



DEPARTMENT OF PHARMACY

SUMANDEEP VIDYAPEETH DEEMED TO BE UNIVERSITY



CURRICULUM

BACHELOR OF PHARMACY (B. Pharm)

AMENDED UP TO DECEMBER - 2020

SUMANDEEP VIDYAPEETH

(Declared as Deemed to be University under Section 3 of the UGC Act
1956) Accredited by NAAC with a CGPA of 3.61 out of four-
point scale at 'A++' Grade Category- Deemed to be university under UGC Act-2018

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CURRICULUM

BACHELOR OF PHARMACY

(B.Pharm)

CHAPTER-I:REGULATIONS

1 Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the B. Pharm. Degree Program(CBCS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by Pharmacy Council of India.

2 Minimum qualification for admission

2.1 First year B.Pharm:

Candidates shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to 10+2 examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B/P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

2.2 B.Pharm lateral entry (to third semester):

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

3 Duration of the program

The course of study for B.Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic years) for lateral entry students. The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

4 Medium of instruction and examinations

Medium of instruction and examinations shall be in English.

5 Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from December/January to May/June in every calendar year.

6 Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7 Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes, etc. are measured in terms of credits. On

satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week.

7.1 Credit assignment

7.1.1 Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and /or tutorial (T) hours, and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and tutorial hours, and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having three lectures and one tutorial per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

7.2 Minimum credit requirements

The minimum credit points required for award of a B. Pharm. degree is 208. These credits are divided into Theory courses, Tutorials, Practical, Practice School and Project over the duration of eight semesters. The credits are distributed semester-wise as shown in Table IX. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

The lateral entry students shall get 52 credit points transferred from their D. Pharm program. Such students shall take up additional remedial courses of 'Communication Skills' (Theory and Practical) and 'Computer Applications in Pharmacy' (Theory and Practical) equivalent to 3 and 4 credit points respectively, a total of 7 credit points to attain 59 credit points, the maximum of 60 in 8 semesters.

8 Academic work

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

9 Course of study

The course of study for B. Pharm shall include Semester Wise Theory & Practical as given in Table-I to VIII. The number of hours to be devoted to each theory, tutorial and practical course

in any semester shall not be less than that shown in Table-I to VIII.

Table-I: Course of study for semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I – Theory	3	1	4
BP102T	Pharmaceutical Analysis I – Theory	3	1	4
BP103T	Pharmaceutics I – Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP105T	Communications skills – Theory*	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology – Practical	4	-	2
BP108P	Pharmaceutical Analysis I – Practical	4	-	2
BP109P	Pharmaceutics I – Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communications skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
Total		32/34\$/36#	4	27/29\$/30#

#Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

\$Applicable ONLY for the students who have studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

*Non University Examination (NUE)

Table-II: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II – Theory	3	1	4

BP202T	PharmaceuticalOrganicChemistryI–Theory	3	1	4
BP203T	Biochemistry–Theory	3	1	4
BP204T	Pathophysiology–Theory	3	1	4
BP205T	ComputerApplications inPharmacy –Theory*	3	-	3
BP206T	Environmentalsciences–Theory*	3	-	3
BP207P	HumanAnatomyandPhysiologyII–Practical	4	-	2
BP208P	PharmaceuticalOrganicChemistryI–Practical	4	-	2
BP209P	Biochemistry– Practical	4	-	2
BP210P	ComputerApplicationsinPharmacy–Practical*	2	-	1
Total		32	4	29

*NonUniversityExamination(NUE)

Table-III:CourseofstudyforsemesterIII

Course code	Name of thecourse	No.of hours	Tutorial	Credit points
BP301T	PharmaceuticalOrganicChemistryII –Theory	3	1	4
BP302T	PhysicalPharmaceuticsI–Theory	3	1	4
BP303T	PharmaceuticalMicrobiology–Theory	3	1	4
BP304T	PharmaceuticalEngineering–Theory	3	1	4
BP305P	PharmaceuticalOrganicChemistryII –Practical	4	-	2
BP306P	PhysicalPharmaceuticsI–Practical	4	-	2
BP307P	PharmaceuticalMicrobiology–Practical	4	-	2
BP 308P	PharmaceuticalEngineering–Practical	4	-	2
Total		28	4	24

Table-IV:CourseofstudyforsemesterIV

Course code	Name of thecourse	No.of hours	Tutorial	Credit points
BP401T	PharmaceuticalOrganicChemistryIII–Theory	3	1	4
BP402T	MedicinalChemistryI–Theory	3	1	4
BP403T	PhysicalPharmaceuticsII–Theory	3	1	4
BP404T	PharmacologyI –Theory	3	1	4
BP405T	PharmacognosyandPhytochemistryI–Theory	3	1	4
BP406P	MedicinalChemistryI–Practical	4	-	2

BP407P	PhysicalPharmaceuticsII –Practical	4		2
BP408P	PharmacologyI–Practical	4	-	2
BP409P	PharmacognosyandPhytochemistryI–Practical	4	-	2
Total		31	5	28

Table-V: CourseofstudyforsemesterV

Course code	Name of thecourse	No.of hours	Tutorial	Credit points
BP501T	MedicinalChemistryII –Theory	3	1	4
BP502T	IndustrialPharmacyI–Theory	3	1	4
BP503T	PharmacologyII–Theory	3	1	4
BP504T	PharmacognosyandPhytochemistryII–Theory	3	1	4
BP505T	PharmaceuticalJurisprudence –Theory	3	1	4
BP506P	IndustrialPharmacyI–Practical	4	-	2
BP507P	PharmacologyII–Practical	4	-	2
BP508P	PharmacognosyandPhytochemistryII– Practical	4	-	2
Total		27	5	26

Table-VI:Courseof studyfor semesterVI

Course code	Name of thecourse	No.of hours	Tutorial	Credit points
BP601T	MedicinalChemistryIII–Theory	3	1	4
BP602T	PharmacologyIII –Theory	3	1	4
BP603T	HerbalDrug Technology–Theory	3	1	4
BP604T	BiopharmaceuticsandPharmacokinetics – Theory	3	1	4
BP605T	PharmaceuticalBiotechnology –Theory	3	1	4
BP606T	QualityAssurance–Theory	3	1	4
BP607P	MedicinalchemistryIII –Practical	4	-	2
BP608P	PharmacologyIII–Practical	4	-	2
BP609P	HerbalDrugTechnology–Practical	4	-	2
Total		30	6	30

Table-VII: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis–Theory	3	1	4
BP702T	Industrial Pharmacy II–Theory	3	1	4
BP703T	Pharmacy Practice–Theory	3	1	4
BP704T	Novel Drug Delivery System–Theory	3	1	4
BP705P	Instrumental Methods of Analysis–Practical	4	-	2
BP706PS	Practice School*	12	-	6
Total		28	5	24

*Non University Examination (NUE)

Table-VIII: Course of study for semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
BP806ET	Quality Control and Standardization of Herbals			
BP807ET	Computer Aided Drug Design			
BP808ET	Cell and Molecular Biology			
BP809ET	Cosmetic Science			
BP810ET	Experimental Pharmacology			
BP811ET	Advanced Instrumentation Techniques			
BP812ET	Dietary Supplements and Nutraceuticals			
BP813PW	Project Work	12	-	6
Total		24	4	22

Table-IX: Semesterwise credits distribution

Semester	Credit Points
I	27/29\$/30#
II	29
III	26
IV	28
V	26
VI	26
VII	24
VIII	22
Extracurricular/Cocurricular activities	01*
Total credit points for the program	209/211\$/212#

* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit points shall be defined by the colleges from time to time.

\$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics course.

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course.

10 Program Committee

- 1 The B.Pharm. program shall have a Program Committee constituted by the Head of the institution in consultation with all the Heads of the departments.
- 2 The composition of the Program Committee shall be as follows:
A senior teacher shall be the Chairperson; One Teacher from each department handling B.Pharm. courses; and four student representatives of the program (one from each academic year), nominated by the Head of the institution
- 3 Duties of the Program Committee:
 - I Periodically reviewing the progress of the classes.
 - ii Discussing the problems concerning curriculum, syllabus and the conduct of classes.
 - iii Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

iv

Communicating its recommendation to the Head of the institution on academic matters.

v

The Program Committee shall meet at least thrice in a semester preferably at the end of each Sessional exam (Internal Assessment) and before the end semester exam.

11 Examinations/Assessments

The scheme for internal assessment and end semester examinations is given in Table-X.

11.1 End semester examinations

The End Semester Examinations for each theory and practical course through semesters I to VIII shall be conducted by the university except for the subjects with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables-X: Schemes for internal assessments and end semester examinations semesterwise

Semester I

Course code	Name of thecours e	Internal Assessment				EndSemester Exams		TotalM arks
		Continuo usMode	SessionalExams		Total	Marks	Duration	
			Marks	Duration				
BP101T	HumanAn atomy andPhysiolo gyl– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutica lAnalysis I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP104T	Pharmaceutica l InorganicChe mistry– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP105T	Communicatio	5	10	1 Hr	15	55	1.5 Hrs	50

	nskills – Theory*							
BP106R BTBP10 6R MT	Remedial Biology/Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50
BP107P	Human Anatomy and Physiology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP109P	Pharmaceuticals I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	Pharmaceutical I Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP111P	Communication skills – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
BP112 RBP	Remedial Biology – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
Total		70/75^{\$}/80[#]	115/125^{\$}/130[#]	23/24^{\$}/26[#] Hrs	185/200^{\$}/210[#]	490/525^{\$}/540[#]	31.5/33^{\$}/35[#] Hrs	675/725^{\$}/750[#]

[#]Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

^{\$}Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

*Non University Examination (NUE)

SemesterII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP201T	Human Anatomy and Physiology II– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP202T	Pharmaceutical Organic Chemistry– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP203T	Biochemistry– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP204T	Pathophysiology– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP205T	Computer Applications in Pharmacy– Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP206T	Environmental Sciences– Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP207P	Human Anatomy and Physiology II– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP208P	Pharmaceutical Organic Chemistry– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP209P	Biochemistry– Practical	5	10	4 Hrs	15	35	4 Hrs	50

BP210P	Computer Applications in Pharmacy– Practical*	5	5	2 Hrs	10	15	2 Hrs	25
Total		80	125	20 Hrs	205	520	30 Hrs	725

*The subject experts at college level shall conduct examinations

Semester III

Course code	Name of the course	Internal Assessment				EndSemester Exams		Total Marks
		Continuo us Mode	SessionalExams		Total	Marks	Duration	
			Marks	Duration				
BP301T	Pharmaceutic al OrganicChem istryII– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP302T	PhysicalPhar maceuticsI– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP303T	Pharmaceutic alMicrobiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP304T	Pharmaceutic alEngineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP305P	Pharmaceutic al OrganicChem istryII– Practical	5	10	4 Hr	15	35	4 Hrs	50
BP306P	PhysicalPhar maceutics I–	5	10	4 Hr	15	35	4 Hrs	50

	Practical							
BP307P	Pharmaceutic alMicrobiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP308P	Pharmaceutic alEngineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		60	100	20	160	440	28Hrs	600

SemesterIV

Course code	Name of thecours e	Internal Assessment				EndSemester Exams		Total Marks
		Continuou s Mode	SessionalExams		Total	Marks	Duration	
			Marks	Duration				
BP401T	Pharmaceutic al OrganicChem istryIII– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP402T	MedicinalC hemistryI– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP403T	PhysicalPhar maceuticsII – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP404T	Pharmacology I–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP405T	Pharmacogno syl–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP406P	MedicinalC hemistryI– Practical	5	10	4 Hr	15	35	4 Hrs	50

BP407P	PhysicalPharmaceuticsII – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP408P	PharmacologyI–Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP409P	Pharmacognosyl–Practica	5	10	4 Hrs	15	35	4 Hrs	50
Total		70	115	21 Hrs	185	515	31 Hrs	700

Semester V

Course code	Name of thecours e	Internal Assessment				EndSemester Exams		Total Marks
		Continuou s Mode	SessionalExams		Total	Marks	Duration	
			Marks	Duration				
BP501T	MedicinalChemistryII– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP502T	Industrial Pharmacy I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II –Theory	10	15	1 Hr	25	75	3 Hrs	100
BP504T	Pharmacognos yll–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutica lJurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP506P	IndustrialP harmacyl– Practical	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II–Practical	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognos	5	10	4 Hr	15	35	4 Hrs	50

	yll–Practical							
Total		65	105	17Hr	170	480	27Hrs	650

SemesterVI

Course code	Name of the course	Internal Assessment				EndSemester Exams		Total Marks
		Continuo us Mode	SessionalExams		Total	Marks	Duration	
			Marks	Duration				
BP601T	MedicinalChemistryIII–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP602T	Pharmacology III–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP603T	Herbal DrugTechnology–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP604T	Biopharmaceutics andPharmacokinetics –Theory	10	15	1 Hr	25	75	3 Hrs	100
BP605T	Pharmaceutical IBiotechnology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP606T	QualityAs surance–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP607P	Medicinalchem istryIII–Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP608P	Pharmacology III –Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP609P	HerbalDrug Technology–	5	10	4 Hrs	15	35	4 Hrs	50

	Practical							
Total		75	120	18 Hrs	195	555	30 Hrs	750

SemesterVII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Marks	Exams Duration	Total	Marks	Duration	
BP701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP702T	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP705P	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP706 PS	Practice School*	25	-	-	25	125	5 Hrs	150
Total		70	70	8Hrs	140	460	21 Hrs	600

SemesterVIII

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks
		Continuo	Sessional Exams	Total	Marks	Duration	

		us Mode	Marks	Duration				
BP801T	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP802T	Social and Preventive Pharmacology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP803ET	Pharmaceutical Marketing – Theory	10 + 10 =20	15 + 15 = 30	1 + 1= 2 Hrs	25 + 25 = 50	75 + 75 =150	3 + 3=6 Hrs	100 + 100 = 200
BP804ET	Pharmaceutical Regulatory Science – Theory							
BP805ET	Pharmacovigilance – Theory							
BP806ET	Quality Control and Standardization of Herbs – Theory							
BP807ET	Computer Aided Drug Design – Theory							
BP808ET	Cell and Molecular Biology –							

	Theory							
BP809ET	Cosmetic Science– Theory							
BP810ET	Experimental Pharmacology– Theory							
BP811ET	Advanced Instrumentation Techniques – Theory							
BP812PW	Project Work	-	-	-	-	150	4 Hrs	150
Total		40	60	4 Hrs	100	450	16 Hrs	550

11.2 Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessments shall be awarded as per the scheme given below.

Table-XI: Scheme for awarding internal assessment: Continuous mode

Theory		
Criteria	Maximum Marks	
Attendance (Refer Table–XII)	4	2
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, fieldwork, group discussion and seminar)	3	1.5
Student–Teacher interaction	3	1.5
Total	10	5
Practical		
Attendance (Refer Table–XII)	2	
Based on Practical Records, Regular viva voce, etc.	3	
Total	5	

Table-XII: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95– 100	4	2
90– 94	3	1.5
85– 89	2	1
80– 84	1	0.5
Less than 80	0	0

11.2.1 Sessional Exams

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical Sessional examinations is given below. The average marks of two Sessional exams shall be computed for internal assessment as per the requirements given in tables–X.

Sessional exam shall be conducted for 30 marks for theory and shall be computed for 15 marks. Similarly Sessional exam for practical shall be conducted for 40 marks and shall be computed for 10 marks.

Question paper pattern for theory Sessional examinations for subjects having University examination

I. Multiple Choice Questions (MCQs) OR	=	10 x 1 = 10
		O
		R
Objective Type Questions (5x2) (Answer all the questions)	=	05 x 2 = 10
I. Long Answers (Answer 1 out of 2)	=	1 x 10 = 10
II. Short Answers (Answer 2 out of 3)	=	2 x 5 = 10

Total	=	30 marks

For subjects having Non University Examination

I. Long Answers (Answer 1 out of 2)	=	1 x 10 = 10
II. Short Answers (Answer 4 out of 6)	=	4 x 5 = 20

Total	=	30marks

**Question paper pattern for practical
sessionalexaminations**

I.Synopsis	=	10
II.Experiments	=	25
III.Vivavoce	=	05

Total	=	40marks

12 Promotionandawardofgrades

A student shall be declared PASS and eligible for getting grade in a course of B.Pharm.Program if he/she secures at least 50% marks in that particular course including internalassessment. For example, to be declared as PASS and to get grade, the student has tosecureaminimumof50marksforthetotalof100includingcontinuousmodeofassessment and end semester theory examination and has to secure a minimum of 25marksforthetotal50includinginternalassessmentandendsemesterpracticalexamination.

13 Carryforwardofmarks

In case a student fails to secure the minimum 50% in any Theory or Practical course asspecified in 12,then he/she shall reappear for the end semester examination of that course.However his/her marks of the Internal Assessmentsshall be carried over and he/she shallbeentitledforgrade obtained byhim/heron passing.

14 Improvementofinternalassessment

A student shall have the opportunity to improve his/her performance only once in theSessional exam component of the internal assessment. The re-conduct of the Sessionalexamshallbecompletedbeforethecomencementofnextendsemestertheoryexaminations.

15 Re-examinationofendsemesterexaminations

Reexamination of end semester examination shall be conducted as per the schedule givenintableXIII.The exactdates ofexaminationsshallbenotifiedfromtimetotime.

Table-XIII: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I, III, V and VII	November/December	May/June
II, IV, VI and VIII	May/June	November/December

Question paper pattern for end semester theory examinations

For 75 mark paper		
I. Multiple Choice Questions (MCQs) OR Objective Type Questions (10x2)	=	20 x 1 = 20 OR 10x2 = 20
(Answer all the questions)		
II. Long Answers (Answer 2 out of 3)	=	2 x 10 = 20
III. Short Answers (Answer 7 out of 9)	=	7x5 = 35

Total	=	75 marks

For 50 mark paper		
I. Long Answers (Answer 2 out of 3)	=	2 x 10 = 20
II. Short Answers (Answer 6 out of 8)	=	6x5 = 30

Total	=	50 marks

For 35 mark paper		
I. Long Answers (Answer 1 out of 2)	=	1 x 10 = 10
II. Short Answers (Answer 5 out of 7)	=	5x5 = 25

Total	=	35 marks

Question paper pattern for end semester practical examinations		
I. Synopsis	=	5
II. Experiments	=	25

III.Vivavoce	=	5
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Total = 35marks

16 Academic Progression:

No student shall be admitted to any examination unless he/she fulfills the norms given in

6. Academic progression rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I, II and III semesters till the IV semester examinations. However, he/she shall not be eligible to attend the courses of V semester until all the courses of I and II semesters are successfully completed.

A student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of I, II, III and IV semesters are successfully completed.

A student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of I, II, III, IV, V and VI semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to VIII semesters within the stipulated time period as per the norms specified in 26.

A lateral entry student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of III and IV semesters are successfully completed.

A lateral entry student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of III, IV, V and VI semesters are successfully completed.

A lateral entry student shall be eligible to get his/her CGPA upon successful completion of the courses of III to VIII semesters within the stipulated time period as per the norms specified in 26.

Any student who has given more than 4 chances for successful completion of I / III semester courses and more than 3 chances for successful completion of II / IV semester courses shall be permitted to attend V / VII semester classes ONLY during the subsequent academic year as the case may be. In simpler terms there shall NOT be any ODD BATCH for any semester.

Note: Grade AB should be considered as failed and treated as one head for deciding academic progression. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17 Grading of performances

17.1 Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the

end of the semester for each course. The letter grades and their corresponding grade points are given in Table–XII.

Table – XII: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00–100	O	10	Outstanding
80.00–89.99	A	9	Excellent
70.00–79.99	B	8	Good
60.00–69.99	C	7	Fair
50.00–59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned letter grade of F and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18 The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C₁, C₂, C₃, C₄ and C₅ and the student's grade points in these courses are G₁, G₂, G₃, G₄ and G₅, respectively, and then the student's SGPA is equal to:

$$\text{SGPA} = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has an F or ABS grade in course 4, the SGPA shall then be computed as:

$$\text{SGPA} = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 \cdot \text{ZERO} + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

$$C_1 + C_2 + C_3 + C_4 + C_5$$

19 Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the VIII semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all VIII semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$\text{CGPA} = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4 + C_5S_5 + C_6S_6 + C_7S_7 + C_8S_8}{C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_8}$$

where $C_1, C_2, C_3, \dots$ is the total number of credits for semester I, II, III, and $S_1, S_2, S_3, \dots$ is the SGPA of semester I, II, III,

20 Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of 7.50 and above
First Class	= CGPA of 6.00 to 7.49
Second Class	= CGPA of 5.00 to 5.99

21 Project work

All the students shall undertake a project under the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	15 Marks
Methodology adopted	20 Marks
Results and Discussions	20 Marks
Conclusions and Outcomes	20 Marks
Total	75 Marks

Evaluation of Presentation:

Presentation of work	25 Marks
Communications skills	20 Marks
Question and answers skills	30 Marks
Total	75 Marks

Explanation: The 75 marks assigned to the dissertation book shall be same for all the students in a group. However, the 75 marks assigned for presentations shall be awarded based on the performance of individual students in the given criteria.

22 Industrial training (Desirable)

Every candidate shall be required to work for at least 150 hours spread over four weeks in a Pharmaceutical Industry/Hospital. It includes Production unit, Quality Control department, Quality Assurance department, Analytical laboratory, Chemical manufacturing unit, Pharmaceutical R&D, Hospital (Clinical Pharmacy), Clinical Research Organization, Community Pharmacy, etc. After the Semester – VI and before the commencement of Semester – VII, and shall submit satisfactory report of such work and certificate duly signed by the authority of training organization to the head of the institute.

23 Practice School

In the VII semester, every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time.

At the end of the practice school, every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college level and grade point shall be awarded.

24 Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the B. Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the B. Pharm program in minimum prescribed number of years, (four years) for the award of Ranks.

25 Award of degree

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

26 Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the

program and the students have to pass within the said period, otherwise they have to get fresh Registration.

27 Re-admission after break of study

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

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

Program Outcomes (B.Pharm)

Graduates in pharmacy after the completion of their programme with their knowledge they can serve in pharmaceutical industry, sales, marketing, clinical trials, drug inspector, hospital pharmacist, production unit of pharmaceutical industry, part of research and development unit, can open his own drug store and work as an entrepreneur, can serve as an academician in institutions.

Program Specific Outcomes (B.Pharm)

POS1: Graduates with Pharmacy degree are able to work successfully in pharmaceutical industry, educational institutes, hospitals and pharmaceutical marketing agencies, and companies making the databases software.

POS2: Pharmacy graduates are able to provide the services to dispense the drugs by opening the medical shops and serving in the hospitals as a Pharmacist.

POS 3: Pharmacy graduate are able to design and develop quality dosage forms and also constantly improve the existing dosage forms while working in Formulation Development department of Pharmaceutical companies.

POS 4: Pharmacy graduates are able to contribute in all the health programmes of Government, improving the quality of life by giving educative knowledge to rural and urban population as a community Pharmacists, and contribute their knowledge to have control over the adverse effects of the drugs by their intense knowledge of pharmacovigilance.

CHAPTER-II: SYLLABUS

Semester I

BP101T HUMAN ANATOMY AND PHYSIOLOGY-I(Theory) 45 Hours

1 Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

2 Objectives: Upon completion of this course the students should be able to

- 1 Explain the gross morphology, structure and functions of various organs of the human body.
- 2 Describe the various homeostatic mechanisms and their imbalances.
- 3 Identify the various tissues and organs of different systems of human body.
- 4 Perform the various experiments related to special senses and nervous system.
- 5 Appreciate coordinated working pattern of different organs of each system

3 Outcomes: After completion of this course the students shall come to know the fundamental knowledge and practical aspects on the structure and functions of various systems of Human body.

4 Course Content

Unit I

10 Hours

1 Introduction to human body

Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

2 Cellular level of organization

Structure and function of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

3 Tissue level of organization

Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit II

10 Hours

1 Integumentary system

Structure and function of skin

2 Skeletal system

Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of

	muscle contraction, neuromuscular junction	
3	Joints Structural and functional classification, types of joints, movements and their articulation	
Unit III		10 Hours
1	Body fluids and blood Body fluids, composition and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.	
2	Lymphatic system Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system	
Unit IV		8 Hours
1	Peripheral nervous system: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.	
2	Special senses Structure and functions of eye, ear, nose and tongue and their disorders.	
Unit V		7 Hours
1	Cardiovascular system Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.	
BP107P	HUMAN ANATOMY AND PHYSIOLOGY (Practical) Practical physiology is complementary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.	4 Hours/week
List of Experiments		
1	Study of compound microscope.	
2	Microscopic study of epithelial and connective tissue	
3	Microscopic study of muscular and nervous tissue	
4	Identification of axial bones	
5	Identification of appendicular bones	
6	Introduction to hemocytometry.	

- 7 Enumeration of white blood cell (WBC) count
- 8 Enumeration of total red blood corpuscles (RBC) count
- 9 Determination of bleeding time
- 10 Determination of clotting time
- 11 Estimation of hemoglobin content
- 12 Determination of blood group.
- 13 Determination of erythrocyte sedimentation rate (ESR).
- 14 Determination of heart rate and pulse rate.
- 15 Recording of blood pressure.

Recommended Books (Latest Editions)

- 1 Essential of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brother's medical publishers, New Delhi.
- 2 Anatomy and Physiology in Health and Illness by Kathleen J. W. Wilson, Churchill Livingstone, New York
- 3 Physiological basis of Medical Practice- Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- 4 Textbook of Medical Physiology- Arthur C. Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
- 5 Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- 6 Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
- 7 Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
- 8 Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

- 1 Physiological basis of Medical Practice- Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- 2 Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
- 3 Human Physiology (vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata

BP102T PHARMACEUTICAL ANALYSIS(Theory)**45Hours**

- 1 Scope:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 Understand the principles of volumetric and electrochemical analysis
 - 2 Carry out various volumetric and electrochemical titrations
 - 3 Develop analytical skills
- 3 Outcomes:** After finishing of this course the students shall come to know the theoretical and practical fundamentals of analytical chemistry and principles of electrochemical evaluation of drugs.
- 4 Course Content**

Unit I**10 Hours**

- a **Pharmaceutical analysis**-Definition and scope
- i) Different techniques of analysis
 - ii) Methods of expressing concentration
 - iii) Primary and secondary standards.
 - iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate
- b **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures
- c Pharmacopoeia, Sources of impurities in medicinal agents, limit tests

Unit II**10 Hours**

- 1 **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves
- 2 **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

Unit III**10 Hours**

- 1 **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.
- 2 **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
- 3 **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate

- 4 Basic Principles, methods and application of diazotisation titration.

Unit IV

8 Hours

1 Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

Unit V

7 Hours

Electrochemical methods of analysis

1 **Conductometry** - Introduction, Conductivity cell, Conductometric titrations, applications.

2 **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine endpoint of potentiometric titration and applications.

3 **Polarography** -

Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

BP108P PHARMACEUTICAL ANALYSIS (Practical)

4

Hours/week List of Experiments

1 **Limit Test of the following**

- (1) Chloride
- (2) Sulphate
- (3) Iron
- (4) Arsenic

2 **Preparation and standardization of**

- (1) Sodium hydroxide
- (2) Sulphuric acid
- (3) Sodium thiosulfate
- (4) Potassium permanganate
- (5) Cerium ammonium sulphate

3 **Assay of the following compounds along with Standardization of Titrant**

- (1) Ammonium chloride by acid-base titration
- (2) Ferrous sulphate by Cerimetry
- (3) Copper sulphate by Iodometry
- (4) Calcium gluconate by complexometry

(5) HydrogenperoxidebyPermanganometry

(6) Sodiumbenzoatebynon-aqueoustitration

(7) SodiumChloridebyprecipitationtitration

4 **Determinationof Normalitybyelectro-analyticalmethods**

(1) Conductometrictitrationofstrongacidagainststrong base

(2) Conductometrictitrationofstrongacidandweakacidagainst strongbase

(3) Potentiometrictitrationof strong acidagainststrongbase

RecommendedBooks(LatestEditions)

- 1 A.H.Beckett&J.B.Stenlake's,PracticalPharmaceuticalChemistryVoll&II,StahlonePress
ofUniversityofLondon
- 2 A.I.Vogel,TextBookofQuantitativeInorganicanalysis
- 3 P.GunduRao,InorganicPharmaceuticalChemistry
- 4 BentleyandDriver'sTextbookofPharmaceuticalChemistry
- 5 JohnH.Kennedy,Analytical chemistryprinciples
- 6 IndianPharmacopoeia.

BP103T PHARMACEUTICS-I(Theory)**45 Hours**

- 1 **Scope:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with art and science of preparing the different conventional dosage forms.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Know the history of profession of pharmacy
 - 2 Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
 - 3 Understand the professional way of handling the prescription
 - 4 Preparation of various conventional dosage forms
- 3 **Outcomes:** At the end of this course of this course the students shall come to know the theoretical and practical fundamentals on the preparatory pharmacy with art and science of preparing the different conventional dosage forms.
- 4 **Course Content**

Unit I**10 Hours**

- 1 **Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- 2 **Dosage forms:** Introduction to dosage forms, classification and definitions
- 3 **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- 4 **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

Unit II**10 Hours**

- 1 **Pharmaceutical calculations:** Weights and measures—Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
- 2 **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders—official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
- 3 **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

Unit III**8 Hours**

- 1 **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat

Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.

2 **Biphasic liquids:**

Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.

Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

Unit IV

8 Hours

1 **Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.

2 **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

Unit V

7 Hours

1 **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosage forms.

BP109P

PHARMACEUTICS (Practical)

3

Hours/week List of Experiments

1 **Syrups**

a) Syrup IP'66

b) Compound syrup of Ferrous Phosphate BPC'68

2 **Elixirs**

a) Piperazine citrate elixir

b) Paracetamol pediatric elixir

3 **Linctus**

a) Terpin Hydrate Linctus IP'66

b) Iodine Throat Paint (Mandles Paint)

4 **Solution**

a) Strong solution of ammonium acetate

b) Cresol with soap solution

c) Lugol's solution

5 **Suspensions**

- a) Calamine lotion
- b) Magnesium Hydroxide mixture
- c) Aluminium Hydroxide gel
- 6 **Emulsions**
 - a) Turpentine Liniment
 - b) Liquid paraffin emulsion
- 7 **Powders and Granules**
 - a) ORS powder (WHO)
 - b) Effervescent granules
 - c) Dusting powder
 - d) Divided powders
- 8 **Suppositories**
 - a) Glycerogelatin suppository
 - b) Cocoa butter suppository
 - c) Zinc Oxide suppository
- 9 **Semisolid**
 - a) Sulphur ointment
 - b) Nonstaining-iodine ointment with methyl salicylate
 - c) Carbopol gel
- 10 **Gargles and Mouthwashes**
 - a) Iodine gargle
 - b) Chlorhexidine mouthwash

Recommended Books (Latest Editions)

- 1 H.C. Anselet al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
- 2 Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
- 3 M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
- 4 Indian pharmacopoeia.
- 5 British pharmacopoeia.
- 6 Lachmann. Theory and Practice of Industrial Pharmacy, Lea & Febiger Publisher, The University of Michigan.
- 7 Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy,

LippincottWilliams,NewDelhi.

- 8 CarterS.J.,CooperandGunn's.TutorialPharmacy,CBSPublications,NewDelhi.
- 9 E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language BookSociety,ElsevierHealth Sciences,USA.
- 10 IsaacGhebreSellassie:PharmaceuticalPelletizationTechnology,MarcelDekker, INC,NewYork.
- 11 Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, MarcelDekker, INC,NewYork.
- 12 FrancoiseNieloudandGilberteMarti-Mestres:PharmaceuticalEmulsionsandSuspensions,Marcel Dekker,INC,NewYork.

BP104T PHARMACEUTICAL INORGANIC CHEMISTRY (Theory) 45 Hours

- 1 Scope:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
 - 2 Understand the medicinal and pharmaceutical importance of inorganic compounds
- 3 Outcomes:** After the final of this course the students shall come to know the theoretical and practical understanding of monographs of inorganic drugs and pharmaceuticals.
- 4 Course Content**
 - Unit I** **10 Hours**
 - 1 **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate
General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes
 - Unit II** **10 Hours**
 - 1 **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.
 - 2 **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.
 - 3 **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.
 - Unit III** **10 Hours**
 - 1 **Gastrointestinal agents**
Acidifiers: Ammonium chloride* and Dil. HCl
Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminium hydroxide gel, Magnesium hydroxide mixture
Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite
Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations
 - Unit IV** **8 Hours**

1 **Miscellaneous compounds:**

Expectorants: Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium

tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite

Astringents: Zinc Sulphate, Potash Alum

Unit V

7 Hours

- 1 **Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, Properties of α , β , γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I^{131} , Storage conditions, precautions & pharmaceutical application of radioactive substances.

BP110P PHARMACEUTICAL INORGANIC CHEMISTRY (Practical) 4 Hours/week

List of Experiments

1 **Limit tests for following ions**

Limit test for Chlorides and Sulphates

Modified Limit test for Chlorides and Sulphates

Limit test for Iron

Limit test for Heavy metals Li

Limit test for Lead

Limit test for Arsenic

2 **Identification**

test Magnesium hydroxide

Ferrous

sulphate Sodium

bicarbonate Calcium

gluconate Copper

sulphate

3 **Test for purity**

Swelling power of Bentonite

Neutralizing capacity of aluminum hydroxide gel

Determination of potassium iodate and iodine in potassium iodide IV

4 **Preparation of inorganic pharmaceuticals**

Boric acid Potash

alum Ferrous sulphate

hate

RecommendedBooks(LatestEditions)

- 1 A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I &II, Stahlone Press of University of London, 4th edition.
- 2 A.I. Vogel, Text Book of Quantitative Inorganic analysis
- 3 P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
- 4 M.L. Schroff, Inorganic Pharmaceutical Chemistry
- 5 Bentley and Driver's Textbook of Pharmaceutical Chemistry
- 6 Anand & Chatwal, Inorganic Pharmaceutical Chemistry
- 7 Indian Pharmacopoeia

BP105T COMMUNICATIONSKILLS(Theory)**30 Hours**

- 1 **Scope:** This course will prepare the young pharmacy student to interact effectively with doctors,nurses, dentists, physiotherapists and other health workers. At the end of this course the studentwill get the soft skills set to work cohesively with the team as a team player and will add value tothepharmaceuticalbusiness.
- 2 **Objectives:** Uponcompletionofthiscoursethestudentshouldbeableto
 - 1 UnderstandthebehavioralneedsforaPharmacisttofunctioneffectivelyintheareasofpharma ceuticaloperation
 - 2 Communicateeffectively(VerbalandNonVerbal)
 - 3 Effectivelymanagetheteamasaateamplayer
 - 4 Developinterviewskills
 - 5 DevelopLeadershipqualitiesandessentials
- 3 **Outcomes:** After curtaining of this course the students shall be equipped with soft skills set to workcohesivelywithhealthprofessionalsandhealthworkerstogivevaluetothe pharmaceuticalbusiness
- 4 **CourseContent**

UnitI**7 Hours**

- 1 **Communication Skills:** Introduction, Definition, The Importance of Communication, TheCommunication Process – Source, Message, Encoding, Channel,Decoding, Receiver,Feedback,Context
- 2 **Barrierstocommunication:**PhysiologicalBarriers,PhysicalBarriers,CulturalBarriers,Lang uageBarriers,GenderBarriers,InterpersonalBarriers,PsychologicalBarriers,Emotionalbarri ers
- 3 **Perspectives in Communication:** Introduction, Visual Perception, Language, Otherfactorsaffectingourperspective-PastExperiences,Prejudices,Feelings,Environment

UnitII**7 Hours**

- 1 **Elements of Communication:** Introduction, Face to Face Communication - Tone ofVoice, Body Language (Non-verbal communication), Verbal Communication, PhysicalCommunication
- 2 **Communication Styles:** Introduction, The Communication Styles Matrix with exampleforeach-
DirectCommunicationStyle,SpiritedCommunicationStyle,SystematicCommunicationStyl e,Considerate Communication Style

UnitIII**7Hours**

- 1 **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming anActiveListener, Listening in DifficultSituations

- 2 **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication
- 3 **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

Unit IV

5Hours

- 1 **Interview Skills:** Purpose of an interview, Do's and Don'ts of an interview
- 2 **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

Unit V

4Hours

- 1 **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion

BP111P COMMUNICATIONS SKILLS (Practical)

2

Hours/week The following learning modules are to be conducted using words worth[®] English language lab software

- 1 **Basic communication covering the following topics**

Meeting

People Asking

Questions Making

Friends What did

you

do? Do's and Don'ts

s

Pronunciations covering the following

topics Pronunciation (Consonant Sounds) Pronun

ciation and Nouns

Pronunciation (Vowel Sounds)

- 2 **Advanced Learning**

Listening Comprehension / Direct and Indirect

Speech Figures of Speech

Effective

Communication Writing S

kills

Effective

Writing Interview

Handling Skills E-Mail

Skills Presentation Skills

ills

Recommended Books(Latest Editions)

- 1 Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
- 2 Communicationskills, SanjayKumar, Pushpalata, 1st Edition, Oxford Press, 2011
- 3 Organizational Behaviour, Stephen. P. Robbins, 1st Edition, Pearson, 2013
- 4 Brilliant-Communicationskills, Gill Hasson, 1st Edition, Pearson Life, 2011
- 5 The Ace of Soft Skills: Attitude, Communication and Etiquette for success, GopalaSwamyRamesh, 5th Edition, Pearson, 2013
- 6 Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Greenhall, 1st Edition Universe of Learning LTD, 2010
- 7 Communicationskills for professionals, Konarnira, 2nd Edition, New arrivals–PHI, 2011
- 8 Personality development and soft skills, Barun K Mitra, 1st Edition, Oxford Press, 2011
- 9 Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India Pvt. Ltd, 2011
- 10 Soft skills and professional communication, Francis Peters SJ, 1st Edition, Mc Graw Hill Education, 2011
- 11 Effective communication, John Adair, 4th Edition, Pan MacMillan, 2009
- 12 Bringing out the best in people, Aubrey Daniels, 2nd Edition, McGraw Hill, 1999

30Hours

- ## 4 CourseContent

7 Hours

- ## Unit11

7Hours

- 43

- Human respiratory system
- Mechanism of breathing and its regulation
- Exchange of gases, transport of gases and regulation of respiration
- Respiratory volumes

Unit III

7 Hours

1 Excretory products and their elimination

- Modes of excretion
- Human excretory system-structure and function
- Urine formation
- Renin-angiotensin system

2 Neural control and coordination

- Definition and classification of nervous system
- Structure of a neuron
- Generation and conduction of nerve impulse
- Structure of brain and spinal cord
- Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata

3 Chemical coordination and regulation

- Endocrine glands and their secretions
- Functions of hormones secreted by endocrine glands

4 Human reproduction

- Part of female reproductive system
- Part of male reproductive system
- Spermatogenesis and Oogenesis
- Menstrual cycle

Unit IV

5 Hours

1 Plants and mineral nutrition:

- Essential mineral, macro and micronutrients
- Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation

2 Photosynthesis

Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

Unit V

4 Hours

1 Plant respiration: Respiration, glycolysis, fermentation (anaerobic).

- 2 **Plant growth and development**
Phases and rate of
plant growth, Condition of growth, Introduction to plant growth regulators
- 3 **Cell- The unit of life**
Structure and function of cell and cell organelles. Cell division
- 4 **Tissues**
Definition, types of tissues, location and functions.

Textbooks

- A Textbook of Biology by S.B. Gokhale
- B A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

- A A Text book of Biology by B.V. Sreenivasa
- Naidu B A Textbook of Biology by Naidu and Murthy
- C Botany for Degree students By A.C. Dutta.
- D Outlines of Zoology by M. Ekambaranathaayyer and T.N. Ananthakrishnan.
- E A manual for pharmaceutical biology practical by S.B. Gokhale and C.K. Kokate

BP112P REMEDIAL BIOLOGY (Practical) 30

Hours List of Experiments

- 1 Introduction to experiments in biology
 - Study of Microscope
 - Section cutting techniques
 - Mounting and staining
 - Permanent slide preparation
- 2 Study of cell and its inclusions
- 3 Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
- 4 Detailed study of frog by using computer models
- 5 Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower
- 6 Identification of bones
- 7 Determination of blood group
- 8 Determination of blood pressure
- 9 Determination of tidal volume

Reference Books

- 1 Practical human anatomy and physiology by S.R.Kale and R.R.Kale.
- 2 A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
- 3 Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof.M.J.H.Shafi

BP106RMT REMEDIAL MATHEMATICS(Theory) 30Hours

- 1 **Scope:** This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Know the theory and their application in Pharmacy
 - 2 Solve the different types of problems by applying theory
 - 3 Appreciate the important application of mathematics in Pharmacy
- 3 **Outcomes:** After completion of this course the students shall come to know about introduction to partial fraction, logarithm, matrices and determinant, analytical geometry, calculus, differential equation and Laplace transforms

4 Course Content

Unit I

6Hours

- 1 **Partial fraction**
Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics
- 2 **Logarithms**
Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.
- 3 **Function:**
Real Valued function, Classification of real valued functions,
- 4 **Limits and continuity**
Introduction, Limit of a function, Definition of limit of a function

Unit II

6 Hours

- 1 **Matrices and Determinant:**
Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of

determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.

Unit III

6Hours

1 Calculus

Differentiation: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n w.r.t. x , where n is any rational number, Derivative of e^x , Derivative of $\log_e x$, Derivative of a^x , Derivative of trigonometric functions from first principles (**without Proof**), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point.

Unit IV

6Hours

1 Analytical Geometry

Introduction: Signs of the Coordinates, Distance formula,

Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

Integration:

Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application

Unit V

6Hours

- 1 **Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**
- 2 **Laplace Transform :** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetic equations**

Recommended Books (Latest Edition)

- A Differential Calculus by Shanthinarayan
- B Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda

D.H.

C Integral Calculus by Shanthinarayan

D Higher Engineering Mathematics by Dr. B.S. Grewal

SemesterII

BP201T

HUMAN ANATOMY AND PHYSIOLOGY-II(Theory)

45Hours

- 1 **Scope:** This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Explain the gross morphology, structure and functions of various organs of the human body.
 - 2 Describe the various homeostatic mechanisms and their imbalances.
 - 3 Identify the various tissues and organs of different systems of human body.
 - 4 Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
 - 5 Appreciate coordinated working pattern of different organs of each system
 - 6 Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.
- 3 **Outcomes:** After ceasing of this course the students shall come to know the fundamental theoretical knowledge and practical aspects on the structure and functions of various systems of Human body.

4 **Course Content**

UnitI

10 Hours

1 **Nervous system**

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

UnitII

6 Hours

1 **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT,

	digestion and absorption of nutrients and disorders of GIT.	
2	Energetics Formation and role of ATP, Creatinine Phosphate and BMR.	
Unit III		10 Hours
1	Respiratory system Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities, transport of respiratory gases, artificial respiration, and resuscitation methods.	
2	Urinary system Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAAS in kidney and disorders of kidney.	
Unit IV		10 Hours
1	Endocrine system Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.	
Unit V		9 Hours
1	Reproductive system Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition	
2	Introduction to genetics Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	
BP207P	HUMAN ANATOMY AND PHYSIOLOGY (Practical)	4 Hours/week
Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.		
List of Experiments		
1	To study the integumentary and special senses using specimen, models, etc.,	
2	To study the nervous system using specimen, models, etc.,	
3	To study the endocrine system using specimen, models, etc	
4	To demonstrate the general neurological examination	

- 5 To demonstrate the function of olfactory nerve
- 6 To examine the different types of taste.
- 7 To demonstrate the visual acuity
- 8 To demonstrate the reflex activity
- 9 Recording of body temperature
- 10 To demonstrate positive and negative feedback mechanism.
- 11 Determination of tidal volume and vital capacity.
- 12 Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
- 13 Recording of basal mass index
- 14 Study of family planning devices and pregnancy diagnosis test.
- 15 Demonstration of total blood count by cell analyser
- 16 Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

- 1 Essential of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
- 2 Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
- 3 Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- 4 Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
- 5 Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- 6 Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
- 7 Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
- 8 Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

- 1 Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- 2 Textbook of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
- 3 Human Physiology (vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata

BP202T PHARMACEUTICAL ORGANIC CHEMISTRY –I(Theory) 45Hours

1 Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

2 Objectives: Upon completion of this course the students should be able to

- 1 write the structure, name and the type of isomerism of the organic compound
- 2 write the reaction, name the reaction and orientation of reactions
- 3 account for reactivity/stability of compounds,
- 4 identify/confirm the identification of organic compound

3 Outcomes: After cessation of this course the students shall come to know about the classification and nomenclature of simple organic compounds and their physical and chemical properties with appropriate mechanisms.

4 Course Content

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

Unit I

7Hours

1 Classification, nomenclature and isomerism

Classification of Organic Compounds

Common and IUPAC systems of nomenclature of organic compounds (upto 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds

Unit II

10 Hours

1 Alkanes*, Alkenes* and Conjugated dienes*

SP³ hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP² hybridization in alkenes

E₁ and E₂ reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeff's orientation and evidences. E₁ versus E₂ reactions, Factors affecting E₁ and E₂ reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition

reactions of conjugated dienes, allylic rearrangement

Unit III

10 Hours

1 Alkyl halides*

SN₁ and SN₂ reactions-kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.

SN₁ versus SN₂ reactions, Factors affecting SN₁ and SN₂ reactions

Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

2 Alcohols*-Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

Unit IV

10 Hours

1 Carbonyl compounds* (Aldehydes and ketones)

Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanillin, Cinnamaldehyde.

Unit V

8 Hours

1 Carboxylic acids*

Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester

Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid, Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

2 Aliphatic amines* - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

BP208P PHARMACEUTICAL ORGANIC CHEMISTRY-I (Practical) 4 Hours/week

List of Experiments

- 1 Systematic qualitative analysis of unknown organic compounds like
 - 1 Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
 - 2 Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
 - 3 Solubility test

- 4 Functional group test like Phenols, Amides/Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
- 5 Melting point/Boiling point of organic compounds
- 6 Identification of the unknown compound from the literature using melting point/boiling point.
- 7 Preparation of the derivatives and confirmation of the unknown compound by melting point/boiling point.
- 8 Minimum 5 unknown organic compounds to be analysed systematically.
- 2 Preparation of suitable solid derivatives from organic compounds
- 3 Construction of molecular models

Recommended Books (Latest Editions)

- 1 Organic Chemistry by Morrison and Boyd
- 2 Organic Chemistry by I.L. Finar, Volume-I
- 3 Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
- 4 Organic Chemistry by P.L. Soni
- 5 Practical Organic Chemistry by Mann and Saunders.
- 6 Vogel's textbook of Practical Organic Chemistry
- 7 Advanced Practical organic chemistry by N.K. Vishnoi.
- 8 Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
- 9 Reaction and reaction mechanism by Ahluwalia/Chatwal.

BP203T BIOCHEMISTRY(Theory)**45 Hours**

- 1 **Scope:** Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.
- 2 **Objectives:** Upon completion of this course the students should be able to
- 1 Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
 - 2 Understand
 - 3 Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
- 3 **Outcomes:** After completion of this course the students shall come to know about theoretical and practical biochemical facts associated with living cells at molecular levels. It also emphasizes about the genetic organization of mammalian genome and hetero and autocatalytic functions of DNA

4 Course Content**Unit I****8 Hours****1 Biomolecules**

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

2 Bioenergetics

Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

Unit II**10 Hours****1 Carbohydrate metabolism**

Glycolysis–Pathway, energetics and significance Citric acid cycle–

Pathway, energetics and significance

HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency

Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis–Pathway and its significance

Hormonal regulation of blood glucose level and Diabetes mellitus

2 Biological oxidation

Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its

mechanism and substrate phosphorylation
Inhibitors of ETC and oxidative phosphorylation/ Uncouplers

- 4 Unit III 10 Hours**
- 1 **Lipid metabolism**
 β -Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.
- 2 **Amino acid metabolism**
 General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alcaptonuria, tyrosinemia) Synthesis and significance of biological substances: 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice

Unit IV 10 Hours

- 1 **Nucleic acid metabolism and genetic information transfer**
 Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors

Unit V 7 Hours

- 1 **Enzymes**
 Introduction, properties, nomenclature and IUB classification of enzymes
 Enzyme kinetics (Michaelis plot, Lineweaver-Burke plot)
 Enzyme inhibitors with examples
 Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes – Structure and biochemical functions

BP209P BIOCHEMISTRY (Practical) 4

Hours/week List of Experiments

- 1 Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
- 2 Identification tests for Proteins (albumin and Casein)
- 3 Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)

- 4 Qualitative analysis of urine for abnormal constituents
- 5 Determination of blood creatinine
- 6 Determination of blood sugar
- 7 Determination of serum total cholesterol
- 8 Preparation of buffer solution and measurement of pH
- 9 Study of enzymatic hydrolysis of starch
- 10 Determination of Salivary amylase activity
- 11 Study of the effect of Temperature on Salivary amylase activity.
- 12 Study of the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

- 1 Principles of Biochemistry by Lehninger.
- 2 Harper's Biochemistry by Robert K. Murray, Daryl K. Granner and Victor W. Rodwell.
- 3 Biochemistry by Stryer.
- 4 Biochemistry by D. Satyanarayan and U. Chakrapani
- 5 Textbook of Biochemistry by Rama Rao.
- 6 Textbook of Biochemistry by Deb.
- 7 Outlines of Biochemistry by Conn and Stumpf
- 8 Practical Biochemistry by R.C. Gupta and S. Bhargava.
- 9 Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
- 10 Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
- 11 Practical Biochemistry by Harold Varley.

BP204T PATHOPHYSIOLOGY(Theory)**45 Hours**

- 1 **Scope:** Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Describe the etiology and pathogenesis of the selected disease states;
 - 2 Name the signs and symptoms of the diseases; and
 - 3 Mention the complications of the diseases.
- 3 **Outcomes:** Upon completion of this course the students shall come to know about the causes of diseases and reactions of the body to such diseases. It deals with relevant aspects of pathology of various conditions with reference to its pharmacological applications and understanding of basic pathophysiological mechanisms.
- 4 **Course Content**

Unit I**10 Hours**

- 1 **Basic principles of Cell injury and Adaptation:**
Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intracellular accumulation, Calcification, Enzyme leakage and Cell Death, Acidosis, Alkalosis, Electrolyte imbalance
- 2 **Basic mechanism involved in the process of inflammation and repair:**
Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis

Unit II**10 Hours**

- 1 **Cardiovascular System:**
Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)
- 2 **Respiratory system:** Asthma, Chronic obstructive airways diseases.
- 3 **Renal system:** Acute and chronic renal failure

4	Unit III	10 Hours
1	Haematological Diseases: Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia	
2	Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones	
3	Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.	
4	Gastrointestinal system: Peptic Ulcer	
	Unit IV	10 Hours
1	Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.	
2	Diseases of bones and joints: Rheumatoid arthritis, osteoporosis and gout	
3	Principles of cancer: classification, etiology and pathogenesis of cancer	
4	Diseases of bones and joints: Rheumatoid Arthritis, Osteoporosis, Gout	
5	Principles of Cancer: Classification, etiology and pathogenesis of Cancer	
	Unit V	7 Hours
1*	Infectious diseases: Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections, Pneumonia and Severe acute respiratory syndrome-related coronavirus (SARS-CoV)	
2	Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea	

Recommended Books (Latest Editions)

- 1 Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
- 2 Harsh Mohan; Textbook of Pathology; 6th edition; India; Jaypee Publications; 2010.
- 3 Laurence B, Bruce C, Bjorn K.; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
- 4 Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; United States;
- 5 William and Wilkins, Baltimore; 1991 [1990 printing].
- 6 Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.

- 7 Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
- 8 Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy : A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
- 9 V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
- 10 Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

- 1 The Journal of Pathology. ISSN: 1096-9896 (Online)
- 2 The American Journal of Pathology. ISSN: 0002-9440
- 3 Pathology. 1465-3931 (Online)
- 4 International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
- 5 Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

BP205T COMPUTER APPLICATIONS IN PHARMACY (Theory) 30 Hours (2 Hours/week)

1 Scope: This subject deals with the introduction Database, Database Management system, and computer application in clinical studies and use of databases.

2 Objectives: Upon completion of this course the students should be able to

- 1 know the various types of application of computers in pharmacy
- 2 know the various types of databases
- 3 know the various applications of databases in pharmacy

3 Outcomes: After completing of this course the students shall come to know about the Database management system, computer application in pharmacy and clinical studies and use of databases.

4 Course Content

Unit I 6 Hours

1 Number System:

Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division

- 2 Concept of Information Systems and Software :** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

Unit II 6 Hours

1 Web technologies: Introduction to HTML, XML, CSS and

Programming languages, introduction to web servers and Server Products
Introduction

to databases, MYSQL, MS ACCESS, Pharmacy Drug database
Hormonal regulation of blood glucose level and Diabetes mellitus

Unit III 6 Hours

1 Application of computers in Pharmacy –

Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring
Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

Unit IV 6 Hours

1

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

Unit V 6 Hours

1 Computers as data analysis in Preclinical development: Chromatographic data analysis (CDS), Laboratory Information Management System (LIMS) and Text Information Management System (TIMS)

BP210P COMPUTER APPLICATIONS IN PHARMACY (Practical)

List of Experiments

- 1 Design a questionnaire using a word processing package to gather information about a particular disease.
- 2 Create a HTML web page to show personal information.
- 3 Retrieve the information of a drug and its adverse effects using online tools
- 4 Creating mailing labels Using Label Wizard, generating label in MSWORD
- 5 Create a database in MS Access to store the patient information with the required fields Using access
- 6 Design a form in MS Access to view, add, delete and modify the patient record in the database
- 7 Generating report and printing the report from patient database
- 8 Creating invoice table using – MS Access
- 9 Drug information storage and retrieval using MS Access
- 10 Creating and working with queries in MS Access
- 11 Exporting Tables, Queries, Forms and Reports to web pages
- 12 Exporting Tables, Queries, Forms and Reports to XML pages

Recommended Books (Latest Editions)

- 1 Computer Application in Pharmacy – William E. Fassett – Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
- 2 Computer Application in Pharmaceutical Research and Development – Sean Ekins – Wiley-Interscience, A John Wiley and Sons, INC., Publication, USA
- 3 Microsoft Office Access-2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N. Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi-110002
- 4 Bioinformatics (Concept, Skills and Applications) – S.C. Rastogi – CBS Publishers and Distributors, 4596/1-A, 11 Darya Gani, New Delhi – 110002 (INDIA)

BP206T ENVIRONMENTAL SCIENCES(Theory)**30Hours**

- 1 Scope:** Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Create the awareness about environmental problems among learners.
 - 2 Impart basic knowledge about the environment and its allied problems.
 - 3 Develop an attitude of concern for the environment.
 - 4 Motivate learner to participate in environment protection and environment improvement.
 - 5 Acquire skills to help the concerned individuals in identifying and solving environmental problems.
 - 6 Strive to attain harmony with Nature.
- 3 Outcomes:** After winding-off of this course the students shall come to know about the environmental system and status of its inherent or induced changes on organisms. It also gives knowledge about the impact of social and cultural factors of man on environment.

4 Course Content**Unit I****10 Hours**

- 1 The Multidisciplinary nature of environmental studies
- 2 Natural Resources
- 3 Renewable and non-renewable resources:
- 4 Natural resources and associated problems
 - a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit II**10 Hours**

- 1 Ecosystems
 - Concept of an ecosystem.
 - Structure and function of an ecosystem.
 - Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit III**10 Hours**

- 1 Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books(Latest Editions)

- 1 Y.K.Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
- 2 Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- 3 Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India,
- 4 Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
- 5 Clark R.S., Marine Pollution, Clarendon Press Oxford
- 6 Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
- 7 De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- 8 Down of Earth, Centre for Science and Environment

Semester III

BP301T PHARMACEUTICAL ORGANIC CHEMISTRY –II(Theory) 45Hours

- 1 **Scope:** This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 write the structure, name and the type of isomerism of the organic compound
 - 2 write the reaction, name the reaction and orientation of reactions
 - 3 account for reactivity/stability of compounds,
 - 4 prepare organic compounds
- 3 **Outcomes:** After completion of this course the students shall come to know about the theoretical and practical aspects of general methods of preparation and reactions of some organic compounds, chemistry of fats and oils including reactivity of organic compounds.
- 4 **Course Content**

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

Unit I

10 Hours

1 Benzene and its derivatives

- A Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule
- B Reactions of benzene-nitration, sulphonation, halogenation- reactivity, Friedel Crafts alkylation- reactivity, limitations, Friedel Crafts acylation.
- C Substituents, effect of substituents on reactivity and orientation of monosubstituted benzene compound toward electrophilic substitution reaction
- D Structure and uses of DDT, Saccharin, BHC and Chloramine

Unit II

10 Hours

- 1 **Phenols***-Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols
- 2 **Aromatic Amines***-Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts
- 3 **Aromatic Acids***- reactions
Acidity, effect of substituents on acidity and importance of benzoic acid.

4 Unit III

10 Hours

1 Fats and Oils

- a) Fatty acids – reactions.
- b) Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.
- c) Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

Unit IV

8 Hours

1 Polynuclear hydrocarbons:

- a) Synthesis, reactions
- b) Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

Unit V

7 Hours

1 Cyclo alkanes*

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

BP305P

**PHARMACEUTICAL ORGANIC CHEMISTRY-II
(Practical)**

4 Hours/week

List of Experiments

- I Experiments involving laboratory techniques
Recrystallization
Steam distillation
- II Determination of following oil values (including standardization of reagents)
Acid value
Saponification value
Iodine value
- III **Preparation of compounds**
Benzanilide/Phenylbenzoate/Acetanilide from Aniline/ Phenol/Aniline by acylation reaction.
2,4,6-Tribromoaniline/Parabromoacetanilide from Aniline/Acetanilide by halogenation (Bromination) reaction.
5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
Benzoic acid from Benzyl chloride by oxidation reaction.
Benzoic acid/ Salicylic acid from alkylbenzoate/alkylsalicylate by hydrolysis reaction.

1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions. Benzil from Benzoin by oxidation reaction.

Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction
Cinnamic acid from Benzaldehyde by Perkin reaction

p-Iodobenzoic acid from *p*-aminobenzoic acid

Recommended Books (Latest Editions)

- 1 Organic Chemistry by Morrison and Boyd
- 2 Organic Chemistry by I. L. Finar, Volume-I
- 3 Textbook of Organic Chemistry by B. S. Bahl & Arun Bahl.
- 4 Organic Chemistry by P. L. Soni
- 5 Practical Organic Chemistry by Mann and Saunders.
- 6 Vogel's textbook of Practical Organic Chemistry
- 7 Advanced Practical organic chemistry by N. K. Vishnoi
- 8 Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
- 9 Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)

BP302T PHYSICAL PHARMACEUTICS-I(Theory)**45Hours**

- 1 Scope:** The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Understand various physicochemical properties of drug molecules in the designing the dosage forms
 - 2 Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
 - 3 Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
- 3 Outcomes:** After completing of this course the students shall come to know the microorganisms used to produce alcohol, antibiotics, vaccines, vitamins and enzymes. It also provides the practical knowledge about the equipment used for experimental microbiology, processes like; sterilization, culturing methods, staining of microbes and microbiological assay of antibiotics and other pharmaceuticals

4 Course Content**Unit I****10 Hours**

- 1 Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

Unit II**10 Hours**

- 1 States of Matter and properties of matter:** State of matter, changes 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 & polymorphism.
- 2 Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

4 Unit III**8Hours**

- 1 Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions,

surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

Unit IV

8 Hours

1 Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

Unit V

7 Hours

1 pH, buffers and isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

BP306P PHYSICAL PHARMACEUTICS–I (Practical)

4

Hours/week List of Experiments

- 1 Determination of the solubility of drug at room temperature
- 2 Determination of pK_a value by Half Neutralization/Henderson Hasselbalch equation.
- 3 Determination of Partition coefficient of benzoic acid in benzene and water
- 4 Determination of Partition coefficient of Iodine in CCl₄ and water
- 5 Determination of % composition of NaCl in a solution using phenol-water system by CST method
- 6 Determination of surface tension of given liquids by drop count and drop weight method
- 7 Determination of HLB number of a surfactant by saponification method
- 8 Determination of Freundlich and Langmuir constants using activated charcoal
- 9 Determination of critical micellar concentration of surfactants
- 10 Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
- 11 Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Recommended Books (Latest Editions)

- 1 Physical Pharmacy by Alfred Martin
- 2 Experimental Pharmaceutics by Eugene Parott.
- 3 Tutorial Pharmacy by Cooper and Gunn.
- 4 Stocklosa J. Pharmaceutical Calculations, Lea & Febiger, Philadelphia.
- 5 Liberman H.A., Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekker Inc.

- 6 Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Dispersed systems, volume 1, 2, 3. Marcel Dekker Inc.
- 7 Physical Pharmaceutics by Ramasamy C and Manavalan R.
- 8 Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimmasettee
- 9 Physical Pharmaceutics by C.V.S. Subramanyam
- 10 Textbook of Physical Pharmacy, by Gaurav Jain & Roop K. Khar

BP303T PHARMACEUTICAL MICROBIOLOGY(Theory)**45 Hours**

- 1 Scope:** Study of all categories of microorganisms especially for the production of alcohol, antibiotics, vaccines, vitamins, enzymes etc..
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Understand methods of identification, cultivation and preservation of various microorganisms
 - 2 To understand the importance and implementation of sterilization in pharmaceutical processing and industry
 - 3 Learn sterility testing of pharmaceutical products.
 - 4 Carried out microbiological standardization of Pharmaceuticals.
 - 5 Understand the cell culture technology and its applications in pharmaceutical industries.
- 3 Outcomes:** After wrapping of this course the students shall come to know the microorganisms used to produce alcohol, antibiotics, vaccines, vitamins and enzymes. It also provides the practical knowledge about the equipment used for experimental microbiology, processes like; sterilization, culturing methods, staining of microbes and microbiological assay of antibiotics and other pharmaceuticals.

4 Course Content**Unit I****10 Hours**

- 1 Introduction, history of microbiology, its branches, scope and its importance.
- 2 Introduction to Prokaryotes and Eukaryotes
- 3 Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).
- 4 Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

Unit II**10 Hours**

- 1 Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC).
- 2 Study of principle, procedure, merits, demerits and applications of physical, chemical, gaseous, radiation and mechanical methods of sterilization.
- 3 Evaluation of the efficiency of sterilization methods.
- 4 Equipment employed in large scale sterilization. Sterility indicators.

Unit III**10 Hours**

- 1 Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses.
- 2 Classification and mode of action of disinfectants
- 3 Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions
- 4 Evaluation of bactericidal & Bacteriostatic.
- 5 Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Unit IV

8 Hours

- 1 Designing of aseptic area, laminar flow equipments; study of different sources of contamination in aseptic area and methods of prevention, clean area classification.
- 2 Principles and methods of different microbiological assay.
- 3 Methods for standardization of antibiotics, vitamins and amino acids.
- 4 Assessment of a new antibiotic.

Unit V

7 Hours

- 1 Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.
- 2 Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.
- 3 Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.
- 4 Application of cell cultures in pharmaceutical industry and research.

BP307P PHARMACEUTICAL MICROBIOLOGY (Practical)

4

Hours/week List of Experiments

- 1 Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscope used in experimental microbiology.
- 2 Sterilization of glassware, preparation and sterilization of media.
- 3 Subculturing of bacteria and fungus. Nutrient stab and slant preparations.
- 4 Staining methods - Simple, Gram staining and acid fast staining (Demonstration with practical).
- 5 Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
- 6 Microbiological assay of antibiotics by cup plate method and other methods

- 7 MotilitydeterminationbyHangingdropmethod.
- 8 Sterility testingofpharmaceuticals.
- 9 Bacteriologicalanalysisofwater
- 10 Biochemicaltest.

RecommendedBooks(LatestEditions)

- 1 W.B.HugoandA.D.Russel:PharmaceuticalMicrobiology,BlackwellScientificpublications,Oxford London.
- 2 PrescottandDunn.,IndustrialMicrobiology,4thedition,CBSPublishers&Distributors,Delhi.
- 3 Pelczar,ChanKreig,Microbiology,TataMcGrawHilledn.
- 4 MalcolmHarris,BalliereTindallandCox:PharmaceuticalMicrobiology.
- 5 Rose:IndustrialMicrobiology.
- 6 Probisher,Hinsdillet al:FundamentalsofMicrobiology, 9thed.Japan
- 7 CooperandGunn's:TutorialPharmacy,CBSPublisherand Distribution.
- 8 Peppler:MicrobialTechnology.
- 9 I.P.,B.P.,U.S.P.-latesteditions.
- 10 Ananthnarayan:Text Bookof Microbiology, Orient-Longman,Chennai
- 11 Edward:FundamentalsofMicrobiology.
- 12 N.K.Jain:PharmaceuticalMicrobiology,VallabhPrakashan,Delhi
- 13 Bergeysmanualofsystematicbacteriology,WilliamsandWilkins-AWaverlycompany

BP304T PHARMACEUTICAL ENGINEERING(Theory)**45Hours**

- 1 Scope:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 To know various unit operations used in Pharmaceutical industries.
 - 2 To understand the material handling techniques.
 - 3 To perform various processes involved in pharmaceutical manufacturing process.
 - 4 To carry out various tests to prevent environmental pollution.
 - 5 To appreciate and comprehend significance of plant layout design for optimum use of resources.
 - 6 To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.
- 3 Outcomes:** After completion of this course the students shall come to know the fundamental theoretical and practical knowledge on the art and science of various unit operations used in pharmaceutical industry.

4 Course Content**Unit I****10 Hours**

- 1 Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.
- 2 Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edgerunner mill & end runner mill.
- 3 Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

Unit II**10 Hours**

- 1 Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.
- 2 Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of

multiple effect evaporator.

- 3 **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

Unit III

8 Hours

- 1 **Drying:** Objectives, applications & mechanism of drying process, measurements & application of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.
- 2 **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquid mixing and semi-solid mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

Unit IV

8 Hours

- 1 **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Metafilter & Cartridge filter, membrane filters and Seidtz filter.
- 2 **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi-continuous centrifuge & supercentrifuge.

Unit V

7 Hours

- 1 **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and their prevention. Ferrous and non-ferrous metals, inorganic and organic non-metals, basic of material handling systems.

Recommended Books (Latest Editions)

- 1 Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
- 2 Solid phase extraction, Principles, techniques and applications by Nigel J. K. Simpson- Latest edition.
- 3 Unit operation of chemical engineering – McCabe Smith, Latest edition.
- 4 Pharmaceutical engineering principles and practices – C. V. S. Subrahmanyam et al.,

Latest edition.

- 5 Remington practice of pharmacy-Martin, Latest edition.
- 6 Theory and practice of industrial pharmacy by Lachmann., Latest edition.
- 7 Physical pharmaceutics-C.V.S. Subrahmanyam et al., Latest edition.
- 8 Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP308P PHARMACEUTICAL ENGINEERING (Practical) 4 Hours/week

- 1 Determination of radiation constant of brass, iron, unpainted and painted glass.
- 2 Steam distillation—To calculate the efficiency of steam distillation.
- 3 To determine the overall heat transfer coefficient by heat exchanger.
- 4 Construction of drying curves (for calcium carbonate and starch).
- 5 Determination of moisture content and loss on drying.
- 6 Determination of humidity of air—i) From wet and dry bulb temperatures—
use of Dew point method.
- 7 Description of Construction, working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, dehumidifier.
- 8 Size analysis by sieving—To evaluate size distribution of tablet granulations—
Construction
- 9 Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
- 10 Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
- 11 Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/viscosity)
- 12 To study the effect of time on the Rate of Crystallization.
- 13 To calculate the uniformity Index for given sample by using Double Cone Blender.

Semester IV

BP401T PHARMACEUTICAL ORGANIC CHEMISTRY –III(Theory) 45Hours

- 1 Scope:** This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important heterocyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 understand the methods of preparation and properties of organic compounds
 - 2 explain the stereo chemical aspects of organic compounds and stereo chemical reactions
 - 3 know the medicinal uses and other applications of organic compounds
- 3 Outcomes:** After finishing of this course the students shall come to know about the stereo-chemical aspects of organic compound and organic reactions, important named reactions, chemistry of important heterocyclic compounds including the medicinal uses of organic compounds.

4 Course Content

Note: To emphasize on definition, types, mechanisms, examples, uses/applications. **Unit I 10Hours**

1 Stereoisomerism

Optical isomerism–

Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules

DL system of

nomenclature of optical isomers, sequence rules, R/S system of nom

enclature of optical isomers

Reaction of chiral molecules

Racemic modification and resolution of racemic

mixture. Asymmetric synthesis: partial and absolute

Unit II

10 Hours

1 Geometrical isomerism

Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Method of determination of configuration of geometrical isomers.

Conformational isomerism in Ethane, n-Butane and Cyclohexane.

Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.

Stereospecific and stereoselective reactions

Unit III

10Hours

1 Heterocyclic compounds:

Nomenclature and classification

Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene

Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

Unit IV

8 Hours

- 1 Synthesis, reactions and medicinal uses of following compounds/derivatives:
Pyrazole, Imidazole, Oxazole and Thiazole.
Pyridine, Quinoline, Isoquinoline, Acridine and Indole.
Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

Unit V

7 Hours

- 1 **Reaction of synthetic importance**
Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.
Oppenauer-oxidation and Dakin reaction.
Beckmann rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation

Recommended Books (Latest Editions)

- 1 Organic chemistry by I. L. Finar, Volume-I & II.
- 2 A text book of organic chemistry – Arun Bahl, B. S. Bahl.
- 3 Heterocyclic Chemistry by Raj K. Bansal
- 4 Organic Chemistry by Morrison and Boyd
- 5 Heterocyclic Chemistry by T. L. Gilchrist

BP402T MEDICINAL CHEMISTRY–I(Theory)**45Hours**

- 1 Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 understand the chemistry of drugs with respect to their pharmacological activity
 - 2 understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
 - 3 know the Structural Activity Relationship (SAR) of different class of drugs
 - 4 write the chemical synthesis of some drugs
- 3 Outcomes:** After completion of this course the students shall come to know about the fundamental knowledge on the structure, chemistry and therapeutic value of drugs. It gives knowledge on structural activity relationship of drugs, importance of physicochemical properties and metabolism of drugs. It clears the practical aspects about the preparations and assay of some important drugs.
- 4 Course Content**

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted(*)

Unit I**10 Hours**

- 1 Introduction to Medicinal Chemistry**
- 2 History and development of medicinal chemistry**
- 3 Physicochemical properties in relation to biological action**

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.
- 4 Drug metabolism**

Drug metabolism principles-Phase I and Phase II.
Factors affecting drug metabolism including stereochemical aspects.

Unit II**10 Hours**

- 1 Drugs acting on Autonomic Nervous System Adrenergic Neurotransmitters:**

Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution.
- 2 Sympathomimetic agents: SAR of Sympathomimetic agents**

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol.

3 **Adrenergic Antagonists:**

Alpha adrenergic blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betaxolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

Unit III

10 Hours

1 **Cholinergic neurotransmitters:**

Biosynthesis and catabolism of acetylcholine.

Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

2 **Parasympathomimetic agents: SAR of Parasympathomimetic agents**

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isoflurophate, Echothiophate iodide, Parathion, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

3 **Cholinergic Blocking agents: SAR of cholinolytic agents**

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrrolate, Methantheline

bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

Unit IV

8 Hours

1 **Drugs acting on Central Nervous System**

A **Sedatives and Hypnotics:**

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturates: SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Butalbital, Pentobarbital, Secobarbital

Miscellaneous:

Amides&imides:Glutethimide.

Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B Antipsychotics

Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluorobutero phenones: Haloperidol, Droperidol, Risperidone.

Betaaminoketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C Anticonvulsants:

SAR of Anticonvulsants, mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methobarbital. **Hydanto**

ins: Phenytoin*, Mephenytoin,

Ethotoin **Oxazolinediones:** Trimethadione, Paramethadione

Succinimides: Phensuximide, Methsuximide, Ethosuximide* **U**

rea and monoacylureas: Phenacetamide,

Carbamazepine* **Benzodiazepines:** Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

Unit V

7 Hours

1 Drugs acting on Central Nervous System

A General anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbiturates: Methohexital sodium*, Thiopental sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine

hydrochloride.* **Narcotic and non-narcotic analgesics**

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anileridine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartrate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartrate, Naloxone

hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

BP406P MEDICINAL CHEMISTRY–I(Practical)

4

Hours/week List of Experiments

I Preparation of drugs/intermediates

- 1 1,3-pyrazole
- 2 1,3-oxazole
- 3 Benzimidazole
- 4 Benzotriazole
- 5 2,3-diphenylquinoxaline
- 6 Benzocaine
- 7 Phenytoin
- 8 Phenothiazine
- 9 Barbiturate

II Assay of drugs

- 1 Chlorpromazine
- 2 Phenobarbitone
- 3 Atropine
- 4 Ibuprofen
- 5 Aspirin
- 6 Furosemide

III Determination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)

- 1 Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
- 2 Foye's Principles of Medicinal Chemistry.
- 3 Burger's Medicinal Chemistry, Vol I to IV.
- 4 Introduction to principles of drug design - Smith and Williams.
- 5 Remington's Pharmaceutical Sciences.
- 6 Martindale's extra pharmacopoeia.
- 7 Organic Chemistry by I. L. Finar, Vol. II.

- 8 The Organic Chemistry of Drug Synthesis by Lednicher, Vol. 1-5.
- 9 Indian Pharmacopoeia.
- 10 Textbook of practical organic chemistry-A.I. Vogel.

BP403T PHYSICAL PHARMACEUTICS-II(Theory)**45Hours**

- 1 Scope:** The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 Understand various physicochemical properties of drug molecules in the designing of dosage forms
 - 2 Know the principles of chemical kinetics & use them for stability testing and determination of expiry date of formulations
 - 3 Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
- 3 Outcomes:** End completion of this course the students shall come to know about the theoretical and practical aspects of various physical and physicochemical properties and principles involved in dosage forms with their relevance of development and stability study.

4 Course Content**Unit I****7Hours****1 Colloidal dispersions:**

Classification of dispersed systems & their general characteristics, Size & shapes of colloidal particles, Classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coagulation, peptization & protective action.

Unit II**10 Hours**

- 1 Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers
- 2 Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

Unit III**10Hours****1**

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

Unit IV**10Hours**

1Micromeretics: Particle size and distribution, mean particle size, number and weightdistribution,particlenumber,methodsfordeterminingparticlesizebydifferentmethods, counting and separation method, particle shape, specific surface, methods fordeterminingsurfacearea,permeability,adsorption,derivedpropertiesofpowders,porosity, packingarrangement,densities,bulkiness &flowproperties.

UnitV**10Hours**

1 Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basicrateconstants,determinationofreactionorder.Physicalandchemicalfactorsinfluencing the chemical degradation of pharmaceutical product: temperature, solvent,ionicstrength,dielectricconstant,specific&generalacidbasecatalysis,Simplenumerical problems. Stabilization of medicinal agents against common reactions likehydrolysis&oxidation.Acceleratedstabilitytestinginexpirationdatingofpharmaceuticaldosageforms.Photolytic degradation anditsprevention

BP407P PHYSICALPHARMACEUTICS-II(Practical)**3****Hours/weekListofExperiments**

- 1 Determinationofparticlesize,particlesizedistributionusing sievingmethod
- 2 Determinationofparticlesize,particlesizedistributionusingMicroscopicmethod
- 3 Determinationofbulkdensity,truedensityandporosity
- 4 Determinetheangleofreposeandinfluenceoflubricantonangleofrepose
- 5 Determination ofviscosityofliquid using Ostwald'sviscometer
- 6 Determinationsedimentationvolume witheffectofdifferentssuspendingagent
- 7 Determinationsedimentationvolumewitheffectofdifferentconcentrationofsinglesusp endingagent
- 8 DeterminationofviscosityofsemisolidbyusingBrookfieldviscometer
- 9 Determinationofreactionrateconstantfirstorder.
- 10 Determinationofreactionrateconstantsecondorder
- 11 Accelerated stabilitystudies

RecommendedBooks(LatestEditions)

- 1 Physical PharmacybyAlfredMartin,Sixthedition
- 2 Experimental pharmaceuticsbyEugene,Parott.
- 3 Tutorial pharmacybyCooperandGunn.
- 4 StocklosamJ.Pharmaceuticalcalculations,Lea&Febiger,Philadelphia.

- 5 Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
- 6 Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
- 7 Physical Pharmaceutics by Ramasamy C, and Manavalan R.

BP404T PHARMACOLOGY-I(Theory)**45 Hours**

- 1 Scope:** The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drug like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Understand the pharmacological actions of different categories of drugs
 - 2 Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
 - 3 Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
 - 4 Observe the effect of drugs on animals by simulated experiments
 - 5 Appreciate correlation of pharmacology with other biomedical sciences
- 3 Outcomes:** After completion of this course the students shall come to know about the theoretical and practical aspects of mechanism of action, pharmacodynamics and pharmacokinetics, adverse effects, clinical use, interactions, contraindications and route of administration of drugs
- 4 Course Content**

Unit I**8 Hours****1 General Pharmacology**

- A Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and noncompetitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.
- B Pharmacokinetics-
Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination

Unit II**12 Hours****1 General Pharmacology**

- A Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–
coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.

- B Adversedrugreactions.
- C Druginteractions(pharmacokineticandpharmacodynamic)
- D Drugdiscovery and clinicalevaluationofnewdrugs-Drug
discoveryphase,preclinicalevaluationphase,
clinicaltrialphase,phasesofclinicaltrialsandpharmacovigilance.

UnitIII

10Hours

- 1 **Pharmacologyofdrugsacting onperipheralnervoussystem**
- A Organizationandfunctionof ANS.
- B Neurohumoral transmission,co-transmission and classification of
neurotransmitters.C
Parasympathomimetics,Parasympatholytics,Sympathomimetics,sympatholytics.D
Neuromuscularblockingagents andskeletalmusclerelaxants(peripheral).
- E Localanestheticagents.
- F Drugsusedinmyastheniagravisandglaucoma

Unit IV

8Hours

- 1 **Pharmacologyof drugsacting oncentralnervoussystem**
- A NeurohumoraltransmissionintheC.N.S.specialemphasisonimportanceofvariousneurotran
smitters likewithGABA,Glutamate,Glycine,serotonin,dopamine.
- B Generalanestheticsandpre-anesthetics.
- C Sedatives, hypnotics and centrally acting muscle
relaxants.D Anti-epileptics
- E Alcoholsanddisulfiram

UnitV

7Hours

- 1 **Pharmacologyof drugs actingoncentralnervoussystem**
- A Psychopharmacologicalagents:Antipsychotics,antidepressants,anti-anxietyagents,anti-
manicsandhallucinogens.
- B Drugs used in Parkinsons disease and Alzheimer's
disease.C CNSstimulantsandnootropics.
- D Opioidanalgesicsandantagonists
- E Drugaddiction,drugabuse,toleranceanddependence.

BP408P PHARMACOLOGY-I(Practical)

4

Hours/weekListofExperiments

- 1 Introductiontoexperimentalpharmacology.
- 2 Commonlyusedinstrumentsin experimentalpharmacology.
- 3 Studyofcommonlaboratoryanimals.
- 4 Maintenanceoflaboratory animalsasperCPCSEAguidelines.
- 5 Commonlaboratorytechniques.Bloodwithdrawal,serumandplasmaseparation,

- anesthetics and euthanasia used for animal studies.
- 6 Study of different routes of drug administration in mice/rats.
 - 7 Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
 - 8 Effect of drugs on ciliary motility of frog oesophagus
 - 9 Effect of drugs on rabbit eye.
 - 10 Effect of skeletal muscle relaxants using rota-rod apparatus.
 - 11 Effect of drugs on locomotor activity using actophotometer.
 - 12 Anticonvulsant effect of drugs by MES and PTZ method.
 - 13 Study of stereotypic and anti-catatonogenic activity of drugs on rats/mice.
 - 14 Study of anxiolytic activity of drugs using rats/mice.
 - 15 Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by software and videos

Recommended Books (Latest Editions)

- 1 Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
- 2 Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata McGraw-Hill
- 3 Goodman and Gilman's, The Pharmacological Basis of Therapeutics
- 4 Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
- 5 Mycek M.J., Gelnet S. Band Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
- 6 K.D. Tripathi. Essentials of Medical Pharmacology, JAY PEE Brothers Medical Publishers (P) Ltd, New Delhi.
- 7 Sharma H. L., Sharma K.K., Principles of Pharmacology, Paras medical publisher
- 8 Modern Pharmacology with clinical Applications, by Charles R. Craig & Robert,
- 9 Ghosh M.N. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
- 10 Kulkarni S.K. Handbook of experimental pharmacology. Vallabh Prakashan,

BP405T PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory) 45 Hours

- 1 Scope:** The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 to know the techniques in the cultivation and production of crude drugs
 - 2 to know the crude drugs, their uses and chemical nature
 - 3 know the evaluation techniques for the herbal drugs
 - 4 to carry out the microscopic and morphological evaluation of crude drugs
- 3 Outcomes:** After completion of this course the students shall come to know about the aspects of scope, classification, identification, and evaluation of crude drugs including their phytochemicals and medicinal properties.

4 Course Content

Unit I

10 Hours

1 Introduction to Pharmacognosy:

Definition, history, scope and development of Pharmacognosy
Sources of Drugs—Plants, Animals, Marine & Tissue culture

Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo-gum-resins).

2 Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

3 Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.

Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

Unit II

10 Hours

1 Cultivation, Collection, Processing and storage of drugs of natural origin:

Cultivation and Collection of drugs of natural origin

Factors influencing cultivation of medicinal plants. Plant hormones and their applications.

Polyploidy, mutation and hybridization with reference to medicinal plants

2 Conservation of medicinal plants

Unit III**10 Hours****1 Plant tissue culture:**

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Application of plant tissue culture in pharmacognosy. Edible vaccines

Unit IV**10 Hours****1 Pharmacognosy in various systems of medicine:**

Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese system of medicine.

B Introduction to secondary metabolites:

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

Unit V**7 Hours**

1 Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

A Plant Products:

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural

allergens B Primary metabolites:

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic use and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

C Carbohydrates: Acacia, Agar, Tragacanth, Honey**D Proteins and Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).**E Lipids (Waxes, fats, fixed oils) :** Castor oil, Chaulmoogra oil, Wool Fat, Bees**Wax F Marine Drugs:**

Novel medicinal agents from marine sources

**BP408P PHARMACOGNOSY AND PHYTOCHEMISTRY I
(Practical)****4 Hours/week****List of Experiments**

- 1 Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
- 2 Determination of stomatal number and index

- 3 Determination of vein islet number, vein islet termination and palisade ratio.
- 4 Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
- 5 Determination of Fiber length and width
- 6 Determination of number of starch grains by Lycopodium spore method
- 7 Determination of Ash value
- 8 Determination of Extractive values of crude drugs
- 9 Determination of moisture content of crude drugs
- 10 Determination of swelling index and foaming

Recommended Books (Latest Editions)

- 1 W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
- 2 Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
- 3 Text Book of Pharmacognosy by T.E. Wallis
- 4 Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
- 5 Textbook of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (2007), 37th Edition, Nirali Prakashan, New Delhi.
- 6 Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
- 7 Essentials of Pharmacognosy, Dr. S.H. Ansari, 11th edition, Birla Publications, New Delhi, 2007
- 8 Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhale
- 9 Anatomy of Crude Drugs by M.A. Iyengar

Semester V

BP501T MEDICINAL CHEMISTRY–II(Theory)

45Hours

- 1 **Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Understand the chemistry of drugs with respect to their pharmacological activity
 - 2 Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
 - 3 Know the Structural Activity Relationship of different class of drugs
 - 4 Study the chemical synthesis of selected drugs
- 3 **Outcomes:** End of this course the students shall come to know about the fundamental knowledge on the structure, chemistry and therapeutic value of drugs. It gives knowledge on structural activity relationship of drugs, importance of physicochemical properties and metabolism of drugs. It also provides knowledge of chemical synthesis of some important drugs.
- 4 **Course Content**

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drug superscripted(*)

Unit I

10 Hours

- 1 **Antihistaminic agents:** Histamine, receptors and their distribution in the human body
- 2 **H₁-antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Triphenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartrate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetirizine, Cromoglycate sodium
- 3 **H₂-antagonists:** Cimetidine*, Famotidine, Ranitidine.
- 4 **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole
- 5 **Anti-neoplastic agents:**

Alkylating agents: Meclizine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiopeta

Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine,

Methotrexate*, Azathioprine

Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin
Plant products: Etoposide, Vinblastine sulphate, Vincristine sulphate
Miscellaneous: Cisplatin, Mitotane.

Unit II

10 Hours

1

Anti-anginal:

Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrate*, Dipyridamol.

Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.
Diuretics:

Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol

2

Anti-

hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopa hydrochloride, *Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

Unit III

10 Hours

1

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcarinide hydrochloride, Amiodarone, Sotalol.

2

Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholestyramine and Cholestipol

3

Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel

4

Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan

Unit IV

8 Hours

1

Drugs acting on Endocrine system

Nomenclature, Stereochemistry and metabolism of steroids

2

Sex hormones: Testosterone, Nandrolone, Progestones, Oestrone, Oestradiol, Oestrone, Diethyl stilbestrol.

3

Drugs for erectile dysfunction: Sildenafil, Tadalafil.

- 4 **Oral contraceptives:** Mifepristone, Norgestrel, Levonorgestrol
- 5 **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone
- 6 **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

Unit V

7 Hours

- 1 **Antidiabetic agents:**
Insulin and its preparations
Sulfonylureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin.
Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide.
Glucosidase inhibitors: Acarbose, Voglibose.
- 2 **Local Anesthetics:** SAR of Local anesthetics
- 3 **Benzoic acid derivatives:** Cocaine, Hexylcaine, Mepylcaine, Cyclomethycaine, Piperocaine.
- 4 **Amino Benzoic acid derivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.
- 5 **Lidocaine/Anilide derivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine.
- 6 **Miscellaneous:** Phenacaine, Dipreron, Dibucaine.*

Recommended Books (Latest Editions)

- 1 Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
- 2 Foye's Principles of Medicinal Chemistry.
- 3 Burger's Medicinal Chemistry, Vol I to IV.
- 4 Introduction to principles of drug design - Smith and Williams.
- 5 Remington's Pharmaceutical Sciences.
- 6 Martindale's extra pharmacopoeia.
- 7 Organic Chemistry by I. L. Finar, Vol. II.
- 8 The Organic Chemistry of Drug Synthesis by Lednicher, Vol. 1 to 5.
- 9 Indian Pharmacopoeia.
- 10 Textbook of practical organic chemistry - A. I. Vogel

BP502T INDUSTRIAL PHARMACY-I(Theory)**45Hours**

- 1 Scope:** Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 Know the various pharmaceutical dosage forms and their manufacturing techniques.
 - 2 Know various considerations in development of pharmaceutical dosage forms
 - 3 Formulate solid, liquid and semi-solid dosage forms and evaluate them for their quality
- 3 Outcomes:** After curtaining of this course the students shall come to know about the fundamental knowledge on pharmaceutical additives and various dosages forms on the performance of the drug products.

4 Course Content**3Hours/ Week****Unit I****7Hours**

1

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

A **Physical properties:** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

B **Chemical Properties:** Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

Unit II**10 Hours**

1

Tablets:

a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

2 **Liquid orals:** Formulation and manufacturing consideration of syrups and elixir suspensions and emulsions; Filling and packaging; evaluation of liquidorals official in pharmacopoeia

Unit III**8Hours**

1

Capsules:

a. **Hard gelatin capsules.** Introduction, Production of hard gelatin capsules, size

of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

- b. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minimum/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

- 2 **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

Unit IV

10 Hours

- 1 **Parenteral Products:**

- a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity
- b. Production procedure, production facilities and controls, aseptic processing
- c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.
- d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

- 2 **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

Unit V

10 Hours

- 1 **Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.
- 2 **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.
- 3 **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

BP506P INDUSTRIAL PHARMACY-I(PRACTICAL)

4 Hours/week

List of Experiments

- 1 Preformulation studies on paracetamol/aspirin/or any other drug

- 2 Preparation and evaluation of Paracetamol tablets
- 3 Preparation and evaluation of Aspirin tablets
- 4 Coating of tablets-film coating of tablets/granules
- 5 Preparation and evaluation of Tetracycline capsules
- 6 Preparation of Calcium Gluconate injection
- 7 Preparation of Ascorbic Acid injection
- 8 Quality control test of (as per IP) marketed tablets and capsules
- 9 Preparation of Eye drops/ and Eye ointments
- 10 Preparation of Creams (cold/ vanishing cream)
- 11 Evaluation of Glass containers (as per IP)

Recommended Books (Latest Editions)

- 1 Pharmaceutical dosage forms- Tablets, volume 1- 3 by H.A. Liberman, Leon Lachman & J.B. Schwartz
- 2 Pharmaceutical dosage form - Parenteral medication vol- 1 & 2 by Liberman & Lachman
- 3 Pharmaceutical dosage form disperses system VOL-1 by Liberman & Lachman
- 4 Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
- 5 Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
- 6 Theory and Practice of Industrial Pharmacy by Liberman & Lachman
- 7 Pharmaceutics- The science of dosage form design by M.E. Aulton, Churchill livingstone, Latest edition
- 8 Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, 5th edition, 2005
- 9 Drug stability- Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

BP503T PHARMACOLOGY-II(Theory)**45 Hours**

- 1 Scope:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 Understand the mechanism of drug action and its relevance in the treatment of different diseases
 - 2 Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
 - 3 Demonstrate the various receptor actions using isolated tissue preparation
 - 4 Appreciate correlation of pharmacology with related medical sciences
- 3 Outcomes:** After cessation of this course the students shall come to know about the fundamental knowledge on various aspects on classification, mechanisms of action, therapeutic effects, clinical use, side effects, and contraindications of drugs acting on different systems of body. It provides practical knowledge of basic concepts of Bioassays.

4 Course Content**Unit I****10 Hours****1 Pharmacology of drugs acting on cardiovascular system**

- A Introduction to hemodynamic and electrophysiology of heart.
- B Drugs used in congestive heart failure
- C Anti-hypertensive drugs.
- D Anti-anginal drugs.
- E Anti-arrhythmic drugs.
- F Anti-hyperlipidemic drugs.

Unit II**10 Hours****1 Pharmacology of drugs acting on cardiovascular system**

- A Drug used in the therapy of shock.
- B Hematinics, coagulants and anticoagulants.
- C Fibrinolytics and anti-platelet drugs
- D Plasma volume expanders

2 Pharmacology of drugs acting on urinary system

- A Diuretics
- B Anti-diuretics.

Unit III**10 Hours**

1 **Autocoids and related drugs**

A Introduction to autacoids and

classification B Histamine, 5-

HT and their antagonists.

C Prostaglandins, Thromboxanes and

Leukotrienes. D Angiotensin, Bradykinin and

Substance P.

E Non-steroidal anti-inflammatory

agents F Anti-gout drugs

G Antirheumatic drugs

Unit IV

8 Hours

1 **Pharmacology of drugs acting on endocrine system**

A Basic concepts in endocrine pharmacology.

B Anterior Pituitary hormones- analogues and their

inhibitors. C Thyroid hormones- analogues and their inhibitors.

D Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-

D. E Insulin, Oral Hypoglycemic agents and glucagon.

F ACTH and corticosteroids.

Unit V

10 Hours

1 **Pharmacology of drugs acting on endocrine system**

A Androgens and Anabolic steroids.

B Estrogens, progesterone and oral

contraceptives. C Drugs acting on the uterus.

2 **Bioassay**

A Principles and applications of

bioassay. B Types of bioassay

C Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT

3 **Pharmacology of drugs acting on endocrine system**

BP507P PHARMACOLOGY-II (PRACTICAL)

4 Hours/week

List of Experiments

1 Introduction to *in-vitro* pharmacology and physiological salt solutions.

2 Effect of drug on isolated frog heart.

3 Effect of drugs on blood pressure and heart rate of dog.

4 Study of diuretic activity of drugs using rats/mice.

5 DRC of acetylcholine using frog rectus abdominis muscle.

6 Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus

- abdominal muscle and rat ileum respectively.
- 7 Bioassay of histamine using guinea pig ileum by matching method.
 - 8 Bioassay of oxytocin using rat uterine horn by interpolation method.
 - 9 Bioassay of serotonin using rat fundus strip by three point bioassay.
 - 10 Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
 - 11 Determination of PA_2 value of prazosin using rat aortic smooth muscle (by Schild's plot method).
 - 12 Determination of PD_2 value using guinea pig ileum.
 - 13 Effect of spasmogens and spasmolytics using rabbit jejunum.
 - 14 Anti-inflammatory activity of drugs using carrageenan induced paw edema model.
 - 15 Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by software and videos

Recommended Books (Latest Editions)

- 1 Rang H.P., Dale M.M., Ritter J.M., Flower R.J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
- 2 Katzung B.G., Masters S.B., Trevor A.J., Basic and clinical pharmacology, Tata McGraw-Hill.
- 3 Goodman and Gilman's, The Pharmacological Basis of Therapeutics
- 4 Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
- 5 Mycek M.J., Gelnet S. Band Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
- 6 K.D. Tripathi. Essentials of Medical Pharmacology, JAY PEE Brothers Medical Publishers (P) Ltd, New Delhi.
- 7 Sharma H. L., Sharma K.K., Principles of Pharmacology, Paras medical publisher
- 8 Modern Pharmacology with clinical Applications, by Charles R. Craig & Robert.
- 9 Ghosh M.N. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
- 10 Kulkarni S.K. Handbook of experimental pharmacology. Vallabh Prakashan.

BP504T PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory) 45 Hours

- 1 Scope:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
 - 2 to understand the preparation and development of herbal formulation.
 - 3 to understand the herbal drug interactions
 - 4 to carry out isolation and identification of phytoconstituents
- 3 Outcomes:** Upon completion of this course the students shall come to know about the fundamental knowledge on biosynthesis of secondary metabolites and their isolation, identification and industrial production. It also provides the knowledge of production of phytochemicals through plant tissue culture. In addition, it gives the knowledge of herbal drug interaction and principles of traditional systems of medicine.

4 Course Content

Unit I

7 Hours

1 Metabolic pathways in higher plants and their determination

- A Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways-Shikimic acid pathway, Acetate pathways and Amino acid pathway.
- B Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

Unit II

14 Hours

- 1 General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:
- A Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Datura, Nux- Vomica, Berberis, Vasaka and Ashwagandha**
- B Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta
- C Steroids, Cardiac Glycosides & Triterpenoids:** Liquorice, Dioscorea, Digitalis
- D Volatile oils:** Mentha, Clove, Cinnamon, Fennel, Coriander,
- E Tannins:** Catechu, Pterocarpus
- F Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony
- G Glycosides:** Senna, Aloes, Bitter Almond
- H Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids

**Amended through proper procedure of Board of studies and subsequently accepted and approved by Board of Management in the meetings: [SV/DP/ 2022-23/317 DATED 07.02.2023 (BOS) &SVDU/R/2431-C/2022-23 DATED29.05.2023 (BOM)]*

UnitIII**6Hours****1 Isolation, Identification and Analysis of Phytoconstituents****A Terpenoids:** Menthol, Citral,

Artemisin B

Glycosides: Glycyrrhetic acid & Rutin

C Alkaloids:

Atropine, Quinine, Reserpine, Caffeine D Resins:

Podophyllotoxin, Curcumin

Unit IV**10Hours****1 Industrial production, estimation and utilization of the following phytoconstituents:** Forskolin,

Sennoside, Arte

misinin, Diosgeni

n, Digoxin, Atropi

ne, Podophylloto

xin, Caffeine,

Taxol, Vincristi

ne

and Vinblastine

UnitV**8Hours****1 Basic of Phytochemistry**

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

BP508P**PHARMACOGNOSY AND PHYTOCHEMISTRY II****4 Hours/week****(Practical)****List of Experiments**

- 1 Morphology, histology and powder characteristics & extraction & detection of:
Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
- 2 Exercise involving isolation & detection of active
principles
A Caffeine - from tea dust.
B Diosgenin from Dioscorea
C Atropine from
Belladonna
D Sennosides from
Senna
- 3 Separation of sugars by Paper chromatography
- 4 TLC of herbal extract
- 5 Distillation of volatile oils and detection of phytoconstituents by TLC
- 6 Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v)
Myrrh

Recommended Books (Latest Editions)

- 1 W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
- 2 Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
- 3 Textbook of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (2007), 37th Edition, Nirali Prakashan, New Delhi.
- 4 Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
- 5 Essentials of Pharmacognosy, Dr. S.H. Ansari, 11th edition, Birla Publications, New Delhi, 2007
- 6 Herbal Cosmetics by H. Pande, Asia Pacific Business Press, Inc, New Delhi.
- 7 A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
- 8 R. Endress, Plant Cell Biotechnology, Springer-Verlag, Berlin, 1994.
- 9 Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VETaylor.
- 10 The formulation and preparation of cosmetic, fragrances and flavours.
- 11 Remington's Pharmaceutical Sciences.
- 12 Textbook of Biotechnology by Vyas and Dixit.
- 13 Textbook of Biotechnology by R.C. Dubey.

1 Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

2 Objectives: Upon completion of this course, the students should be able to

- 1 The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
- 2 Various Indian pharmaceutical Acts and Laws
- 3 The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
- 4 The code of ethics during the pharmaceutical practice

3 Outcomes: After finishing of this course, the students shall come to know about the basic knowledge of important legislation related to the profession of Pharmacy in India

4 Course Content

Unit I

10 Hours

1 Drugs and Cosmetics Act, 1940 and its rules 1945:

Objectives, Definitions, Legal definitions of schedules to the Act and Rules
Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties.

Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

Unit II

10 Hours

1 Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA)
Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties
Labeling & Packing of drugs-

General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

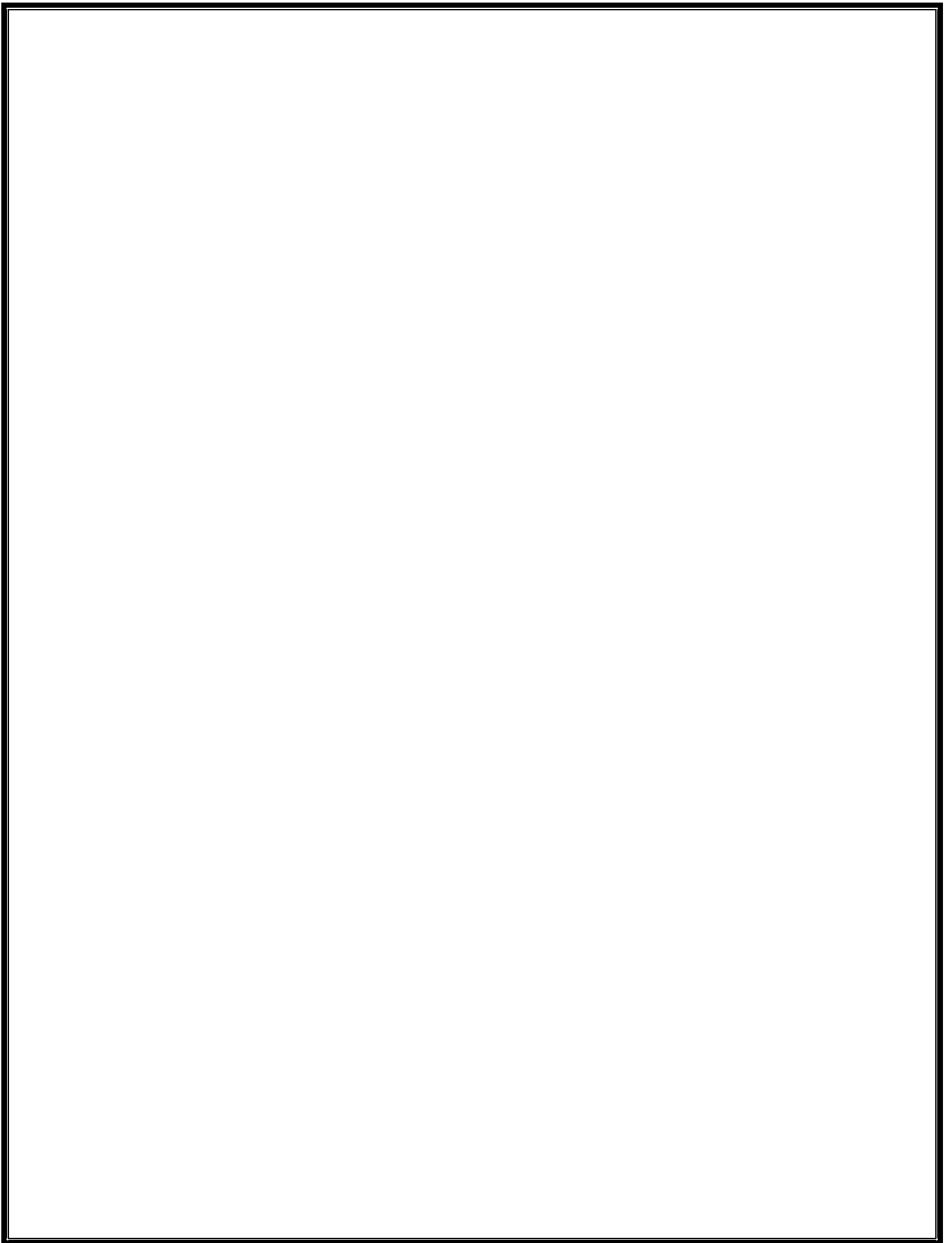
Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

Unit III

10 Hours

1 Pharmacy Act–

1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences



and Penalties

2 **Medicinal and Toilet Preparation Act–**

1955: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.

3 **Narcotic Drugs and Psychotropic Substances Act–**

1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

Unit IV

8 Hours

1 **Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties

2 **Prevention of Cruelty to Animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties

3 **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

Unit V

7 Hours

1 **Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee

2 **Code of Pharmaceutical Ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath

3 **Medical Termination of Pregnancy Act**

4 **Right to Information Act**

5 **Introduction to Intellectual Property Rights (IPR)**

Introduction-Knowledge creation, Innovation and Intellectual Property Rights, Concept of Intellectual Property, Need for protecting intellectual property, Theories on concept of property-Public Vs. Private, Tangible Vs Intangible, Industrial Vs Intellectual, Major IP Laws in India, Types of IPR-Patents-Copyright-Trademark-Industrial Designs-Trade Secrets. A. Role of intellectual property in Pharmaceutical Industry.

B. Patents: Concept of Patent, Criteria for patentability, Inventions not patentable,

Process of obtaining a Patent, Duration of patents, Right of Patentee, Limitations of rights, Infringement and Enforcement.

C.. Copyrights: Meaning of Copyright, Copyright Vs Moral Rights, Copyright eligibility Term of copyright, Registration of Copyright, Infringement and Remedies.

D. Trademark: Meaning of Trademark, Criteria for trademark, Protection of Well-known marks, Concept of distinctiveness, Procedure for Trademark registration, Term of protection, Infringement and Remedies.

RecommendedBooks(LatestEditions)

- 1 ForensicPharmacybyB.Suresh
- 2 TextbookofForensicPharmacybyB.M.Mithal
- 3 Handbookofdruglaw-byM.L.Mehra

- 4 AtextbookofForensicPharmacybyN.K.Jain
- 5 DrugsandCosmetics Act/RulesbyGovt.ofIndiapublications.
- 6 MedicinalandToiletpreparationsact1955byGovt. ofIndiapublications.
- 7 Narcoticdrugsandpsychotropicsubstancesactby Govt.of Indiapublications
- 8 DrugsandMagicRemedies actbyGovt.ofIndiapublication
- 9 BareActsof thesaid lawspublishedbyGovernment. Reference books(Theory)

Semester VI

BP601T MEDICINAL CHEMISTRY–III(Theory)

45Hours

- 1 **Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Understand the importance of drug design and different techniques of drug design.
 - 2 Understand the chemistry of drugs with respect to their biological activity.
 - 3 Know the metabolism, adverse effects and therapeutic value of drugs.
 - 4 Know the importance of SAR of drugs.
- 3 **Outcomes:** Upon completion of this course the students shall come to know about the fundamental knowledge on the structure, chemistry and therapeutic value of drugs. It emphasizes on rational drug design like QSAR, Prodrug, combinatorial chemistry and CADD including mechanism of action, metabolism, adverse effect, SAR, therapeutic uses and synthesis of some important drugs.
- 4 **Course Content**

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drug superscripted by (*)

Unit I

10 Hours

- 1 **Antibiotics**

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.
- 2 **β -Lactam antibiotics:** Penicillin, Cephalosporins, β -Lactamase inhibitors, Monobactams
- 3 **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin
- 4 **Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

Unit II

10 Hours

- 1 **Antibiotics**

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

- 2 **Macrolide:**Erythromycin,Clarithromycin,Azithromycin.
- 3 **Miscellaneous:**Chloramphenicol*,Clindamycin.
- 4 **Prodrugs:**Basicconceptsandapplicationof prodrugsdesign.
- 5 **Antimalarials:**Etiologyofmalaria.
- 6 **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate,Pamaquine*,Quinacrinehydrochloride,Mefloquine.
- 7 **Biguanidesanddihydrotriazines:**Cycloguanilpamoate,Proguanil.
- 8 **Miscellaneous:**Pyrimethamine,Artesunate,Artemether,Atovaquone.

UnitIII

10Hours

- 1 **Anti-tubercularAgents**
Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide,Para amino salicylicacid.*
Antitubercularantibiotics:Rifampicin,Rifabutin,
- 2 **Urinarytract anti-infectiveagents**
Quinolones:SARofquinolones,NalidixicAcid,Norfloxacin,Enoxacin,Ciprofloxacin*,Ofloxacin,Lomefloxacin,Sparfloxacin,
Miscellaneous:Furazolidine,Nitrofurantoin*,Methanamine.
- 3 **Antiviralagents:**
Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride,Acyclovir*,Gancyclovir,Zidovudine,Didanosine,Zalcitabine,Lamivudine,Loviride,Delavirding,Ribavirin, Saquinavir,Indinavir,Ritonavir.
Anti-tubercularAgents

Unit IV

8 Hours

- 1 **Antifungalagents:**
Antifungalantibiotics:Amphotericin-B,Nystatin,Natamycin,Griseofulvin.
SyntheticAntifungalagents:Clotrimazole,Econazole,Butoconazole,Oxiconazole,Tioconazole,Miconazole*,Ketoconazole,Terconazole,Itraconazole,Fluconazole,Naftifinehydrochloride,Tolnaftate*.
- 2 **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol,Pentamidinethionate,Atovaquone,Eflornithine.
- 3 **Anthelmintics:**Diethylcarbamazinecitrate*,Thiabendazole,Mebendazole*,Albendazole,Niclosamide, Oxamniquine, Praziquantel, Ivermectin. Sulphonamidesand Sulfones
Historical development, chemistry, classification and SAR of Sulfonamides:

Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*,
Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mefenide
acetate, Sulfasalazine.

4 **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole.

5 **Sulfones:** Dapsone*.

Unit V

7 Hours

1 Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis.

Pharmacophore modeling and docking techniques.

2 **Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

BP607P MEDICINAL CHEMISTRY-III (Practical)

List of Experiments

I Preparation of drugs and intermediates

1 Sulphanilamide

2 7-Hydroxy, 4-methyl coumarin

3 Chlorobutanol

4 Triphenyl imidazole

5 Tolbutamide

6 Hexamine

II Assay of drugs

1 Isonicotinic acid hydrazide

2 Chloroquine

3 Metronidazole

4 Dapsone

5 Chlorpheniramine maleate

6 Benzylpenicillin

III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique

IV Drawing structures and reactions using ChemDraw

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeness screening

(LipinskiesRO5)

Recommended Books(Latest Editions)

- 1 WilsonandGiswold'sOrganicmedicinalandPharmaceuticalChemistry.
- 2 Foye'sPrinciplesofMedicinalChemistry.
- 3 Burger'sMedicinalChemistry,VolltoIV.
- 4 Introductiontoprinciplesofdrugdesign-SmithandWilliams.
- 5 Remington'sPharmaceuticalSciences.
- 6 Martindale'sextrapharmacopoeia.
- 7 OrganicChemistrybyI.L.Finar,Vol.II.
- 8 TheOrganicChemistry ofDrugSynthesisbyLednicer,Vol.1-5.
- 9 IndianPharmacopoeia.
- 10 Textbookofpracticalorganicchemistry-A.I.Vogel.

BP602T PHARMACOLOGY–III(Theory)**45Hours**

- 1 Scope:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immunopharmacology and in addition, emphasis on the principles of toxicology and chronopharmacology.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
 - 2 comprehend the principles of toxicology and treatment of various poisonings and
 - 3 appreciate correlation of pharmacology with related medical sciences.
- 3 Outcomes:** End of this course the students shall come to know about the fundamental knowledge on various aspects on classification, mechanisms of action, therapeutic effects, clinical use, side effects, and contraindications of drugs acting on respiratory, GIT infectious diseases, immunopharmacology and principles of toxicology and chronopharmacology.

4 Course Content**Unit I****10 Hours**

- 1 **Pharmacology of drugs acting on Respiratory system**
 - A Anti-asthmatic drugs
 - B Drugs used in the management of COPD
Expectorants and antitussives
 - D Nasal decongestants
 - E Respiratory stimulants
- 2 **Pharmacology of drugs acting on the Gastrointestinal Tract**
 - A Antiulcer agents.
 - B Drugs for constipation and diarrhoea.
 - C Appetite stimulants and suppressants.
 - D Digestants and carminatives.
 - E Emetics and anti-emetics.

Unit II**10 Hours**

- 1 **Chemotherapy**
 - A General principles of chemotherapy.
Sulfonamides and cotrimoxazole.
 - C Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides

Unit III**10 Hours**

- 1 **Chemotherapy**
- A Antitubercular agents
- B Antileprotic agents
- C Antifungal agents
- D Antiviral drugs
- E Anthelmintics
- F Antimalarial drugs
- G Antiamoebic agents

Unit IV**8 Hours**

- 1 **Chemotherapy**
- A Urinary tract infections and sexually transmitted diseases.
- B Chemotherapy of malignancy.

2

Immunopharmacology

- A Immunostimulants
- B Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

Unit V**7 Hours**

- 1 **Principles of toxicology**
- A Definition and basic knowledge of acute, subacute and chronic toxicity. B
Definition and basic knowledge of genotoxicity, carcinogenicity,
teratogenicity and mutagenicity
- C General principles of treatment of poisoning
- D Clinical symptoms and management of barbiturates, morphine,
organophosphorus compound and lead, mercury and arsenic poisoning.

2

Chronopharmacology

- A Definition of rhythm and cycles.
- B Biological clock and their significance leading to chronotherapy.

BP608P PHARMACOLOGY-III (Practical)**List of Experiments**

- 1 Dose calculation in pharmacological experiments
- 2 Anti-allergic activity by mast cell stabilization assay
- 3 Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAID induced ulcer model.

- 4 Study of effect of drugs on gastrointestinal motility
- 5 Effect of agonist and antagonists on guinea pig ileum
- 6 Estimation of serum biochemical parameters by using semi-auto analyser
- 7 Effect of saline purgative on frog intestine
- 8 Insulin hypoglycemic effect in rabbit
- 9 Test for pyrogens (rabbit method)
- 10 Determination of acute oral toxicity (LD₅₀) of a drug from agivendata
- 11 Determination of acute skin irritation/corrosion of a test substance
- 12 Determination of acute eye irritation/corrosion of a test substance
- 13 Calculation of pharmacokinetic parameters from agivendata
- 14 Biostatistics methods in experimental pharmacology (student's t test, ANOVA)
- 15 Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

**Experiments are demonstrated by simulated experiments/videos*

Recommended Books (Latest Editions)

- 1 Rang H.P., Dale M.M., Ritter J.M., Flower R.J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
- 2 Katzung B.G., Masters S.B., Trevor A.J., Basic and clinical pharmacology, Tata McGraw-Hill.
- 3 Goodman and Gilman's, The Pharmacological Basis of Therapeutics
- 4 Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
- 5 Mycek M.J., Gelnet S. Band Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
- 6 K.D. Tripathi. Essentials of Medical Pharmacology, JAY PEE Brothers Medical Publishers (P) Ltd, New Delhi.
- 7 Sharma H. L., Sharma K.K., Principles of Pharmacology, Paras medical publisher
- 8 Modern Pharmacology with clinical Applications, by Charles R. Craig & Robert.
- 9 Ghosh M.N. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
- 10 Kulkarni S.K. Handbook of experimental pharmacology. Vallabh Prakashan.
- 11 N. Udupa and P.D. Gupta, Concepts in Chronopharmacology.

BP603T HERBALDRUG TECHNOLOGY(THEORY)**45 Hours**

- 1 Scope:** This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 understand raw material as source of herbal drugs from cultivation to herbal drug product
 - 2 know the WHO and ICH guidelines for evaluation of herbal drugs
 - 3 know the herbal cosmetics, natural sweeteners, nutraceuticals
 - 4 appreciate patenting of herbal drugs, GMP.
- 3 Outcomes:** After cessation of this course the students shall come to know about the fundamental knowledge on basic understanding of herbal drug industry, quality and guidelines of raw materials, herbal cosmetics, natural sweeteners, nutraceuticals etc. It also emphasizes on GMP, patenting and regulatory issues of herbal drugs.

4 Course Content**Unit I****11 Hours****1 Herbs as raw materials**

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation
Source of Herbs Selection, identification and authentication of herbal materials
Processing of herbal raw material

2 Biodynamic Agriculture

Good agricultural practices in cultivation of medicinal plants including Organic farming.
Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

3 Indian Systems of Medicine

Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy
Preparation and standardization of Ayurvedic formulations viz Arishta and Asawa, Ghutika, Churna, Lehya and Bhasma.

Unit II**7 Hours****1 Nutraceuticals**

General aspects, Market, growth, scope and types of products available in the market.
Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastrointestinal diseases.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

2 **Herbal-Drug and Herb-**

Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypericum, kava-kava, Ginkgo biloba, Ginseng, Garlic, Pepper & Ephedra.

Unit III

10 Hours

1 **Herbal Cosmetics**

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums, colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

2 **Herbal excipients:**

Herbal Excipients—Significance of substances of natural origin as excipients—colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

3 **Herbal formulations:**

Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

Unit IV

10 Hours

1 **Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs

2 **Patenting and Regulatory requirements of natural products:**

- A. Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy
- B. Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

3 **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

Unit V

7 Hours

1 **General Introduction to Herbal Industry**

Herbal drugs industry: Present scope and future prospects.

A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India

2 **Schedule T—Good Manufacturing Practice of Indian systems of medicine**

Components of GMP (Schedule –T) and its objectives

Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

BP609P HERBAL DRUG TECHNOLOGY (Practical)**List of Experiments**

- 1 To perform preliminary phytochemical screening of crude drugs.
- 2 Determination of the alcohol content of Asava and Arista
- 3 Evaluation of excipients of natural origin
- 4 Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotion and shampoos and their evaluation.
- 5 Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
- 6 Monograph analysis of herbal drugs from recent Pharmacopoeias
- 7 Determination of Aldehyde content
- 8 Determination of Phenol content
- 9 Determination of total alkaloids

Recommended Books (Latest Editions)

- 1 Textbook of Pharmacognosy by Trease & Evans.
- 2 Textbook of Pharmacognosy by Tyler, Brady & Robber.
- 3 Pharmacognosy by Kokate, Purohit and Gokhale
- 4 Essential of Pharmacognosy by Dr. S. H. Ansari
- 5 Pharmacognosy & Phytochemistry by V. D. Rangari
- 6 Pharmacopoeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
- 7 Mukherjee, P. W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

BP604T

**BIOPHARMACEUTICS AND PHARMACOKINETICS
(Theory)**

45 Hours

- 1 **Scope:** This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems raised therein.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
 - 2 Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
 - 3 To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
 - 4 Understand various pharmacokinetic parameters, their significance & applications.
- 3 **Outcomes:** After completion of this course the students shall come to know about the fundamental knowledge on biopharmaceutics and pharmacokinetics and their application in pharmaceutical development, design of dose and dosage regimen.

4 Course Content

Unit I

10 Hours

1 Introduction to Biopharmaceutics

Absorption: Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non-peroral extra-vascular routes, **Distribution:** Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

Unit II

10 Hours

- 1 **Elimination:** Drug metabolism and basic understanding of metabolic pathways, renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non-renal routes of drug excretion of drugs
- 2 **Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Unit III

10 Hours

- 1 **Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment

models, Noncompartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetic parameters- K_E , $t_{1/2}$, V_d , AUC , K_a , Cl and CL_R - definitions, methods of elimination, understanding of their significance and application

Unit IV

8 Hours

1

Multicompartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

Unit V

7 Hours

1

Nonlinear Pharmacokinetics:

- a. Introduction,
- b. Factors causing Non-linearity.
- c. Michaelis-
Menton method of estimating parameters, Explanation with example of drugs

Recommended Books (Latest Editions)

- 1 Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
- 2 Biopharmaceutics and Pharmacokinetics; By Robert F Notari
- 3 Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B. C. Yu 4th edition, Prentice-Hall International edition. USA
- 4 Biopharmaceutics and Pharmacokinetics-
A Treatise, By D. M. Brahmkar and Sunil B. Jaiswal, Vallabh Prakashan Pitampura, Delhi
- 5 Pharmacokinetics: By Milo Gibaldi Donald, R. Mercel Dekker Inc.
- 6 Handbook of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
- 7 Biopharmaceutics; By Swarbrick
- 8 Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
- 9 Dissolution, Bioavailability and Bioequivalence, By Abdou H. M, Mack, Publishing Company, Pennsylvania 1989.
- 10 Biopharmaceutics and Clinical Pharmacokinetics- An introduction 4th
edition Revised and expanded by Robert F Notari Marcel Dekker Inc, New York and Basel, 1987.
- 11 Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvania

BP605T

**PHARMACEUTICAL BIOTECHNOLOGY
(Theory)**

45Hours

1 Scope:

- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises a lot more.
- It is basically a research-based subject.

2 Objectives: Upon completion of this course the students should be able to

- 1 Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
- 2 Genetic engineering applications in relation to production of pharmaceuticals
- 3 Importance of Monoclonal antibodies in Industries
- 4 Appreciate the use of microorganisms in fermentation technology

3 Outcomes: After completing of this course the students shall come to know about the fundamental knowledge on genetic engineering, fermentation technology, diagnostic, prevention and cure of diseases, and production of transgenic animals.

4 Course Content

Unit I

10 Hours

- A Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. B Enzyme Biotechnology- Methods of enzyme immobilization and applications.
- C Biosensors- Working and applications of biosensors in Pharmaceutical Industries. D Brief introduction to Protein Engineering.
- E Use of microbes in industry.
- F Basic principles of genetic engineering.

Unit II

10 Hours

- A Study of cloning vectors, restriction endonucleases and DNA ligase.
- B Recombinant DNA technology. Application of genetic engineering in medicine. C Application of rDNA technology and genetic engineering in the production of:
i) Interferon ii) Vaccines- hepatitis- B iii) Hormones- Insulin. D Brief introduction to PCR

Unit III

10 Hours

- Types of immunity- humoral immunity, cellular immunity
- A Structure of Immunoglobulins
- B Structure and Function of MHC
- C Hypersensitivity reactions, Immune stimulation and Immune suppressions.
- D General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
- E Storage conditions and stability of official vaccines
- F Hybridoma technology- Production, Purification and Applications
- G Blood products and Plasma Substitutes.

Unit IV

8 Hours

- A Immunoblotting techniques-ELISA, Western blotting, Southern blotting.
- B Genetic organization of Eukaryotes and Prokaryotes
- C Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
- D Introduction to Microbial biotransformation and applications.
- E Mutation: Types of mutation/mutants.

Unit V

7 Hours

- A Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
- B Large scale production fermenter design and its various controls.
- C Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
- D Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

Recommended Books (Latest Editions)

- 1 B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
- 2 R.A. Goldshy et al.: Kuby Immunology.
- 3 J.W. Goding: Monoclonal Antibodies.
- 4 J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
- 5 Zaborsky: Immobilized Enzymes. CRC Press, Dearland Ohio.
- 6 S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific

Publication.

- 7 Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

BP606T PHARMACEUTICAL QUALITY ASSURANCE(Theory) 45 Hours

- 1 Scope:** This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 understand the cGMP aspects in pharmaceutical industry
 - 2 appreciate the importance of documentation
 - 3 understand the scope of quality certifications applicable to pharmaceutical industries
 - 4 understand the responsibilities of QA & QC departments
- 3 Outcomes:** After the finale of this course the students shall come to know about the fundamental knowledge on Quality Control and Quality Assurance aspects of Pharmaceutical Industry, cGMP, QC test, Documentation, Quality Certification and Regulatory affairs.

4 Course Content

Unit I

10 Hours

- A **Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP
- B **Total Quality Management (TQM):** Definition, elements, philosophies
- C **ICH Guidelines:** purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines
- D **Quality by design (QbD):** Definition, overview, elements of QbD program, tools **ISO 9000 & ISO 14000:** Overview, Benefits, Elements, steps for registration
- F **NABL accreditation:** Principles and procedures

Unit II

10 Hours

- A **Organization and personnel:** Personnel responsibilities, training, hygiene and personal records.
- B **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.
- C **Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

Unit III

10 Hours

- A **Quality Control:** Quality control test for containers, rubber closures and secondary packing materials.
- B **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for

Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

Unit IV

8 Hours

- A **Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.
- B **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

Unit V

7 Hours

- A **Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.
- B **Warehousing:** Good warehousing practice, materials management

Recommended Books (Latest Editions)

- 1 Quality Assurance Guide by organization of Pharmaceutical Products of India.
- 2 Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
- 3 Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
- 4 A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
- 5 How to Practice GMP's - PP Sharma.
- 6 ISO 9000 and Total Quality Management - Sadhan K Ghosh
- 7 The International Pharmacopoeia - Vol I, II, III, IV -
General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
- 8 Good laboratory Practices - Marcel Dekker Series
- 9 ICH guidelines, ISO 9000 and 14000 guidelines

SemesterVII

BP701T INSTRUMENTALMETHODSOFANALYSIS(Theory)

45 Hours

- 1 **Scope:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
 - 2 Understand the chromatographic separation and analysis of drugs.
 - 3 Perform quantitative & qualitative analysis of drugs using various analytical instruments.
- 3 **Outcomes:** After finishing of this course the students shall come to know about the application of instrumental methods in qualitative and quantitative analysis of drugs. It provides practical knowledge on principle and instrumentation of spectroscopic and chromatographic techniques used for drug testing.
- 4 **Course Content**

Unit I

10 Hours

1 UV Visible spectroscopy

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.

Instrumentation- Sources of radiation, wavelength selectors, sample cells, detectors- Phototube, Photomultiplier tube, Photovoltaic cell, Silicon Photodiode.

Applications- Spectrophotometric titrations, Single component and multi component analysis

2 Fluorimetry

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

Unit II

10 Hours

1 IR spectroscopy

Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations

Instrumentation- Sources of radiation, wavelength selectors, detectors-

Golay cell, Bolometer, Thermocouple, Thermistor, Pyroelectric detector and applications

2 Flame Photometry- Principle, interferences, instrumentation and applications

3 **Atomic absorptionspectroscopy-**
Principle,interferences,instrumentationandapplications

4 **Nepheloturbidometry-**Principle,instrumentationandapplications

UnitIII

10Hours

1 **Introductiontochromatography**

Adsorption and partition column chromatography-Methodology,
advantages,disadvantagesandapplications.

Thin layer chromatography- Introduction, Principle, Methodology, Rf
values,advantages,disadvantagesand applications.

Paper chromatography-Introduction, methodology, development
techniques,advantages,disadvantagesandapplications

2 **Electrophoresis–**

Introduction,factorsaffectingelectrophoreticmobility,Techniquesofpaper,gel,capillaryelectr
ophoresis,applications

Unit IV

8 Hours

1**Gas chromatography** - Introduction, theory, instrumentation,derivatization,
temperatureprogramming,advantages,disadvantagesandapplications

Highperformanceliquidchromatography(HPLC)-

Introduction,theory,instrumentation,advantagesand applications.

UnitV

7 Hours

1 **Ionexchangechromatography-**

Introduction,classification,ionexchangeresins,properties,mechanismofionexchangeproce
ss,factorsaffectingionexchange,methodologyand applications

2 **Gelchromatography-**Introduction,theory,instrumentationandapplications

3 **Affinitychromatography-** Introduction,theory, instrumentationandapplications

BP705P INSTRUMENTALMETHODSOFANALYSIS(Practical)

4Hours/ Week

Listof Experiments

- 1 Determinationofabsorptionmaximaandeffectofsolventsonabsorptionmaximaoforgani
c compounds
- 2 Estimationofdextrosebycolorimetry
- 3 Estimation of sulfanilamidebycolorimetry
- 4 Simultaneousestimation of ibuprofenandparacetamolbyUVspectroscopy
- 5 AssayofparacetamolbyUV-Spectrophotometry
- 6 Estimationofquinine sulfatebyfluorimetry
- 7 Studyofquenching offluorescence
- 8 Determinationofsodiumbyflamephotometry

- 9 Determination of potassium by flame photometry
- 10 Determination of chlorides and sulphates by nepheloturbidometry
- 11 Separation of amino acids by paper chromatography
- 12 Separation of sugars by thin layer chromatography
- 13 Separation of plant pigments by column chromatography
- 14 Demonstration experiment on HPLC
- 15 Demonstration experiment on Gas Chromatography

Recommended Books (Latest Editions)

- 1 Instrumental Methods of Chemical Analysis by B. K. Sharma
- 2 Organic spectroscopy by Y. R. Sharma
- 3 Textbook of Pharmaceutical Analysis by Kenneth A. Connors
- 4 Vogel's Textbook of Quantitative Chemical Analysis by A. I. Vogel
- 5 Practical Pharmaceutical Chemistry by A. H. Beckett and J. B. Stenlake
- 6 Organic Chemistry by L. L. Finar
- 7 Organic spectroscopy by William Kemp
- 8 Quantitative Analysis of Drugs by D. C. Garrett
- 9 Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
- 10 Spectrophotometric identification of Organic Compounds by Silverstein

BP702T INDUSTRIAL PHARMACY II (Theory)**45 Hours**

- 1 Scope:** This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market.
- 2 Objectives:** Upon completion of this course the students should be able to
 - 1 Know the process of pilot plant and scale up of pharmaceutical dosage forms
 - 2 Understand the process of technology transfer from lab scale to commercial batch
 - 3 Know different Laws and Acts that regulate pharmaceutical industry
 - 4 Understand the approval process and regulatory requirements for drug products
- 3 Outcomes:** End of this subject the students shall come to know about the fundamental knowledge on pharmaceutical product development and translation from laboratory to market.
- 4 Course Content**

Unit I**10 Hours**

1 Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

Unit II**10 Hours**

1 Technology development and transfer: WHO guidelines for Technology Transfer (TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R&D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

Unit III**10 Hours**

1 Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals

Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for

FDASubmissions,ManagementofClinicalStudies.

Unit IV

8 Hours

1Qualitymanagementsystems:Qualitymanagement&Certifications:ConceptofQuality,TotalQualityManagement,QualitybyDesign(QbD),SixSigmaconcept,Outof Specifications (OOS), Change control, Introduction toISO 9000 series of qualitysystemsstandards, ISO14000,NABL,GLP

UnitV

7 Hours

1IndianRegulatoryRequirements:CentralDrugStandardControlOrganization(CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate ofPharmaceutical Product (COPP), Regulatory requirements and approval procedures forNewDrugs.

RecommendedBooks(LatestEditions)

- 1 Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April availableat [http, //en.wikipedia.org/wiki/Regulatory_Affairs](http://en.wikipedia.org/wiki/Regulatory_Affairs).
- 2 International Regulatory Affairs Updates, 2005. available at<http://www.iraup.com/about.php>
- 3 DouglasJPisanoandDavidS. Mantus.TextbookofFDARegulatoryAffairsAGuidefor PrescriptionDrugs,MedicalDevices,andBiologics'SecondEdition.
- 4 RegulatoryAffairsbroughtbylearningplus,inc.availableat[http. //www.cgmp.com/ra.htm](http://www.cgmp.com/ra.htm).

BP703T PHARMACY PRACTICE(Theory)**45Hours**

1 Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community setup.

2 Objectives: Upon completion of this course the students should be able to

- 1 Know various drug distribution methods in a hospital
- 2 Appreciate the pharmacy stores management and inventory control
- 3 Monitor drug therapy of patient through medication chart review and clinical review
- 4 Obtain medication history interview and counsel the patients
- 5 Identify drug related problems
- 6 Detect and assess adverse drug reactions
- 7 Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
- 8 Know pharmaceutical care services
- 9 Do patient counseling in community pharmacy;
- 10 Appreciate the concept of Rational drug therapy.

3 Outcomes: Upon completion of this course the students shall come to know about the hospital pharmacy to learn various skills like drug distribution, drug information, therapeutic drug monitoring, dispensing of drugs, safe medication and patient counseling

4 Course Content**Unit I****10 Hours****A Hospital and its organization**

Definition, Classification of hospital-

Primary, Secondary and Tertiary hospitals, Classification based on clinical and non-clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

B Hospital pharmacy and its organization

Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

C Adverse drug reaction

Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction-

beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods of

or detecting drug

interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

D Community Pharmacy

Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Unit II

10 Hours

A Drug distribution system in a hospital

Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

B Hospital formulary

Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

C Therapeutic drug monitoring

Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

D Medication adherence

Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

E Patient medication history interview

Need for the patient medication history interview, medication interview forms.

F Community pharmacy management

Financial, materials, staff, and infrastructure requirements.

Unit III

10 Hours

A Pharmacy and therapeutic committee

Organization, functions, Policies of the pharmacy and therapeutic committee including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

B Drug information services

Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

C Patient counseling

Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

D Education and training program in the hospital

Role of pharmacist in the education and training program, Internal and external training program, Service to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

E Prescribed medication order and communications skills

Prescribed medication order- interpretation and legal requirements, and Communications skills-communication with prescribers and patients.

Unit IV

8 Hours

A Budget preparation and implementation

Budget preparation and implementation
B Clinical Pharmacy

Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care.

Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

C Over the counter (OTC) sales

Introduction and sale of over the counter, and Rational use of common over the counter medications.

Unit V

7 Hours

A Drug store management and inventory control

Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

B Investigational use of drugs

Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

C Interpretation of Clinical Laboratory Tests

Blood chemistry, hematology, and urinalysis

Recommended Books (Latest Editions)

- 1 Merchant S.H. and Dr. J.S. Quadry. A text book of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.

- 2 Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice- essential concepts and skills, 1st ed. Chennai: Orient Longman Private Limited;2004.
- 3 William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea & Febiger; 1986.
- 4 Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
- 5 Scott LT. Basic skills in interpreting laboratory data, 4th ed. American Society of Health System Pharmacists Inc; 2009.
- 6 Parmar N. S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers & Distributors; 2008.

Journals:

- 1 Therapeutic drug monitoring. ISSN: 0163-4356
- 2 Journal of pharmacy practice. ISSN: 0974-8326
- 3 American journal of health system pharmacy. ISSN: 1535-2900 (online)
- 4 Pharmacy times (Monthly magazine)

BP704T NOVEL DRUG DELIVERY SYSTEMS(Theory)**45 Hours**

- 1 **Scope:** This subject is designed to impart basic knowledge on the area of novel drug delivery systems.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 To understand various approaches for development of novel drug delivery systems.
 - 2 To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation
- 3 **Outcomes:** After completion of this course the students shall come to know about the fundamental knowledge on selection of drug and polymers for the development of Novel Drug Delivery System, their formulation and evaluation.
- 4 **Course Content**

Unit I**10 Hours**

- A **Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations
- B **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Unit II**10 Hours**

- A **Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications
- B **Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion/mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems
- C **Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump

Unit III**10 Hours**

- A **Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches
- B **Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications
- C **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of

drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

Unit IV

8 Hours

A Targeted drug Delivery: Concepts and approaches, advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

Unit V

7 Hours

- A **Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome – Preliminary study, ocular formulations and ocuserts
- B **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intrauterine devices (IUDs) and applications

Recommended Books (Latest Editions)

- 1 YW. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
- 2 Robinson, J.R., Lee V.H.L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
- 3 Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
- 4 N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
- 5 S.P. Vyas and R.K. Khar, Controlled Drug Delivery- concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals:

- 1 Indian Journal of Pharmaceutical Sciences (IPA)
- 2 Indian Drugs (IDMA)
- 3 Journal of Controlled Release (Elsevier Sciences)
- 4 Drug Development and Industrial Pharmacy (Marcel & Decker)
- 5 International Journal of Pharmaceutics (Elsevier Sciences)

Semester

VIII BP801T **BIOSTATISTICS AND RESEARCH METHODOLOGY** (Theory)

45 Hours

1 Scope: To understand the applications of Biostatistics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

2 Objectives: Upon completion of this course the students should be able to

- 1 Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
- 2 Know the various statistical techniques to solve statistical problems
- 3 Appreciate statistical techniques in solving the problems.

3 Outcomes: After completion of this course the students shall come to know about the application of Biostatistics in Pharmacy. It gives the knowledge of descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory. The students will know about the sampling technique, parametric tests, Non Parametric tests, ANOVA and use of Design of Experiments, SPSS, R and MINITAB statistical software's in designing of the formulations.

4 Course Content

Unit I

10 Hours

- A **Introduction:** Statistics, Biostatistics, Frequency distribution
- B **Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples
- C **Measures of dispersion:** Dispersion, Range, standard deviation, Pharmaceutical problems
- D **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation- Pharmaceutical examples

Unit II

10 Hours

- A **Regression:** Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression- Pharmaceutical Examples
- B **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties-problems
Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM)- Pharmaceutical examples
- C **Parametric test:** t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significant difference

Unit III**10 Hours**

- A **Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test
- B **Introduction to Research:** Need for research, Need for design of Experiments, Experimental Design Technique, plagiarism
- C **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Contour Plot graph
- D **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts

Unit IV**8 Hours**

- A Blocking and confounding system for Two-level factorials
- B **Regression modeling:** Hypothesis testing in Simple and Multiple regression models
- C **Introduction to Practical components of Industrial and Clinical Trials Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach

Unit V**7 Hours**

- A **Design and Analysis of experiments:**
- B **Factorial Design:** Definition, $2^2, 2^3$ design. Advantage of factorial design **Response**
- C **Surface methodology:** Central composite design, Historical design, Optimization Techniques

Recommended Books (Latest Editions)

- 1 Pharmaceutical Statistics - Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.
- 2 Fundamental of Statistics - Himalaya Publishing House - S.C. Gupta
- 3 Design and Analysis of Experiments - PHI Learning Private Limited, R. Pannarselvam,
- 4 Design and Analysis of Experiments - Wiley Students Edition, Douglas and C. Montgomery

BP802T SOCIAL AND PREVENTIVE PHARMACY**45 Hours**

- 1 **Scope:** The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.
- 2 **Objectives:** Upon completion of this course the students should be able to
 - 1 Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
 - 2 Have a critical way of thinking based on current health care development.
 - 3 Evaluate alternative ways of solving problems related to health and pharmaceutical issues
- 3 **Outcomes:** After completing of this course the students shall come to know about the number of health issues and their challenges. It provides the knowledge of National health programme and contribution of Pharmacists in such national programmes.

4 Course Content**Unit I****10 Hours**

- A **Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.
- B **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.
- C **Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health
- D **Hygiene and health:** personal hygiene and health care; avoidable habits

Unit II**10 Hours**

- A **Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chikungunya, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

Unit III**10 Hours****A**

National health programs, its objectives, functioning and outcome of the following:
HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme,

National mental health program,
National programme for prevention and control of deafness,
Universal immunization programme,
National programme for control of blindness,
Pulse polio programme.

Unit IV

8 Hours

- A National health intervention programme for mother and child,
National family welfare programme,
National tobacco control programme,
National Malaria Prevention Program,
National programme for the health care for the elderly,
Social health programme;
Role of WHO in Indian national program

Unit V

7 Hours

- A Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

Recommended Books (Latest Editions)

- 1 Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
- 2 Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Sahal Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
- 3 Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
- 4 Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
- 5 Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
- 6 Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

- 1 Research in Social and Administrative Pharmacy, Elsevier, Ireland

BP803ET PHARMAMARKETINGMANAGEMENT(Theory)**45 Hours**

- 1 **Scope:** The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.
- 2 **Objectives:** The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.
- 3 **Outcomes:** This course provides knowledge of know-how of marketing management of Pharmamarketing.
- 4 **Course Content**

Unit I**10 Hours****A Marketing:**

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

B Pharmaceutical market:

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.

Unit II**10 Hours****A Product decision:**

Classification, product line and product mix decisions, product lifecycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Unit III**10 Hours****A Promotion:**

Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Unit IV**10 Hours****A Pharmaceutical marketing channels:**

Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

B Professional sales representative (PSR):

Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Unit V

10 Hours

A Pricing:

Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

B Emerging concepts in marketing:

Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

Recommended Books (Latest Editions)

- 1 Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
- 2 Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata McGraw Hill, New Delhi.
- 3 Dhruv Grewal and Michael Levy: Marketing, Tata McGraw Hill
- 4 Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
- 5 Rajan Saxena: Marketing Management; Tata McGraw-Hill (India Edition)
- 6 Ramaswamy, U. S. & Nanakamari, S: Marketing Management: Global Perspective, Indian Context, Macmillan India, New Delhi.
- 7 Shanker, Ravi: Service Marketing, Excel Books, New Delhi
- 8 Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

BP804ET PHARMACEUTICAL REGULATORY SCIENCE(Theory) 45 Hours

1 Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

2 Objectives: Upon completion of the subject student shall be able to;

- 1 Know about the process of drug discovery and development
- 2 Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
- 3 Know the regulatory approval process and their registration in Indian and international markets

3 Outcomes: It provides the fundamental knowledge on the regulatory requirement of approval of new drugs and drug products in regulated market of India & other country like; US, EU, Japan, Australia, UK etc.

4 Course Content

Unit I

10 Hours

A New Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit II

10 Hours

A Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

B Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

Unit III

10 Hours

A Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical

Unit IV**8 Hours****A Clinical trials**

Developing clinical trial protocols, Institutional Review Board/Independent Ethics committee-formation and working procedures, Informed consent process and procedures, GCP obligation of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance-safety monitoring in clinical trials

Unit V**7 Hours****A Regulatory Concepts**

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended Books (Latest Editions)

- 1 Drug Regulatory Affairs by Sachin Itkar, Dr. N. S. Vyawahare, Nirali Prakashan.
- 2 The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol. 185. Informa Health care Publishers.
- 3 New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol. 190.
- 4 Guidebook for drug regulatory submissions/Sandy Weinberg. By John Wiley & Sons. Inc.
- 5 FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics / edited by Douglas J. Pisano, David Mantus.
- 6 Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol. 143
- 7 Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
- 8 Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
- 9 Drugs: From Discovery to Approval, Second Edition By Rick Ng

BP805T PHARMACOVIGILANCE(Theory)**45Hours**

1 Scope: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

2 Objectives: Upon completion of this course the students should be able to

- 1 Why drug safety monitoring is important?
- 2 History and development of pharmacovigilance
- 3 National and international scenario of pharmacovigilance
- 4 Dictionaries, coding and terminologies used in pharmacovigilance
- 5 Detection of new adverse drug reactions and their assessment
- 6 International standards for classification of diseases and drugs
- 7 Adverse drug reaction reporting systems and communication in pharmacovigilance
- 8 Methods to generate safety data during preclinical, clinical and post approval phases of drugs' lifecycle
- 9 Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
- 10 Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
- 11 ICH guidelines for CSR, PSUR, expedited reporting, pharmacovigilance planning
- 12 CIOMS requirements for ADR reporting
- 13 Writing case narratives of adverse events and their quality.

3 Outcomes: This Elective course provides the fundamental knowledge of Pharmacovigilance and its use in generating safety data and signal detection

4 Course Content**Unit I****10 Hours****A Introduction to Pharmacovigilance**

History and development of Pharmacovigilance
Importance of safety monitoring of Medicine
WHO international drug monitoring programme
Pharmacovigilance Program of India (PvPI)

B Introduction to adverse drug

reactions Definitions and classification of ADRs
Detection and reporting
Methods in Causality
assessment
Severity and seriousness

assessment

- Predictability and preventability
assessmentManagement
ofadversedrugreactions
- C **Basic terminologies used in pharmacovigilance** Terminologiesof
adversemedicationrelatedeventsRegulatoryterminol
ogies

UnitII

10 Hours

- A **Druganddiseaseclassification**
Anatomical,therapeuticandchemicalclassificationofdrugsInt
ernationalclassification ofdiseases
Dailydefineddoses
InternationalNonproprietaryNamesfordrugs
- B **Drugdictionariesandcodinginpharmacovigilance**
WHO adverse reaction
terminologiesMedDRAandStandardisedMed
DRAqueriesWHOdrugdictionary
Eudravigilancemedicinalproductdictionary
- C **Informationresourcesin pharmacovigilance**
Basicdrug
informationresourcesSpecialised
resourcesforADRs
- D **Establishingpharmacovigilanceprogramme**
Establishing inahospital
Establishment&operationofdrugsafetydepartment
inindustryContractResearchOrganisations(CROs)

UnitIII

10Hours

- A **Vaccine safety surveillance**Vaccine
PharmacovigilanceVaccinati
onfailure
AdverseeventsfollowingimmunizationB
- Pharmacovigilancemethods**
Passive surveillance–
SpontaneousreportsandcaseseriesStimulatedreporting
Active surveillance – Sentinel sites, drug event monitoring and
registriesComparativeobservationalstudies
Crossectionalstudy,casecontrolstudyandcohort study

Targeted clinical investigations

C Communication in pharmacovigilance

Effective communication in

Pharmacovigilance Communication in Drug Safety Crisis management

Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

Unit IV

8 Hours

A Safety data

generation Preclinical phase

Preclinical phase

Post approval phase (PMS)

B ICH Guidelines for

Pharmacovigilance Organization and

objectives of ICH Expedited reporting

Individual case safety

reports Periodic safety update

reports Post approval expedited

reporting Pharmacovigilance planning

ing

Good clinical practice in pharmacovigilance studies

Unit V

7 Hours

A Pharmacogenomics of adverse drug reactions

Genetics related ADR with example focusing PK parameters.

B Drug safety evaluation in special population

Paediatrics

Pregnancy and lactation

Geriatrics

C CIOMS

CIOMS Working

Groups CIOMS Form

D CDSCO (India) and Pharmacovigilance

D & C Act and Schedule Y

Differences in Indian and global pharmacovigilance requirements

Recommended Books (Latest Editions)

- 1 Textbook of Pharmacovigilance: SK Gupta, Jaypee Brothers, Medical Publishers.
- 2 Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett

- Publishers.
- 3 Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
 - 4 Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
 - 5 An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.
 - 6 Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones & Bartlett Publishers.
 - 7 Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E. Kimmel, Sean Hennessy, Wiley Publishers.
 - 8 A Textbook of Clinical Pharmacy Practice - Essential Concepts and Skills: G. Parthasarathi, Karin Nyfort Hansen, Milap C. Nahata
 - 9 National Formulary of India
 - 10 Text Book of Medicine by Yashpal Munjal
 - 11 Textbook of Pharmacovigilance: concept and practice by G. P. Mohanta and P. K. Manna
 - 12 <http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297>
 - 13 <http://www.ich.org/>
 - 14 <http://www.cioms.ch/>
 - 15 <http://cdsco.nic.in/>
 - 16 http://www.who.int/vaccine_safety/en/
 - 17 http://www.ipc.gov.in/PvPI/pv_home.html

BP806ET QUALITY CONTROL AND STANDARDIZATION OF 45 Hours
HERBALS (Theory)

1 Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

2 Objectives: Upon completion of this course the students should be able to

- 1 Know WHO guidelines for quality control of herbal drugs
- 2 Know Quality assurance in herbal drug industry
- 3 Know the regulatory approval process and their registration in Indian and international markets
- 4 Appreciate EU and ICH guidelines for quality control of herbal drugs

3 Outcomes: It provides the fundamental knowledge on various methods and guidelines for evaluation and standardization of herbs and herbal drugs. This subject also gives knowledge of cGMP, GAP and GLP in traditional system of medicines

4 Course Content

Unit I 10 Hours

- A Basic tests for drugs –
Pharmaceutical substances, Medicinal plants materials and dosage forms
- B WHO guidelines for quality control of herbal drugs.
- C Evaluation of commercial crude drugs intended for use

Unit II 10 Hours

- A **Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP in traditional system of medicine.
- B WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines
WHO Guidelines on GACP for Medicinal Plants.

Unit III 10 Hours

- A EU and ICH guidelines for quality control of herbal drugs.
- B Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

Unit IV 8 Hours

- A Stability testing of herbal medicines.
- B Application of various chromatographic techniques in standardization of herbal products.
Preparation of documents for new drug application and export registration
- D GMP requirements and Drugs & Cosmetics Act provisions.

Unit V 7 Hours

- A Regulatory requirements for herbal medicines.

- B WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems C
Comparison of various Herbal Pharmacopoeias.
- D Role of chemical and biological markers in standardization of herbal products

Recommended Books (Latest Editions)

- 1 Pharmacognosy by Trease and Evans
- 2 Pharmacognosy by Kokate, Purohit and Gokhale
- 3 Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.
- 4 Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
- 5 EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
- 6 Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
- 7 Shinde M.V., Dhalwalk K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p.4-8.
- 8 WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
- 9 WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
- 10 WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
- 11 WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
- 12 WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP807ET COMPUTERAIDEDDRUGDESIGN(Theory)**45 Hours**

- 1 Scope:** This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.
- 2 Objectives:** Upon completion of this course the students should be able to
- 1 Design and discovery of lead molecules
 - 2 The role of drug design in drug discovery process
 - 3 The concept of QSAR and docking
 - 4 Various strategies to develop new drug like molecules.
 - 5 The design of new drug molecules using molecular modeling software
- 3 Outcomes:** This Elective course provides the fundamental knowledge of rational drug design process and various *In silico* techniques used in rational drug design process

4 Course Content**Unit I****10 Hours****Introduction to Drug Discovery and Development**

Stages of drug discovery and development

Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

- C Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

Unit II**10 Hours****A Quantitative Structure Activity Relationship (QSAR)**

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Unit III**10 Hours****A Molecular Modeling and virtual screening techniques**

Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

Unit IV**8 Hours**

A Informatics & Methods in drug design

Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

Unit V

7 Hours

A Molecular Modeling:

Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minimization determination.

Recommended Books (Latest Editions)

- 1 Robert GCK, ed., "Drug Action at the Molecular Level" University Park Press Baltimore.
- 2 Martin YC. "Quantitative Drug Design" Dekker, New York.
- 3 Delgado JN, Remers WA eds "Wilson & Gisvold's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
- 4 Foye WO "Principles of Medicinal Chemistry" Lea & Febiger.
- 5 Korolkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
- 6 Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
- 7 Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
- 8 Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
- 9 Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

BP808ET CELL AND MOLECULAR BIOLOGY (Elective subject)**45 Hours****1 Scope:**

- Cell biology is a branch of biology that studies cells— their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

2 Objectives: Upon completion of this course the students should be able to

- 1 Summarize cell and molecular biology history.
- 2 Summarize cellular functioning and composition.
- 3 Describe the chemical foundations of cell biology.
- 4 Summarize the DNA properties of cell biology.
- 5 Describe protein structure and function.
- 6 Describe cellular membrane structure and function.
- 7 Describe basic molecular genetic mechanisms.
- 8 Summarize the Cell Cycle

3 Outcomes: This Elective course provides the fundamental knowledge of cell, their physiological properties, structure, life cycle, division, death and function at microscopic and molecular level**4 Course Content****Unit I****10 Hours**

- A Cell and Molecular Biology: Definition, theory and basics and Applications. B Cell and Molecular Biology: History and Summation.
- C Properties of cells and cell membrane. D Prokaryotic versus Eukaryotic
- E Cellular Reproduction
- F Chemical Foundations—an Introduction and Reactions (Types)

Unit II**10 Hours**

- A DNA and the Flow of Molecular
- B Information DNA Functioning
- C DNA and RNA
- D Types of RNA
- E Transcription and Translation

Unit III**10 Hours**

- A Proteins:Defined**and**AminoAcids
- B ProteinStructure
- C RegularitiesinProteinPathways
- D CellularProcesses
- E PositiveControlandsignificanceof ProteinSynthesis

Unit IV

8 Hours

- A ScienceofGenetics
- B TransgenicsandGenomic Analysis
- C CellCycleanalysis
- D MitosisandMeiosis
- E CellularActivitiesandCheckpoints

UnitV

7 Hours

- A CellSignals:Introduction
- B Receptorsfor CellSignals
- C SignalingPathways:Overview
- D MisregulationofSignalingPathways
- E Protein-Kinases:Functioning

RecommendedBooks(LatestEditions)

- 1 W.B.HugoandA.D.Russel:PharmaceuticalMicrobiology,BlackwellScie
ntificpublications,OxfordLondon.
- 2 Prescott and Dunn., Industrial Microbiology, 4th edition,
CBSPublishers&Distributors,Delhi.
- 3 Pelczar,ChanKreig,Microbiology,TataMcGrawHilledn.
- 4 MalcolmHarris,BalliereTindallandCox:PharmaceuticalMicrobiology.
- 5 Rose:IndustrialMicrobiology.
- 6 Probisher,Hinsdillet al:Fundamentalsof Microbiology,9thed.Japan
- 7 CooperandGunn's:TutorialPharmacy,CBSPublisherandDistribution.
- 8 Peppler:MicrobialTechnology.
- 9 Edward:FundamentalsofMicrobiology.
- 10 N.K.Jain:PharmaceuticalMicrobiology,VallabhPrakashan,Delhi
- 11 Bergeys manual of systematic bacteriology, Williams and Wilkins-
AWaverlycompany
- 12 B.R.Glickand J.J.Pasternak:MolecularBiotechnology:Principles andApplications
ofRecombinantDNA:ASMPressWashingtonD.C.
- 13 RAGoldshyet. al.,:KubyImmunology.

BP809ET COSMETICSCIENCE(Theory)**45Hours**

- 1 Outcomes:** This Elective course provides the fundamental knowledge of cosmetic products and their evaluation. It also gives the knowledge of cosmetic excipients and their reactions on skin, hair and oral cavity.

2 Course Content**Unit I****10 Hours**

- A Classification of cosmetic and cosmeceutical products
- B Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs
- C **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application
- D **Skin:** Basic structure and function of skin.
- E **Hair:** Basic structure of hair. Hair growth cycle.
- F **Oral Cavity:** Common problem associated with teeth and gums.

Unit II**10 Hours**

- A **Principles of formulation and building blocks of skin care products:**
Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.
- B **Antiperspirants & deodorants** - Actives & mechanism of action.
- C **Principles of formulation and building blocks of Hair care products:**
Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils.
Chemistry and formulation of Para-phenylenediamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

Unit III**10 Hours**

- A Sun protection, Classification of Sunscreens and SPF.
- B **Role of herbs in cosmetics:**
Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove
- C **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste.

Unit IV**8 Hours**

- A Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer.
Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties

Soaps, and syndet bars. Evolution and skin benefits.

Unit V

7 Hours

- A Oily and dry skin, causes leading to dry skin, skin moisturisation.
Basic understanding of the terms Comedogenic, dermatitis.
- B Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.
- C Antiperspirants and Deodorants- Actives and mechanism of action

Recommended Books (Latest Editions)

- 1 Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
- 2 Cosmetics—
Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
- 3 Textbook of cosmeticology by Sanju Nanda & Roop K. Khar, Tata Publishers.

BP810ET PHARMACOLOGICAL SCREENING METHODS**45 Hours**

- 1 Scope:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretation of results
- 2 Objectives:** Upon completion of the course the students shall be able to,
 - 1 Appreciate the applications of various commonly used laboratory animals.
 - 2 Appreciate and demonstrate
 - 3 Appreciate and demonstrate the importance of biostatistics and research methodology
 - 4 Design and execute a research hypothesis independently
- 3 Outcomes:** It provides the fundamental knowledge of preclinical studies in experimental animals including design, conduct and interpretation of results.
- 4 Course Content**

Unit I**8 Hours****A Laboratory Animals:**

Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

Unit II**10 Hours****A Preclinical screening models**

Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationales for selection of animal species and sex for the study.

B Study of screening animal models for

Diuretics, nootropics, anti-Parkinson's, antiasthmatics,

C Preclinical screening models: for CNS activity-analgesic, antipyretic, anti-

inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, anti-epileptic, anti-parkinsonism, Alzheimer's disease

Unit III**10 Hours****A Preclinical screening models: for ANS activity, sympathomimetics,**

sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics

Unit IV**10 Hours****A Preclinical screening models: for CVS activity-**

anti-hypertensives, diuretics, antiarrhythmic, anti-dyslipidemic, anti-aggregatory, coagulants, and

anticoagulants

Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics

Unit V

5 Hours

A Research methodology and Bio-statistics

B Selection of research topic, review of literature, research hypothesis and study design
C Pre-clinical data analysis and interpretation using Student's 't' test and One-way ANOVA. Graphical representation of data

Recommended Books (Latest Editions)

- 1 Fundamental of experimental Pharmacology-by M.N. Ghosh
- 2 Handbook of Experimental Pharmacology-S.K. Kulakarni
- 3 CPCSEA guidelines for laboratory animal facility.
- 4 Drug discovery and Evaluation by Vogel H.G.
- 5 Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
- 6 Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

BP811ET ADVANCED INSTRUMENTATION TECHNIQUES**45 Hours**

- 1 Scope:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.
- 2 Objectives:** Upon completion of the course the students shall be able to,
- 1 Understand the advanced instruments used and its applications in drug analysis
 - 2 Understand the chromatographic separation and analysis of drugs.
 - 3 Understand the calibration of various analytical instruments
 - 4 Know analysis of drugs using various analytical instruments.
- 3 Outcomes:** It will provide the knowledge of application of modern instrumental methods in qualitative and quantitative analysis of drugs.
- 4 Course Content**

Unit I**10 Hours****A Nuclear Magnetic Resonance spectroscopy**

Principles of ¹H-NMR and ¹³C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin-spin coupling, relaxation, instrumentation and applications

B Mass Spectrometry-Principles, Fragmentation, Ionization techniques—Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications

Unit II**10 Hours**

A Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

B X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X-ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

Unit III**10 Hours**

A Calibration and validation-as per ICH and USFDA

guidelines B Calibration of following Instruments

Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC

Unit IV**8 Hours**

A Radioimmunoassay: Importance, various components, Principle, different methods,

	Limitation and Application of Radioimmunoassay	
B	Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	
Unit V		7 Hours
A	Hyphenated techniques- LC-MS/MS, GC-MS/MS, HPTLC-MS	

Recommended Books (Latest Editions)

- 1 Instrumental Methods of Chemical Analysis by B. K. Sharma
- 2 Organic spectroscopy by Y. R. Sharma
- 3 Textbook of Pharmaceutical Analysis by Kenneth A. Connors
- 4 Vogel's Textbook of Quantitative Chemical Analysis by A. I. Vogel
- 5 Practical Pharmaceutical Chemistry by A. H. Beckett and J. B. Stenlake
- 6 Organic Chemistry by I. L. Finar
- 7 Organic spectroscopy by William Kemp
- 8 Quantitative Analysis of Drugs by D. C. Garrett
- 9 Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
- 10 Spectrophotometric identification of Organic Compounds by Silverstein

BP812ET DIETARY SUPPLEMENTS AND NUTRACEUTICALS**No. of Hours: 3****Tutorial: 1****Credit Point: 4**

- 1 Scope:** This subject covers foundational topics that are important for understanding the need and requirements of dietary supplements among different groups in the population.
- 2 Objectives:** This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to
- 1 Understand the need of supplements by the different group of people to maintain healthy life.
 - 2 Understand the outcome of deficiencies in dietary supplements.
 - 3 Appreciate the components in dietary supplements and the application.
 - 4 Appreciate the regulatory and commercial aspects of dietary supplements including health claims.
- 3 Outcomes:** This Elective course provides the fundamental knowledge for understanding the need and requirements of dietary supplements among different groups in the population. It gives the knowledge of Nutraceuticals, phytochemicals as nutraceuticals, production of free radicals and its effect on various diseases, and use of antioxidants. It also provides the detailed knowledge of storage and interaction of various environmental factors on the potential of nutraceuticals and various regulatory aspects like; FSSAI, FDA, MPO, AGMARK, HACCP and GMP on food safety. It also emphasizes about the Pharmacopoeial specifications for dietary supplements and nutraceuticals.

4 Course Content**Unit I****7 Hours**

- A Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.
- B Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.
- C Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

Unit II**15 Hours**

- Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature, medicinal benefits) of following
- A Carotenoids- α and β -Carotene, Lycopene, Xanthophylls, lutein

- B Sulfides:Diallylsulfides,Allyltrisulfide.C
Polyphenolics:Reservetrol
- D Flavonoids-Rutin,Naringin,Quercitin,Anthocyanidins,catechins,FlavonesE
Prebiotics/Probiotics.:Fructooligosaccharides,Lactobacillum
- F Phyto estrogens : Isoflavones, daidzein, Geebustin,
lignansG Tocopherols
- H

Proteins,vitamins,minerals,cereal,vegetablesandbeveragesasfunctionalfoods:oats,w
heatbran,rice bran,seafoods,coffee,tea andthelike.

UnitIII

7Hours

- A Introduction to free radicals: Free radicals, reactive oxygen species, production of
freeradicals in cells, damaging reactions of free radicals on lipids, proteins,
Carbohydrates,nucleic acids.
- B Dietaryfibresandcomplexcarbohydratesasfunctionalfoodingredients.

Unit IV

10Hours

- A FreeradicalsinDiabetesmellitus,Inflammation,Ischemicreperfusioninjury,Can
cer, Atherosclerosis, Free radicals in brain metabolism and
pathology,kidney damage, muscle damage. Free radicals involvement in
otherdisorders.Freeradicalstheoryofageing.
- B Antioxidants: Endogenous antioxidants – enzymatic and
nonenzymaticantioxidant defence, Superoxide dismutase, catalase,
Glutathione peroxidase,GlutathioneVitaminC,Vitamin E,α-
Lipoicacid,melatonin
Syntheticantioxidants: ButylatedhydroxyToluene,ButylatedhydroxyAnisole.
- C Functionalfoodsforchronicdiseaseprevention

UnitV

7 Hours

- A Effect of processing, storage and interactions of various environmental factors on
thepotentialofnutraceuticals.
- B RegulatoryAspects; FSSAI, FDA,FPO,MPO,
AGMARK.HACCPandGMPsonFoodSafety.Adulteration offoods.
- C PharmacopoeialSpecificationsfordietarysupplementsandnutraceuticals.

RecommendedBooks(LatestEditions)

- 1 DieteticsbySriLakshmi
- 2 Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti
andP.Faizal:BSPunblication.
- 3 Advanced NutritionalTherapiesbyGopalanK.A. (1996).

- 4 The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
- 5 Prescription for Nutritional Healing by James F. Balch and Phyllis A. Balch 2nd Edn., Avery Publishing Group, NY (1997).
- 6 G. Gibson and C. Williams Editors 2000 *Functional Foods* Woodhead Publ. Co. London.
- 7 Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.
- 8 Labuza, T. P. 2000 *Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in Essential of Functional Foods* M. K. Sachmidland T. P. Labuza eds. Aspen Press.
- 9 Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
- 10 Shils, M. E., Olson, J. A., Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

BP813E Elective course on Pharmaceutical Product Development No. of Hours:

3 Tutorial: 1

Credit Point: 4

1 Course Content

Unit I

10 Hours

A Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms

Unit II

10 Hours

A An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

- A Solvents and solubilizers
- B Cyclodextrins and their applications
- C Non - ionic surfactants and their applications
- D Polyethyleneglycols and sorbitols
- E Suspending and emulsifying agents
- F Semisolid excipients

Unit III

10 Hours

A An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

- A Tablet and capsule excipients
 - B Directly compressible vehicles
 - C Coat materials
 - D Excipients in parenteral and aerosols products
 - E Excipients for formulation of NDSS
- Selection and application of excipients in pharmaceutical formulations with specific industrial applications

Unit IV

8 Hours

- A Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.

Unit V

7 Hours

- A Selection and quality control testing of packaging materials for pharmaceutical product development-regulatory considerations.

Recommended Books(Latest Editions)

- 1 Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, Charles Bon; Marcel Dekker Inc.
- 2 Encyclopedia of Pharmaceutical Technology, edited by James Swarbrick, Third Edition, Informa Healthcare publishers.
- 3 Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman and Leon Lachman; Marcel Dekker, Inc.
- 4 The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by R. K. Khar, S. P. Vyas, Farhan J. Ahmad, Gaurav K. Jain; CBS Publishers and Distributors Pvt. Ltd. 2013.
- 5 Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BIP Publications Pvt. Ltd.
- 6 Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K. Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
- 7 R. K. Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
- 8 Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B. Popovich, Howard C. Ansel, 9th Ed. 40
- 9 Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton, 3rd Ed.
- 10 Remington – The Science and Practice of Pharmacy, 20th Ed.
- 11 Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman and Joseph B. Schwartz
- 12 Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H. A. Liberman, Martin, M. Rand and Gilbert S. Banker.
- 13 Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis and H. A. Libermann.

