of 80% attendance during the calendar period of study before appearing for next examination.

28. REVALUATION / RETOTALLING OF ANSWER PAPERS

There is no provision for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates can apply for retotalling.

29. PRACTICAL TRAINING:

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

30. PROJECT WORK

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

- x) Pharmaceutics
- y) Pharmaceutical Chemistry
- z) Pharmacognosy
- aa) Pharmacology
- bb) Pharmacy Practice
- cc) Pharmaceutical Analysis

- ❖ 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 25 pages).
- ❖ The project will be evaluated by the examiner at the time of the Practical examination (Final year) 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.

31. 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.

32. CLASSIFICATION OF SUCCESSFUL CANDIDATES

The candidate should have appeared for theory practical and Oral examinations for securing a pass in a subject.

Distinction to the candidates who secure 75% marks will be awarded.

(31st Meeting of the S.A.B.)

The name of FIRST TEN University rank holders in each batch of candidates who have passed all the subjects from first year to final year in the first attempt and completed the course, taking their cumulative aggregate into consideration, the rank list will be published in the University Website and the Rank Certificates will be issued to the candidates.

It was implemented for the batch of students of all the courses appearing for final examination in August 2007 onwards. (32nd S.A.B. dated 21.12.2006).

33. RE-ADMISSION AFTER BREAK OF STUDY:

As per the University common Regulations for Re-admission after break of study for all courses. (As approved by the Standing Academic Board in its XXVI Meeting held on 16-12-03).

34. MIGRATION / TRANSFER OF CANDIDATES

Migration/Transfer of candidates from one recognized institution to another recognized institution of this University shall be granted on the following conditions:-

- a) All migrations / transfers are subject to the approval of the Vice-Chancellor.
- b) Transfer shall be effected only at the beginning of the academic year.
- c) The transfer application should be sent through proper channel to the Academic Officer within three months of publications of the results or admission to the course.
- d) Transfers shall be effected during any year of study after fulfillment of the regulations of this university.
- e) The Vice-Chancellor has been empowered to decide and issue transfer from one college to another college, subject to verification of the vacancy position available in the college without contravention to the statutory rules of the Central Council and such transfers permitted by the University be placed in the Governing Council for information.
- a) The provision of combination of attendance shall be granted to the transfers for admission to the examination of the University on satisfactory fulfillment of the regulations of this University.

35. VACATION:

Six (6) Weeks in an Academic year.

36. AWARD OF MEDALS AND PRIZES:

The University shall award at its Convocation, medals and prizes to outstanding candidates as and when instituted by the donors as per the schedule prescribed for the award.

37. AUTHORITY TO ISSUE TRANSCRIPT:

The controller of Examinations shall be the Authority for issuing Transcript of marks after remitting the prescribed fee of Rs. 1,000/- (Rupees One thousand only) or as may be prescribed from time to time.

38. SCHEME OF EXAMINATION (2009-10 Batch Regulation): THEORY

Sl. No.	Sub Code	SUBJECT	Year of study	Course of study / Wk	Duration	Uty. Marks	I.A.	Total
1.	PCI	Pharmaceutical Inorganic Chemistry	I B.Pharm	3 Hrs.	3 Hrs	80	20	100
2.	PCII	Pharmaceutical Organic Chemistry	I B. Pharm	3 Hrs.	3 Hrs	80	20	100
3.	PGL-I	Anatomy, Physiology & Health Education	I B. Pharm	3 Hrs.	3 Hrs	80	20	100
4.	PGL-II	Biochemistry	I B.Pharm	3 Hrs.	3 Hrs	80	20	100
5.	PGL-III	Biostatistics and Computer Applications	I B.Pharm	3 Hrs.	3 Hrs	80	20	100
6.	P-1	Physical Pharmaceutics	II B.Pharm	3 Hrs.	3 Hrs	80	20	100
7.	PC-III	Pharmaceutical Analysis and Physical Chemistry	II B. Pharm	3 Hrs.	3 Hrs	80	20	100
8.	PC-IV	Advanced Pharmaceutical Organic Chemistry	II B. Pharm	3 Hrs.	3 Hrs	80	20	100
9.	P-II	Pharmaceutical Technology	II B.Pharm	3 Hrs.	3 Hrs	80	20	100
10.	P-III	Pharmacy Practice & Pathophysiology	II B.Pharm	3 Hrs.	3 Hrs	80	20	100
11.	PCOG-I	Pharmacognosy and Phytochemistry	III B.Pharm	3 Hrs.	3 Hrs	80	20	100
12.	PC-V	Medicinal Chemistry-1	III B.Pharm	3Hrs.	3 Hrs	80	20	100
13.	P-IV	Pharmaceutical Dosage Forms and Cosmetic Technology	III B.Pharm	3 Hrs.	3 Hrs	80	20	100
14.	PT-1	Pharmacology -1	III B.Pharm	3 Hrs.	3 Hrs	80	20	100
15.	P-V	Hospital and Clinical Pharmacy	III B.Pharm	3 Hrs	3 Hrs	80	20	100
16.	P-VI	Pharmaceutical Biotechnology	III B.Pharm	3 Hrs	3 Hrs	80	20	100
17.	P-VII	Formulative Pharmacy and Biopharmaceutics	IV B.Pharm	3 Hrs.	3 Hrs	80	20	100

18.	PCOG -II	Advanced Pharmacognosy	IV B.Pharm	3 Hrs.	3 Hrs	80	20	100
19.	PT-2	Pharmacology –II	IV B. Pharm	3 Hrs	3 Hrs	80	20	100
20.	PC-VI	Modern Methods of Pharmaceutical Analysis	IV B .Pharm	3 Hrs.	3 Hrs	80	20	100
21.	PC-VII	Medicinal Chemistry –II	IV B.Pharm	3 Hrs	3 Hrs	80	20	100
22	PGL-IV	Pharmaceutical Jurisprudence & Pharmacy Business Management	IV B.Pharm	3 Hrs	3 Hrs	80	20	100

SCHEME OF EXAMINATION (2009-10 Batch Regulation):
PRACTICAL

Scheme of examination

Sl. No.	Sub Code	SUBJECTS	Year of study	Course of study/ week	Duration	Uty. Marks	I.A.	Record	Uty orals	Total
1.	PCI	Pharmaceutical Inorganic Chemistry	I B.Pharm	3 Hrs.	4 Hrs	70	15	5	10	100
2.	PCII	Pharmaceutical Organic Chemistry	I B. Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
3.	PGL-I	Anatomy, Physiology & Health Education	I B. Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
4	PGL-II	Biochemistry	I B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
5.	PGL-III	Biostatistics and Computer Applications	I B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
6.	P-1	Physical Pharmaceutics	II B. Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
7.	PC-III	Pharmaceutical Analysis and Physical chemistry	II B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
8.	PC-IV	Advanced Pharmaceutical Organic Chemistry	II B. Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
9.	P-II	Pharmaceutical Technology	II B.Pharm	-	-	-	-	-	-	-
10.	P-III	Pharmacy Practice & Pathophysiology	II B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100

11.	PCOG-I	Pharmacognosy and Phytochemistry	III B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
12.	PC-V	Medicinal Chemistry-1	III B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
13.	P-IV	Pharmaceutical Dosage Forms and Cosmetic Technology	III B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
14.	PT-1	Pharmacology -1	III B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
15.	P-V	Hospital and Clinical Pharmacy	III B.Pharm	-	-	-	-	-	-	
16.	P-VI	Pharmaceutical Biotechnology	III B.Pharm	3 Hrs	4 Hrs	70	15	5	10	100
17.	P-VII	Formulative Pharmacy and BioPharmaceutics	IV B.Pharm	3 Hrs.	4 Hrs	70	15	5	10	100
18.	PCOG-II	Advanced Pharmacognosy	IV B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
19.	PT-2	Pharmacology –II	IV B. Pharm	3 Hrs	4 Hrs.	70	15	5	10	100
20.	PC-VI	Modern Methods of Pharmaceutical Analysis	IV B.Pharm	3 Hrs.	4 Hrs.	70	15	5	10	100
21.	PC-VII	Medicinal Chemistry –II	IV B.Pharm	3 Hrs	4 Hrs.	70	15	5	10	100
22.	PGL-IV	Pharmaceutical Jurisprudence & Pharmacy Business Management	IV B.Pharm	-	-	-	-	-	-	

ANNEXURE – 1**DECLARATION**

I.....
... son / daughter of
.....
residing at
.....
and admitted to I year of (Name
of the course U.G./P.G.) at
.....
.....
.....
(Name of the college) do hereby solemnly affirm and sincerely state as follows:

I declare that I shall abide by the rules and regulations prescribed by The Tamil Nadu Dr. M. G. R. Medical University, Chennai for the.....
.....(course) including regulations for re-admission after the break of study.

Date:

Signature of candidate.

/Counter signed/

Dean / Principal /
Director

(Office date seal)

FIRST YEAR B.PHARMACY DEGREE

1.1. PHARMACEUTICAL INORGANIC CHEMISTRY

THEORY (Total 75 Hours)

1. Fundamentals of Volumetry

5 hours

Methods of expressing concentrations, primary and secondary standards & practical oriented theory

2. **Introduction:** Learning symbols and valency of elements. Writing molecular formula, balancing equation, Pharmacopoeia and monograph. Development of periodic table on the modern concept of atomic structure and its importance. **10 hours**

3. **Quality control and test for purity:** Sources of impurities in pharmaceutical substances. Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals, lead and modifications in procedures with suitable examples. **12 hours**

4. **Radiopharmaceuticals and contrast media:** Nuclear reactions, nomenclature, units and measurement of radioactivity, clinical applications and dosage, hazards and precautions, Radio pharmaceutical preparations and standards of radioactive material such as ^{131}I Iodine, ^{58}Co Cobalt. Radio opaque contrast medium-barium sulphate. **8 hours**

5. **Method of preparation, assay, identification test, test for purity, official preparation, storage conditions and uses of inorganic compounds listed in I.P belonging to the following categories.** **30 hours**

a) Gastrointestinal agents and related compounds

- i. Acidifiers: Dilute hydrochloric acid, Sodium phosphate, Ammonium chloride.
- ii. Antacids: Classification, qualities of an ideal antacid, side effects, advantages, combination therapy, acid neutralizing capacity, sodium bicarbonate, potassium citrate, aluminium hydroxide gel, dried aluminium hydroxide gel, aluminium phosphate, magnesium hydroxide, light and heavy magnesium trisilicate, light and heavy magnesium carbonate, calcium carbonate, magaldrate and bismuth carbonate.
- iii. Adsorbents and protectives: Light kaolin, heavy kaolin and bismuth sub-carbonate.
- iv. Saline cathartics: Magnesium hydroxide, magnesium sulphate, magnesium carbonate and sodium phosphate.

b) Topical Agents

- i. Protectives: Talc, zinc oxide, calamine, zinc stearate, titanium dioxide, kaolin, silicon polymers and dimethicone.
- ii. Astringents: Alum, zinc sulphate and zinc chloride.
- iii. Anti-microbials: Hydrogen peroxide, potassium permanganate, chlorinated lime, iodine, boric acid, silver nitrate, sodium stilboglucanate, povidone-iodine, selenium sulphide and zinc undecenoate.

c) Dental products

- i. Anti-caries Agents: Role of fluorides as anti-caries agents, sodium fluoride.
- ii. Dentifrices: Calcium carbonate, dibasic calcium phosphate, strontium chloride, zinc chloride.

d) Major intra and extra cellular electrolytes:

- i. Physiological role of chloride, phosphate, bicarbonate, sodium, potassium, calcium and magnesium.
- ii. Electrolytes used for replacement therapy: Sodium chloride, potassium chloride, calcium chloride, calcium gluconate, calcium lactate, dibasic calcium phosphate, tribasic calcium phosphate.
- iii. Physiological acid-base balance and its importance.
- iv. Electrolytes used in the acid-base therapy : Sodium acetate, potassium acetate, sodium bicarbonate, potassium bicarbonate, sodium citrate, sodium lactate, ammonium chloride. electrolyte combination therapy, compound sodium chloride solution, sodium chloride injection and oral rehydration salt.

e) **Gases:** Oxygen, carbon dioxide, helium, nitrogen and nitrous oxide.

f) **Essential and Trace ions:** Definition, physiological role of iron, copper, zinc, chromium, manganese, molybdenum, selenium, sulphur and iodine ferrous fumarate, ferrous gluconate, ferrous sulphate, iron and ammonium citrate.

Official formulation: Iron dextran injection, strong iodine solution.

g) **Pharmaceutical Aids:** Sodium bisulphite, sodium metabisulphite, sulphurdioxide, bentonite, magnesium stearate, zinc stearate, aluminium sulphate, sodium carboxy methyl cellulose, sodium formaldehyde sulfoxylate, purified water, water for injection and sterile water for injection.

h) Miscellaneous:

- i. Sclerosing agents: Hypertonic saline, sodium tetra decyl sulphate.
- ii. Expectorants: Potassium citrate and potassium iodide.
- iii. Sedative: Potassium bromide.
- iv. Antidotes: Sodium nitrite, sodium thiosulphate and charcoal
- v. Respiratory stimulant: Ammonium carbonate.

6. **Theory of co-ordination compounds** with special reference to application in pharmacy and pharmaceutical analysis. EDTA, dimercaprol, penicillamine and 1, 10-phenanthroline. **10 hours**

PRACTICALS**I. Volumetric analysis**

- a. Preparation and standardization of some standard solutions
- b. Volumetric analysis of some important compounds mentioned in theory

II. Preparation of the following inorganic pharmaceuticals and their identification tests and other tests given in I.P.

- | | |
|------------------------|----------------------|
| a. Aluminium hydroxide | b. Zinc oxide |
| c. Barium sulphate | d. Calcium carbonate |
| e. Potassium citrate | f. Boric acid |
| g. Magnesium sulphate | h. Ferrous sulphate. |

III. Test for purity for the following:

- a. Swelling property of bentonite.
- b. Acid neutralizing capacity of aluminium hydroxide gel.
- c. Ammonium salts in potash alum.
- d. Adsorption power in heavy kaolin.
- e. Presence of iodates in potassium iodide.
- f. Ferric ion and reducing sugars in ferrous gluconate.

IV. Limit test for chlorides, sulphates, iron, heavy metals, arsenic and modified procedure for limit test for chloride and sulphates on potassium permanganate, sodium bicarbonate, sodium benzoate and sodium salicylate.

V. Systematic qualitative analysis of inorganic mixtures upto two acid radicals and two basic radicals.

REFERENCES

1. Pharmaceutical inorganic Chemistry by Discher.
2. Advanced inorganic Chemistry by G.R.Chatwal
3. Bentley and Driver's, Textbook of Pharmaceutical Chemistry.
4. Inorganic Medicinal and Pharmaceutical Chemistry by J.H. Block, E.B. Roche, T.O.Soine and C.O.Wilson.
5. Roger's Inorganic Pharmaceutical Chemistry by T.O.Soine and C.O.Wilson.
6. Pharmaceutical Chemistry by M.L. Schroff.
7. Indian Pharmacopoeia 1985, 1996 and 2007.
8. Organic Chemistry Reactions and Reagents by O.P. Agarwal.
9. Analytical chemistry principles by John H. Kennedy
10. A text book Inorganic medicinal chemistry by Surendra N. Pandeya
11. A. H. Beckett and J. B. Stanlake's Practical Pharmaceutical chemistry Vol-I & II
12. Inorganic Pharmaceutical Chemistry III-Edition P.Gundu Rao
13. Inorganic Pharmaceutical Chemistry by Anand & Chatwal.
14. Pharmaceutical Inorganic chemistry by Dr.B.G.Nagavi

1.2. PHARMACEUTICAL ORGANIC CHEMISTRY

THEORY (Total 75 Hours)

1. Molecular orbital theory, wave equations, molecular orbitals, bonding, anti-bonding orbitals, unshared pair of electrons and hybrid orbitals. intra-molecular and inter-molecular forces, their effect on solubility, boiling point, melting point, covalent bond, polarity of bond, polarity of molecule, dipole moment, bond dissociation energy, energy of activation, solubility of ionic solutes and non ionic solutes. inductive effect, electromeric effect, mesomeric effect, resonance effect, resonance, tautomerism, conjugation, hyper conjugation, types of bond fission, electrophiles and nucleophiles. iupac nomenclature of organic compounds. **10 hours**

2. Structure, nomenclature, preparation and reactions of alkanes, alkenes, alkynes, cycloalkanes and dienes with special emphasis on the following:

Mechanism of halogenation of alkanes, thermodynamics and kinetics of the reactions of methane with a halogen, Saytzeff's rule, free radical and electrophilic addition on C=C bond, Markownikoff's rule, peroxide effect, ozonolysis, Bayer's strain theory, Coulson and Moffitt's modification, mechanism of Diel's–Alder reaction and addition reaction of conjugated dienes.

15 hours

3. Benzene: Kekule structure, heat of hydrogenation and stability, C-C bond length in benzene, Resonance structure of benzene, orbital picture, aromatic character, Huckel's rule, Mechanism of electrophilic and nucleophilic aromatic substitution, theory of effect of substituent on reactivity and orientation. **10 hours**

4. a) Preparation and properties of poly aromatic compounds : naphthalene, anthracene, phenanthrene, diphenyl methane, triphenyl methane and diphenyl ethane.

b) Preparation, test for purity and medicinal uses of dicophane, gammaxene, saccharin, methyl salicylate, phenindione, ethylbiscoumacetate, vanillin, urethane, carbromal, amphetamine and acetanilide. **10 hours**

5. a) General structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides (Mechanism of SN_1 , SN_2 , E_1 and E_2), alcohols, ethers, epoxides, amines (basicity of amines, influence of substituent on basic property), aldehydes, ketones, carboxylic acids and functional derivatives of carboxylic acids.

b) Preparation, test for purity and medicinal uses of Chloroform, Iodoform, Mephenesin, Citric acid, Lactic acid, Benzoic acid, Sodium lauryl sulphate and Glycol. **15 hours**

6. a) Reactive intermediates: Carbocations, carbanions, carbenes, free radicals – generation, relative stability, fate and applications.

b) Properties of Alpha (α) and Beta (β) unsaturated carbonyl compounds.

c) Preparation and synthetic utility of aceto-acetic ester, malonic ester, Grignard reagent and diazonium salts. **15 hours**

PRACTICALS

1. Assay of organic compounds involving acidimetry, alkalimetry and iodimetry.
(at least 04).
2. Systematic qualitative analysis of organic compounds including preparation of derivative
(not less than 10 compounds with different functional groups).
3. Preparation of organic drugs or intermediate involving one-step reaction
(at least 08 compounds).
4. Determination of melting point and 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(The ball and stick stereo molecules may be prepared by students using china clay and plastic sticks in order to explain the formation of bonds, bond angles, bond lengths, etc.)

REFERENCES

1. Organic Chemistry by R.L. Morrison and R.N. Boyd.
2. Organic Chemistry by I.L. Finar Vol. I and II.
3. Organic Chemistry by P.L. Soni.
4. Textbook of Organic Chemistry by B.S. Bahl and Arun Bahl.
5. Reaction and reagents by O.P. Agarwal.
6. Bentley and Driver's, Textbook of Pharmaceutical Chemistry.
7. Indian Pharmacopoeia (I.P.) , 1985, 1996 and 2007.
8. Vogel's Practical Organic Chemistry, Vol I, II and III.
9. Stereo Chemistry of Organic Compounds by E.I. Eliel.
10. Advanced Organic Chemistry by Arun Bahl.
11. Organic chemistry – J.M.Cram and D.J.Cram
12. Organic chemistry- Brown
13. Organic chemistry- Cram and Hammered, Pine Hendrickson

1.3. ANATOMY, PHYSIOLOGY AND HEALTH EDUCATION

THEORY (Total 75 Hours)

1. Scope of anatomy, physiology and basic terminology. **1 hour**
2. **Cell physiology:** Different type of cells, cell membrane physiology, development of action potential, impulse transmission, cardiac and skeletal muscles electrophysiology, cell stimulation and neuronal functions. **4 hours**
3. **Tissues:** Epithelial, connective, muscular and nervous tissues, their types and characteristics. **2 hours**
4. **Bones and Joints:** Structure and function of skeleton, types of joints and their disorders. **5 hours**
5. **Blood and Lymph:** Composition and functions of blood including their disorders. Blood grouping and its significance, mechanism of coagulation, bleeding and clotting disorders. Formation of lymph and its composition. Reticulo-endothelial system and its functions. **7 hours**
6. **Cardiovascular system:** Anatomy and physiology of heart, blood circulation - systemic, hepatic, pulmonary, fetal and circle of Willis, cardiac cycle, heart rate, blood pressure and its regulation, ECG and heart sounds. **6 hours**
7. **Digestive system:** Gross anatomy of the G.I.T. and its physiology with special reference to liver, pancreas and stomach. Digestion, absorption, movements of intestine and disorders of digestive system- constipation, diarrhoea and vomiting. **6 hours**
8. **Respiratory system:** Anatomy of respiratory tract, mechanism of respiration, lung volumes, transport of oxygen and carbon dioxide. Disorders like cyanosis, mountain sickness and Caisson's disease. Cough and sneezing reflex. **5 hours**
9. **Urinary system:** Structure and functions of kidney and urinary tract. Physiology of urine formation and acid-base balance. **5 hours**
10. **Reproductive system:** Structure and functions of male and female reproductive systems, sex hormones, physiology of menstruation, coitus and fertilization. Spermatogenesis and oogenesis, pregnancy and parturition, oral contraceptives. **4 hours**
11. **Endocrine system:** Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands. **7 hours**
12. **Central nervous system:** Structure and functions of brain and spinal cord. Functions of cerebrum, cerebellum, vital centers of medulla oblongata, cerebral ventricles, cranial nerves and their functions. Reflex arc, cerebrospinal fluid and its functions, meninges. **7 hours**
13. **Autonomic nervous system:** Anatomy, physiology and divisions of ANS. Motor and sensory pathways. **3hours**
14. **Sense organs:** Physiology of vision, audition, olfaction, taste and skin. **4 hours**
15. **Health education:** Concepts of health and disease. Disease causing agents and prevention of disease. **2 hours**

16. **Nutrition:** Balanced diet, deficiency disorders of various nutrients, their prevention and treatment. **2 hours**

17. **Communicable diseases:** The causative agents, modes of transmission and prevention of chicken pox, measles, diphtheria, tuberculosis, malaria, poliomyelitis, filariasis, rabies, tetanus, STD and AIDS. Vaccination schedule. **3 hours**

18. **First Aid:** Emergency treatment of shock, snakebite, burns, poisoning, fractures and resuscitation methods. **1 hour**

19. **Family planning:** Different measures of family planning in male and female. **1 hour**

PRACTICALS

1. Study of different organs and systems using models and specimen
2. Microscopic study of different tissues.
3. Blood experiments: Enumeration of RBC and WBC, Haemoglobin estimation, ESR, blood group determination, bleeding and clotting time, heart rate and blood pressure recording, differential leucocyte count
4. Identification of bones and points of identification.
5. Health education – charts for various communicable diseases.
6. Determination of vital capacity.

REFERENCES

1. Best and Taylor's "Physiological basis of Medical Practice".
2. Guyton A.C. Hall J.E. Text book of Medical Physiology.
3. Human Physiology by C.C. Chatterjee.
4. Samson Wright's Applied Physiology by Cyril A. Keek, Eric Neil and Norman Joels.
5. Textbook of Preventive and Social Medicine by J.E. Park and K. Park.

1.4. BIOCHEMISTRY

THEORY (Total 75 Hours)

- 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. **10 hours**
- 2. Biochemical organization of the cell and transport process across cell membrane.** **1 hour**
- 3 Enzymes:** Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, enzymes of clinical importance. **5 hours**
- 4 Carbohydrates:** Classification and their properties. Starch, glycogen, dextrin, inulin, cellulose. Metabolism of carbohydrates – glycolysis, gluconeogenesis, glycogen synthesis and break down, HMP shunt. Role of sugars in nucleotide biosynthesis **8 hours**
- 5. Lipids:** Classification and properties, study of sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, oxidation of fatty acids, α , β - oxidation and biosynthesis of fatty acids, ketone bodies, lipoproteins. **8 hours**
- 6. Proteins and amino acids:** Classification and properties of amino acids and proteins, Essential amino acids, metabolism of amino acids and proteins. **6 hours**
- 7. Macromolecules:** Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein. **4 hours**
- 8. Vitamins:** Classification and their properties, occurrence, functions, requirements, deficiency manifestations; role of vitamins as coenzymes and their significance **4 hours**
- 9. Hormones:** Classes of hormones and their mechanisms of action. Chemical nature, properties and biochemical functions of hormones. **8 hours**
- 10. Nucleic acid and genetics:** Brief introduction to genetic organization of the mammalian genome, genetic code, nucleic acids and structure of DNA and RNA. Biosynthesis of DNA mutation, mutagenesis and carcinogenesis. **8 hours**
- 11. Metabolism of Nitrogen containing monomers:** Nitrogen balance, Porphyrin biosynthesis, formation of bile pigments, hyper bilirubinaemia. **6 hours**
- 12. Mineral metabolism:** Functions and properties of minerals including metabolism – calcium, phosphorous, magnesium, iron, sodium, potassium and trace elements. **2 hours**
- 13. Nutrition:** Principles and nutritional significance of carbohydrates, lipids and proteins in major food stuffs, calorific value and basal metabolic rate. Functional tests of liver and kidney. Elementary basis of biochemical mode of action of drugs, liposomal benzoxidation, biochemistry of urine and blood. **5 hours**

PRACTICALS

1. Preparation of standard buffer (nitrate, phosphate, carbonate and measurement of pH).
2. Experiments on amino acids by two-dimensional paper chromatography and gel electrophoresis.
3. Separation of lipids by TLC.
4. Quantitative estimation of amino acids.
5. Quantitative estimation of proteins.
6. Isolation and assay of glycogen from the liver and skeletal muscle of rats.
7. Estimation of blood glucose, blood cholesterol, SGPT and SGOT activity.
8. Enzymatic hydrolysis of glycogen by α and β amylase.
9. Acid hydrolysis and action of salivary amylase on starch.
10. Estimation of chloride, glucose, ammonia, creatinine and urea in urine.
11. Identification of carbohydrates, proteins and fats.
12. Identification of abnormal constituents of urine.

REFERENCES

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 T. Plummer. (II Edition)
8. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
9. Handbook of practical Biochemistry by V.K. Malhotra.
10. Practical Biochemistry by Harold Varley.
11. Text book of Biochemistry by Satyanarayana.

1.5. BIO-STATISTICS AND COMPUTER APPLICATIONS

THEORY (Total 75 Hours)

BIOSTATISTICS

34 hours

1. Scope of statistical methods in Medicine and Pharmacy.
2. Collection of data.
3. Classification and tabulation of collected data.
4. Visual aids, diagrams, charts and graphs.
5. Measure of central tendency.
6. Dispersion.
7. Theory of sampling.
8. Statistical inference.
9. Regression and correlation.
10. Probabilities.

COMPUTER APPLICATIONS

1.1 Introduction to computers:

3 hours

Basic components of computers, Types of computers, characteristics and hardware aspects of computer.

1.2 Operating systems:

5 hours

Definition, Types of operating systems, MS-DOS

Memories: RAM, ROM and secondary memory.

1.3 Languages of computer

Introduction to programming languages

9 hours

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.

Decision making and Branching – Decision making with IF statements (simple IF statements, IF-ELSE statement, Nesting of IF-ELSE, the ELSE, IF Ladder)-Switch statement.

Decision making and looping: Which statement - the Do statement – FOR statement, Arrays–String handling functions.

1.4 Computer Packages:

9 hours

MS Office: MS Word, MS Excel, MS Power Point, advantages and use.

1.5 Introduction to Computer Networks:

4 hours

Definition, LAN, WAN, Advantages. Internet, World Wide Web.

1.6 Computer Graphics:

6 hours

Definition, display devices, graphical input and output devices, multimedia – definition and application.

1.7 Computer applications in pharmaceutical and clinical studies. Introduction to ACD softwares, Concepts of CPOE (Computerised Prescription Order Entry). **5 hours**

PRACTICALS

Exercises based on the following are to be dealt:

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

REFERENCES

1. Statistical methods by S.P. Gupta.
2. Statistics by Sancheti D.C., Kapoor V.K., Sultan Chand and son's.
3. E. Balaguruswamy – 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 commonsense, 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 Jersey.
9. Tanen Baum, computer networks.
10. Medication errors-Michael R.Cohen.

SECOND YEAR B. PHARMACY DEGREE**2.1. PHYSICAL PHARMACEUTICS****THEORY (Total 75 Hours)****1. Diffusion and Dissolution****8 hours**

Diffusion: steady state diffusion, diffusion principles in biological systems (gastro intestinal absorption of drugs).

Dissolution: Dissolution rate and factors affecting rate of dissolution, Noyes Whitney equation.

2. Colloids**8 hours**

Definition, types of colloids, purification, stabilization of colloids, solubilization, optical properties, kinetic properties and electrical properties.

3. Coarse Dispersion**8 hours**

Suspensions: Settling of suspensions, preparation, physical stability and evaluation of suspensions.

Emulsions: Theories of emulsification, instabilities of emulsion, microemulsion, multiple emulsions.

4. Interfacial phenomenon**9 hours**

Interfacial phenomenon, surface active agent, hydrophilic lipophilic balance, spreading coefficient, theory of micelle formation, factors influencing critical micelle concentration, electrical properties at interface.

5. Kinetics**9 hours**

Rate and orders of reaction. Determination of order, factors influencing rate of reaction, decomposition and stabilization study of medicinal agents, accelerated stability studies.

6. Micromeritics**8 hours**

Particle shape and size distribution, Methods of determining particle size, shape, surface area and derived properties of powders.

7. Rheology**8 hours**

Newtonian and Non-Newtonian system, thixotropy, determination of rheological properties, application of rheology in pharmacy.

8. Complexation and protein binding**9 hours**

Types of complexes, metal complexes, organic molecular complexes, inclusion complexes, methods of analysis of complexes, protein binding, binding equilibria.

9. pH, buffer and isotonic solutions**8 hours**

pH determination, applications, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems and buffered isotonic solutions.

PRACTICALS

1. Determination of particle size, particle size distribution and surface area using various methods.
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. Study 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. Preparation of pharmaceutical buffers and determination of buffer capacity.
11. Experiments involving tonicity adjustments.

REFERENCES

1. Physical Pharmacy by Alfred 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 M.M, & Banker G. Pharmaceutical dosage forms - Disperse systems, Vol.1, 2 and 3 Marcel Dekker Inc, Ny.
6. Liberman H.A, Lachman C. Pharmaceutical Dosage forms, Tablets, Vol.1-3, Marcel Dekker Inc.
7. Physical Pharmaceutics by R. Manavalan and C. Ramasamy.

2.2. PHARMACEUTICAL ANALYSIS AND PHYSICAL CHEMISTRY

THEORY (Total 75 Hours)

Pharmaceutical analysis

1. Introduction:

5 Hours

Importance of quality control, computation of analytical results, significant figure, concept of error, precision, accuracy, standard deviation, normal distribution curve, calibration of volumetric apparatus, titration - concepts and different types of titration.

2. Neutralization titrations:

6 Hours

Acid-base concepts, relative strength of acids and bases, ionisation, law of mass action, common ion effect, ionic product of water, pH, Henderson–Hasselbalch equation, buffer solutions, theory of indicators, neutralization curves, choice of indicators, mixed and universal indicators, titration of polyprotic system (Mixture of acids), determination of carbonates and bicarbonates by titration.

3. Non-aqueous titrations:

5 Hours

Theory, types of solvents, leveling effect, scope, limitations, preparation and standardization of perchloric acid, lithium, sodium and potassium methoxide, tetrabutyl ammonium hydroxide, titration of weak acid, weak bases and choice of indicators.

4. Precipitation titrations:

4 Hours

Principles of precipitation titrations, solubility product, effect of acids, temperature and solvent on the solubility of precipitate. Argentimetric titration including, Mohr's method, Volhard's method, Fajan's method and Gay Lussac method. Mercurimetric titration involving ammonium or potassium thiocyanate, barium sulphate.

5. Complexometric titrations:

5 Hours

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.

6. Oxidation – reduction titrations:

4 Hours

Concepts of oxidation–reduction, standard oxidation potential, Nernst equation, theory of redox titrations, redox indicators, preparation, standardization and titrations involving ceric ammonium sulphate, potassium permanganate, titanous chloride, sodium–2,6–dichlorophenol– indophenol, iodimetry, iodometry.

7. Gravimetric analysis:

4 Hours

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 and organic precipitants.

8. Miscellaneous methods:

5 Hours

Diazotisation, Kjeldhal method of nitrogen estimation, oxygen flask combustion, gasometry, analysis of oils, fats and waxes

Phyzical chemistry**1. Solutions:****4 Hours**

Definition and types of solutions, Ideal and real solutions, colligative properties, partition coefficient, Debye-Huckel theory.

2. Thermodynamics:**10 Hours**

Terminology of thermodynamics, First law of thermodynamics, internal energy, enthalpy of a system, relation between ΔH and ΔE , molar heat capacity, Joule – Thomson effect, Adiabatic expansion of an ideal gas and Zeroeth law of thermodynamics.

Second law of thermodynamics: Need for second law, spontaneous processes, concept of entropy, statement of second law of thermodynamics and Carnot cycle.

Change in entropy for isothermal changes: Entropy of vaporization, Trouton's rule, hydrogen bonding, need for Gibb's free energy and definition of free energy, predicting spontaneity of reaction, equilibrium constant and Vant-hoff equation.

Third law of thermodynamics: Definition, Zero entropy.

Phase rule – Definition of phase, component and degree of freedom. Study of one, two and three component system, and applications of phase rule.

3. Thermochemistry:**5 Hours**

Enthalpy of combustion, neutralization, solution, formation, precipitation, Hess's law of constant heat of summation, Lavoiser – Laplace law, bond energies and its application in calorimetry, e.g. Bomb calorimeter.

4. Adsorption:**4 Hours**

Definition, chemisorption, state of adsorbed molecule, factors influencing

adsorption, types of adsorption isotherms, Freundlich, Langmuir's and Gibb's adsorption isotherms.

5. Catalyst:**3 Hours**

Definition, characteristics, types- homogeneous & heterogeneous, theory and mechanism of catalysis, phase transfer catalysts, enzyme catalysts (biocatalysts), mechanism of catalysis, pharmaceutical applications.

6. Chemical Kinetics:**6 Hours**

Rate of reaction, order of reaction, molecularity of reaction, rate constant or velocity constant, methods for determining the order of reaction, factors affecting the rate of chemical reaction. Concept of activation energy, theories of reaction rates and kinetics of complex reactions.

7. Polarimetry and Refractometry :**5 Hours**

Polarimetry- Principle, Polarized light, rotation of the plane of polarized light, Instrumentation and Applications.

Refractometry- Refractometer – theory, refractive index, construction, principle of operation of refractometers and applications.

PRACTICALS**PHARMACEUTICAL ANALYSIS**

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Preparation and standardization of volumetric solutions and assay of official compounds involving Acidimetry, Alkalimetry, (including Non-aqueous titrimetry), Permanganometry, Ceriometry, Iodimetry, Iodometry, Gravimetry and Complexometry. At least 10 primary standard solution to be prepared and used for 10 different assays strictly as per IP' 96.

PHYSICAL CHEMISTRY

1. Behaviors of gases, kinetic theory of gases, deviation from behaviors and explanation.
2. The liquid state physical properties – surface tension, parachor, viscosity, rheochor, refractive index, optical rotation and chemical constitution.
3. Experiment involving partition co-efficient.
4. Determination of specific rotation of a compound.
5. Determination of refractive index.
6. Determination of acidity constant.
7. Determination of molecular weight by Rast's camphor method.
8. Determination of equilibrium constant of a chemical reaction.
9. Determination of order of reaction.
10. Adsorption isotherm study.
11. Determination of heat of neutralization.
12. Preparation of any one buffer solution and verification of its pH.

REFERENCES

1. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake.
2. Quantitative analysis by V. Alexysev.
3. A textbook of Quantitative Analysis by A.L. Vogel.
4. Indian Pharmacopoeia '96.
5. Physical chemistry by Bahl and Tuli.
6. Elements of physical chemistry by P.W. Akkins.
7. Principles of physical chemistry by B.R. Puri, I.R. Sharma and M.S. Pathania.
8. Physical pharmaceutics by R. Manavalan and C. Ramaswamy.
9. Pharmaceutical Analysis by Parimoo.
10. Fundamentals of Analytical Chemistry by Skoog, West and James Holler.

2.3. ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY

THEORY (Total 75 Hours)

ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY

1. Stereochemistry: 14 hours

a) **Optical isomerism:** Definition, Tetrahedral carbon, chirality, relative and absolute configurations and sequence rule. Conventions used in stereochemistry. Lexicon of elements of symmetry, racemic modifications, properties, resolution of racemic modifications and conformational analysis. Walden inversion and stereo mutation. Asymmetric synthesis, stereo-specific and stereo-selective synthesis.

b) **Geometrical isomerism:** Nature, rotation about a carbon-carbon double bond. Modern theory of double bonds, Nomenclature of isomers and determination of configuration. Stereochemistry of cyclic compounds.

2. Synthetic tools: 9 hours

Catalytic hydrogenation, dehydrogenation, metal hydride reduction. Reduction with hydrazine and its derivatives, Birch reduction, Clemmenson's reduction, Meerwin – Pondoiff reduction, oxidation with periodic acid, lead tetra acetate, mercuric acetate and selenium oxide. Beckmann rearrangement, Schmidt rearrangement and Darzen's reaction.

3. Heterocyclic chemistry: 18 hours

a) Classification of Heterocyclic compounds, nature and nomenclature.

b) Preparation and important reactions of

i) Pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole, pyridine and pyrimidine

ii) Indole, quinoline, isoquinoline, acridine, phenothiazine, azepines and Diazepines.

CHEMISTRY OF NATURAL PRODUCTS

1. Terpenoids: 5 hours

Classification, chemistry and uses of citral, menthol, thymol, camphor, alpha-terpineol and alpha-pinene.

2. Alkaloids: 8 hours

Classification, chemistry and pharmacological activity of

i. Atropine and related compounds ii. Papaverine iii. Ephedrine

3. Glycosides: 5 hours

Basic ring system, nomenclature and stereochemistry of steroid nucleus. Chemistry of Digitoxin, Digoxin, Lanatosides, Diosgenin and Sennosides.

4. Vitamins: 10 hours

Chemistry, medicinal and pharmaceutical uses of vitamin A, D, E, K, B₁, B₂, B₆, B₁₂ and Folic acid.

5. Purines: 4 hours

A brief account of chemistry and structural elucidation of uric acid, interrelation between caffeine, theophylline and theobromine.

6. Flavonoids: Classification and chemistry of hesperidine 2 hours

PRACTICALS

1. Synthesis of at least five compounds involving heterocyclic ring systems.
2. Qualitative analysis of mixture of organic compounds containing two compounds – methods of separation and analysis.
3. Isolation of active principles from natural sources (atleast three).
4. Determination of hydroxyl (phenolic and alcoholic), aldehydes, ketones and carboxylic acid groups.

REFERENCES

1. Organic Chemistry by Morrison and Boyd.
2. Organic Chemistry by I.L. Finar. Vol. I & II
3. Advanced Organic Chemistry by Jerry March.
4. Stereochemistry of Carbon compounds by E.L. Eliel.
5. Stereochemistry by Potapov.
6. Roberts JD and Caserto MC, Basic Principles of Organic chemistry, WA Benjamin Inc., New York
7. Sykes P, A Guidebook to Mechanism in organic chemistry, Orient Longman, New Delhi.
8. Harkishan Singh and Kapoor V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
9. Vogel A.I., A textbook of practical organic chemistry. The English language book society and Longman group limited, London.
10. Gilchrist, T.L. Heterocyclic Chemistry, 3rd Edition, Pitman Publishing, London, 1985.
11. David D. Davies, Aromatic Heterocyclic chemistry, Oxford chemistry Primers.
12. Phytochemical Methods – J.B. Harbone.
13. Alkaloids Chemical and biological perspectives by S.William Pelletier
14. Alkaloids by Manske.
15. Chemistry of Natural Products, Agarwal and Chatwal, Vol I & II.

2.4. PHARMACEUTICAL TECHNOLOGY

THEORY (Total 75 Hours)

1. **Materials 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. **7 hours**
2. **Industrial Hazards and Safety Precautions:** Mechanical, Chemical, Electrical, Fire and Dust hazards, Industrial dermatitis, Accident records, etc. **4 hours**
3. **Fluid Flow:** Types of flow, Reynold's number, Viscosity, Concepts of boundary layer, Basic equation of fluid flow, Valves, Pumps, Flow meters, Manometers and Measurement of flow and pressure. **6 hours**
4. **Filtration and Centrifugation:** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum-cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters & centrifugal sedimenters. **8 hours**
5. **Crystallization:** Characters 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 crystalliser, Super saturation theory, its limitations, nucleation mechanism and crystal growth. Study of various types of crystallisers. Caking of crystals and its prevention and numerical problems on yields. **6 hours**
6. **Dehumidification and Humidity Control:** Basic concepts, definition, wet bulb and adiabatic saturation temperatures, psychometric chart and measurement of humidity, application of humidity measurement in pharmacy. Equipments for dehumidification operations. **7 hours**
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. **8 hours**
8. **Evaporation:** Basic concepts of phase equilibria, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation. **6 hours**
9. **Distillation:** Raoult's law, phase diagrams, volatility, simple steam flash distillation, principles of rectification, method for calculation of number of theoretical plates, Azeotropic and extractive distillation and Mathematical problems of distillation. **6 hours**
10. **Drying:** Moisture content, mechanism of drying, rate of drying, time of drying, calculations; classification, types of dryers, dryers used in pharmaceutical industries, special drying methods and mathematical problems on drying. **6 hours**
11. **Size reduction and Size separation:** Definition, objective of size reduction, factors affecting size reduction, laws governing energy and power requirement of mills, including ball mill, hammer mill, fluid energy mill, etc. **6 hours**
12. **Mixing:** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments. **5 hours**

REFERENCES

1. Introduction to Chemical Engineering by Walter J. Badger.
2. Cooper and Gunn's Tutorial Pharmacy, S.J. Carter.
3. Theory and practice of Industrial Pharmacy by Lachman.
4. Remington's, The Science and Practice of Pharmacy, Mack Publishing Co. Easton.
5. McCabe WL and Smith J.C. Unit operations of Chemical Engineering McGraw Hill International Book Co. London.
6. Parry R.H. and Chilton, C.H. Chemical Engineers Handbook of Kogakusha Ltd.

2.5. PHARMACY PRACTICE AND PATHOPHYSIOLOGY

THEORY (Total 75 Hours)

PHARMACY PRACTICE

1. **Prescription:** Parts of prescription, handling of prescription, source of errors in prescription, care required in dispensing procedures including labelling of dispensed products. **3 hours**

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

10 hours

3. **Principles involved and procedures adopted in dispensing:** Typical prescription like mixtures, emulsions, powders, pastilles, lozenges, pills, lotions, liniments, inhalations, mouthwashes, gargles, douches, paints, sprays and tablet triturates.

10 hours

4. **Incompatibilities:** Physical, chemical and therapeutic incompatibilities – definition, reasons and correction of incompatibilities, role of pharmacist in overcoming such incompatibilities in prescription. Incompatibility of alkaloidal salts, barbiturates, salicylates, iodides salts, gas production (chemical types), etc.

7 hours

5. **Community pharmacy:** 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 whole sale, rational drug therapy, OTC medication, code of ethics, health screening services, role of pharmacist in community health care and education.

7 hours

6. **Surgical supplies:** An account of surgical dressing like primary wound dressing, absorbents, bandage, adhesive tapes, protectives, sutures and suture materials (method of preparation are to be avoided).

3 hours

PATHOPHYSIOLOGY

1. **Basic principles of cell injury and adaptation:** Causes of cellular injury, Pathogenesis and morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, cellular adaptation, atrophy and hypertrophy.

Basic mechanism involved in the process of inflammation and repair: alteration in vascular permeability and blood flow, migration of WBC's, acute and chronic inflammation and mediators of inflammation. Brief outline of the process of repair.

10 hours

2. **Pathophysiology of common diseases:** Rheumatoid arthritis, gout, epilepsy, hypertension, angina, Congestive Heart Failure (CHF), atherosclerosis, myocardial infarction, diabetes, hepatitis, Parkinson's disease, thyroid diseases, osteoporosis, syphilis & gonorrhea, peptic ulcer, asthma, ulcerative colitis, acute and chronic renal failure, tuberculosis, urinary tract infections. Wherever applicable the molecular basis should be discussed.

25 hours

PRACTICALS

1. Dispensing of prescription falling under the following categories:

Mixtures, emulsions, powders, mouthwashes, gargles, douches, capsules, lozenges, lotions, liniments, inhalations, paints, etc.

2. Identification of various types of incompatibilities in prescription, correction thereof and dispensing of such prescriptions.

3. Dispensing procedures involving pharmaceutical calculations, pricing of prescriptions and dosage calculations for paediatric and geriatric patients.

REFERENCES

1. Remington's Pharmaceutical Sciences (RPS).
2. Cooper and Gunn's Dispensing for Pharmaceutical students by S.J. Carter.
3. Dispensing of Medication by Robert E. King.
4. Introduction to Pharmaceutical dosage form by H.C. Ansel.
5. Goodman Gilman's The Pharmacological Basis of Therapeutics.
6. Hospital Pharmacy by William E. Hassan.
7. A Textbook of Hospital Pharmacy by S.H. Merchant and J.S. Quadry.
8. Best and Taylor's Physiological basis of medical practice by William and Wilkins, Baltimore.
9. Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.
10. Guyton A, Hall J.E., Textbook of Medical Physiology, WB Saunders Company.
11. Parmar N.S. Health Education and Community Pharmacy, CBS Publishers.
12. Pharmacotherapy: A Pathophysiological Approach, Dipiro, JL Elsevier.
13. Robbins SL and Kumar V Basic Pathology, WB Saunders Company.

THIRD YEAR B. PHARMACY DEGREE

3.1. PHARMACOGNOSY AND PHYTO CHEMISTRY

THEORY (Total 75 Hours)

1. Definition, history, present status, future scope & development of pharmacognosy **2hours**

2. **Classification of crude drugs:** **5 hours**

Alphabetical, biological, chemical, pharmacological, taxonomical, chemotaxonomical & serotaxonomical.

3. **Cultivation, Collection, Processing & Storage** **5 hours**

a. General principles of cultivation & collection of vegetable drugs of commercial significance from wild & cultivated source.

b. Factors influencing cultivation of medicinal plants.

c. Processing, storage, and preservation of crude drugs.

d. Study of natural pesticides .

4. **Quality control of herbal drugs as per WHO Guidelines.** **6 hours**

Adulteration of crude drugs & their detection by evaluation methods. Introduction, morphological, microscopical, physical, chemical, biological and spectral analysis of herbal drugs.

5. Detailed study of crude drugs with emphasis on source, cultivation, collection, preparation, storage, diagnostic characters (Macroscopic & Microscopic techniques applicable), constituents, chemical tests, substitutes, adulterants & uses of: **40 hours**

a. **Carbohydrates and their derived products:** Agar, Gum Acacia, Gum tragacanth, Honey, Isapgol, pectin, Starch.

b. **Tannins:** Gambier, Black Catechu, Gall, Myrobalan, Pale catechu and Tannic acid.

c. **Lipids:** Castor oil, Shark liver oil, Wool fat, Beeswax, Neem oil, Cod liver oil and Bran oil.

d. **Proteins:** Gelatin, Spirullina and soya.

e. **Volatile oils:** Mentha, Coriander, Cinnamon, Cassia, Caraway, Dill, Clove, Fennel, Nutmeg, Cardamom, Lemon grass oil, Eucalyptus, Sandalwood, palmarosa and citronellal.

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

g. **Cardio active sterols:** Digitalis, Squill and Strophanthus.

h. **Anthraquinone cathartics:** Aloes, Senna, Rhubarb and Cascara.

i. **Pyridine and Piperidine alkaloids:** Areca and Lobelia.

j. **Tropane alkaloids:** Belladonna, Hyoscyamus, Datura, Cocoa.

k. **Quinoline and Isoquinoline alkaloids:** Cinchona, Ipecac and Opium

l. **Indole alkaloids:** Ergot, Rauwolfia, Nuxvomica, Physostigmine.

- m. **Imidazole:** Pilocarpus.
 - n. **Steroid:** Kurchi, Solasodine.
 - o. **Alkaloidal amines:** Ephedra and Colchicum.
 - p. **Glycoalkaloids:** Solanum species.
 - q. **Purines:** Tea, Coffee.
 - r. **Resins:** Colophony, Cannabis, Capsicum, Balsam of Tolu, Benzoin, Balsam of Peru, Asafoetida, Turmeric and Ginger.
 - s. **Quinazolidine alkaloids:** Adathoda
 - t. **Terpenes:** Neem, Artemesia.
 - u. **Others:** Gentian, Saffron, Ashwagandha
6. **Tumor inhibitors:** Taxol, Vinca and Podophyllum **2 hours**
7. **Anti-hepatotoxic and oral hypoglycemic agents:** **2 hours**
Phyllanthus niruri, Eclipta alba, Gymnema sylvestre.
8. **Plant fibres used as surgical dressings:** **4 hours**
a. Cotton, Silk, Wool, Nylon, Rayon, Alginate dressing, Gelatin Sponge, Oxidized cellulose.
b. Sutures and ligatures.
9. **Pharmaceutical aids:** **2 hours**
Talc, Kaolin, Bentonite and Natural colours.
10. **Studies of traditional drugs:** **7 hours**
Common vernacular names, botanical sources, morphology and chemical nature of chief constituents, pharmacology, common use and marketed formulations of the following indigenous drugs.
Amla, Satavari, Tylophora, Bhilawa, Kalijiri, Rasna, Punarnava, Chitrack, Apamarga Gokhru, Shankapuspi, Brahmi, Arjuna, Ashoka, Methi, Lahsun, Guggal, Shilajit, Pyrethrum, Coleus forskolii.

PRACTICALS

1. Identification of crude drugs listed in theory (entire condition) by Morphological characters.
2. Microscopical studies of some selected drugs mentioned in theory: Datura, Digitalis, Senna, Vinca, Cinchona, Cinnamon, Clove, Nuxvomica, Ephedra, Rauwolfia, Ipecac, Ginger, Liquorice, Neem and Phyllanthus.
3. Microscopical studies of some selected powdered drugs of single component or mixture of two components: Datura, Cinchona, Cinnamon, Senna, Digitalis, Rauwolfia, Liquorice, Ipecac, Clove, Nuxvomica, Rhubarb, Neem, Phyllanthus, Fennel and Coriander.
4. Identification of unorganized drugs mentioned in theory by Morphological characters and chemical tests.
5. Quantitative microscopy:

- a. Microscopical measurements of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibres.
 - b. Determination of leaf constants i.e., stomatal index, stomatal number, vein islet number, vein termination number and palisade ratio.
 - c. Lycopodium spore method.
6. To do simple chemical tests to identify the pharmaceutically important phytoconstituents based on the theory.

REFERENCES

1. Pharmacognosy: Varro E. Tyler, Lynn R. Brady, James E. Robgers.
2. Textbook of Pharmacognosy – T.E. Wallis
3. Study of crude drugs – Ed. 4-M.A. Iyengar
4. A Textbook of Pharmacognosy – Shah and Quadry
5. Anatomy of Crude drugs – M.A. Iyengar and Nayak
6. Pharmacognosy of Powdered Crude drugs – Iyengar and Nayak
7. Trease and Evans – Pharmacognosy – 14th and 15th edition.
8. Pharmacognosy and Pharmaco biotechnology – James Robbers, Marilyn K. Speedice and Varro E., Tyler.
9. Drug Plant Resources of Central Indian Inventory – Srivastava.
10. Pharmacognosy – Ed. 3 – Kokate C.K, Purohit A.P, Gokhale S.B.
11. Practical Pharmacognosy by Rasheeduz Zafar and Neeraj Gandhi.
12. Practical Pharmacognosy by C.K. Kokate.

3.2. MEDICINAL CHEMISTRY – I

THEORY (Total 75 Hours)

I. Basic Principles of Medicinal Chemistry

10 hours

A. History and development of medicinal chemistry.

B. Physicochemical properties in relation to biological action :

Ionization, Drug distribution and pKa values, hydrogen bonding, protein binding, chelation, isosterism, optical and geometrical isomerism, steric effect, redox potential and surface activity. Types of receptors, drug-receptor interaction including signal transduction mechanism.

C. Drug metabolism: General pathways of drug metabolism (different types of reaction in phase-I and phase-II with examples), factors affecting drug metabolism including stereo chemical aspects, significance of drug metabolism in medicinal chemistry.

D. Drug latention and Prodrugs: Basic concepts and application of prodrug design.

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

II. Drugs acting on CNS

15 hours

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

B. Anxiolytics, Sedatives and Hypnotics: Chlordiazepoxide*, Diazepam*, Oxazepam, Lorazepam, Halazepam, Flurazepam, Alprazolam, Barbitol*, Phenobarbital, Mephobarbital, Talbutal, Secobarbital, Triclofos sodium*.

C. Antipsychotics: Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Mesoridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate*, Trifluoperazine hydrochloride, Chlorprothixene, Thiothixene, Lexapine succinate, Haloperidol, Droperidol, Risperidone.

D. Anticonvulsants or antiepileptics: Barbiturates, Mephentyoin*, Ethotoin, Trimethadione*, Paramethadione, Phensuximide, Ethosuximide*, Phenacemide, Carbamazepine*, Primidone*, Valporic acid* and Clonazepam*.

E. CNS stimulants and Psychedelics: Nikethamide*, Doxapram hydrochloride*, Dextroamphetamine sulphate*, Pentylenetetrazole, Phenelzine sulphate, Pargyline hydrochloride, Amitriptyline hydrochloride*, Imipramine hydrochloride*, Desipraminehydrochloride, Doxepin hydrochloride*, Psilocybin and Psilocyn, Mescaline, Phenyclidine (PCP) and Tetrahydrocannabinol (THC).

III. Drugs acting on ANS**17 hours**

A. Adrenergic Neurotransmitters: Structure and physiochemical properties, biosynthesis and metabolism.

B. Sympathomimetic agents: Adrenergic receptor hypothesis, Epinephrine, Nor-

epinephrine, Dopamine, Phenylephrine*, Salbutamol*, Terbutaline*, Ephedrine*, Pseudoephedrine*, Methyldopa, Isoproterenol, Salmeterol, Bitolterol, Ritodrine, Dobutamine, Hydroxyamphetamine, Propylhexadrine, Metaraminol, Naphazoline, Tetrahydrazoline, Oxymetazoline and Xylometazoline.

C. Adrenergic Antagonists: Tolazoline*, Phentolamine*, Phenoxybenzamine,

Prazosin, Tetracosin, Doxazosin, Ergotamine, Methysergide, Propranolol*, Dichloroisoproterenol, Practolol, Metibranolol, Acebutolol*, Atenolol*, Betazolol, Bisoprolol, Esmolol, Metoprolol*, Labetalol and Carvedilol.

D. Cholinergic receptors drugs and related agents: Cholinergic receptors, biochemical effects of muscarinic stimulation, cholinergic neuro chemistry and stereochemistry of cholinergics. Acetylcholine*, Carbachol*, Bethanechol, Methacholine, Pilocarpine, Physostigmine, Neostigmine, Pyridostigmine*, Edrophonium chloride, Ambinonium chloride, Pralidoxime chloride, Isoflurophate, Echothiophate iodide, Parathion and Malathion.

E. Cholinergic Blocking agents: Homatropine hydrogen bromide*, Ipratropium bromide*, Tropicamide*, Cyclopentolate hydrochloride*, Clindinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Biperidine hydrochloride, Procyclidine hydrochloride* and Isopropamide iodide.

F. Ganglionic blocking agents and Neuromuscular blockers: Nicotine,

Trimethaphan camsylate, Mecamylamine hydrochloride*, Tubocurarine chloride, Mectrocurine iodide, Galamine triethiodide*, Decamethonium bromide* and Pancuronium bromide.

IV. Local Anaesthetics:**3 hours**

Cocaine, Hexycaine, Meprylcaine, Cyclomethycaine, Piperocaine, Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate, Mepivacaine, Prilocaine, Etidocaine, Phenacaine, Dipreron, Dibucaine* and Dyclonine.

V. Diuretics:**2 hours**

Acetazolamide*, Dichlorphenamide, Chlorthiazide*, Hydrochlorthiazide*, Furosemide*, Bumetanide, Ethacrynic acid, Spironolactone, Triamterene*, Amiloride* and Mannitol.

VI. Antihistaminic agents:**10 hours**

H₁, H₂ and H₃ receptors. Termination of histamine action. Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine Succinate*, Carbinoxamine maleate*, Clemastine fumarate*, Tripelenamine hydrochloride*, Pyrilamine maleate*, Cyclizine hydrochloride*, Chlorcyclizine hydrochloride*, Meclizine hydrochloride*, Pheniramine maleate, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate*, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride*, Astemizole, Loratadine, Cimetidine*, Famotidine, Ranitidine, Nizatidine, Omeprazole and Lansoprazole.

VII. Prostaglandins and other Eicosanoids:**3 hours**

Eicosanoids biosynthesis. Drug action mediated by eicosanoids, design of eicosanoid drugs and eicosanoids approved for human clinical use.

VIII. Analgesics, antipyretics and anti-inflammatory drugs.**15 hours**

A. Morphine and related drugs : Morphine sulphate, Codeine phosphate.

Hydromorphone hydrochloride, Oxymorphone hydrochloride, Apomorphine hydrochloride, Meperidine hydrochloride*, Anileridine hydrochloride, Diphenoxylate hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Levorphanol tartarate, Nalorphine hydrochloride, Levallorphan tartarate and Naloxone hydrochloride*.

B. Anti-tussives: Noscapine, Dextromethorphan hydrogen bromide and Benzonatate.

C. Anti-inflammatory agents: Sodium salicylate, Aspirin, Indomethacin*, Sulindac, Salsalate*, Tolmetin sodium, Zomepirac sodium, Diclofenac sodium, Ibuprofen*, Naproxen*, Flurbiprofen, Piroxicam*, Acetaminophen, Phenylbutazone* and Oxyphenbutazone.

PRACTICALS

1. Synthesis of selected medicinally important compounds (**10 drugs**)
2. Identification test including I.R. spectrum.
3. Establishing the Pharmacopoeial standards for the drugs synthesized (**10 drugs**).
4. Synthesis of any two drug intermediate/drug synthesis by using Microwave irradiation technique

REFERENCES

1. Burger's Medicinal Chemistry Vol I to IV.
2. Remington's Pharmaceutical Sciences, 20th edition.
3. Ashutoshkar's Medicinal Chemistry.
4. Organic spectroscopy by William Kemp .ELBS, London
5. Medicinal Chemistry by W.A. Foye.
6. Medicinal Chemistry Wilson and Giswold
7. Indian Pharmacopoeia, 1985, 1996 and 2007.
8. Bentley and Driver's Textbook of Pharmaceutical Chemistry.
9. Pharmaceutical Chemistry (Drug synthesis) Vol. I by Roth.
10. Essentials of Medical Pharmacology by Tripathi
11. Medicinal Chemistry by K. Ilango
12. The Organic Chemistry of Drug Synthesis Volume 1-6 by Deniel Lednicer , john Wiley and sons, Inc. New York.
13. Pharmaceutical Substances Synthesis (two parts) ,patents, applications by A.Kleemann, J.Engel by Thieme Stuttgart New York .

14. Organic Chemistry volume 1 & 2 by I.L. Finar publishers ELBS/Longman London .
15. Principles of Medicinal Chemistry by Dr. S. S. Kadam, K.G. Bothara , Nirali Prakashan Pune
16. Medicinal and Pharmaceutical Chemistry by Harkishan Singh, V.K.Kapoor by Vallabh Prakashan New Delhi .
17. Fundamentals of Drug Metabolism and Disposition by H.N. Ladu, H. G. Mandal and E.L. Way Williams and Wilkins Co. Baltimore.
18. Vogel`s Text Book of Practical Organic Chemistry, ELBS / Longman, London.
19. Practical Organic Chemistry by Mann and Saunder. Orient Longman, UK.
20. The Systematic Identification of Organic Compounds by Shriner, Hermann,Morrill, Curtin & Fuson, John Wiley and sons , USA.
21. An Introduction to the chemistry of heterocyclic compounds by R.M. Acheson Wiley Eastern Ltd. New Delhi.
22. Spectrometric identification of Organic Compounds by R. M. Silverstein, G. Claytorn Bassel`s. T.C. Mivvill. John Wiley & Sons USA.

3.3 PHARMACEUTICAL DOSAGE FORMS AND COSMETIC TECHNOLOGY

THEORY (Total 75 Hours)

1. **Liquid Dosage forms:** Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubiliser, colours, flavours, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia. **12 hours**

2. **Semisolid Dosage Forms:** Definition, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels, manufacturing procedure, evaluation and packaging. **8 hours**

3. **Suppositories:** Ideal requirements, bases, manufacturing procedure, packaging and evaluation. **4 hours**

4. **Blood Products and Plasma Substitutes:** Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements of PVP, dextran, etc. Control of blood products as per IP. **4 hours**

5. **Pharmaceutical Aerosols:** Definition, propellants, general formulation, manufacturing, packaging methods, pharmaceutical applications and evaluation. **6 hours**

6. **Cosmeticology and cosmetic preparation:** Fundamentals of cosmetic science. Structure and functions of skin and hair. Formulation, Evaluation, packaging of cosmetics for skin, hair, dentifrices and manicure preparations, nail polish, lipsticks, eye lashes, baby care products. **15 hours**

7. **Packaging of pharmaceutical products:** Types and tests assuring quality of glass. Types of plastics used, permeation, leaching, sorption, chemical reactions, biological tests, modification of plastics by drugs; Different types of closures and closure liners; film wrapper; blister packs, bubble packs, shrink handling; foil / plastic pouches, bottle seals, tape seals, breakable seals and sealed tubes; quality control of packaging material and filling equipment. **10 hours**

8. Sterile pharmaceutical products

a) Formulation - requirements, factors & related aspects, evaluation of injectable solutions, suspensions and sterile powders, containers and closures.

b) Total parenteral nutrition (TPN) & IV additives.

c) Production facilities and process control – layout, air control, design of aseptic area, LAF and maintenance.

d) Ophthalmic preparations: Requirements, formulation, methods of preparation, containers and evaluation. **12 hours**

9. a) **Good Manufacturing Practice (GMP):** Human behaviour, infestation, condition of equipments and utensils, condition of raw materials, the plant, waste disposal and storage conditions.

b) **Quality Assurance (QA):** Salient features of ISO 9000, Total quality management and productivity, process, product and equipment validation. **4 hours**

PRACTICALS**I. Preparation, evaluation and packaging of:****1. Syrups**

- a) Syrup IP
- b) Cough syrup
- c) Antipyretic syrup

2. Ointments

- a) Simple ointment IP
- b) Sulphur ointment IP
- c) Cetrimide emulsifying ointment BPC

3. Suppositories

- a) Indomethacin suppositories BP
- b) Aminophylline suppositories
- c) Iodoform suppositories

4. Sterile products**II. Formulation of various types of cosmetics for skin, hair, dentifrices and manicure preparations.****III. Packaging materials: Evaluation of materials used in pharmaceutical packaging.****REFERENCES**

1. Ansel H.C., Introduction to Pharmaceutical dosage forms, K.M. Varghese and Co, Bombay.
2. Aulton M.E., Pharmaceutics – The Science of Dosage form Design, ELBS/Churchill Livingstone.
3. 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.
6. Lea and Febiger Pharmaceutical Dosage form and Drug Delivery Systems, Philadelphia.
7. Sagarin & Balsam M.S., Cosmetic Science and Technology, Vol-1-3. 2nd ed. John Wiley sons, NY.
8. Stoklosa MJ, Pharmaceutical calculation, Lea and Febiger, Philadelphia.
9. Thomssen S.G., Modern Cosmetics, Universal Publishing Corporation, Bombay.
10. Harry's Cosmeticology.

3.4. PHARMACOLOGY – I

THEORY (Total 75 Hours)

1. General Pharmacology:

16 hours

Introduction to Pharmacology, Sources of drugs, dosage forms and routes of drug administration, mechanism of action of drugs. Combined effect of drugs, factors modifying drug action, tolerance and dependence. Pharmacogenetics. Absorption, Distribution, Metabolism and Excretion of drugs. Principles of basic and clinical pharmacokinetics. Drug interactions, biological standardization and bioassay of drugs- insulin, heparin, oxytocin, digitalis and d-tubocurarine.

2. Pharmacology of Peripheral Nervous System:

17 hours

- a. Receptor, types of receptor, molecular mechanism of drug action, transduction mechanism by G protein coupled receptors and ion channels.
- b. Various neurotransmitters and Neurohumoral transmission (Autonomic and Somatic).
- c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Adrenergic receptor and neuron blocking agents, Ganglionic stimulants and blocking agents.
- d. Neuromuscular blocking agents.
- e. Local anaesthetic agents.

3. Pharmacology of Central Nervous System:

19 hours

- a. Neurohumoral transmission in the central nervous system
- b. General anaesthetics.
- c. Alcohols and disulfiram.
- d. Sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants.
- e. Psychopharmacological agents: Antipsychotics, antidepressants, antimaniacs and hallucinogens.
- f. Antiepileptic drugs.
- g. Drugs used in the treatment of neurodegenerative disorders such as Parkinson's and Alzheimer's diseases.
- h. Analgesics, antipyretics, antiinflammatory and antitussive drugs
- i. Narcotic analgesics and antagonists.
- j. C.N.S. stimulants.
- k. Drug addiction and drug abuse.

4. Pharmacology of Cardiovascular System:

13 hours

- a. Digitalis and cardiac glycosides.
- b. Antihypertensive drugs.
- c. Antianginal and vasodilator drugs including calcium channel blockers and beta adrenergic antagonists.
- d. Antiarrhythmic drugs.
- e. Antihyperlipidemic drugs.
- f. Drugs used in the therapy of shock.

5. Drugs acting on Urinary System:

5 hours

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

6. Drugs acting on Respiratory system:**5 hours**

- a. Antiasthmatic drugs including bronchodilators.
- b. Antitussives and expectorants.
- c. Respiratory stimulants.

PRACTICALS

1. Common laboratory animals and anaesthetics used in animal studies. Some common and standard techniques of bleeding, intravenous injection, intra-gastric administration, procedures for rendering animal unconscious and chemical euthanasia, separation of plasma and serum.

2. Study of different routes of administration of drugs in mice/rats. To study the effect of hepatic microsomal enzyme inhibitors and inducers on the phenobarbitone sleeping time in mice.

3. Experiments on central nervous system:

- Evaluation of drugs for anxiolytic, stereotypic behaviour, CNS stimulant and depressant activities
- Evaluation of drugs for analgesic activity in rodents using thermal, chemical and physical stimuli.
- Evaluation of muscle relaxant properties using rotarod apparatus, chimney test
- Measurement of extra pyramidal side effects like catatonia
- Demonstration of anticonvulsant and antiinflammatory activities
- Evaluation of local anesthetic activity.

4. Effect of autonomic drugs on rabbit's eye.

5. Statistical calculations in Pharmacology

- a. Student's - t test
- b. ANOVA

6. Experiments based on computer models like ExPharm.

REFERENCES

1. Rang, M.P, Dale M.M, Ritter J.M-Pharmacology.
2. Pharmacology and Therapeutics – Satoskar.
3. Goodman and Gilman's, The Pharmacological basis of therapeutics.
4. Kulkarni S.K., Hand book of Experimental Pharmacology.
5. Chronopharmacology by B. Lammer.
6. Topics of Molecular Pharmacology I & II by Nurger and Roberts.
7. Medical Pharmacology by K.D. Tripathi.
8. Essentials of Pharmacotherapeutics by F.S.K. Barar.

3.5. HOSPITAL AND CLINICAL PHARMACY

THEORY (Total 75 Hours)

1. Organisation and structure: 8 hours

Organisation of a hospital, hospital pharmacy, Responsibilities of a hospital pharmacist, Pharmacy and Therapeutic committee, Budget preparation and Implementation.

2. Hospital formulary: 3 hours

Contents, drug profile, preparation and revision of hospital formulary.

3. Purchase, Distribution and inventory control of drugs in hospitals: 8 hours

- i) Purchasing Procedures
- ii) Dispensing of drugs to outpatients and inpatients
- iii) Types of distribution of drugs and charging policies in Hospital
- iv) Dispensing of Controlled drugs.

4. Central sterile supply unit and their management:

Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments and supply of sterile materials.

6 hours

5. Drug information services: 6 hours

Drug information centre, sources of information on drugs, disease treatment schedules, procurement of information, computerized services (e.g. MEDLINE), retrieval of information.

6. Nuclear Pharmacy: 6 hours

Introduction to Radiopharmaceuticals, radioactive half-life, units of radioactivity. Production of radiopharmaceuticals, methods of isotopic tagging, preparation of radioisotopes in laboratory using radiation dosimetry and radioisotope generators. Permissible radiation dose level, radiation hazards, their prevention and specifications for radioactive laboratory.

7. i) **Adverse drug reactions:** Classification, excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden drug withdrawal. Methods of detecting adverse drug effects: spontaneous case reports, record linkage studies, Cohort studies & case control studies.

ii) **Drug interactions :** Types - Pharmacokinetic and Pharmacodynamic drug interactions with suitable examples. Common Drug –Drug and Drug –Food interactions.

18 hours

8. **Concept of** medication history interviews, patient medication profile, patient medication counseling . Barriers and steps in counseling, types of medication error and patient compliance.

7 hours

9. Therapeutic Drug Monitoring:

Introduction, indications, dosage individualization, Pharmacist's intervention, TDM of specific drugs- Digoxin, Theophyllin, Gentamycin & Phenytoin.

5 hours

10. Clinical Trials:

Reasons for conducting clinical trials , different phases of clinical trials. Guidelines governing clinical trials – GCP-ICH, Ethics in clinical research.

8 hours

FIELD WORK

1. Posting to Pharmacy (drug stores) to know prescription handling, dispensing, storage, record keeping and to know various companies and their brand names (8days / 4 weekends). Submission of a report after the posting period is over.

2. Posting to Hospital (Private or Government)

a. To know purchasing procedures, storage, record keeping, pharmacy service to in patients and out patients.

b. To prepare a model hospital formulary.

c. To go towards along with doctors and nurses to know about drug distribution

d. Prescription charging, methods of suggesting dosage regimen, (8 days/ 4 weekends).

After the period of posting, submission of an assignment about whatever drugs the candidate had learned in the hospital and their drug interactions with other drugs from literature/reference books.

REFERENCES

1. Remington's Pharmaceutical Sciences, Eighteenth edition.

2. A textbook of Hospital Pharmacy by S.H. Merchant and J.S. Qadry.

3. Hospital Pharmacy by William E. Hassan.

4. Textbook of Biopharmaceutics and Clinical Pharmacokinetics by Sartaray Hiage.

5. Clinical Pharmacokinetics concepts and Application by Malcom.

6. A text book of clinical Pharmacy Practice-Essential concepts and skills by G. Parthasarathy, Karin Nyfort-Hansen, Milap C. Nahara.

7.GCP-ICH Guidelines.

3.6. PHARMACEUTICAL BIOTECHNOLOGY

THEORY (Total 75 Hours)

II. Basic aspects of Pharmaceutical Microbiology and Biotechnology

1. a) Microbes of Pharmaceutical importance. **1 Hour**
 b) Importance of Aseptic technique.
2. Classification of Microorganisms with detailed reference to Bacteria – Morphology, isolation and identification, growth and cultural characteristics, enumeration and reproduction. Brief study on fungi and viruses – Morphology, growth and reproduction. **14 Hours**
3. Sterilization & Disinfection **12 Hours**
 - a) Official sterilization methods – heat, gaseous, filtration & radiation – study of Mechanism, instrumentation and conditions, applications, merits and demerits. Detailed study of official sterility testing method.
 - b) Disinfection – Classification, Mechanism and uses of disinfectants in brief. Factors affecting disinfection and methods of disinfectant evaluation.

II. Microbial Biotechnology **6 Hours**

1. Microbial genetics including transformation, transduction, conjugation and transposable elements.
2. Microbial biotransformation and production of single cell protein.
3. Microbiological assay of antibiotics and vitamins.

III. Immunology and Immuno Biotechnology **14 Hours**

1. Introduction, types of Immunity, antigens and haptens. Antibodies, antigen – antibody reactions, complement systems, structure and functions of MHC, antigen recognition and presentation. Hypersensitivity response, immunostimulation and suppression, immuno deficiency diseases and autoimmune disorders.
2. Immunologicals: Preparation and quality control of products representing various categories like

Toxoids	– Diphtheria and Tetanus,
Live Bacterial Vaccines	– BCG
Killed Bacterial Vaccines	– Cholera, DPT.
Viral Vaccines	– Polio, Rabies and small pox
Antitoxins	– Diphtheria
Official Immunoglobulins.	
3. Hybridoma Technology – Introduction, techniques of production and applications.
4. Immunoblotting techniques: ELISA, Western blot, Southern blot and Northern blot.

IV. Molecular Biology and Genetic Engineering **12 Hours**

1. Introduction to Molecular Biology, transcription and translation processes.
2. Study of cloning vectors, restriction endonucleases, cloning strategies and gene expression.

3. Applications of recombinant DNA technology and genetic engineering in the production of following products.
 - (i) Regulatory Protein – Interferon
 - (ii) Vaccines – Hepatitis B
 - (iii) Hormones – Insulin
4. Brief study of regulatory aspects of Biopharmaceutical Products.

V. Bioprocess technology 10 Hours

1. Basic principles of fermentation, brief study on screening methods of industrially important microbes.
2. Study design and operation of fermentor and study of different parameters.
3. Bioprocess of following metabolites.

Organic Solvent	– Alcohol
Organic acid	– Citric acid
Antibiotics	– Penicillin
Vitamin	– Vitamin B ₁₂
Amino acid	– Glutamic acid

VI. Enzyme Biotechnology 3 Hours

Brief introduction to immobilization methods and applications. Biosensors.

VII. Animal Biotechnology 3 Hours

Growth of animal cells in culture. General procedure for maintenance of cell culture, Medias used, primary and established cell culture and applications of animal tissue culture.

PRACTICALS

- (1) Aseptic Transfer
- (2) Preparation of Nutrient Media
- (3) Culture Techniques
 - (1) Liquid Media Inoculation
 - (2) Solid Media Inoculation like Streak plate, Pour plate, Stab culture, Swab culture.
- (4) Microscopic Techniques:
 - (1) Unstained preparation: Motility study by hanging drop method.
 - (2) Stain Preparations
 - a) Simple
 - b) Differential staining: Gram staining
 - c) Spore Staining
 - d) Capsule Staining

- (5) Identification of Bacteria, based on biochemical tests like amylolytic, proteolytic carbohydrate fermentation, citrate utilization, indole production.
- (6) Bacterial enumeration by standard plate count technique (viable count).
- (7) Sterility testing – Direct inoculation technique.
- (8) Disinfectant evaluation by Riedel Walker test.
- (9) Production of Fermentation products like Alcohol, Amylase and streptomycin.
- (10) Food microbiology: Microbiology of milk quality control test by methylene blue reduction test and plate count method.
- (11) Microbiological assays of antibiotics and vitamins by
 - 1) Kirby Bauer Method
 - 2) Turbidimetric Method
- (12) Bacteriology of water: Identification of coliform bacteria.
- (13) Isolation of DNA and its purity estimation.
- (14) Immobilization of whole cells / Enzyme.

REFERENCES

- 1. Microbiology by Pelczar, Reid and Chan.
- 2. Essential and applications of Microbiology by Judy Kandal.
- 3. Microbial Genetics by David Freifeider.
- 4. General Microbiology by R.Y. Stanier.
- 5. Microbiology by Prescott.
- 6. Textbook of Microbiology by Anathanarayanan and Panicker
- 7. Immunology by Weir
- 8. Immunology by Ivan Roitt.
- 9. Microbiology – A laboratory manual by James G. Cappuchino
- 10. Laboratory Microbiology by L. Jack Bradshaw.
- 11. Practical Medical Microbiology – Mackie and Mc Cartney.
- 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

FOURTH YEAR B. PHARMACY DEGREE**4.1. FORMULATIVE PHARMACY AND BIOPHARMACEUTICS****THEORY (Total 75 Hours)****1. Preformulation studies:****4 hours**

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

2. Stability studies:**7 hours**

a) Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemisation, polymerization, etc. and their influence on formulation and stability of products.

b) Stabilization and stability testing protocol for various pharmaceutical products.

3. Capsules:**6 hours**

Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules and method of capsule filling. Soft gelatin capsule, capsule shell and capsule content, importance of base absorption, manufacturing, quality control, stability testing and storage of capsule dosage forms.

4. Micro-encapsulation:**7 hours**

Types of microcapsules, importance of micro encapsulation in pharmacy, micro encapsulation by Co-acervation phase separation, multi-orifice centrifugation, spray drying, spray congealing, polymerisation, air suspension technique, pan coating and other techniques. Evaluation of microcapsules.

5. Tablets**12 hours**

a) Classification of different types of tablets, tablet excipients, granulation technology on large scale by various techniques, different types of tablet compression machinery and equipment employed, processing problems of tablets and evaluation of tablets.

b) Coating of tablets: Types of coating, film-forming materials, formulation of coating solution, equipments for coating, film defects and evaluation of coated tablets.

6. Prolonged Action Pharmaceuticals:**7 hours**

Benefits, limitations, oral products terminology, types and construction of products and evaluation.

7. Novel Drug delivery systems:**12 hours**

Transdermal delivery systems, Osmotic drug delivery systems, Liposomes, Nanoparticles.

8. Bio-pharmaceutics and Pharmacokinetics**20 hours**

a) **Bio-pharmaceutics:** Rate of drug absorption after administration, drug concentration in blood, biological factors in drug absorption, physico-chemical factors, dosage form consideration for gastrointestinal absorption, drug distribution, site seeking and drug elimination.

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

c) **Bioavailability and bio-equivalency testing:** Definitions, dosage forms, dissolution rate and bio-equivalency testing.

PRACTICALS

Experiments devised to study the formulation of dosage forms, stability testing of formulated dosage forms, evaluation of dosage forms, evaluation of dosage form necessities (additives) in the stable formulation of dosage forms, bioavailability testing and others to illustrate topics mentioned in theory.

REFERENCES

1. Pharmaceutical dosage forms: Tablets volume – 3 by Liberman and Lachman
2. Pharmaceutical dosage forms: Parenteral medications Vol-1, 2 by Liberman and Lachman.
3. Pharmaceutical dosage forms: Disperse systems Vol-1, by Liberman and Lachman.
4. Remington's Pharmaceutical Sciences (RPS).
5. Modern Pharmaceutics by Banker and 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 System by Y.W. Chein.
10. Biopharmaceutics and Pharmacokinetics –an introduction by Robert. E. Notari.

4.2. ADVANCED PHARMACOGNOSY

THEORY (Total 75 Hours)

1. **7 hours**
 a. Modern methods of extraction, application of latest techniques like Chromatography, Electrophoresis and spectroscopic methods in the isolation, purification and identification of crude drugs.
 b. Stability test for herbal extracts.
 c. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.
2. **Enzyme Biotechnology** **6 hours**
 Introduction, General methods of isolation, purification, enzyme reactors and applications of immobilized enzymes in drug analysis.
 Enzyme used in pharmacy; methods of preparation & isolation of
 a. Papain b. Pepsin c. Pancreatin d. Pectinase e. streptokinase.
3. **Plant tissue culture:** **10 hours**
 a. Introduction, Historical development, types of cultures, nutritional requirements, application of plant tissue culture for the production of secondary metabolites.
 b. Detailed study of callus culture, cell suspension culture, single cell culture, totipotency and application, clonal propagation, enzyme immobilization technique.
 c. Role of plant growth regulators for the production of secondary metabolites.
4. Industrial production and pharmaceutical application of phytoconstituents such as, **10 hours**
 Sennosides, Cardiac glycosides, Vinca alkaloids, Quinoline alkaloids, Menthol, Citric acid, Podophyllotoxin, Diosgenin, Solasodine, and Tropane alkaloids.
5. **Natural allergens:** **10 hours**
 Introduction, classification of allergens, preparation of allergenic extracts, Sensitivity testing and treatment of allergy, Hallucinogenic, teratogenic and other toxic plants.
6. **Preparation and standardization of herbal formulations** **6 hours**
 a. Preparation and uses of Tinctures, Herbal syrups, Herbal creams, Herbal shampoos
 b. WHO guidelines for the assessment of herbal medicines.
 c. Estimation of heavy metals in herbal preparations.
7. **Alternative system of medicine.** **9 hours**
 a. Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy.
 b. Types of formulation used in alternative system of medicine.
 c. Preparation and standardization of Aristas, Asawas, Gutikas, Churnas, Lehyas and Bhasmas

8. **4 hours**

- a. A brief account of plant based industries and utilization involved in work on medicinal and aromatic plants in India.
- b. Export potential of medicinal and aromatic plants of India.

9. **Antibiotics and Antiviral drugs** **7 hours**

Biosynthesis of Penicillin. Biosynthesis of Cephalosporin. Amino glycosides: Biosynthesis of streptomycin. Antiviral drugs, Glycyrrhizin, Gossypol, Hypericin, Inophyllum B, Calanotide A&B, Vidarabine. Plant constituents with Anti-HIV activity.

10. **6 hours**

- a) Basic metabolic pathways leading to the formation of plant secondary metabolites.
- b) Biogenesis and pharmaceutical application of the following phytoconstituents Atropine, Morphine, digoxin, Reserpine, Ergometrine.

PRACTICALS

1. Monograph exercise as per I.P.

- a) Castor oil.
- b) Shark liver oil.
- c) Honey.

2. Exercise involving isolation of active principles

- a) Caffeine – from tea dust.
- b) Quinine – from Cinchona bark.
- c) Citric acid – from Lemon.
- d) Casein – from Milk.
- e) Starch – from Potato.
- f) Pectin – from Orange peel

3. Nutraceuticals – Spirullina, Almond, Amla, Corn oil, Soyabean oil, Honey.

4. Chemical Assays

- Aldehyde content of volatile oil.
- Ester value of fixed oil.
- Phenol content of volatile oil.
- Alkaloidal assay of belladonna leaf.
- Eugenol content of clove oil.
- Cineole content of eucalyptus oil.

5. Physical evaluation of powdered drugs

- Determination of Moisture content (Loss of drying).
- Extractive values.
- Ash values.
- Swelling factors.
- Determination of foreign organic matter.
- Determination of crude fibre content.

6. Demonstration of experiments in plant tissue culture –callus culture.
7. Extraction of volatile oils – menthe oil, coriander oil, fennel oil.
8. Identification of natural products such as amino acids, alkaloids and glycosides using TLC and paper chromatographic profiles.
9. Preparation and standardization of Ayurvedic formulations -tailam.
10. Preparation and standardization of herbal extracts – garlic, turmeric, garcinia.
11. Preparation of herbal cosmetics – shampoos, creams and lipsticks.
12. Demonstration of experiments in column chromatography.
15. Isolation of a plant enzyme – papain and pectinase.

REFERENCES

1. The formulation and preparation of cosmetics, fragrances and flavours.
2. Pharmacognosy by Trease and Evans 15th Edition.
3. Biochemistry – Harold Varley.
4. Pharmacognosy by Trease and Evans – 14th edition.
5. Herbal Drug Industry R.D. Chowdary.
6. Remington's Pharmaceutical Sciences.
7. WHO Guidelines – Website. <http://www/who.int/druginformation>
8. Pharmacognosy and Pharmaco biotechnology – 10th edition, James Robbers Mary Lyn., K Speedy and Varro, E. Tylor.
9. Standardisation of Botanicals.
10. Quality control herbal drugs –Pulok K. Mukherjee.
1. Pharmacognosy and Phytochemistry Ist Edition, Vol I and II by Vinod. D. Rangari.
2. Practical Pharmacognosy, IIIrd Edition, C.K. Kokate.

4.3. PHARMACOLOGY – II

THEORY (Total 75 Hours)

1. Drugs acting on the Gastrointestinal Tract:

6 hours

- a) Antacids, antisecretory and antiulcer drugs.
- b) Laxatives and Antidiarrhoeal drugs.
- c) Appetite stimulants and suppressants.
- d) Emetics and antiemetics.

2. Pharmacology of Endocrine system:

12 hours

- a) Hypothalamic and pituitary hormones.
- b) Thyroid hormones and antithyroid drugs, Parathormone, Calcitonin and Vitamin D.
- c) Insulin, Oral hypoglycaemic agents and glucagon.
- d) Adrenocortico tropic hormone and corticosteroids.
- e) Androgens and anabolic steroids
- f) Estrogens, progesterone and oral contraceptives.
- g) Drugs acting on the uterus.

3. Chemotherapy:

18 hours

- a) General principles of chemotherapy, development of drug resistance and its intervention.
- b) Sulfonamides and co-trimoxazole.
- c) Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, Erythromycin, Quinolones and miscellaneous antibiotics.
- d) Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.
- e) Chemotherapy of malignancy.
- f) Study of antimalarial, antiamoebic, anthelmintic and anti AIDS drugs.

4. Drugs acting on the Haemopoietic system:

6 hours

- a) Haematinics.
- b) Anticoagulants, vitamin K and haemostatic agents.
- c) Fibrinolytic and anti-platelet drugs.
- d) Blood plasma volume expanders.

- 5. Autocoids:** **8 hours**
- a) Histamine, 5-hydroxy tryptamine and their antagonists.
 - b) Prostaglandins, Thromboxanes and Leukotrienes.
 - c) Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.
- 6. Principles of Toxicology:** **6 hours**
- a) Definition of poison, general principles in the treatment of poisoning.
 - b) Heavy metals and heavy metal antagonists.
 - c) Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity.
 - d) Hepatotoxicity and drugs used to correct hepatic function
- 7. Ophthalmic Pharmacology:** **4 hours**
- Eye functions and pathophysiology of different eye diseases
 - Drugs used to treat glaucoma and conjunctivitis
- 8. Chronopharmacology:** **2 hours**
- Definition of rhythms and cycles. Biological clock and their significance leading to chronotherapy.
- 9. New drug development:** **4 hours**
- Concepts, pre-clinical trials, design of clinical trials phases of clinical trials and testing of drugs in human.
- 10. Immunopharmacology:** **4 hours**
- Study of body defense mechanism, disease related to immune system, Immunostimulants and immunosuppressants.
- 11. Bio-statistics** **5 hours**
- 1. Scope of statistical methods in Pharmacy.
 - 2. Collection of tabulation of data.
 - 3. Definition of arithmetic mean, median, mode, standard deviation and standard error of mean deviation
 - 4. Student's t – test and Paired t-test
 - 5. ANOVA
 - 6. Chi square test
 - 7. Fischer's exact test
 - 8. Kruskal Wallid wilcoxon signed rank test, P values
 - 9. Regression and correlation.

PRACTICALS

1. Experiments on isolated preparations:

- Study on basic concept of *in vitro* experimental pharmacology. Commonly used instruments in experimental pharmacology- organ bath, levers, balancing, mounting procedures to be followed in *in vitro* measurements.
- Study on different tissues, agonists, antagonists and receptors employed in *in vitro* evaluation.
- Dose response curve (cumulative and non-cumulative) and pD₂ measurement of agonist in different tissues like skeletal muscles and smooth muscles (rat fundus, colon, guinea pig ileum, rabbit jejunum)
- Blocking of agonist response using appropriate antagonist in isolated tissue preparation
- Study of potentiating response of different drugs in isolated tissue preparation
- To estimate the strength of the test sample of agonist / drug (e.g. Acetylcholine, Histamine, 5-HT, Oxytocin, etc.) using a suitable isolated muscle preparation employing matching bioassay, bracketing bioassay and interpolation bioassay.
- To record the CRC of 5-HT on rat fundus preparation
- To record the CRC of nor-adrenaline on rat anococcygeus muscle preparation.

2. Biochemical measurements

- Hyperglycaemic and euglycaemic activity of oral hypoglycaemic agents
- Anticoagulants studies using sheep blood
- Liver function tests
- Demonstrate the antiulcer activity using simple models and evaluation of ulcer index.

3. Estimation of bioavailability parameters *viz.* AUC, t_{max} , K_{el} from blood and urine samples in human volunteers or in laboratory animals.

REFERENCES

1. Craig C.R. and Stitzel R.R. Modern Pharmacology.
2. Ghosh M. N, Fundamentals of Experimental Pharmacology.
3. Katzung, B.G., Basic and Clinical Pharmacology.
4. Laurence, D.R. and Bennet P.N, Clinical Pharmacology.
5. Mycek M.J., Gerlmet S.B and Perper M.M. Pharmacology: Lippincott's Illustrated Reviews.
6. Rang M.P. Dale M.M, Ritter J.M. Pharmacology.
7. Pharmacology and Therapeutics, Satoskar.
8. Goodman and Gilman's, The Pharmacological Basis of Therapeutics.
9. Handbook of Experimental Pharmacology by S.K. Kulkarni.
10. Chronopharmacology by B. Lammer.
11. Topics of Molecular Pharmacology I and II by Nurger and Roberts.

4.4. MODERN METHODS OF PHARMACEUTICAL ANALYSIS

THEORY (Total 75 Hours)

I. Introduction and theoretical aspects, basic instrumentation, and applications of the following analytical techniques. 17 hours

1. UV and Visible Spectroscopy
2. Fluorimetry,
3. Infrared Spectroscopy.
4. Atomic Absorption Spectroscopy.
5. Flame emission spectroscopy.
6. Nephelo - turbidimetry.

II. Separation techniques 18 hours

Introduction and theoretical concepts, preparation, procedure, instrumentation, method of detection and application of the following chromatographic techniques.

1. Column chromatography: Adsorption and Partition theory, preparation, procedure and methods of detection.
2. Paper chromatography: Theory of partition, different techniques employed and different grades of papers used, quantitative and qualitative detection.
3. Thin layer chromatography: Theoretical consideration, preparation, procedure and detection of compounds.
4. Ion Exchange chromatography: Types of exchangers, mechanism of ion exchange and column operation.
5. Gas Chromatography: Introduction, fundamentals of column operation and detection.
6. High performance liquid chromatography
7. High Performance Thin Layer Chromatography.
8. Counter current extraction, ultra centrifugation and gel filtration.
9. Electrophoresis.

III. Electrometric titrations. 15 hours

1. **Potentiometric titrations:** Introduction, Electrochemical cells, Nernst equation, half-cells, electrodes, measurement of potential, applications and advantages
2. **Conductometric titrations:** Basic concepts, different types of conductometric titrations, apparatus used, applications and advantages.
3. **Polarography:** Introduction, Theory, apparatus, method of analysis, pulse polarography, applications and advantages.
4. **Amperometry:** Amperometric titrations with one electrode, general procedure, titration curves, applications and advantages.

IV. A preliminary introductory study of following topics.**10 hours**

1. Nuclear Magnetic Resonance Spectroscopy.
2. Electron Spin Resonance spectroscopy.
3. Mass Spectrometry
4. Radio Immuno Assay.
5. X-ray Diffraction.

V. Quality Assurance**15 hours**

Basics concepts of GLP, ISO 9000, TQM, International Conference of Harmonization (ICH), Regulatory aspects, calibration and validation of analytical equipments and procedures.

PRACTICALS

1. Chromatographic analysis of some pharmaceutical products.
2. Exercises involving Nephelo-turbidimeter, colorimeter, spectrophotometer, flamephotometer, pH meter and fluorimeter, conductometric, potentiometric, polarographic, amperometric titrations.
3. Infra Red spectra peak identification for different functional groups.

REFERENCES

1. How to practice GMP – A Plant for total quality control by P.P. Sharma.
2. Pharmaceutical process validation by Ira. R. Berry and Robert A. Nash.
3. Practical Pharmaceutical Analysis by Beckett and Stenlake.
4. Organic Spectroscopy by Y.R. Sharma.
5. Instrumental methods of analysis by Gurdeep Chatwal.
6. Spectroscopy by William Kemp.
7. Textbook of Chemical Analysis A.J. Vogel.
8. Textbook of Pharmaceutical Analysis by K.A. Connors.
9. Indian Pharmacopoeia '96, Vol I and II.
10. Spectrometric identification of organic compounds by R.M. Silverstein, John Wiley and Sons Inc.
11. Quantitative analysis of Drugs in Pharmaceutical Formulations by P.D. Seth.
12. Analytical Chemistry by Garry Christian.
13. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer.

4.5. MEDICINAL CHEMISTRY-II

THEORY (Total 75 Hours)

I. Principles of drug design:

8 hours

Traditional analog, Quantitative Structure Activity Relationship (QSAR) and mechanism based approaches. A brief introduction to graph theory, application of mechanism based approaches. Application of quantum mechanics, computer aided drug designing (CADD) and molecular modeling.

II. Classification, mode of action (biochemical and molecular basis wherever applicable) structure activity relationship (selected topics viz. IIB, IIC, III, IV, VII and X) including physiochemical and stereo chemical properties and synthesis of selected drugs (Drugs marked with asterisk only) in the following categories.

1. Anti-infective agents:

15 hours

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*, Methylbenzethonium chloride*, Cetylpyridiniumchloride, Chlorhexidine gluconate*, Gentian violet, Methylene blue, Thiomersal, Methyl paraben and Sodium benzoate.

B. **Anti-Fungal Agents:** Clotrimazole, Econazole nitrate, Butoconazole,

Miconazole*, Ketoconazole*, Fluconazole, Naftifine hydrochloride, Tolnaftate*, Cyclopiroxolamine, Amphotericin-B, Nystatin, Natamycin and Griseofulvin.

C. **Synthetic Antibacterial Agents:** Nalidixic Acid*, Cinoxacin, Norfloxacin,

Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Furazolidine, Nitrofurantoin* and Methanamine.

D. **Anti-tubercular Agents:** INH*, Ethionamide, Pyrazinamide, Para amino salicylic acid*, Rifampicin, Rifabutin, Cycloserine* and Sterile capreomycin sulphate.

E **Anti-protozoal Agents:** Metronidazole*, Diloxanide*, Iodoquinol*, Pentamidine Isethionate, Atovaquone and Eflornithine,

F. **Anthelmintics:** Piperazine salts*, DEC*, Thiabendazole*, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal and Ivermectin.

G. **Anti-scabious and Anti-pedicular Agents:** Benzyl Benzoate*, Lindane* (Gamaxene), Crothamiton* and Permethrin.

2 . Sulphonamides and Sulphones:

5 hours

Historical development, chemistry and nomenclature, reducing crystalluria by lowering pKa, synergism of sulfonamides and folate reductase inhibitors, sulphamethizole*, sulfisoxazole, sulphamethizine, sulfacetamide sodium*, sulphapyridine, sulfamethoxazole*, sulphadiazine, mixed sulfonamides, mafenide acetate, silver sulfadiazine*, sulfasalazine, dapsone* and solapsone.

3. Antimalarials:

4 hours

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

4. Antibiotics:**8 hours**

History, background and current status of

a. Penicillins and Cephalosporins. b. Aminoglycosides. c. Tetracyclines. d. Macrolides.
e. Lincomycins. f. Polypeptides. g. Unclassified antibiotics like: Chloramphenicol* and its prodrugs, Novobiocin sodium and Mupirocin.

5. Antiviral agents:**2 hours**

Amantadine hydrochloride*, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Foscarnet sodium, Zidovudine, Didanosine, Lamivudine, Ribavirin and Ritonavir.

6. Anti-neoplastic agents:**4 hours**

Mecllorethamine, Cyclophosphamide*, Melphalan, Chlorambucil, Busulfan, Thiotepe, 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 and Dromostanolone propionate.

7. Drugs acting on CVS:**12 hours**

A. **Anti-anginal:** Vasodilators and Cardiotonics: Amylnitrate, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrate*, Verapamil, Diltiazem hydrochloride and Nifedipine, Amlodipine, Bepridil hydrochloride, Felodipine, Nicardipine, Dipyridamole, Digoxin, Digitoxin and Deslanoside.

B. **Anti-arrythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride*, Disopyramide phosphate*, Lidocaine hydrochloride and Phenytoin sodium*.

C. **Anti-hypertensive Agents:** Captopril, Lisinopril, Enalapril, Benzapril hydrochloride, Quinapril hydrochloride, Reserpine, Guanethidine monosulphate*, Methyldopate hydrochloride*, Clonidine hydrochloride, Hydralazine hydrochloride*, Sodium nitroprusside, Diazoxide and Minoxidil.

D. **Anti-hyperlipidemic agents:** Clofibrate, Dextrothyroxine sodium, Cholestyramine resin, Niacin* and Probucol.

E. **Anti-coagulants and anti-thrombolytics:** Protamine sulphate, Dicoumarol*, Warfarin sodium and Anisindione.

8. Hormones and related drugs:**6 hours**

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

9. Steroids and related drugs**6 hours**

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

10 . Diagnostic drugs and reagents :**3 hours**

Congo Red, Evans Blue, Methacoline Chloride, Erythrosine Sodium, Benzyl Penicilloyl-polylysine, Iodipamide meglumine, Tyropanoate sodium, Pentagastrin, Phenolsulphonphthalein, Indocyanin Green and Fluorescein sodium*.

11. Brief Introduction to Combinatorial Chemistry**2 hours**

PRACTICALS

1. Synthesis of selected drugs from course content involving two or more steps of synthesis and study spectral analysis of drug 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).

REFERENCES

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.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Medicinal Chemistry by K. Ilango
10. The Organic Chemistry of Drug Synthesis Volume 1-6 by Deniel Lednocer, John Wiley and sons, Inc. New York.
11. Pharmaceutical Substances Synthesis (two parts) ,patents, applications by A. Kleemann, J.Engel by Thieme Stuttgart New York.
12. Medicinal and Pharmaceutical Chemistry by Harkishan Singh, V.K.Kapoor by Vallabh Prakashan New Delhi.
13. Spectrometric identification Of Organic Compounds by R. M. Silverstein, G. Claytorn Bassel's. T.C. Mivvill. John wiley & sons USA.
14. Organic spectropsocopy by William Kemp .ELBS, London
15. Fundamentals of Drug Metabolism and Disposition by H.N. Ladu, H. G. Mandal and E.L. Way Williams and W;kins Co. Baltimore.
16. Vogel's Text Book of Practical Organic Chemistry , ELBS / Longman , London.
17. Practical Organic Chemistry BY Mann and Saunder. Orient Longman, UK.
18. The Systematic Identification of Organic Compounds by Shriner, Hermann,Morrill, Curtin & Fuson, John Wiley and sons , USA.
19. An Introduction To The Chemistry Of heterocyclic Compounds by R.M. Acheson Wiley Eastern Ltd. New Delhi.
20. Spectrometric identification Of Organic Compounds by R. M. Silverstein, G. Claytorn Bassel's. T.C. Mivvill. John wiley & sons USA.
21. Indian Pharmacopoeia, 1985, 1996 and 2007

4.6. PHARMACEUTICAL JURISPRUDENCE AND PHARMACY BUSINESS MANAGEMENT

THEORY (Total 75 Hours)

FORENSIC PHARMACY

1. Definition and scope of Forensic Pharmacy, Pharmacist's role in drug treatment, drug usage and pharmacist as a member of health care team. **9 hours**
2. Pharmaceutical legislation in India: Historical development of Pharmaceutical education in India and its present status, Professional ethics in Pharmacy practice, legal and ethical responsibilities of Pharmacists. **8 hours**
3. A detailed study and the understanding of the various act and rules (as last amended) governing the Pharmaceutical Profession in India. **20 hours**
 - a. Pharmacy Act 1948.
 - b. Drugs and Cosmetics Act 1940 and Rules 1945.
 - c. Narcotics and Psychotropic Substances Act.
 - d. Drugs and Magic Remedies (Objectionable Advertisement) Act 1955.
 - e. Medicinal and Toilet Preparations (Excise duties) Act and Rules.
 - f. Essential Commodities Act.
 - g. Drugs (Price Control) order 1995, Pharmaceutical policy 2002.
 - h. Medical Termination of Pregnancy Act.
 - i. Prevention of Cruelty of Animal Act 1960 including study of CPCSEA guidelines, INSA and ICMR guidelines.
 - j. Indian Patent Act with special reference to pharmaceutical products.

PHARMACY BUSINESS MANAGEMENT

1. Concept of Management: 14 hours

Administrative management (Planning, Organizing, Staffing, Directing and Controlling), Entrepreneurship Development and Operative Management, (Personnel, Materials, Production, Financial Marketing, Time/Space Margin / Morale). Principles of Management (Co-ordination, Communication, Motivation, Decision-Making, Leadership, Innovation, Creativity, Delegation of Authority / Responsibility, Record keeping), Identification of key points to give maximum thrust for development and perfection.

2. Pharmaceutical marketing: 12 hours

Functions, buying, selling, transportation, storage, finance, insurance, feedback, information, channels of distribution, wholesale, retail departmental store, multiple shops and mail order business.

3. Salesmanship: 12 hours

Principles of sales promotion, advertising, ethics of sales merchandising, literature, detailing, recruitment, training, evaluation and compensation to the pharmacist.

REFERENCES

1. Handbook of Labour Laws by B.K. Buhr.
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 and Ethics by S.C. Mahajan.
8. Laws relating to Drugs and Cosmetics by P.L. Malik.
9. Handbook of Drug Law by M.L. Mehra.
10. Forensic Pharmacy and Ethics by Mehta.
11. Textbook 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. CPCSEA, ICMR, and Helisinki guidelines.
16. Drug Control by P.K. Dutta.
17. The Drugs and Cosmetics Act and Rules by The India Drug Manufacturers Association Publication.
18. Dangerous Drugs Act 1930 by Govt. of India Publications.
19. Drugs and Magic Remedies Act by Govt. of India Publications.
20. Management by James A.F. Stoner.
21. Statistics for Management by Richard I. Levin.
22. Personnel Management by Arun Monappa.
23. Business Organisation and Office Management by Santhosh Bushan.