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

REGULATION AND SYLLABUS
B. PHARMACY DEGREE COURSE
2004-2005

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI – 600 032
B. PHARMACY COURSE

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 2004-2005.

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

2. 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 12^{th} 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.

(i) 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.

(ii) 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 1^{st} 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.

e) Evidence of payment of Development Charges of US$ 100.

**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.

a. English, Physics, Chemistry, Botany, Zoology.

b. 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 THROUGH LATERAL ENTRY:

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.

REVISED:

The candidates should obtain 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. WEBITE 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 upto 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 Academic Officer of this University through the affiliated Institution within 60 days from the Cut-off date prescribed for B. Pharmacy Degree course for admission.

14. DURATION OF THE COURSE :

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

15. COMMENCEMENT OF THE COURSE :

From 1st August of the academic year.

16. 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.

18. WORKING DAYS IN THE ACADEMIC YEAR :

1. Each academic year shall consist of not less than 200 working days.
2. From the academic year 2005-2006 onwards each academic year shall consist of not less than 240 working days.

*** (XXIX SAB dated 05-08-05).

19. ATTENDANCE REQUIRED FOR ADMISSION TO EXAMINATIONS :

a. 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.

b. A candidate is required to put in a minimum of 75% 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.

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

20. CONDONATION FOR LACK OF ATTENDANCE:

There shall be no condonation of lack of attendance.

21. INTERNAL ASSESSMENT:

(1) The following procedure shall be adopted for the candidates admitted during the academic year 2004-05:

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 (From Aug'06 University exam onwards).

(2) The following procedure shall come into force for all the years of the B. Pharmacy course with effect from August 2006 Examinations onwards:

** The Standing Academic Board in its XXX Meeting held on 28-12-2005 resolved to follow the uniform date for submission of internal assessment Marks for B. Pharmacy Course.

For the subjects of one year duration:

The internal assessment marks should be submitted at the end of January, April & June for 60 marks and the aggregate of Final Internal Assessment Marks on or before 10th July.

The aggregate of Final Internal Assessment Marks submitted on or before 10th July / 10th January as per scheme of examination shall be taken by the University as Internal Assessment Marks and minimum of 35% marks is mandatory for permitting the candidates to sit for the University examinations.

The above modification shall take effect from August 2006 examinations onwards.

22. SUBJECTS OF STUDY:

FIRST B. PHARM:

1. Pharmaceutical Inorganic Chemistry
2. Pharmaceutical Organic Chemistry
3. Anatomy, Physiology & Health Education
4. Physical Pharmaceutics

*** S.A.B. Meeting held on 28-12-2005

From the Academic year 2006-07, the subject Biochemistry shall be included in the First year B. Pharmacy Course and the subject. Physical Pharmaceutics in the second year B.Pharmacy course. There will not be any change in the Syllabus for the above two subjects.

Those First B. Pharmacy Students who have passed the subject Physical Pharmaceutics during 2005-06 will be exempted from the subject Physical Pharmaceutics and instead will have to study the subject Biochemistry in the Second year.

SECOND B. PHARM

1. Bio- Chemistry
2. Advanced Pharmaceutical Organic Chemistry
3. Pharmaceutical Analysis and Physical Chemistry
4. Pharmaceutical Technology
5. Pharmacy Practice and Pathophysiology
6. Bio-statistics and Computer Applications

** XXX S.A.B. Meeting held on 28-12-2005

Lateral Entry direct Second Year B. Pharmacy students admitted during 2006-2007 should take up the subject Physical Pharmaceutics in the Second Year B. Pharmacy and they will be exempted from the subject Bio-Chemistry.

THIRD B. PHARM

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

FOURTH B. PHARM

1. Pharmaceutical Biotechnology
2. Formulative Pharmacy and Bio-Pharmaceutics
3. Advanced Pharmacognosy
4. Pharmacology-II
5. Medical Chemistry-II
6. Modern Methods of Pharmaceutical Analysis

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

Theory

Practical / Clinical

Viva Voce

23. 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.

24. QUESTION PATTERN :-

FOR 90 MARKS	**MARKS**	**TIME**
20 MCQs	20 X 1 = 20 Marks	20 mts
4 Short Notes	4 X 5 = 20 Marks	
2 Essay Questions	2 X 15 = 30 Marks	2.40 hrs
1 Essay Question	1 X 20 = 20 Marks	
	90 Marks	3 Hrs

Theory	- 90 Marks
Internal Assessment (Theory)	- 30 Marks
Viva Voce	- 30 Marks
Practical	- 70 Marks
Internal Assessment + Record	- 20 + 10 = 30 Marks

Question Paper Pattern for i.) Biostatistics and Computer Applications (PGL – III), ii.) Pharmaceutical Analysis and Physical Chemistry (PC – III), iii.) Pharmacy Practice and Pathophysiology (P-III) & iv.) Forensic Pharmacy and Pharmacy Business Management (PGL – IV):

Biostatistics and Computer Applications paper one divided as Part I and Part II each carrying 45 Marks.

One Essay Question (Out of 2)	- 15 Marks
Short Questions (4 x 5)	- 20 Marks (3 Short Notes for Biostatistics and Computer Application (PGL IV) paper only)
MCQ (10 x 1)	- 10 Marks

QUESTION PAPER PATTERN FOR ALL THE UNDER GRADUATE COURSES*

20 (Twenty) MCQs (20 x 1)	= 20 Marks
2 (Two) Essays of 15 Marks each (2 x 15)	= 30 Marks
10 (Ten) Short Notes (10 x 5)	= 50 Marks
Total	= 100 Marks

Examination from August 2007 onwards.

Note:

The long essay question for 20 marks shall be one single question or it shall consist of two sections A & B.

The other papers are having 90 marks, 80 marks, 75 Marks, 45 Marks, 40 Marks etc, the question paper pattern and marks shall be distributed proportionately.

The above modification shall take effect from August 2006 examinations onwards.

* XXXII S.A.B. Meeting held on 21.12.2006.

25. CARRY OVER OF FAILED SUBJECTS:

a) A Candidate is permitted to carry over 2 first year subjects to the second year, but should have passed all the first year subjects before admission to the third year.

b) The Candidate is permitted to carry over 2 second year subjects to third year, but should have passed the second year subjects before admission to the fourth year.

c) The candidate is permitted to carry over 2 failed subjects in third year and appear along with the final year examination. A subject means theory, practical and oral taken together.

d) Lateral Entry Candidates.

The Provisions to carry Mathematics to the Third B. Pharmacy Course has been extended to all the students including those admitted in the first B. Pharmacy course along with lateral entry student. The above modifications shall be effective only for the candidates admitted on /before 2003-04, and for 2004-05 lateral entry students.

** * XXX S.A.B. Meeting held on 28-12-2005.

26. 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 bonafide record of the work done by the candidate.

The practical record shall be evaluated by the concerned Head 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 candidates shall have the option to improve his performance by submission of fresh records.

27. 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.

28. 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 75% attendance during the calendar period of study before appearing for next examination.

c) Failed candidates will not be permitted to appear for examination if he/she failed in the said subjects for more than four chances (actual appearance in the examination) provided the four chances are completed within three years from the date of final appearance. He/she will have to appear for the whole course of study in the prevailing regulations of this university if he /she desire to continue his studies.

29. 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.

REVISED:

Reintroduction of Revaluation of answer papers for all U.G. Courses from February 2007 examination session onwards with the following guidelines:

a) The application for revaluation should reach the University, within 15 days from the date of receipt of the statement of marks by the colleges.

b) The revaluation of answer papers is not permissible, for failure in practical / clinicals.

c) The revaluation of papers is not permissible, if the candidates have failed in more than one subject.

d) The revaluation is allowed only if the failure leads to break of semester / year.

e) Notwithstanding anything contained in guidelines.

f) The revaluation is allowed in the case of candidates, who fail in final year.

g) The revaluation is not permissible if the candidates have failed in any subject in the previous semesters / years.

h) A Demand Draft of Rs.1,000/- has to be sent in favour of the Registrar, The Tamilnadu Dr. M.G.R. Medical University, Chennai, as fee for revaluation.

i) The fee once paid will not be refunded. Hence, any application in this regard should be sent only after careful scrutiny.

j) The application should be sent to the University through the Dean / Principal of College only. Application submitted directly to the University by the students will summarily be rejected.

k) The application should be sent only in the prescribed format (which can be downloaded from the University Website (www.tnmmu.ac.in under the columns forms).

(Special S.A.B. dated 19.04.2007 and approved by 164th G.C. dated 24.04.2007).

30. 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.

31. PROJECT WORK

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

a) Pharmaceutics

b) Pharmaceutical Chemistry

c) Pharmacognosy

d) Pharmacology

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.

32. 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.

33. 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.)

REVISED:

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).

34. 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).

35. 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.

f) The provision of combination of attendance shall be granted to the transfers for admission to the examination of the University on satisfactory fulfilment of the regulations of this University.

36. VACATION:

6 Weeks in an Academic year.

37. 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.

38. 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.

39. SCHEME OF EXAMINATION (2004-05 Batch regulation):

THEORY

Sl.no.	Sub Code	SUBJECT	Year of Study	Course of study / week	Scheme of Examination				
					Duration	Uty Marks	I.A	Viva-voce	Total
1.	PCI	Pharmaceutical Inorganic Chemistry	I B.Pharm	4 Hrs.	3 Hrs	90	30	30	150
2.	PCII	Pharmaceutical Organic Chemistry	I B. Pharm	4 Hrs.	3 Hrs	90	30	30	150
3.	PGL-I	Anatomy, Physiology & Health Education	I B. Pharm	4 Hrs.	3 Hrs	90	30	30	150
4.	P-1	Physical Pharmaceutics	I B.Pharm	4 Hrs.	3 Hrs	90	30	30	150
5.	PGL-II	Biochemistry	II B.Pharm	3 Hrs.	3 Hrs	90	30	30	150
6.	PC-III	Pharmaceutical Analysis and Physical chemistry	II B. Pharm	3 Hrs.	3 Hrs	90	30	30	150
7.	PC-IV	Advanced Pharmaceutical Organic Chemistry	II B. Pharm	3 Hrs.	3 Hrs	90	30	30	150
8.	P-II	Pharmaceutical Technology	II B.Pharm	3 Hrs	3 Hrs	75	25	-	100
9.	P-III	Pharmacy Practice & Pathophysiology	II B.Pharm	3 Hrs.	3 Hrs	90	30	30	150
10.	PGL-III	Biostatistics and Computer Applications	II B.Pharm	3 Hrs.	3 Hrs	90	30	30	150
11.	PCOG-I	Pharmacognosy and Phytochemistry	III B.Pharm	3 Hrs.	3 Hrs	90	30	30	150

12. PC-V	**Medicinal Chemistry-1**	**III B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
13. P-IV	**Pharmaceutical Dosage Forms and Cosmetic Technology**	**III B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
14. PT-1	**Pharmacology -1**	**III B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
15. P-V	**Hospital and Clinical Pharmacy**	**III B.Pharm**	**3 Hrs**	**3 Hrs**	**75**	**25**	**-**	**100**
16. PGL-IV	**Forensic Pharmacy and Pharmacy business Management (*)**	**III B.Pharm**	**3 Hrs**	**3 Hrs**	**80**	**20**	**-**	**100**
17. P-VI	**Pharmaceutical Bio technology**	**IV B.Pharm**	**3 Hrs**	**3 Hrs**	**90**	**30**	**30**	**150**
18. P-VII	**Formulative Pharmacy and Biopharmaceutics**	**IV B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
19. PCOG-II	**Advanced Pharmacognosy**	**IV B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
20. PT-2	**Pharmacology –II**	**IV B. Pharm**	**3 Hrs**	**3 Hrs**	**90**	**30**	**30**	**150**
21. PC-VI	**Modern Methods of Pharmaceutical Analysis**	**IV B.Pharm**	**3 Hrs.**	**3 Hrs**	**90**	**30**	**30**	**150**
22. PC-VII	**Medicinal Chemistry –II**	**IV B.Pharm**	**3 Hrs**	**3 Hrs**	**90**	**30**	**30**	**150**

Note: (*) For students admitted in 2006-07 batch, refer Section 20 for details

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SCHEME OF EXAMINATION (2004-05 Batch regulation):

PRACTICAL

Sl.no.	Sub Code	SUBJECT	Year of Study	Course of study / week	Scheme of Examination				
					Duration	Uty Marks	I.A	Record	Total
1.	PCI	Pharmaceutical Inorganic Chemistry	I B.Pharm	4 Hrs.	4 Hrs	70	20	10	100
2.	PCII	Pharmaceutical Organic Chemistry	I B. Pharm	4 Hrs.	4 Hrs.	70	20	10	100
3.	PGL-I	Anatomy, Physiology & Health Education	I B. Pharm	4 Hrs.	4 Hrs.	70	20	10	100
4.	P-1	Physical Pharmaceutics	I B. Pharm	4 Hrs.	4 Hrs.	70	20	10	100
5.	PGL-II	Biochemistry	II B.Pharm	3 Hrs.	4 Hrs.	70	20	10	100
6.	PC-III	Pharmaceutical Analysis and Physical chemistry	II B. Pharm	3 Hrs.	4 Hrs.	70	20	10	100
7.	PC-IV	Advanced Pharmaceutical Organic Chemistry	II B. Pharm	3 Hrs.	4 Hrs.	70	20	10	100
8.	P-II	Pharmaceutical Technology	II B.Pharm	-	-	-	-	-	-
9.	P-III	Pharmacy Practice & Pathophysiology	II B.Pharm	3 Hrs.	4 Hrs.	70	20	10	100
10.	PGL-III	Biostatistics and Computer Applications	II B.Pharm	3 Hrs.	4 Hrs.	70	20	10	100

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

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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 B. PHARMACY

1.1 PHARMACEUTICAL INORGANIC CHEMISTRY

THEORY

1. **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.

2. **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 with suitable examples.

3. **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 iodine–131(I^{131}), Cobalt 58. Radio opaque contrast medium-barium sulphate.

4. 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.

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, Dimethicone, Magaldrate, Bismuth carbonate.

   iii. **Adsorbents and protectives:** Light Kaolin, Heavy kaolin, Activated charcoal Bismuth subcarbonate.

   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 Stilbogluconate, 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, Potassium 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, Ammonium citrate, Zinc chloride and Potassium iodide.

Official formulation: Iron dextran injection, Strong iodine solution.

g. **Pharmaceutical Aids:** Sodium bisulphate, Sodium metabisulphate, Sulphurdioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium benzoate, Sodium carboxy methyl cellulose, Sodium formaldehyde sulphoxylate, Sodium methylparaben, Sodium lauryl sulphate, Purified water, Water for injection, Sterile water for injection and Zinc chloride.

h. **Miscellaneous:**

i. **Sclerosing agents:** Hypertonic saline, Sodium tetra decyl sulphate.

ii. **Expectorants:** Ammonium chloride, Potassium iodide.

iii. **Sedative:** Potassium bromide.

iv. **Antidotes:** Sodium nitrite, Sodium thiosulphate, Charcoal.

v. **Respiratory stimulant:** Ammonium carbonate.

5. Theory of co-ordination compounds with special reference to application in Pharmacy and Pharmaceutical analysis:

EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline

6. A study of preparation and specific uses of the following reagents in organic synthesis:

Aluminium isopropoxide, Aluminium tertiary butoxide, N-bromo succinimide, Sodium azide, Lithium aluminium hydride, Diazomethane, Periodic acid, Polyphosphoric acid, Sodmide, Sodium borohydride, Ozone, Thionyl chloride.

PRACTICALS

I. 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.	

II. 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.

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

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

REFERENCES

1. Bentley and Driver's Textbook of Pharmaceutical Chemistry.

2. Inorganic Medicinal and Pharmaceutical Chemistry by J.H. Block,

E.B. Roche, T.O.Soine and C.O.Wilson.

3. Roger's Inorganic Pharmaceutical Chemistry by T.O.Soine and C.O.Wilson.
4. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake Vol. I.
5. Pharmaceutical Chemistry by M.L. Schroff.
6. Indian Pharmacopoeia 1996.
7. Organic Chemistry Reactions and Reagents by O.P. Agarwal.

1.2 PHARMACEUTICAL ORGANIC CHEMISTRY

THEORY

1. **Structure and Properties**

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.

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.

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. Preparation and properties of poly aromatic compounds, naphthalene, anthracene, phenanthrene, diphenyl methane, triphenyl methane and diphenyl ethane. Preparation test for purity and medicinal uses of Dicophane, Gammaxene, Saccharin, Chloramine, Chloramine-T, Salicylic acid, Methyl salicylate, Aspirin, Phenindione, Ethyl biscoumacetate, Hexamine, Vanillin, EDTA, Urethane, Carbromal, Amphetamine and Acetanilide.

4. 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 substitutent on basic property), aldehydes, ketones, carboxylic acids and functional derivatives of carboxylic acids. Preparation, test for purity and medicinal uses of Chloroform, Iodoform, Mephenesin, Glyceryl trinitrate, Propylene, Citric acid, Lactic acid, Benzoic acid, Sodium lauryl sulphate, Glycol, Benzoic acid and Benzyl benzoate.

a. **Reactive intermediates**: Carbocations, Carbanions, Carbenes, Free radicals, generation and 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.

PRACTICALS

1. Systematic qualitative analysis of organic compounds including preparation of derivative (not less than 16 compounds with different functional groups).
2. Preparation of organic drugs or intermediate involving one-step reaction (at least 16 compounds).
3. Determination of melting point and boiling point of organic compounds including mixed melting point technology.
4. Introduction to the use of stereo models
    a) Methane b) Ethane c) Acetylene d) Ketone e) Benzene

(Students may be asked to prepare the ball and stick stereo molecules by using china clay and plastic sticks individually and they have 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.) '96.
8. Vogel's Practical Organic Chemistry.
9. Stereo Chemistry of Organic Compounds by E.I. Elliel.
10. Advanced Organic Chemistry by Arun Bahl.

1.3 ANATOMY, PHYSIOLOGY, AND HEALTH EDUCATION

THEORY

1. Scope of Anatomy, Physiology and basic terminology.
2. **Structure and functions of cell**: Ion channels, signal transduction, second messengers, electrophysiology of muscles, cell stimulation and neuronal functions.
3. **Tissues**: Epithelial, Connective, Muscular and Nervous tissues, their types and characteristics.
4. **Bones and Joints:** Structure and function of skeleton, types of joints and their disorders.
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 function.
6. **Cardiovascular system:** Anatomy and physiology of heart, blood circulation, cardiac cycle, heart rate, blood pressure, ECG and heart sounds.
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.
8. **Respiratory system:** Anatomy of respiratory tract, Mechanism of respiration, Lung volumes, Transport of oxygen and carbondioxide. Disorders like Cyanosis, Mountain sickness and Caisson's disease.
9. **Urinary System:** Structure and functions of Kidney and Urinary Tract. Physiology of urine formation and acid base balance.
10. **Reproductive system:** Structure and function of Male and Female reproductive systems, Sex hormones, physiology of menstruation, coitus and fertilization. Spermatogenesis and Oogenesis, Pregnancy and parturition.
11. Basic anatomy and physiology of Pituitary, Thyroid, Parathyroid, Adrenal and Pancreatic hormones and disorders of these glands.
12. **Central Nervous System:** Structure and function of brain and spinal cord. Functions of cerebrum, cerebellum. Vital centers of medulla oblongata, cerebral ventricles, cranial nerves and their functions.
13. **Autonomic Nervous System:** Anatomy, Physiology and Divisions of ANS. Motor and sensory pathways.

14. **Sense organs:** Physiology of vision, audition, olfaction, taste and skin.
15. **Health education:** Concepts of health and disease. Disease causing agents and prevention of disease.
16. **Nutrition:** Balanced diet, Deficiency disorders of various nutrients, their prevention and treatment.
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.
18. **First Aid:** Emergency treatment of shock, snakebite, burns, poisoning, fractures and resuscitation methods.

PRACTICALS

1. Study of different systems with the help of models.
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.
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 Tailor'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 PHYSICAL PHARMACEUTICS

THEORY

1. **Matter, Properties of Matter:** State of matter, Change in the state of matter, Latent heats, vapour pressure, Sublimation-critical point, Eutectic mixtures, Gases, Aerosols-inhalers, Relative humidity, Liquid complexes, Liquid crystals, Glassy states, Solid-crystalline, Amorphous and Polymorphism.

2. **Solutions:** Solubility, factors affecting solubility, steady state diffusion, dissolution and drug release, diffusion principles in biological systems, isotonic solution and calculations involved.

3. **Colloids:** Introduction, types of colloidal system, optical properties, kinetic properties, electric properties of colloids and solubilization.

4. **Coarse Dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of suspensions, emulsions and theories of emulsification. Physical stability of emulsions, preservation of emulsions, rheological properties of emulsions, phase equilibria and emulsion formulation, special emulsion systems, semisolids and gels.

5. **Surface and Interfacial Phenomenon:** Surface tension and its determination. Classification of surfactants. Liquid interfaces, adsorption at liquid, solid interfaces and electrical properties of interfaces.

6. **Kinetics:** Rate and orders of reaction. Influence of temperature and other factors on rate, decomposition and stabilization of medicinal agents, kinetics in the solid state, accelerated stability analysis and kinetics of drug transport *in vivo*.

7. **Micromeritics:** Particle size and size distribution, Methods of determining particle size, particle shape, surface area and pore size, derived properties of powders.

8. **Rheology:** Viscosity, Newtonian and Non-Newtonian fluids, thixotropy, its application, rheology of disperse system and viscometers.

9. **Complexation and protein binding:** Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

PRACTICALS

1. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
3. Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
4. Study of rheological properties of various types of systems using different viscometers.
5. 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.

SECOND B.PHARMACY

2.1 BIOCHEMISTRY

THEORY

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.

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

3. Enzymes: Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance.

4. Carbohydrates: Classification and their properties. Starch, glycogen, dextrin, inulin, cellulose. Metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. Role of sugar in nucleotide biosynthesis and pentose phosphate pathway.

5. Lipids: Classification and properties, study of sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, oxidation of fatty acids, α,β - oxidation and biosynthesis of ketone bodies.

6. Proteins and amino acids: Classification and properties, biosynthesis of amino acids and proteins, Essential amino acids, metabolism of amino acids and proteins.

7. Macromolecules: Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein.

8. Vitamins: Classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme.

9. Hormones: Chemical nature and properties. Biochemical functions of hormones.

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 and its replication, mutation, mutagenesis and carcinogenesis. Biosynthesis of RNA, structure of t-RNA. Brief account on genetic engineering.

11. Metabolism of Nitrogen containing monomers: Nitrogen balance, Porphyrin biosynthesis, formation of bile pigments, hyper bilirubinaemia, purine biosynthesis and pyrimidine biosynthesis.

12. Mineral metabolism : Functions and properties of minerals including metabolism – calcium, phosphorous, magnesium, iron, sodium, potassium and other trace elements.

13. Nutrition: Principles and nutritional significance of carbohydrates, lipids and proteins in major food stuffs. Functional tests of liver and kidney. Elementary basis of biochemical mode of action of drugs, liposomal benzoxidation, biochemistry of urine and blood.

14. Regulation of gene expression: Positive and negative regulations, Operon concept, enhancers and silencers, fusion or chimeric genes.

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. Identification of C-terminal amino acids of proteins.
7. Isolation and assay of glycogen from the liver and skeletal muscle of rats.
8. Isolation and determination of RNA and DNA.
9. Estimation of blood glucose, blood cholesterol, SGPT and SGOT activity.
10. Enzymatic hydrolysis of glycogen by α and β amylase.
11. Acid hydrolysis and action of salivary amylase on starch.
12. Estimation of chloride, glucose, ammonia and creatinine in urine.
13. Identification of carbohydrates, proteins and fats.
14. 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. Phummer. (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.

2.2 ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY

THEORY

1. Stereochemistry:

a) **Optical isomerism:**

Stereoisomerism, 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.

c) **Stereochemistry of Biphenyl compounds and Nitrogen compounds:**

Walden inversion, nature, factors affecting, mechanism of asymmetric synthesis and configuration of Biphenyl molecules. Optical activity, Hybridisation of orbitals, stereochemistry of Nitrogen compounds, amines and oximes.

2. **Synthetic tools:**

Catalytic hydrogenation, dehydrogenation, metal hydrate reduction. Reduction with hydrazine and its derivatives, Birch reduction, Clemmenson's reduction. Meerwin - Pondroff reduction, oxidation with perchloric acid, lead tetra acetate, mercuric acetate and selenium oxide. Beckmann rearrangement, Schmidt rearrangement, Darzen's reaction.

3. **Heterocyclic chemistry:**

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

4. **Chemistry of Bio-molecules of Pharmaceutical importance:**

a. **Proteins and Amino acids:** Classification of Amino acids and proteins. General properties, reaction and preparation of amino acids, essential amino acids, peptide linkage, geometry, determination of structure and synthesis of peptides. Structure and formation of proteins.

b. **Terpenoids:** Classification, general methods of determining the structure, chemistry and uses of citral, menthol, thymol, camphor, alpha-terpineol, alpha-pinene.

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

i. Atropine and related compounds
ii. Quinine and quinidine
iii. Reserpine
iv. Morphine and related compounds
v. Papaverine
vi. Ephedrine
vii. Ergot and
viii. Vinca alkaloids

d. **Glycosides:** Basic ring system, nomenclature and stereochemistry of steroid nucleus. Chemistry of Digitoxin, Digoxin, Lanatosides, Diosgenin and Sarasapogenin, Hecogenin and Sennosides.

e. **Vitamins:** Chemistry and medicinal and pharmaceutical uses of vitamin A, D, E, K, B_1, B_2, B_6, B_{12} and Folic acid.

f. **Purines:** A brief account of chemistry and structural elucidation of uric acid, caffeine, theobromine and theophylline.

g. A brief account of chemistry and medicinal uses of Flavanoids, Taxol and its derivatives, podophyllotoxin and its derivatives, Coumarin and Artemisinin.

PRACTICALS

1. Synthesis of at least five compounds involving heterocyclic ring systems.
2. Exercise involving stereo selective synthesis of compounds.
3. Resolution of racemic DL-alanine or any other example.
4. Workshop on molecular modelling of elements of symmetry, optically active compounds and geometrical isomers.

5. Workshop on molecular modelling of primary, secondary and tertiary structures of proteins. Molecular modelling on double helical structure of nucleic acid showing hydrogen bonding.
6. Qualitative analysis of mixture of organic compounds containing two compounds – methods of separation and analysis.
7. Determination of number of functional groups.
8. Isolation, identification and quantitative analysis of certain natural constituents.

REFERENCES

1. Organic Chemistry by Morrison and Boyd.
2. Organic Chemistry by I.L. Finar.
3. Advanced Organic Chemistry by Jerry March.
4. Stereochemistry of Carbon compounds by E.L. Eliel.
5. Stereochemistry of 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.

2.3 PHARMACEUTICAL ANALYSIS AND PHYSICAL CHEMISTRY

THEORY

PHARMACEUTICAL ANALYSIS

Introduction: Importance of quality control, computation of analytical results, significant figure, concept of error, precision, accuracy, standard deviation, normal distribution curve, calibration of analytical equipments, fundamental of volumetric analysis, methods of expressing concentrations, primary and secondary standards.

1. **Neutralization titrations:** 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.
2. **Non-aqueous titrations:** Theoretical basis, types of solvents, scope, limitations, preparation and standardization of titrant solutions. Titration of weak acid, weak bases and indicators. Standardization of perchloric acid, lithium and sodium methoxide, tetrabutyl ammonium hydroxide.
3. **Precipitation titrations:** Principles of precipitation titrations, solubility product, effect of acids, temperature and solvent on the solubility of precipitate. Argentimetric titration, mercurimetric and titration involving ammonium or potassium thiocyanate, barium sulphate, adsorption indicators, Gay Lussac stas' method, Mohr's method, Volhard's method and Fajan's method.
4. **Complexometirc titrations:** Complexation, chelation, Werner's co-ordination number, stability of complexes, titration curves, importance of buffer, types of complexometric titration, methods of end point detection. PM indicator, masking and demasking agents.
5. **Oxidation – reduction titrations:** Concepts of oxidation–reduction, standard oxidation potential, Nernst equation, theory of redox titrations, redox indicators, titrations involving cerric ammonium sulphate, potassium permanganate, titanous chloride, sodium–2,6–dichlorophenol–indophenol, iodimetry, iodometry, preparation, standardization and titration.
6. **Gravimetric analysis:** Basic concepts, precipitation techniques, co-precipitation, post-precipitation. Various steps involved in gravimetric analysis. Pharmaceutical application eg: Determination of barium sulphate as barium chromate, calcium as calcium oxalates, Magnesium as magnesium pyrophosphate and organic precipitants.

7. **Miscellaneous methods:** 1. Diazotisation, 2. Kjeldhal method of nitrogen estimation, 3. Oxygen Flask combustion 4. Gasometry, 5. Analysis of oils, fats and waxes.

PHYSICAL CHEMISTRY

1. **Solutions:** Ideal and real solutions, solutions of gases in liquids, colligative properties, partition coefficient, Debye-Huckel theory.

2. **Thermodynamics:** 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 and its applications.

3. **Thermochemistry:** Enthalpy of combustion, neutralization, solution, formation, precipitation, Hess's law of constant heat of summation, bond energies and its application in calorimetry, e.g. Bomb calorimeter.

4. **Adsorption:** Definition, chemisorption, state of adsorbed molecule, factors influencing adsorption, types of adsorption isotherms, Freundlich, Langmuir's and Gibb's adsorption isotherms.

5. **Chemical Kinetics:** 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.

6. **Quantum mechanics:** Postulates of quantum mechanics, operations in quantum mechanics, Schrodinger wave equation.

PRACTICALS

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.

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.

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.

2.4 PHARMACEUTICAL TECHNOLOGY

THEORY

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.

2. **Industrial Hazards and Safety Precautions:** Mechanical, Chemical, Electrical, Fire and Dust hazards, Industrial dermatitis, Accident records, etc.

3. **Fluid Flow:** Types of flow, Reynold's number, Viscosity, Concepts of boundary layer, Basic equation of fluid flow, Valves, Flow meters, Manometers and Measurement of flow and pressure.

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 and centrifugal sedimenters.

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. **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. **Refrigeration and Air Conditioning:** Principle and applications of refrigeration and air conditioning.

8. **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.

9. **Evaporation:** Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation.

10. **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.

11. **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.

12. **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.

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

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. Refrigeration and Air conditioning by L. Ballaney.
5. Remington's, The Science and Practice of Pharmacy, Mack Publishing Co. Easton.
6. MaCabe WL and Smith J.C. Unit operations of Chemical Engineering McGraw Hill International Book Co. London.
7. Parry R.H. and Chi Kon, C.H. Chemical Engineers Handbook of Kogakusha Ltd.

2.5 PHARMACY PRACTICE AND PATHOPHYSIOLOGY

THEORY

PHARMACY PRACTICE

1. **Prescription:** Handling of prescription, source of errors in prescription, care required in dispensing procedures including labelling of dispensed products.

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, displacement value, etc.

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.

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.

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, patient counselling, role of pharmacist in community health care and education.

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).

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.

2. **Pathophysiology of Common Diseases:** Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania, hypertension, angina, congestive heart failure (CHF), atherosclerosis, myocardial infarction, diabetes, peptic ulcer, asthma, ulcerative colitis, hepatic disorders, acute and chronic renal failure, tuberculosis, urinary tract infections, sexually transmitted diseases, anaemia and common types of neoplasm. Wherever applicable the molecular basis should be discussed.

PRACTICALS

1. Dispensing of prescription falling under the following categories:
   Mixtures, emulsions, powders, mouthwashes, gargles, douches, capsules, jellies, lozenges, pills, tablet triturates, 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 geriartric 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.

2.6 BIOSTATISTICS AND COMPUTER APPLICATIONS

THEORY

BIOSTATISTICS

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

1.2 **Operating systems:** Definition, Types of operating systems, MS-DOS, UNIX, LINUX, Memories: RAM, ROM and secondary memory.

1.3 **Languages of computer**

Introduction to programming languages

Overview of C, Introduction – Character set – C Token-Keyword, Flowchart and Identifier's-Assigning values to variables-Defining symbolic constants-Arithmetic, Relational, Logical Assignment, conditional, Bitwise, special increment and decrement operators – Reading and writing a character.

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 – user defined functions.

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

1.5 **Introduction to Computer Networks:** Definition, LAN, WAN, Advantages. Internet, World Wide Web.

1.6 **Computer Graphics:** Definition, Display devices, Graphical input and output devices, multimedia – definition and application.

1.7 Computer applications in pharmaceutical and clinical studies.

PRACTICALS

Exercises based on the following are to be dealt:

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

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. Rajaraman – FORTRAN.

THIRD B. PHARMACY

3.1 PHARMACOGNOSY AND PHYTOCHEMISTRY

THEORY

1. Definition, History, Present status, Future scope & development of pharmacognosy

2. **Classification of crude drugs:** Alphabetical, Biological, chemical, Pharmacological, Taxonomical, Chemotaxonomicial & Serotaxonomical.

3. **Cultivation, Collection, Processing & Storage**
   A. General principles of cultivation & collection of vegetable drugs of commercial significance from wild & cultivated source.
   B. Advantages & disadvantages of cultivation.
   C. Factors influencing cultivation of medicinal plants, types of soils & Fertilizers of common use.
   D. Plant hormones & their applications.
   E. Polyploidy, Mutation & hybridization with special reference to Medicinal plants.
   F. Processing, storage & preservation of crude drugs.

4. **Quality control of crude drugs**

   Adulteration of crude drugs & their detection by evaluation methods.

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:

   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 and Spirullina.
   e. **Volatile oils:** Mentha, Coriander, Cinnamon, Cassia, Caraway, Dill, Clove. Fennel, Nutmeg, Cardamom, Lemon grass oil, Eucalyptus and Sandalwood.
   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:** Belladona, Hyoscyamus, Datura, Aswagandha.

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

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

m. **Imidazole:** Pilocarpus.

n. **Steroidal:** Kurchi

o. **Alkaloidal amines:** Ephedra and Colchicum.

p. **Glycoalkaloids:** Solanum species.

q. **Purines:** Tea

r. **Resins:** Colophony, Cannabis, Capsicum, Balsam of Tolu, Benzoin, Balsam of Peru, Asafoetida, Turmeric and Ginger.

s. **Others:** Gentian, Saffron.

6. **Tumor inhibitors:** Taxol, Vinca and Podophyllum

7. **Anti-hepatotoxic and oral hypoglycemic agents:**

   Phyllanthus niruri, Gymnema sylvestre.

8. **Plant fibres used as surgical dressings:**

   Cotton, Silk, Wool, Nylon, Rayon, Alginate dressing, Gelatin Sponge, Oxidized cellulose.

   Sutures – surgical catguts and ligatures.

9. **Pharmaceutical aids:** Talc, Kaolin, Bentonite, Gelatin and Natural colours.

10. **Studies of traditional drugs:** 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, Aparnarg Gokhru, Shankapuspi, Brahmi, Arjuna, Ashoka, Methi, Lahsun, Guggal, Gymnema, Shilajit, Pyrethrum, Lycopodium.

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 and Liquorice.
3. Microscopical studies of some selected powered drugs of single component or mixture of two components: Datura, Cinchona, Cinnamon, Senna, Digitalis, Rauwolfia, Liquorice, Ipecac, Clove, Nuxvomica and Rhubarb.
4. Identification of unorganized drugs mentioned in theory by Morphological characters and chemical tests.
5. Microscopical measurements of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibres.
6. Determination of leaf constants i.e., stomatal index, stomatal number, vein islet number, vein termination number and palisade ratio.
7. Microscopical studies of crude drugs and their powders and of drug containing volatile oils, Fennel and coriander.
8. To do simple physical tests to identify the crude drugs and to detect substitutes and adulterants as per I.P.
9. Determination of percentage purity of the crude drugs.

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 – 14^{th} and 15^{th} 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

I. **Basic Principles of Medicinal Chemistry**

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.

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.

Drug latentiation 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

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

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

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

D. **Anticonvulsants or antiepileptics:** Phenytoin*, Barbiturates, Mephenytoin, 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*, Desipramine hydrochloride, Doxepin hydrochloride*, Psilocybin and Psilocyn, Mescaline, Phenyclidine (PCP), Tetrahydrocannabinol (THC).

III. Drugs acting on ANS

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*, Clonidine, Methyldopa, Isoproterenol, Salmeterol, Bitolterol, Ritodrine, Dobutamine, Hydroxyamphetamine, Propylhexadrine, Metaraminol, Naphazoline, Tetrahydrazoline, Oxymetazoline and Xylometazoline.

C. **Adrenergic Antagonists:** Tolazoline*, Phentolamine*, Phenoxybenzamine, Prazosin, Tetrazosin, Doxazosin, Ergotamine, Methysergide, Propranolol*, Dichloroisoproterenol, Practolol, Metibranolol, Acebutolol*, Atenolol*, Betazolol, Bisoprolol, Esmolol, Metoprolol*, Labetolol 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, Isofluorphate, Echothiophate iodide, Parathione, Malathion.

E. **Cholinergic Blocking agents:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrogen bromide, Homatropine hydrogen bromide*, Ipratropium bromide*, Tropicamide*, Cyclopentolate hydrochloride*, Clindinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Biperidine hydrochloride, Procylidine 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: Cocaine, Hexycaine, Meprylcaine, Cyclomethycaine, Piperocaine, Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate, Lignocaine*, Mepivacaine, Prilocaine, Etidocaine, Phenacaine, Diperodon, Dibucaine* and Dyclonine.

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

VI. Antihistaminic agents: H1, H2 and H3 receptors. Termination of histamine action, Diphenhydramine hydrochloride*, Dimenhydrinate, Bromo diphenhydramine hydrochloride*, Doxylamine Succinate*, Carbinoxamine maleate*, Clemastine fumarate*, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride*, Pyrilamine maleate*, Cyclizine hydrochloride*, Chlorcyclizine hydrochloride*, Meclizine hydrochloride*, Buclizine hydrochloride, Pheniramine maleate, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate*, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride*, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Acrivastine, Cromolyn sodium, Cimetidine*, Famotidine, Ranitidine, Nizatidine, Omeprazole and Lansoprazole.

VII. Prostaglandins and other Eicosanoids: 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.

A. **Morphine and related drugs**: Morphine sulphate, Codeine phosphate. Hydromorphone hydrochloride, Oxymorphone hydrochloride, Apomorphine hydrochloride, Meperidine hydrochloride*, Alphaprodine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Levorphanol tartarate, Pentazocine, 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, Zomoperce sodium, Diclofenac sodium, Ibuprofen*, Naproxen*, Flurbiprofen, Piroxicam*, Acetaminophen, Phenylbutazone* and Oxyphenbutazone.

PRACTICALS

1. Synthesis of selected compounds from the course content (10 drugs)
2. Identification test including I.R. spectrum
3. Establishing the pharmacopoeial standards for the drugs synthesised.
4. Identification and estimation of drug metabolites from biological fluids (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 by W.A. Foye.
6. Medicinal Chemistry Wilson and Giswold
7. Indian Pharmacopoeia, '96

3.3 PHARMACEUTICAL DOSAGE FORMS AND COSMETIC TECHNOLOGY

THEORY

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.

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.

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

4. **Extraction and Galenical Products:** Principle and method of extraction, Preparation of infusion, tinctures, dry and soft liquid extracts.

5. **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.

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

7. **Ophthalmic Preparations:** Requirements, formulation, methods of preparation, containers and evaluation.

8. **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, etc.

PRACTICALS

I. Preparation, evaluation and packaging of:

1. Syrups

a) Syrup IP
b) Tolu syrup IP’66
c) Parish syrup
d) Syrup of Ferrous iodide

e) Any one commercially available cough syrup

2. Eye Drops

a) Chloramphenicol eye drops BP
b) Zinc sulphate eye drops BP
c) Ephedrine HCl eye drops BPC

3. Ointments

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

4. Suppositories

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

5. Crude extracts

a) Compound tincture of benzoin IP' 66
b) Tincture of orange IP' 66
c) Liquid tincture of liquorice BPC

II. Formulation of various types of cosmetics for skin, hair, dentrifices and manicure preparations.

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

1. **General Pharmacology:** 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. Adverse drug reactions and treatment of Poisoning. Drug interactions, Bioassay of drugs and biological standardisation, discovery and development of new drugs.

2. **Pharmacology of Peripheral Nervous System:**

a. Neurohumoral transmission (Autonomic and Somatic).
b. Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Adrenergic receptor and neuron blocking agents, Ganglionic stimulants and blocking agents.
c. Neuromuscular blocking agents.
d. Local anaesthetic agents.

3. **Pharmacology of Central Nervous System:**

a. Neurohumoral transmission in the C.N.S.
b. General anaesthetics.
c. Alcohols and disulfiram.
d. Sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants.
e. Psychopharmacological agents: Anti-psychotics, antidepressants, anti-maniacs and hallucinogens.
f. Anti-epileptic drugs.
g. Anti-parkinsonism drugs.
h. Analgesics, antipyretics, anti-inflammatory and anti-gout drugs
i. Narcotic analgesics and antagonists.
j. C.N.S. stimulants.
k. Drug addiction and drug abuse.

4. **Pharmacology of Cardiovascular System**

a. Digitalis and cardiac glycosides.
b. Anti-hypertensive drugs.

c. Anti-anginal and vasodilator drugs including calcium channel blockers and beta-adrenergic antagonists.
d. Anti-arrhythmic drugs.
e. Anti-hyperlipidemic drugs.
f. Drugs used in the therapy of shock.

5. **Drugs acting on Urinary System**

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

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

a. Anti-asthmatic drugs including bronchodilators.
b. Anti-tussives and expectorants.
c. Respiratory stimulants.

PRACTICALS

1. Common laboratory animals and anaesthetics used in animal studies. Commonly used instruments in experimental pharmacology. Some common and standard techniques. Bleeding and intravenous injection, intra-gastric administration, Procedures for rendering animal unconscious and chemical euthanasia.

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:** Recording of spontaneous motor activity, Stereotype activity, analgesic activity, anticonvulsant activity, anti-inflammatory activity and muscle relaxant activity of drugs using simple experiments.

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, Reter J.M-Pharmacology.
2. Pharmacology and Therpeutics – 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

1. **Organisation and structure:** Organisation of a hospital, hospital pharmacy, Responsibilities of a hospital pharmacist, Pharmacy and Therapeutic committee, Budget preparation and Implementation.
2. **Hospital formulary:** Contents, preparation and revision of hospital formulary.
3. **Drug store management and inventory control:**
   a. Organisation of drug store, types of materials stocked and storage conditions.
   b. Purchase and inventory control: Principles, Purchase procedures, Purchase order, Procurement and Stocking.
4. **Drug distribution system in Hospital:**
   a. Outpatient dispensing and methods adopted.
   b. Dispensing of drugs to in-patients, types of drug distribution systems, charging policy and labelling.
   c. Dispensing of drugs to ambulatory patients.
   d. Dispensing of controlled drugs.
5. **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. **Manufacture of sterile and Non-sterile products:** Policy making of manufacturing items, demand, costing, personnel requirements, manufacturing practice, master formula card, production control and manufacturing records.

7. **Drug information services:** Drug information centre, sources of information on drugs, disease treatment schedules, procurement of information, computerized services (e.g. MEDLINE), retrieval of information and medication error.

8. **Records and Reports:** Prescription filling, drug profile, patient medication profile, cases on drug interaction and adverse drug reactions, idiosyncratic cases, etc.

9. **Nuclear Pharmacy:** 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.

10. **Adverse drug reactions:** Classification, excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden drug withdrawal, drug interactions, beneficial interactions, adverse interactions, pharmacokinetic drug interactions and methods of detecting adverse drug effects, spontaneous case reports and record linkage studies. Case control studies specific examples: Phenytoin with phenothiazines and phenylbutazones, Anti-diabetics with corticoseroids.

11. Concept of medication history interviews, patient medication counselling and ward pharmacy. Barriers and steps in counselling, dosage individualization and pharmacist interventions.

12. Role of Hospital Pharmacist in Educational and Training Programme: Professional training for student pharmacy technicians, pharmacists and supporting staff. Public awareness and continuing education programmes.

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 week ends). 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 to wards along with doctors and nurses to know about drug distribution
    d. Prescription charging, methods of suggesting dosage regimen, (8 days/ 4 week ends).

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.

3.6 FORENSIC PHARMACY AND PHARMACY BUSINESS MANAGEMENT

THEORY

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.

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.

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

a. Pharmacy Act 1948.
b. Drugs and Cosmetics Act 1940 and Rules 1945.
c. Narcotics and Psychotropic Substance Act.
d. Drugs and Magic Remedies (Objectionable Advertisement) Act 1955.
e. Poisons Act and Rules 1919.
f. New Drug Policy 1986.
g. Medicinal and Toilet Preparations (Excise duties) Act and Rules.
h. Shops and Establishment Act.
i. Essential Commodities Act.
j. Drugs (Price Control) order 1995.
k. Medical Termination of Pregnancy Act.
l. Prevention of Cruelty of Animal Act 1960.
m. Insecticide Act.
n. Sales promotion employees (Condition of Service) Act.
o. Patents Act.

PHARMACEUTICAL BUSINESS MANAGEMENT

1. **Concept of Management:** 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:** Functions, buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail departmental store, multiple shops and mail order business.

3. **Salesmanship:** 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. Drug Control by P.K. Dutta.
16. The Drugs and Cosmetics Act and Rules by The India Drug Manufacturers Association Publication.
17. Dangerous Drugs Act 1930 by Govt. of India Publications.
18. Drugs and Magic Remedies Act by Govt. of India Publications.
19. Management by James A.F. Stoner.
20. Statistics for Management by Richard I. Levin.
21. Personnel Management by Arun Monappa.
22. Business Organisation and Office Management by Santhosh Bushan.

23. Business Management by Dinker.

24. Modern Business Correspondence by Lartside.

25. Business Administration by Hall.

FOURTH B. PHARMACY

4.1 PHARMACEUTICAL BIOTECHNOLOGY

THEORY

I. **Microbiology-Principles and Practice**

1. Scope of Microbiology, Microbes of Medicinal interest, Microbes and diseases.

2. Classification of microbes: Bacteria, fungi, virus and protozoa. Their morphology, cell organelles and its functions. Methods of isolation and identification of bacteria with emphasis to staining techniques and biochemical reactions. Bacterial counting methods.

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

4. Detailed study of different methods of sterilization including their merits and demerits. Sterilization methods of all pharmaceutical products. Detailed study of sterility testing of different pharmaceutical preparation.

5. Disinfection: Study of disinfectants, antiseptics, fungicidal and virucidal agents. Factors affecting their action and evaluation of bactericidal, bacteriostatic, virucidal activities and evaluation of preservatives in pharmaceutical preparations.

6. Principles and methods of different microbiological assays including sensitivity testing with reference to antibiotics and vitamins.

II. **Microbial Biotechnology**

1. Microbial genetics including transformation, transduction, conjugation and transposable elements.

2. Microbial biotransformation, introduction, types of reactions mediated by microorganisms, biotransformation of steroids and production of single cell protein.

III. **Immunology and Immuno Biotechnology**

1. Introduction, types of immunity, antigens and haptens, Antigen-antibody reactions, complement systems, structure and functions of MHC, antigen recognition and presentation, hypersensitivity response, immuno stimulation and suppression and Autoimmune disorders.

2. **Immunization –** Definition, types, preparation, standardization and application of official vaccines, containerisation, storage conditions and stability of official vaccines.

3. **Hybridoma technology –** Introduction, techniques of production and purification of monoclonal antibodies. Application of monoclonal antibodies in clinical diagnosis and pharmaceutical research.

Immuno blotting techniques such as ELISA, Western blot, Southern blot and Northern blot.

IV. **Molecular Biology and Genetic Engineering**

1. Introduction to molecular biology, structure of DNA and RNA, replication, transcription and translation processes.

2. Study of cloning vectors, restriction endonucleases, cloning strategies and gene expression.

3. Application of rDNA technology and genetic engineering in production of below mentioned, using above techniques.

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

V. **Bioprocess technology**

1. Basic principles of fermentation, isolation and screening of industrially important microbes.
2. Study, design and operation of fermenter and study of different parameters
3. Bioprocess of following metabolites
    i) Organic solvents – Alcohol
    ii) Organic acids – Citric acid
    iii) Antibiotics – Penicillin, Griseofulvin
    iv) Vitamins – Vit B_{12}
    v) Amino acids – Glutamic acid

VI**. Enzyme biotechnology**

Enzyme: Introduction, classification and uses. Techniques of immobilization, application, biosensors and their applications. Production of Amylase, Protease, Streptokinase and Penicillinase by immobilization technique.

VII**. Animal Biotechnology:**

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

PRACTICALS

Microscopy

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

Cultivation techniques and isolation

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

Staining methods

6. Simple staining, Gram staining, Acid-fast staining, Spore staining, Capsule staining, Flagella staining.

   Minimum inhibitory concentration of antibiotics
7. By serial dilution and gradient plate techniques.

Microbial assays

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

Standard qualitative analysis of water

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

Motility study:

10. Motility study on microorganism by hanging drop technique.

Evaluation of disinfectants

11. Phenol co-efficient test.

Molecular Biology and Biotechnology

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

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

16. Textbook of Fermentation technology by Stanbury
17. Industrial Microbiology by L.E. Casida
18. Biochemical Engineering by Webb and Steel.
19. Microbial Technology by Peppler Vol. I and II.
20. Genes V and VI by Benjamin Lewin.

4.2 FORMULATIVE PHARMACY AND BIOPHARMACEUTICS

THEORY

1. **Preformulation studies:**

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.

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

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

2. **Capsules:** 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, minimum / gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.

3. **Micro-encapsulation:** 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.

4. **Tablets**

a) Classification of different types of tablets, tablet excipients, granulation technology on large-scale by various techniques, physics of tablet making, 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.

5. **Parenteral products**

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

b) Formulation details, containers and closures and selection.

c) Prefilling treatment, washing of containers and closures, preparation of solution and suspension, filling and closing of ampoules, vials, infusion fluids, lyophilisation and

preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.

d) Aseptic Techniques: Source of contamination, methods of prevention, design of aseptic area, laminar flow bench services and maintenance.

6. **Prolonged Action Pharmaceuticals:** Benefits, limitations, oral products terminology, drug elimination rate, types and construction of products, evaluation, parenteral products, absorption and evaluation.

7. **Novel Drug delivery systems:** Transdermal delivery systems, Osmotic drug delivery systems, Liposomes.

8. **Bio-pharmaceutics and Pharmacokinetics**

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.

4.3 ADVANCED PHARMACOGNOSY

THEORY

1. a. Modern methods of extraction, application of latest techniques like Chromatography and Electrophoresis in the isolation, purification and identification of crude drugs.
   b. Application of spectroscopic methods in the evaluation of plant constituents.
   c. Stability test for herbal extracts
   d. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

2. **Enzyme Biotechnology**

Introduction, General methods of isolation, purification, enzyme reactors and applications of immobilized enzymes in drug analysis.

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

a. Papain	b. Diastase	c. Pepsin
d. Trypsin	e. Pancreatin	f. Urokinase
g. Hyaluronidase	h. Asparaginase	i. Pectinase.

3. **Plant tissue culture:**

Historical development, types of cultures, nutritional requirements, growth and their maintenance, applications of plant tissue culture in pharmacy and pharmacognosy, cloning and propagation.

4. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India, Industrial production and utilization of phytoconstituents, i.e. Sennosides, Cardiac glycosides, Vinca, Menthol, Quinine, Citric acid, Podophyllotoxin, Diosgenin, Solasodine and Tropane alkaloids.

5. **Natural allergens:** Allergenic preparations, hallucinogenic, teratogenic and other toxic plants.

- Natural allergens, photosensitizing and fungal toxins.
- Classification of allergens.
- Preparation of allergenic extracts.
- Sensitivity testing and treatment of allergy.

6. **Herbal preparations (Herbal cosmetics)**

- Preparation of total extracts, exudates and tinctures.
- WHO guidelines for the assessment of herbal medicines.
- Study of different methods used for standardization with special reference to HPLC and HPTLC.
- Estimation of heavy metals (Mg, Cu, Zn, As, etc) in herbal preparations.
- Importance of pharmacognosy in herbal drug industry.

7. **Basic principles involved in the alternative system of medicine.**

- Ayurveda, Siddha, Unani and Homeopathy.
- Preparation and standardization of Ayurvedic formulations i.e., Aristas, Asawas, Gutikas, Churnas, Lehyas and Bhasmas.
- The holistic concept of drug administration of traditional system of medicine.

8. Role of medicinal and aromatic plants in India, importance and status of herbal medicines and cosmetics. Export potential of medicinal and aromatic plants from India.

9. **Antibiotics and Antiviral drugs**

- Biosynthesis of Penicillin.
- Amino glycosides: Biosynthesis of streptomycin.
- Polypeptide: Lincosamid biosynthesis – Minor.
- Cytotoxic: Rifamycin.
- Antiviral drugs.
- Plant constituents with Anti-HIV activity.

10. Introduction to plant physiology and plant biochemistry with special reference to basic metabolic pathways. Introduction to biogenesis of secondary metabolites like Atropine, Morphine and Steroidal glycosides.

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.

3. **Marine Pharmacognosy**

   Biologically active components from marine organisms.

4. **Nutraceuticals**

5. **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.

6. **Physical evaluation of powdered drugs**
   - Determination of Moisture content (Loss of drying).
   - Extractive values.
   - Ash values.
   - Swelling factors.

7. Demonstration of experiments in plant tissue culture.

8. Extraction of volatile oils.

9. Identification of natural products using TLC and paper chromatographic profiles.

10. Preparation and standardization of Ayurvedic formulations.

11. Preparation and standardization of herbal extracts.

12. Preparation of herbal cosmetics.

13. Herbal allergenic preparations.

14. Demonstration of experiments in column chromatography.

15. Isolation of a plant enzyme.

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.
11. Pharmacognosy and Phytochemistry I Edition, Vol I and II by Vinod. D. Rangari.
12. Practical Pharmacognosy, III Edition, C.K. Kokate.

4.4 PHARMACOLOGY – II

THEORY

1. **Drugs acting on the Gastrointestinal Tract:**

   a. Antacids, anti-secretory and anti-ulcer drugs.
   b. Laxatives and Anti-diarrhoeal drugs.
   c. Appetite stimulants and suppressants.
   d. Emetics and anti-emetics.

2. **Pharmacology of Endocrine system:**

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

3. **Chemotherapy:**

   a) General principles of chemotherapy.
   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 and immuno suppressive agents.

4. **Drugs acting on the Haemopoietic system:**

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

5. **Autocoids:**

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

6. **Principles of Toxicology:**

a. Definition of poison, general principles of treatment of poisoning.
b. Heavy metals and heavy metal antagonists.
c. Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.

7. **Molecular Pharmacology:**

a. Various neurotransmitters and receptors involved in signal transduction with special reference to CNS.

b. G-protein coupled receptors and their mechanism of action.

8. **Chronopharmacology:**

Definition of rhythms and cycles. Biological clock and their significance leading to chronotherapy.

9. **Clinical Pharmacology:**

Clinical trials, design of clinical trials and testing of drugs in human.

10. **Immunopharmacology:**

Immunostimulants, immunosuppressants and Anti-AIDS drugs.

PRACTICALS

1. **Experiments on isolated preparations:**

a. To calculate the pA_2 value of Atropine using Acetylcholine as an agonist on rat ileum preparation.
b. To calculate the pA_2 value of Mepyramine or Chlorpheniramine using Histamine as agonist on guinea pig ileum.

c. 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, interpolation bioassay, three point bioassay and four point bioassay.
d. To record the CRC of 5-HT on rat fundus preparation.
e. To record the CRC of nor-adrenaline on rat anococcygeus muscle preparation.

2. **Pharmacology of Gastro intestinal tract:**

To study the Anti-ulcer activity using pylorus ligated rats.

3. Estimation of bioavailability parameters viz AUC, Tmax, 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, Little Brown and Company, 1994.
2. Ghosh M. N, Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
3. Katzung, B.G., Basic and Clinical Pharmacology, Prentice Hall International.
4. Laurence, D.R. and Bennet P.N, Clinical Pharmacology, Churchill Livingstone
5. Mycek M.J., Gerlnet S.B and Perper M.M. Pharmacology, Lippincott's Illustrated Reviews, Lipincott Company, Philadelphia.
6. Rang M.P. Dale M.M, Reter 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.

4.5 MODERN METHODS OF PHARMACEUTICAL ANALYSIS

THEORY

Theoretical consideration and application in drug analysis and quality control of the following analytical techniques.

1. **Chromatography**
    i. **Column chromatography:** Adsorption and Partition theory, preparation, procedure and methods of detection.
    ii. **Thin layer chromatography:** Theoretical consideration, preparation, procedure and detection of compounds.
    iii. **Paper chromatography:** Theory of partition, different techniques employed and different grades of papers used, quantitative and qualitative detection.
    iv. **Gas Chromatography:** Introduction, fundamentals of column operation and detection.
    v. **Ion Exchangers:** Types of exchangers, mechanism of ion exchange and column operation.
    vi. Counter current extraction, ultra centrifugation and gel filtration.
    vii. HPLC and HPTLC.

2. **Potentiometric titrations:** Introduction, Electrochemical cells, half-cells, electrodes, measurement of potential and application in pharmaceutical analysis.

3. **Conductometric titrations:** Basic concepts, different types of conductometric titrations, apparatus used and applications in Pharmaceutical Analysis.

4. **Colorimetry:** Titrations, Basic Concepts and Applications in Pharmaceutical Analysis.

5. **Polarography:** Basic concept, theoretical considerations, Basic instrumentation, apparatus, principles, general polarography analysis and applications in pharmaceutical analysis.

6. **Amperometry:** Amperometric titrations with one polarized electrode, general procedure, titration curves and applications.

7. **Electrophoresis:** Principle, instrumentation and application.

8. **Turbidimetry and Nephelometry:** Theory of light scattering, Nephelometry, Turbidimetry for Practical Analysis of dispersions, study of the working principles of instrument used for analysis and applications in Pharmacy.

9. **Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be discussed.**

a. UV and Visible Spectrophotometry.
b. Fluorimetry.
c. Infrared Spectrophotometry.
d. Nuclear Magnetic Resonance Spectroscopy including ^{13}C-NMR.
e. Mass Spectrometry.
f. Flame Photometry.
g. Emission Spectroscopy.
h. Atomic Absorption Spectroscopy.
i. X-ray diffraction.
j. Radio Immuno Assay.

10. **Quality Assurance**

a. GLP, ISO 9000, TQM, Quality Review, quality documentation and International Conference of Harmonization (ICH).
b. Regulatory control, regulatory drug analysis and interpretation of analytical data.
c. Validation, quality audit, quality of equipment, validation of equipment and validation of analytical procedures.

PRACTICALS

1. Chromatographic analysis of some pharmaceutical products.

2. Exercises involving Nephelo-turbidimeter, colorimeter, spectrophotometer, refractometer, polarimeter, flamephotometer, pH meter and fluorimeter, conductometric, potentiometric, polarographic, amperometric titrations.

3. IR of samples with different functional groups

4. Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.

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.

4.6 MEDICINAL CHEMISTRY - II

THEORY:

I. **Principles of drug design:**

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 modelling.

Classification, mode of action (biochemical and molecular basis wherever applicable) structure activity relationship including physiochemical and stereo chemical properties and synthesis of selected drugs (Drugs marked with asterisk only) in the following categories.

II. **Anti-infective agents:**

A. **Local Anti-infective Agents:** Ethyl alcohol, Isopropyl alcohol, Formaldehyde, Sodium glutaraldehyde solution, Liquefied phenol, Hexachlorophene*, Eugenol, Hexyl resorcinol, Anthralin, Hydrous benzoylperoxide, Halazone*, Benzalkonium chloride*, Methylbenzethorium chloride*, Cetylpyridinium chloride, Chlorhexidine gluconate*, Gentian violet, Methylene blue, Thiomersal, Methyl paraben and Sodium benzoate.

B. **Anti-Fungal Agents:** Clotrimazole, Econoazole nitrate, Butoconazole, Oxyconazole nitrate, Tioconozole, Miconazole*, Ketoconazole*, Terconazole, Itraconazole, 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, Eflornithine, Dimercaprol*,

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

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

III**. Sulphonamides and Sulphones:**

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

IV. **Antimalarials:**

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

V. **Antibiotics:**

History, background, current status of

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

VI. **Antiviral agents:**

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

VII. **Anti-neoplastic agents:**

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

VIII. **Drugs acting on CVS:**

A. **Anti-anginal**: Vasodilators and Cardiotonics: Amylnitrate, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrate*, Verapamil, Diltiazem hydrochloride, Nifedipine, Amlodipine, Bepridil hydrochloride, Felodipine, Nicardipine, Dipyridamole, Digoxin, Digitoxin, Deslanoside.
B. **Anti-arrythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Lidocaine hydrochloride, 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, Minoxidil.
D. **Anti-hyperlipidemic agents**: Clofibrate, Dextrothyroxine sodium, Cholestyramine resin, Niacin, Probucol.
E. **Anti-coagulants and anti-thrombolytics**: Protamine sulphate, Dicoumarol, Warfarin sodium, Anisindione.

IX. **Hormones and related drugs:**

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

X. **Steroids and related drugs**

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

XI**. Diagnostic drugs and reagents**:

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

XII **Brief Introduction to Combinatorial Chemistry**

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.