Pharmacy Council of India

New Delhi

Rules & Syllabus for the Bachelor of

Pharmacy (B. Pharm) Course

[Framed under Regulation 6, 7 & 8 of the Bachelor of Pharmacy (B. Pharm) course regulations 2014]

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:

Candidate 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 examination 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 I and II 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	Communication 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	Communication skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
BP113CE	Comprehensive online examination**	-	-	-
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)

**Audit course

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	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP203T	Biochemistry – Theory	3	1	4
BP204T	Pathophysiology – Theory	3	1	4
BP205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP206T	Environmental sciences – Theory *	3	-	3
BP207P	Human Anatomy and Physiology II –Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I– Practical	4	-	2
BP209P	Biochemistry – Practical	4	-	2
BP210P	Computer Applications in Pharmacy – Practical*	2	-	1
BP211CE	Comprehensive online examination**	-	-	-
	Total	**32**	**4**	**29**

*Non University Examination (NUE)
**Audit course

Table-III: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering –Practical	4	-	2
BP309CE	Comprehensive online examination**	-	-	-
	Total	**28**	**4**	**24**

**Audit course

Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
BP410CE	Comprehensive online examination**	-	-	-
	Total	**31**	**5**	**28**

** Audit course

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Industrial PharmacyI– Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Industrial PharmacyI – Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
BP509CE	Comprehensive online examination**	-	-	-
	Total	**27**	**5**	**26**

** Audit course

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance –Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
BP610CE	Comprehensive online examination**	-	-	-
Total		**30**	**6**	**30**

**Audit course

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 PharmacyII – 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
BP707CE	Comprehensive online examination**	-	-	-
Total		**28**	**5**	**24**

* Non University Examination (NUE)

**Audit course

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
BP814CE	Comprehensive online examination**	-	-	-
	Total	**24**	**4**	**22**

**Audit course

Table-IX: Semester wise credits distribution

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

Program Committee

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.

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.

Duties of the Program Committee:

Periodically reviewing the progress of the classes.
Discussing the problems concerning curriculum, syllabus and the conduct of classes.
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.
Communicating its recommendation to the Head of the institution on academic matters.
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.

2. 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 coursethrough 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 semester wise

Semester I

Course code	Name of the course	Internal Assessment				End Semester Exams		Total
		Continuous Mode	Sessional Exams		Total	Marks	Duration	Marks
			Marks	Duration				
BP101T	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis 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	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP105T	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50
BP106RBT BP106RMT	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	Pharmaceutics I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	Pharmaceutical 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
BP112RBP	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)

Semester II

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 I – 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 I– 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				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP302T	PhysicalPharmaceuticsI –Theory	10	15	1 Hr	25	75	3 Hrs	100
BP303T	Pharmaceutical Microbiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**60**	**100**	**20**	**160**	**440**	**28Hrs**	**600**

Semester IV

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP401T	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP402T	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP403T	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP404T	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP405T	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP406P	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP407P	Physical Pharmaceutics II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP408P	Pharmacology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP409P	Pharmacognosy I – Practical	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 the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP502T	Industrial PharmacyI– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP504T	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP506P	Industrial PharmacyI– Practical	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognosy II – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**65**	**105**	**17 Hr**	**170**	**480**	**27 Hrs**	**650**

Semester VI

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP601T	Medicinal Chemistry III – 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 Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP605T	Pharmaceutical Biotechnology– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP606T	Quality Assurance– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP609P	Herbal Drug Technology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
	Total	**75**	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

Semester VII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			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
BP705 P	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**

***** The subject experts at college level shall conduct examinations

Semester VIII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP801T	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP802T	Social and Preventive Pharmacy – 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 Herbals – 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 Assessment 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, field work, 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)	= 10 x 1 = 10
OR	OR
Objective Type Questions (5 x 2)	= 05 x 2 = 10
(Answer all the questions)	
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	=	30 marks

Question paper pattern for practical sessional examinations

I. Synopsis	=	10
II. Experiments	=	25
III. Viva voce	=	05
Total	=	40 marks

12. Promotion and award of grades

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 internal assessment. For example, to be declared as PASS and to get grade, the student has to secure a minimum of 50 marks for the total of 100 including continuous mode of assessment and end semester theory examination and has to secure a minimum of 25 marks for the total 50 including internal assessment and end semester practical examination.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 12,then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the Sessional exam component of the internal assessment. The re-conduct of the Sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Re-examination of end semester examinations

Re examination of end semester examination shall be conducted as per the schedule given in table XIII. The exact dates of examinations shall be notified from time to time.

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 marks paper

I. Multiple Choice Questions(MCQs) = 20 x 1 = 20
OR OR
Objective Type Questions (10 x 2) = 10 x 2 = 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) = 7 x 5 = 35

Total = 75 marks

For 50 marks paper

I. Long Answers (Answer 2 out of 3) 2 x 10 = 20
II. Short Answers (Answer 6 out of 8) = 6 x 5 = 30

Total = 50 marks

For 35 marks paper

I. Long Answers (Answer 1 out of 2) 1 x 10 =10
II. Short Answers (Answer 5 out of 7) = 5 x 5 = 25

Total = 35 marks

Question paper pattern for end semester practical examinations

I. Synopsis = 5
II. Experiments = 25
III. Viva voce = 5

Total = 35 marks
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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 hasgiven 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 a letter grade of AB 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 pointsin these courses are G1, G2, G3, G4 and G5, respectively, and then students' 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 ABSgrade awarded in that semester. For example if a learner has a F or ABS grade in course 4, theSGPA shall then be computed as:

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

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 statusin case of F grade(s),till the course(s) is/are passed. When the course(s)is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA 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,... is the total number of credits for semester I,II,III,…. and S_1,S_2, S_3,...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 projectunder 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
Communication skills	20 Marks
Question and answer 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 presentation 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 leveland 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 fee.

Program	B. Pharm
Year /Semester	First year / 1st semester
Name of the course	Human Anatomy & Physiology – I
Course Code	BP101T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: This course is aimed to provide fundamental knowledge on the structure and functions of the human body. This course emphasizes both homeostasis mechanisms and homeostatic imbalances of various body systems. This course also describes the structure and functions of various organ systems of the human body like haemopoietic, skeletal, lymphatic and cardiovascular systems. This course also describes the structure and functions of sense organs.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures

CO 2: Synthesize ideas to make a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.

CO 3: Describe the structure and functions of various organs of the human body.

Theory Course: Contents

Unit	Topics	No. of hours
I	**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. **Cellular level of organization** Structure and functions 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 **Tissue level of organization**	**13**

	Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	
II	**Integumentary system** Structure and functions of skin **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. **Joints** Structural and functional classification, types of joints movements and its articulation.	**13**
III	**Body fluids and blood** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system.	**13**
IV	**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. **Special senses** Structure and functions of eye, ear, nose and tongue and their disorders.	**11**
V	**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.	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Tortora Gerard J, Derrikson Bryan. Principles of anatomy and physiology. 11th ed. Wiley: 2006.
2. Wilson K JW. Ross and Wilson's foundations of anatomy and physiology. 5th ed. Churchill Livingstone: Edinburg; 1981.
3. Guyton arthur C. Physiology of human body.6 th ed. Brooks coole Publisher: 1983.
4. Chatterjee C C. Human physiology. Volume I & II. Medical allied agency: Calcutta; 2004.
5. Anne Waugh and Alon Grant. Ross and Wilson Anatomy & Physiology. 11th ed. Churchill Livingstone: 2010.
6. Guyton Arthur C. Text book of Medical Physiology. 10 th ed. Harcot Publishers: Singapore; 2000.
7. Inderbir Singh. Textbook of Human Histology. Jaypee Brother's Medical Publishers: New Delhi.

Program	B. Pharmacy
Year & Semester	1st Year & 1st Semester
Name of the course	Pharmaceutical Analysis I – Theory
Course Code	BP 102T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.

Course Description:

The pharmaceutical analysis I course provides the knowledge of sources of errors, impurities and titrimetric analysis in quantitative pharmaceutical analysis and aid opportunity to develop awareness of drug quality and its control. It also covers different analytical techniques like Potentiometry, Conductometry, and Polarography techniques.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: Know the different types of errors, its minimization and sources of impurities in pharmaceuticals.

CO 2: Understand the principles of volumetric and electro chemical analysis methods.

CO 3: Develop analytical skills in the determination of percentage purity of the various pharmaceuticals.

Course Content

Unit	Topics	Hours
I (4 Weeks)	**(a) Pharmaceutical analysis**- Definition and scope Different techniques of analysis Methods of expressing concentration Primary and secondary standards. Preparation and standardization of various molar and normal solutions-Oxalic acid, sodium hydroxide,	**16**

	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.	
II (2 Weeks)	**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	**8**
	Non-aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	
III (3 Weeks)	**Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.	**12**
	Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.	
	Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration.	
IV (3 Weeks)	**Redox titrations** Concepts of oxidation and reduction Types of redox titrations (Principles and applications)	**12**
	Cerimetry, Iodimetry, Iodometry, Bromatometry,	
	Dichrometry, Titration with potassium iodate	
V (3 Weeks)	**Electrochemical methods of analysis** **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications.	**12**
	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 end point of potentiometric titration and applications.	

	Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications.	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Vogel AI. Textbook of quantitative chemical analysis. Fifth ed. Newyork: Longman Scientific & Technical; 1989. ISBN 0582446937

2. Indian pharmacopeia. (2014). Government of India, Ministry of health and family welfare. Vol 1, 2, 3. Ghaziabad: Published by Indian Pharmacopoeial commission.

3. The British Pharmacopoeia. (2014).The commission of human medicines pursuant to the medicines act 1968, Vol 1 to 5, London: Published by stationery office on behalf of the medicines and health care products regulatory agency (MHRA).

4. The United states pharmacopoeia-National formulary. (USP 37-NF 32). Rockville: Published by the United States Pharmacopoeial convention.

5. The European pharmacopoeia. (2008). sixth ed., Strasbourg: Published by the council of Europe.

6. The Japanese Pharmacopoeia. (2006). 13th ed., Japan: Published by the society of Japanese Pharmacopoeia, under the supervision of the R & D division, Pharmaceutical affairs bureau, Ministry of health & welfare.

7. Skoog DA, James HF, Crouch SR. Principles of Instrumental Analysis. Sixth ed. India: Cengage Learning; 2007. ISBN-13: 978-0495012016, ISBN-10: 0495012017.

8. Connors KA. A textbook of Pharmaceutical Analysis. Third ed. India: Wiley India Pvt. Ltd; 1982. ISBN: 8LGYW9TY5P8.

Program	B. Pharm
Semester	I Semester
Name of the course	PHARMACEUTICS I – Theory
Course Code	BP103T
Credits	4
Hours /week	4 hours

Course Description: This course is designed to impart a fundamental knowledge on history of pharmacy, Prescription, medical and Pharmaceutical terminology, preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO 1: Define various medical and Pharmaceutical terms.
CO 2: Explain various principles and procedures involved in formulation of different types of dosage forms.
CO 3: Demonstrate professional way of handling the prescription and pharmaceutical incompatibilities
CO 3: Calculate different Pharmaceutical calculations involved in formulation.

Theory Course Contents:

Unit	Topic	Hours
I	**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. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	14
II	**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. **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.	14
III	**Monophasic liquids:** Definitions and preparations of Gargles,	12

	Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **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.	
IV	**Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	10
V	**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 dosages forms.	10

Recommended Books: (Latest Editions)

1. H.C. Ansel et 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, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

Program	B. Pharmacy
Year & Semester	1st Year & 1st Semester
Name of the course	Pharmaceutical Inorganic Chemistry – Theory
Course Code	BP104T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Course description: Pharmaceutical Inorganic chemistry course mainly deals withfundamentals of chemical composition, preparation methods, properties, identification tests,storage, assay &medicinal uses of various inorganic pharmaceuticals according to their monographsmentioned in the various pharmacopoeias. This course provides knowledge on sources of impurities, methods to determine the impurities in inorganic drugsand gives the importance of radiopharmaceuticals in the various fields.

Course Outcomes: Upon successful completion of this course, the student should beable to:

CO 1: State the concept & content of specifications mentioned in monograph for variouscategories of inorganic pharmaceuticals along with their medicinal uses.

CO 2: Demonstrate the knowledge of various types of errors and various sources of impuritiesin the pharmaceuticals.

CO 3: Apply the suitable principles in determination of purity by limit tests and percentagepurity by assay methods as per the pharmacopoeias (Indian Pharmacopeia, BritishPharmacopoeia, United States Pharmacopoeia)

Course Content

Unit	Topics	Hours
I (3 Weeks)	**Impurities in pharmaceutical substances:** History of Pharmacopoeia,Sources and types of impurities,	12
	Principle involved in the limit test for Chloride, Sulphate, Iron, Lead	
	Principle involved in the limit test for Arsenic, Heavy metals and modified limit test for Chloride and Sulphate.	
*General methods of preparation, assay for the compounds superscriptedwith **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes*		

II (4 Weeks)	**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.	**16**
	Major extra and intracellular electrolytes: Functions of majorphysiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride,	
	Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.	
	Dental products: Dentifrices, role of fluoride in the treatment of dentalcaries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	
III (3 Weeks)	**Gastrointestinal agents** **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*,	**12**
	Aluminum hydroxide gel, Magnesium hydroxide mixture **Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin andBentonite	
	Antimicrobials: Mechanism, classification, Potassium permanganate, Boricacid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	
IV (3 Weeks)	**Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics**: Copper sulphate*, Sodium potassium tartarate	**10**
	Haematinics: Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodiumnitrite	
	Astringents: Zinc Sulphate, Potash Alum	
V (3 Weeks)	**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity,Properties of α, β, γ radiations, Half-life,	**10**
	Radioisotopes and study of radioisotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.	
	Revision	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

Text Books:

1. A.H.Beckett and J.B.Stenlake. Practical pharmaceutical chemistry. Part-I. The Athtonepress: University of London; 1968.

2. J.H Block, E.Roche, T.O Soine and C.O. Wilson. Inorganic Medical and PharmaceuticalChemistry. Lea &Febiger Philadelphia PA; 1974.

3. G.R. Chatwal. Pharmaceutical Chemistry – Inorganic. Fifth edition. Himalaya PublishingHouse: Mumbai, India; 2014.

4. A.A. Napoleon. Pharmaceutical Titrimetric Analysis Theory and Practical. Second ed.Kalaimani Publishers & Distributers: Kanchipuram; 2013.

5. J. Mendham, R.C. Denney, J. D. Barnes and M.J.K. Thomas. Vogel's QuantitativeChemical Analysis. Sixth edition. Pearson education Delhi; 2000.

References:

1. Gary L. Miessler, Paul J. Fischer and Donald A. Tarr. Inorganic chemistry. Fifth edition.Pearson education New Delhi; 2014.

2. P. Gundu Rao. Pharmaceutical and Medicinal Inorganic Chemistry. First edition. VallabhPrakashan Delhi; 2008.

3. G.D. Tuli, R.D. Madan, S.K. Basu and Satya Prakash. Advanced Inorganic Chemistry.Volume 1. Published by S. Chand & Company Ltd; 2014.

4. William L. Jolly. Modern Inorganic Chemistry. Second edition. Mc Graw-Hill: New York;1984.

5. A.H.Beckett and J.B.Stenlake.Textbook of Pharm. Analysis. CBS Publishers, Delhi.

6. Indian Pharmacopoeia.

Program	**B. Pharm**
Year /Semester	**First year / 1st semester**
Name of the course	**Communication Skills**
Course Code	**BP105T**
Credits	**2**
Hours /week	**30 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: 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 student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Course Learning Outcomes: Upon completion of this course, the student shall be able to:

CO1: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation.

CO2: Communicate effectively (Verbal and Non Verbal)

CO3: Effectively manage the team as a team player.

CO4: Develop interview skills, Leadership qualities and essentials .

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context. **Barriers to Communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers. **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our Perspective – Past Experiences, Prejudices, Feelings, Environment.	07
II	**Elements of Communication:** Introduction, Face to Face Communication – Tone of Voice, Body Language (Non – Verbal communication), Verbal Communication, Physical Communication.	07

	Communication Styles: Introduction, The Communication Styles Matrix with example for each – Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.	
III	**Basic Listening Skills:** Introduction, Self – Awareness, Active Listening, Becoming an Active Listening in Difficult Situations. **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. **Writing Effectively :** Subject Line, Put the Main Point First, Know Your Audience, Organization of the Message.	07
IV	**Interview Skills :** Purpose of an interview, Do's and Don't's of an interview. **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.	05
V	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don't's of group discussion.	04

Recommended Books: (Latest Editions)

3. Basic communication skills for Technology, Andreha.J. Ruther Ford, 2nd Edition, Pearson Education, 2011.
4. Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011.
5. Organizational Behaviorur, Stephen . P . Robbins, 1st Edition, Pearson, 2013
6. Brilliant – Communication skills, Gill Hasson, 1st Edition, Pearson Life, 2011
7. The Ace of soft skills : Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5th Edition, Pearson, 2013
8. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
9. Communication skills for professionals, Konar nira, 2nd Edition, New arrivals – PHI, 2011
10. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India Pvt.Ltd, 2011
11. Soft skills and professional communication, Francis Peters SJ, 1st Edition, Mc Graw Hill Education, 2011
12. Effective communication, John Adair, 4th Edition, Pan Mac Millan, 2009.

Program	**B. Pharm**
Year /Semester	**First year / 1st Semester**
Name of the course	**REMEDIAL BIOLOGY (Theory)**
Course Code	**BP 106RBT**
Credits	**2**
Hours /week	**2 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: To learn and understand the components of living world, structure and functionalsystem of plant and animal kingdom.

Course Learning Outcomes:

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

CO1: know the classification and salient features of five kingdoms of life

CO2:understand the basic components of anatomy & physiology of plant

CO3: know understand the basic components of anatomy & physiology animal with special reference to human

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**Living world:** Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons &Dicotylidones.	07

II	**Body fluids and circulation** Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels Cardiac cycle, cardiac output and ECG **Digestion and Absorption** Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food **Breathing and respiration** Human respiratory system Mechanism of breathing and its regulation Exchange of gases, transport of gases and regulation of respiration Respiratory volumes	07
III	**Excretory products and their elimination** Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotensin system **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 **Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands **Human reproduction** Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle	07
IV	**Plants and mineral nutrition:** Essential mineral, macro and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	05

V	**Plant respiration:**Respiration, glycolysis, fermentation (anaerobic). **Plant growth and development** Phases and rate of plant growth, Condition of growth,Introduction to plant growthregulators **Cell - The unit of life** Structure and functions of cell and cell organelles.Cell division **Tissues** Definition, types of tissues, location and functions.	04

Text Books

1. Text book of Biology by S. B. Gokhale
2. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

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

Program	**B. Pharm**
Year /Semester	**First year /1st semester**
Name of the course	**Remedial Mathematics**
Course Code	**BP106RMT**
Credits	**2**
Hours /week	**2 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This is an introductory course in mathematics. This subject deals with the Introduction to Algebra, Trigonometry, Co-Ordinate geometry, Differential Calculus, Integral Calculus, Differential Equations, Laplace Transforms.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Define Algebra, Trigonometry, Co-Ordinate geometry, Differential Calculus, Integral Calculus, Differential Equations, Laplace Transforms and their applications;

CO 2: Solve the problems of different types by applying theory

CO 3: Appreciate the important applications of Mathematics in Pharmacy.

Theory Course: Contents

Unit	Topics	No. of hours
I	**Algebra :** Arithmetic Progression –Geometric Progression, Logarithms: Logarithm of a real number to an arbitrary base, theorems on Logarithms, application of logarithms in Pharmaceutical computations and Partial fractions	**10**
II	**Trigonometry:** Trigonometric ratios and the relations between them, Sin (A+B),Cos (A+B),Tan(A+B) formulae only, Trigonometric ratios of multiple and submultiple angles	**10**
III	**Co-Ordinate Geometry** Distance between points, Area of a Triangle, Co-Ordinates of a point dividing a given line segment in a given ratio, equation to a straight line in different forms.	**9**
IV	**Differential calculus:** Limit of a function differentiation, derivatives of trigonometric functions, logarithmic and partial differentiation, Maxima and minima (elementary).	**9**
V	**Integration:** Definition of integration, indefinite of integrals, standard integrals, fundamental rules of Integration, Integration by substitution, integration by parts and definite Integrals, properties of definite Integrals	**9**
VI	**Differential Equations:** Order and degree, formation of the differential equation, solutions of the first order and first degree	**7**

	differential equations (variable separable). Applications of first order and first degree differential equation: law of natural growth and decay, Newton's law of cooling.	
VII	**Laplace transforms:** Definition, elementary functions, Properties of linearity and shifting, transforms of multiplication by tn	**6**

Learning Resources/Recommended Texts/Reference books/web resources

1. Intermediate first and second year mathematics text books printed and published by Telugu Academy.
2. P.Seshagiri Rao. A Text book of Remedial Mathematics. Pharma med press; 2008.

Program	B. Pharm
Year /Semester	First year / 1st semester
Name of the course	Human Anatomy & Physiology – I Practical
Course Code	BP107P
Credits	2
Hours /week	4 hours (Practical)
Pre / co-requisite/s	Nil

Practical Course: Contents

Week	Topics
1.	Introduction to laboratory safety techniques and Study of compound microscope
2.	Microscopic study of epithelial tissue and connective tissue
3.	Microscopic study of muscular tissue and nervous tissue
4.	Identification of axial bones
5.	Identification of appendicular bones
6.	Introduction of hemocytometry and Enumeration of white blood cell (WBC) count
7.	Enumeration of total red blood corpuscles (RBC) count
8.	Determination of bleeding time
9.	Determination of clotting time
10.	Estimation of haemoglobin content
11.	Determination of blood group
12.	Determination of erythrocyte sedimentation rate (ESR)
13.	Determination of heart rate and pulse rate
14.	Recording of Blood pressure.
15.	**Revision**

Learning Resources/Recommended Texts/Reference books/web resources

1. Tortora Gerard J, Derrikson Bryan. Principles of anatomy and physiology. 11th ed. Wiley: 2006.

2. Wilson K JW. Ross and Wilson's foundations of anatomy and physiology. 5th ed. Churchill Livingstone: Edinburg; 1981.
3. Guyton arthur C. Physiology of human body.6 th ed. Brooks coole Publisher: 1983.
4. Chatterjee C C. Human physiology. Volume I & II. Medical allied agency: Calcutta; 2004.
5. Anne Waugh and Alon Grant. Ross and Wilson Anatomy & Physiology. 11th ed. Churchill Livingstone: 2010.
6. Guyton Arthur C. Text book of Medical Physiology. 10 th ed. Harcot Publishers: Singapore; 2000.
7. Kale S R,Kale R R.practical human anatomy and physiology.19 th ed. Pune. Nirali prakashan;2009.
8. Goyal R K, Natvar M P, Shah S A. Practical anatomy, Physiology and biochemistry,1st ed. Publisher: B S Shah Publisher: Ahmadabad; 1988.
9. C.L. Ghai. Textbook of Practical Physiology. Jaypee brother's medical publishers.
10. K. Srinageswari Rajeev Sharma. Practical workbook of Human Physiology. Jaypee brother's medical publisher

Program	B. Pharmacy
Year & Semester	1st Year & 1st Semester
Name of the course	Pharmaceutical Analysis I – Practical
Course Code	BP 108P
Credits	2
Hours /week	4 Hours
Pre / co-requisite/s	Nil

Course Description: The Pharmaceutical Analysis – I practical course describes the fundamental skills of limit tests, standardization and assay methods for the various pharmaceutical products. It also provides the awareness of determinate and indeterminate errors while performing the analysis like Potentiometry, Conductometry.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: Illustrate the limits of chloride, sulphate & heavy metals content in various pharmaceuticals.

CO 2: Understand the quantitative standardization and assay methods by volumetric analysis.

CO 3: Adapt various electrochemical techniques to quantify the acids & bases.

Week	Topic
I. Limit test of the following	
1	Chloride
2	Sulphate
3	Iron
4	Arsenic
II. Preparation and standardization of	
5	Sodium hydroxide
6	Sulphuric acid
7	Sodium thiosulfate
8	Potassium permanganate
9	Ceric ammonium sulphate

III	**Assay of the following compounds along with Standardization of Titrant**
10	Ammonium chloride by acid base titration
11	Ferrous sulphate by Cerimetry
12	Copper sulphate by Iodometry
13	Calcium gluconate by Complexometry
14	Hydrogen peroxide by Permanganometry
15	Sodium benzoate by non-aqueous titration
16	Sodium Chloride by precipitation titration
IV. Determination of Normality by electro-analytical methods	
17	Conductometric titration of strong acid against strong base
18	Conductometric titration of strong acid and weak acid against strong base
19	Potentiometric titration of strong acid against strong base

Learning Resources/Recommended Texts/Reference books/web resources

1. Vogel AI. Textbook of quantitative chemical analysis. Fifth ed. New York: Longman Scientific & Technical; 1989. ISBN 0582446937

2. Indian pharmacopeia. (2014). Government of India, Ministry of health and family welfare. Vol 1, 2, 3. Ghaziabad: Published by Indian Pharmacopoeial commission.

3. The British Pharmacopoeia. (2014).The commission of human medicines pursuant to the medicines act 1968, Vol 1 to 5, London: Published by stationery office on behalf of the medicines and health care products regulatory agency (MHRA).

4. The United states pharmacopoeia-National formulary. (USP 37-NF 32). Rockville: Published by the United States Pharmacopoeial convention.

5. Skoog DA, James HF, Crouch SR. Principles of Instrumental Analysis. Sixth ed. India: Cengage Learning; 2007. ISBN-13: 978-0495012016, ISBN-10: 0495012017.

6. Connors KA. A textbook of Pharmaceutical Analysis. Third ed. India: Wiley India Pvt. Ltd; 1982. ISBN: 8LGYW9TY5P8.

7. Napoleon AA. Pharmaceutical titrimetric analysis, India: Kalaimani publishers and distributors; 2013.

Program	B. Pharm
Semester	I Semester
Name of the course	PHARMACEUTICS I – Practical
Course Code	BP109P
Credits	2
Hours /week	4 hours

Course Description: The General Pharmacy and Dosage forms practical course is aimed to train the students on formulation of different types of dosage forms. This course also deals with pharmaceutical calculations which are essential in compounding and utilization of dosage forms. This course also provides the skills to identify various incompatibilities in handling of prescriptions.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:
CO 1: Identify various incompatibilities in handling of Prescriptions
CO 2: Calculate different Pharmaceutical calculations involved in formulation.
CO 3: Formulate different types of dosage forms.

Practical Course Contents:

S.no	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.	**Solutions** 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) Aluminimum 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) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository
9.	**Semisolids** a) Sulphur ointment b) Non staining-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. Ansel et 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, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.

Program	B. Pharmacy
Year & Semester	1st Year & 1st Semester
Name of the course	Pharmaceutical Inorganic Chemistry – Practical
Course Code	BP110P
Credits	2
Hours /week	4 hours
Pre / co-requisite/s	Nil

Course Description: Pharmaceutical inorganic chemistry laboratory course aimed to trainthe students on experimental techniques for the determination of impurities and their limits asper the pharmacopoeias. This course also deals with identification of various cations & anionsof inorganic compounds by their chemical tests. This course also provide laboratory skillsrelated to calibration and percentage purity analysis by volumetric titrations as per monographsspecified in various pharmacopoeias.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: Perform the limit tests, assay methods to know the impurities limit, and percentagepurity of the pharmaceuticals.

CO 2: Differentiate various cations and anions by chemical tests.

CO 3: Identify the purity of the various pharmaceuticals by suitable methods

Week	TOPICS
Limit tests for the following ions	
1	Limit test for Chlorides and Sulphates
2	Modified limit test for Chlorides and Sulphates
3	Limit test for Iron
4	Limit test for Heavy metals
5	Limit test for Lead
6	Limit test for Arsenic
Identification tests for the following	
7	Identification testsfor Magnesium hydroxide
8	Identification tests for Ferrous sulphate

9	Identification tests for Sodium bicarbonate
10	Identification tests for Calcium gluconate
11	Identification tests for Copper sulphate
Test for purity	
12	Swelling power of Bentonite
13	Neutralizing capacity of aluminum hydroxide gel
14	Determination of potassium iodate and iodine in potassium Iodide
Preparation of inorganic pharmaceuticals	
15	Boric acid
16	Potash alum
17	Ferrous sulphate

Recommended Books (Latest Editions)

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. IndianPharmacopoeia

Program	**B. Pharm**
Year /Semester	**First year / 1nd semester**
Name of the course	**Communication Skills (Practical)**
Course Code	**BP111P**
Credits	**1**
Hours /week	**2 hours / week**
Pre / co-requisite/s	**Nil**

Course Description: 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 student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Course Learning Outcomes: Upon completion of this course, the student shall be able to:

CO1: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation.

CO2: Communicate effectively (Verbal and Non Verbal).

Practical Course: Contents

S. No.	Topic
1.	**Basic communication covering the following topics :** Meeting People, Asking Questions, Making Friends, What did you do?, Do's and Don't's.
2.	**Pronunciations covering the following topics :** Pronunciation (Consonant Sounds), Pronunciation and Nouns, Pronunciation (Vowel Sounds).
3.	**Advanced Learning:** Listening Comprehension/Direct and Indirect Speech, Figures of Speech, Effective Communication, Writing Skills, Effective Writing, Interview Handling Skills, E – Mail etiquette, Presentation Skills.

Recommended Books: (Latest Editions)

1.Basic communication skills for Technology, Andreha.J. Ruther Ford, 2nd Edition, Pearson Education, 2011.

2.Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011.

3.Organizational Behaviorur, Stephen . P . Robbins, 1st Edition, Pearson, 2013

4.Brilliant – Communication skills, Gill Hasson, 1st Edition, Pearson Life, 2011

5.The Ace of soft skills : Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5th Edition, Pearson, 2013

6.Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010

7.Communication skills for professionals, Konar nira, 2nd Edition, New arrivals – PHI, 2011

8.Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India Pvt.Ltd, 2011

9.Soft skills and professional communication, Francis Peters SJ, 1st Edition, Mc Graw Hill Education, 2011

10.Effective communication, John Adair, 4th Edition, Pan Mac Millan, 2009

Program	**B. Pharm**
Year /Semester	**First year / 1st Semester**
Name of the course	**REMEDIAL BIOLOGY (Practical)**
Course Code	**BP112RBP**
Credits	**1**
Hours /week	**2 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: To learn and understand the components of living world, structure and functionalsystem of plant and animal kingdom.

Course Learning Outcomes:

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

CO1: know the classification and salient features of five kingdoms of life

CO2:understand the basic components of anatomy & physiology of plant

CO3: know understand the basic components of anatomy & physiology animal with special reference to human

Practical Course: Contents

S. No.	Topic
1.	Introduction to experiments in biology Study of Microscope
2.	A. Section cutting techniques B. Mounting and staining C. Permanent slide preparation
3.	Study of cell and its inclusions
4.	Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
5.	Detailed study of frog by using computer models
6.	Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower
7.	Identification of bones
8.	Determination of blood group
9.	Determination of blood pressure
10.	Determination of tidal volume

Reference Books

1. Practical human anatomy and physiology. byS.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

Program	**B. Pharm**
Year /Semester	**First year / 2nd semester**
Name of the course	**Human Anatomy & Physiology – II**
Course Code	**BP201T**
Credits	**4**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to provide fundamental knowledge on the structure and functions of the human body. This course deals with the role of hormones and its regulation. This course describes the structure and functions of various organ systems of the human body like nervous, digestive, respiratory, urinary, endocrine, reproductive systems. This course describes about basics of genetics.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Describe the structure and functions of various organs of the human body.

CO 2: Explain about various hormones and their imbalance.

CO 3: Synthesize ideas to make a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.

Theory Course: Contents

Unit	Topics	No. of hours
I	**Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, 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)	**13**
II	**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	**09**

	functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. **Energetics** Formation and role of ATP, Creatinine Phosphate and BMR.	
III	**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. **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 RAS in kidney and disorders of kidney.	**13**
IV	**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.	**13**
V	**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 • **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	**12**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Tortora Gerard J, Derrikson Bryan. Principles of anatomy and physiology. 11th ed. Wiley: 2006.
2. Wilson K JW. Ross and Wilson's foundations of anatomy and physiology. 5th ed. Churchill Livingstone: Edinburg; 1981.
3. Guyton arthur C. Physiology of human body.6 th ed. Brooks coole Publisher: 1983.
4. Chatterjee C C. Human physiology. Volume I & II. Medical allied agency: Calcutta; 2004.

5. Anne Waugh and Alon Grant. Ross and Wilson Anatomy & Physiology. 11th ed. Churchill Livingstone: 2010.
6. Guyton Arthur C. Text book of Medical Physiology. 10 th ed. Harcot Publishers: Singapore; 2000.
7. Inderbir Singh. Textbook of Human Histology. Jaypee Brother's Medical Publishers: New Delhi.

Program	**B. Pharmacy**
Year /Semester	**I year /II semester**
Name of the course	**Pharmaceutical organic chemistry-I**
Course Code	**BP202T**
Credits	**4**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The pharmaceutical organic chemistry-I course is aimed to present fundamental in chemistry of organic compounds. It emphasizes on basic nomenclature, physical and chemical properties of various organic compounds. The course will describe the pharmaceutical importance of these functional groups, isomerism and their molecular structures and properties in chemistry of drug substances. This also deals with various mechanisms involved in synthesis and reaction of chemical compounds.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Define the nomenclature, physical and chemical properties of a molecule in relation to the structure of organic compounds.

CO2: Write the structure, name and the type of isomerism of the organic compound

CO3: Explain the possible mechanism and the intermediate product involved in a chemical reaction

CO4: Identify and confirm the unknown organic compound

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	Topics	Hours
I (3 Weeks)	Classification, nomenclature and isomerism Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds. (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds	**8**

II (4 Weeks)	Alkanes*, Alkenes* and Conjugated dienes* SP3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins.	**15**
	Stabilities of alkenes, SP2 hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences.	
	E1 verses 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	
III (3 Weeks)	Alkyl halides* SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.	**15**
	SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions . Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.	
	Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol.	
IV (3 Weeks)	Carbonyl compounds* (Aldehydes and ketones) Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation,.	**12**
	Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests,	
	Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde	
V (3 Weeks)	Carboxylic acids* Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester	**10**
	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	
	Aliphatic amines* - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	
	TOTAL	**60**

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

Program	**B. Pharmacy**
Year /Semester	**I year /II semester**
Name of the course	Biochemistry
Course Code	**BP203T**
Credits	**4**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description

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.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Define enzymes, enzyme inhibitors,carbohydrates,proteins,lipids and nucleic acids, electron transport chain and oxidative phosphorylation.

CO2: Explain the chemistry, classification, uses and metabolism of carbohydrates, proteins, lipids and nucleic acids.

CO 3: Discuss the metabolic disorders of carbohydrates, proteins, lipids and nucleic acids. Synthesize DNA and RNA

CO4: Analyze the constituents present in urine .

Unit	Topics	Hours
I (3 Weeks)	**Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids.	**12**
	nucleic acids, amino acids and proteins **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 AM	

II (3Weeks)	**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.	**12**
	Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance Hormonal regulation of blood glucose level and Diabetes mellitus	
	Biological oxidation Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate levelphosphorylation, Inhibitors ETC and oxidative phosphorylation/Uncouplers	
III (4 Weeks)	**Lipid metabolism** β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosisDe novo synthesis of fatty acids (Palmitic acid) ,	**16**
	Biological significance of cholesterol and conversion of holesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.	
	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 (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia)	
	Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline . Catabolism of heme; hyperbilirubinemia and jaundice	
IV (3 Weeks)	Nucleic acid metabolism and genetic information transfer. Biosynthesis of purine and pyrimidine nucleotides .	**10**
	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	
V (3 Weeks)	Enzymes : Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes:	**10**
	enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes	
	Coenzymes –Structure and biochemical functions	
	TOTAL	**60**

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, 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 Stump

Program	B. Pharm
Year /Semester	First year / 2nd semester
Name of the course	Pathophysiology
Course Code	BP204T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: The Pathophysiology course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions and understanding of basic pathophysiological mechanisms. The course covers the basics of cell biology, inflammation, mechanism of body defense, abnormal cell growth and focuses on the pathophysiology of common disease processes of human body system.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Define the basic terminology related to pathophysiology.

CO 2: Describe the etiology and pathogenesis of the selected disease states.

CO 3: Name the signs, symptoms and complications of the diseases.

CO 4: Define the basic approach to diagnosis and diagnostic procedures of human diseases.

CO 5: Correlate the Pathophysiology with prognosis, medical treatment of the diseases.

Theory Course: Contents

Unit	Topics	No. of hours
I	**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, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis, Electrolyte imbalance **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	**13**
II	**Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, Chronic obstructive airways diseases. **Renal system**: Acute and chronic renal failure	**13**
III	**Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Gastrointestinal system:** Peptic Ulcer	**13**
IV	Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout **Principles of cancer:** Classification, etiology and pathogenesis of cancer **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout	**11**

	Principles of Cancer: Classification, etiology and pathogenesis of Cancer	
V	**Infectious Diseases**: Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary Tract Infections. **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book 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. 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.

Program	**B. Pharm**
Year /Semester	**Second year / 2nd semester**
Name of the course	**COMPUTER APPLICATIONS IN PHARMACY**
Course Code	**BP205T**
Credits	**4**
Hours /week	**4 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The Computer Applications In Pharmacy course is aimed at to learn the fundamentals of computers like scope, classification of computers, their number system, software, data base, application of computer in pharmacy and role of management information system used in the organizations.

Computer is mandatory in this advanced era and pharmacy and related subjects are not exception to it. This review mainly focuses on the various applications, softwares and use of computers in pharmacy. Computer science and technology is deeply utilized in pharmacy field everywhere like in pharmacy colleges, pharmaceutical industries, research centers, hospital pharmacy and many more. Computer significantly reduces the time, expenditure, and manpower required for any kind of work. Development of various softwares makes it trouble-free to handle huge data. In short, computers are playing critical role in pharmacy field, without computers pharmacy research will be long-lasting and expensive.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Demonstrates the introduction of computers.

CO2: State importance of computers, processing the data in MS-Office.

CO3: Navigate a Windows operating system environment as well as install and operate basic software utilities

CO4: Identifies the development life cycle of system.

CO5: Demonstrates the maintenance of pharmacy drug database.

CO6: Recognize basic technologies related to an office environment

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**Introduction to Computers:** **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, subtraction, multiplication, division One's complement, Two's complement method. **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.	18
II	**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.	15
III	**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 .	12
IV	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	9

V	**Computers as data analysis in Preclinical development**: Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)	6

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 Willey and Sons, INC., Publication, USA.
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA).
4. 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

Program	B. Pharmacy
Year & Semester	1st Year & 2nd Semester
Name of the course	Environmental Sciences – Theory
Course Code	BP 206T
Credits	3
Hours /week	3 Hours (lectures)
Pre / co-requisite/s	Nil

Course description: Environmental Sciences is the scientific study of the environmental system andthe 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.

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

CO 1: Create the awareness about environmental problems among learners.

CO 2: Impart basic knowledge about the environment, its allied problems and develop an attitudeof concern for the environment.

CO 3: Motivate learner to participate in environment protection and environment improvement.

CO 4: Acquire skills to help the concerned individuals in identifying and solving environmental problems.

Course Content

Unit	Topic	Hours
I	The Multidisciplinary nature of environmental studies Natural	18

(6 Weeks)	Resources	
	Renewable and non-renewable resources: 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.	
II (5 Weeks)	Ecosystems Concept of an ecosystem.	15
	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)	
III (4 Weeks)	Environmental Pollution: Air pollution	12
	Water pollution	
	Soil pollution	
	Revision	
	TOTAL	45

Recommended Books (Latest edition):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. BharuchaErach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p

Program	**B. Pharm**
Year /Semester	**First year /2nd semester**
Name of the course	**Human Anatomy & Physiology – II Practical**
Course Code	**BP207P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

7. De A.K., Environmental Chemistry, Wiley Eastern Ltd. Down of Earth, Centre for Science and Environment

Course Description: This course is aimed to train the students on experimental techniques and allows the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This course also aimed to expertise the students on identification of various types of tissues & organ systems of the human body.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:
CO 1: Understand the coordinated working pattern of different organs of each system
CO 2: Explain different family planning methods.
CO 3: Estimate tidal volumes, vital capacity, temperature and basal mass index
CO 4: Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.

Practical Course: Contents

Week	Topics
1	Study the integumentary and special senses using specimen, models, etc.,
2	Study of the nervous system using specimen, models, etc.,
3	Study of the endocrine system using specimen, models, etc
4	Demonstrate the general neurological examination
5	Demonstrate the function of olfactory nerve
6	Examine the different types of taste.

7	Demonstrate the visual acuity and reflex activity
8	Recording of body temperature and basal mass index
9	Demonstrate positive and negative feedback mechanism.
10	Determination of tidal volume and vital capacity.
11	Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
12	Study of family planning devices and pregnancy diagnosis test.
13	Demonstration of total blood count by cell analyser
14	Permanent slides of vital organs and gonads.
	Revision

Learning Resources/Recommended Texts/Reference books/web resources

11. Tortora Gerard J, Derrikson Bryan. Principles of anatomy and physiology. 11th ed. Wiley: 2006.
12. Wilson K JW. Ross and Wilson's foundations of anatomy and physiology. 5th ed. Churchill Livingstone: Edinburg; 1981.
13. Guyton arthur C. Physiology of human body.6 th ed. Brooks coole Publisher: 1983.
14. Chatterjee C C. Human physiology. Volume I & II. Medical allied agency: Calcutta; 2004.
15. Anne Waugh and Alon Grant. Ross and Wilson Anatomy & Physiology. 11th ed. Churchill Livingstone: 2010.
16. Guyton Arthur C. Text book of Medical Physiology. 10 th ed. Harcot Publishers: Singapore; 2000.
17. Kale S R,Kale R R.practical human anatomy and physiology.19 th ed. Pune. Nirali prakashan;2009.
18. Goyal R K, Natvar M P, Shah S A. Practical anatomy, Physiology and biochemistry,1st ed. Publisher: B S Shah Publisher: Ahmadabad; 1988.
19. C.L. Ghai. Textbook of Practical Physiology. Jaypee brother's medical publishers.
20. K. Srinageswari Rajeev Sharma. Practical workbook of Human Physiology. Jaypee brother's medical publishers.

Year /Semester	**I year /II semester**
Name of the course	**Pharmaceutical organic chemistry-I**
Course Code	**BP208P**
Credits	**2**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The pharmaceutical organic chemistry I laboratory course is aimed to train the students on experimental techniques for the determination of physical constants of organic compounds. This course also deals with wet laboratory based experiments on identification of various chemical classes of organic compounds using basic principle of organic chemistry. This course also provides the laboratory skills related to reaction design, chemical synthesis and purification process for few organic medicinal compounds.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Demonstrate the skills on determination of various physical properties of organic molecules**.**

CO2: Differentiate various classes of organic compounds by experimental techniques.

CO3: Perform chemical reaction and purification of organic compounds of pharmaceutical interest**.**

CO4: Analyze the identification of the organic compounds with different functional groups.

4 Hours / week

S.NO	Name of the experiment
I	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
II	Preparation of suitable solid derivatives from organic compounds

III	Construction of molecular models

Recommended Books (Latest Editions

Program	B. Pharmacy

1. Practical Organic Chemistry by Mann and Saunders.
2. Vogel's text book of Practical Organic Chemistry
3. Advanced Practical organic chemistry by N.K.Vishnoi.
4. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
5. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

Year /Semester	**I year /II semester**
Name of the course	**Biochemistry Practical**
Course Code	**BP209P**
Credits	**2**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The pharmaceutical Biochemistry laboratory course is aimed to train the students on experimental techniques for the identification of carbohydrates, proteins, amino acids and lipids. This course also deals with experiments on estimation of constituents in urine and blood and their significance in diagnosis of various diseases.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Identify the carbohydrates proteins and lipids based upon chemical tests.

CO2: Quantify the sugars ,proteins and lipids in bood and serum.

CO 3. Demonstrate the skills on determination of various constituents present in urine.

Course content

S.NO	Name of the experiment
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 the effect of Temperature on Salivary amylase activity.
12	Study the effect of substrate concentration on salivary amylase activity

Recommended Books (Latest Editions

1 Practical Biochemistry by R.C. Gupta and S. Bhargavan
2 Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
3 Practical Biochemistry for Medical students by Rajagopal and Ramakrishna
4 Practical Biochemistry by Harold Varley.

Program	**B. Pharm**
Year /Semester	**Second year / 2nd semester**

Name of the course	**COMPUTER APPLICATIONS IN PHARMACY (Practical)**
Course Code	**BP210P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

Course Description: The Pharmacognosy and Phytochemistry I laboratory course is aimed to train the students regarding practical skills of different computer technologies, programming languages and development of web pages. This course also deals with laboratory based experiments on maintenance of database in MS-Access, formation of queries, exporting queries, tables, forms and reports to web page.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Demonstrates the introduction of MS-Access, CRUD operations on data base.
CO2: State importance of tables, queries, forms and reports.
CO 2: Demonstrate knowledge on creation of web pages, working with tables and queries.

Practical Course: Contents

S. No.	Topic
4.	Design a questionnaire using a word processing package to gather information about a particular disease.
5.	Create a HTML web page to show personal information.
6.	Retrieve the information of a drug and its adverse effects using online tools.
7.	Creating mailing labels Using Label Wizard , generating label in MS WORD.
8.	Create a database in MS Access to store the patient information with the required fields Using access.
9.	Design a form in MS Access to view, add, delete and modify the patient record in the database.
10.	Generating report and printing the report from patient database.
11.	Creating invoice table using – MS Access.
12.	Drug information storage and retrieval using MS Access.
13.	Creating and working with queries in MS Access.

14.	Exporting Tables, Queries, Forms and Reports to web pages.
15.	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 Willey and Sons, INC., Publication, USA.
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA).
4. 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.

Program	**B. Pharmacy**
Year & Semester	**2st Year & 1stSemester**

Name of the course	Pharmaceutical Organic Chemistry II–Theory
Course Code	BP301T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: This subject deals with general methods of preparation and reactions of someorganic compounds. Reactivity of benzene, polynuclear compounds and cycloalkane compounds also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. This course also deals with the chemistry of fats and oils.

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

1. Read the evidences in the derivation of structure of benzene, its reactivity, orientation towards the reactions and polynuclear compounds.
2. Interpret the effect of substituents on acidity or basicity, reactivity and uses of different phenols, aromatic amines and carboxylic acids.
3. Judge the reactivity/stability of organic compounds like fats, oils and cycloalkanes.

Course Content

Unit	Topics	Hours
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		
I (4 Weeks)	**Benzene and its derivatives** Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule.	**16**
	Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedel crafts alkylation- reactivity, limitations, Friedel crafts acylation.	
	Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction.	
	Structure and uses of DDT, Saccharin, BHC and Chloramine	
II (3 Weeks)	**Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitativetests, structure and uses of phenol, cresols, resorcinol, naphthols.	**12**
	Aromatic Amines* - Basicity of amines, effect of substituents on basicity,and synthetic uses of aryl diazonium salts	

	Aromatic Acids* –Acidity, effect of substituents on acidity andimportant reactions of benzoic acid.	

Program	**B. Pharmacy**

III (3 Weeks)	**Fats and Oils** a. Fatty acids – reactions.	**12**
	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.	
IV (2 Weeks)	**Polynuclear hydrocarbons:** Synthesis, reactions	**8**
	Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	
V (3 Weeks)	**Cyclo alkanes*** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification,	**12**
	Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.	
	Revision	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Allyn, Bacon. Morrison and Boyd: Organic Chemistry. 7thEd. Pearson education; NewDelhi: 2011.

2. T.W. Solomons. Organic Chemistry. 8thEd. University of South Florida, John Wiley &Sons, Inc; New York: 2004.

3. ArunBahl, B.S. Bahl. Advanced Organic Chemistry. S.Chand and limited; New Delhi:2010.

4. I.L. Finar. Organic Chemistry. Longman, Scientific & Technical. 5thEd. Co publishedin USA with John Wiley & Sons, Inc; New York: 2004.

5. Zimmerman and Zimmerman. Elements of Organic Chemistry. 2ndEd. CollierMacmillan Publishers; London: 1983.

6. O. P Agarwal. Organic chemistry Reaction and Reagents. 26thEd. Goel PublishingHouse. New Delhi: 1996.

Semester	3rd Semester
Name of the course	Physical Pharmaceutics I – Theory
Course Code	BP302T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course Description: The course deals with the various physical and physicochemical properties, andprincipals 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.

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

CO 1: Understand various physicochemical properties of drug molecules in the designing the dosage forms

CO 2: Know the principles of chemical kinetics & to use them for stability testing anddetermination of expiry date of formulations

CO 3: Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Content

Unit	Topics	Hours
I (3 Weeks)	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions,ideal solubility parameters, solvation & association,	12
	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	

II (4 Weeks)	**States of Matter and properties of matter:** State of matter, changes in the state of matter,latent heats, vapour pressure, sublimation critical point	**16**
	Eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid-crystalline, amorphous & polymorphism.	
	Physicochemical properties of drug molecules: Refractive index, optical rotation,dielectric constant	
	dipole moment, dissociation constant, determinations and applications	
III (3 Weeks)	**Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions,surface free energy, measurement of surface & interfacial tensions,	**12**
	spreading coefficient, adsorption at liquid interfaces, surface active agents.	
	HLB Scale, solubilisation, detergency, adsorption at solid interface.	
IV (3 Weeks)	**Complexation and protein binding:** Introduction, Classification of Complexation,Applications.	**12**
	methods of analysis, protein binding, Complexation and drug action.	
	crystalline structures of complexes and thermodynamic treatment of stability constants.	
V (2 Weeks)	**pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination(electrometric and calorimetric),	**8**
	applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Sinko P.J. Martin's Physical Pharmacy and Pharmaceutical Sciences. 5th ed. New Delhi:Wolters Kluwer Health Pvt.Ltd.,; 2007.
2. Subramanyam C.V.S. Essentials of Physical Pharmacy. 1st ed. Delhi: VallabhPrakashan; 2008.
3. Manavalan. R, Ramaswamy. C. Physical pharmaceutics. 2nded. Tamilnadu: Vigneshpublisher; 2008.
4. Experimental Pharmaceutics by Eugene, Parott.
5. Tutorial Pharmacy by Cooper and Gunn.
6. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
7. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
8. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
9. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
10. Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar.
11. http://www.e-booksdirectory.com
12.http://www.jblearning.com

Program	B. Pharm
Semester	III rd Semester
Name of the course	PHARMACEUTICAL

	MICROBIOLOGY –Theory
Course Code	**BP 303 T**
Credits	**4**
Hours /week	**3 hours**

Course Description: The course deals with the various aspects of microorganisms, its classification, morphology, laboratory cultivation identification and maintenance. It also discusses with sterilization of pharmaceutical products, equipment, media etc.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO01: Understand methods of identification, cultivation and preservation of various microorganisms.

CO2: To understand the importance and implementation of sterilization in pharmaceutical processing and industry

CO3: Learn sterility testing of pharmaceutical products.

CO 4: Carried out microbiological standardization of Pharmaceuticals.

CO5: Understand the cell culture technology and its applications in pharmaceutical industries.

1. Understanding the importanc

Theory Course: Contents

Unit	Topic	Hours
I	Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes 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). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.	**10**
II	Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization.Sterility indicator.	10

III	Study of morphology, classification, reproduction/replication and Cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile Products) according to IP, BP and USP.	10
IV	Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, Clean area classification. Principles and methods of different microbiological assay. Methods for Standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	10
V	Pharmaceutical products, sources and types of microbial contaminants, Assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, Evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.	05

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. .
2. Prescott and Dunn. Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. Rose: Industrial Microbiology.
5. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
6. Peppler: Microbial Technology.
7. I.P., B.P., U.S.P. - latest editions.
8. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergey's manual of systematic bacteriology, Williams and Wilkins- a Waverly Company

Program	B. Pharm
Semester	III Semester
Name of the course	Pharmaceutical Engineering – Theory
Course Code	BP304T
Credits	4
Hours /week	4 hours

Course Description:
This course is designed to impart a fundamental knowledge on the art and scienceof various unit operations used in pharmaceutical industry. This course emphasizes pharmaceutical importance of different equipment's, their construction, workingapplications, merits and demerits.

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO 1: Define various unit operations and material handling techniques used in Pharmaceutical industries.
CO 2: Recognize significance of plant lay out design for optimum use of resources.
CO 3: Demonstrate various processes involved in pharmaceutical manufacturing process.
CO 4: Appraise the various preventive methods used for corrosion control in Pharmaceutical industries.

Theory Course Contents:

Unit	Topic	Hours
I	**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. **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, Edge runner mill & end runner mill. **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.	14
II	**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier'slaw, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **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. **Distillation:** Basic Principles and methodology of simple	14

	distillation,flashdistillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation	
III	**Drying:** Objectives, applications & mechanism of drying process, measurements& applications 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. **Mixing:** Objectives, applications & factors affecting mixing, Difference betweensolid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids 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,	12
IV	**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, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation,principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.	10
V	**Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plantconstruction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.	10

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 – Mcabe 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.

Program	B. Pharmacy
Year & Semester	2st Year & 1stSemester
Name of the course	Pharmaceutical Organic Chemistry II– Practical
Course Code	BP305P
Credits	2
Hours /week	4hours
Pre / co-requisite/s	Nil

Course Description: The Pharmaceutical Organic Chemistry II laboratory course aimed totrain the students on laboratory techniques for purification of organic compounds. This course also deals with experiments onidentification of purity and standard of the oils by their analytical constants. This course also provides the laboratory skills related to reaction design,chemical synthesis and purification process for few organic medicinal compounds.

Course Learning Outcomes: Upon successful completion of this course, the student should beable to:

CO1: Demonstrate the skills on separation & purification of various organicmolecules.

CO 2: Analyze the analytical constants (values) by different tests to find the purity of oils.

CO 3: Identify the preparation mechanism and purification process of the various organic compounds.

Week	TOPICS
Experiments involving laboratory techniques	
1	Recrystallization
2	Steam distillation
Determination of following oil values (including standardization of reagents)	
3	Acid value
4	Saponification value
5	Iodine value
Preparation of compounds	
6	Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by

	acylation reaction.
7	2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/Acetanilide by halogenation (Bromination) reaction.
8	5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
9	Benzoic acid from Benzyl chloride by oxidation reaction.
10	Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
11	1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.
12	Benzil from Benzoin by oxidation reaction.
13	Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction
14	Cinnammic acid from Benzaldehyde by Perkin reaction
15	*P*-Iodo benzoic acid from *P*-amino benzoic acid

Recommended Books (Latest Editions)

1. Vogel, A.I, Tatchell A.R, Furnis B.S, Hannaford A.J, Smith P.W.G. Practical OrganicChemistry. 5thEd. Pearson Publishers Prentice Hall; New Delhi: 1996.
2. R.K. Bansal, Laboratory Manual of Organic Chemistry, 5th Ed. New Age International;New Delhi 2007.
3. O.P. Agarwal, Advanced Practical Organic Chemistry, 3rd Ed. Goel Publication;Meerut: 2011.
4. F.G.Mann& B.C. Saunders, Practical Organic Chemistry, 4th Ed. Chaman enterprises;New5. Delhi:2004.

Program	B. Pharmacy
Semester	3rd Semester
Name of the course	PHYSICAL PHARMACEUTICS – I (Practical)
Course Code	BP 306P
Credits	2
Hours /week	4 Hours
Pre / co-requisite/s	Nil

Course Description: The Physical Pharmacy – I laboratory course is aimed to train thestudents on experimental techniques for the determination of physico-chemical properties. Thiscourse also deals with wet laboratory based experiments on identification critical solutiontemperatures of binary phase systems. This course also provides the laboratory skills related todetermination of pH, physical & colligative properties.

Course Outcomes: Upon successful completion of this course, the student should beable to:

CO 1: Demonstrate the skills on determination of various physical properties of drugmolecules**.**

CO2: Operate equipments like pH meter, Refractometer etc.,

CO 3: Calculate the buffer capacities of pharmaceutical buffers by experimental techniques.

Week	Topic
1	Determination the solubility of drug at room temperature
2	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3	Determination of Partition co- efficient of benzoic acid in benzene and water
4	Determination of Partition co- efficient of Iodine in CCl_4 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 char coal
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

Learning Resources/Recommended Texts/Reference books/web resources

1. Sinko P.J. Martin's Physical Pharmacy and Pharmaceutical Sciences. 5th ed. New Delhi:Wolters Kluwer Health Pvt.Ltd.,; 2007.
2. Subramanyam C.V.S. Essentials of Physical Pharmacy. 1st ed. Delhi: VallabhPrakashan; 2008.
3. Manavalan. R, Ramaswamy. C. Physical pharmaceutics. 2nded. Tamilnadu: Vignesh publisher; 2008.
4. Experimental Pharmaceutics by Eugene, Parott.
5. Tutorial Pharmacy by Cooper and Gunn.
6. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
7. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
8. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
9. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
10. Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar.
11. http://www.e-booksdirectory.com
12.http://www.jblearning.com

Program	B.Pharm
Year	III Semester
Name of the course	Pharmaceutical Microbiology (Lab)
Course Code	BP 307P
Paper	Practical
Hours /week	4 hours (laboratory)/Week
Pre / co-requisite/s	Nil

Course Description: The course is designed to focus on identification, nutritional requirements of microorganisms. Since microbiology is an upcoming and fascinating branch of biological sciences, medical and pharmaceutical sciences, the approach of performing experiments will lead to success of learning the subject.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:
CO 1: Learn procedure to cultivate and identification of the microorganisms in the laboratory
CO2: propose the procedure for microbiological assays and biochemical tests.

Practical Course: Contents

Week	Topics
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, microscopes used in experimental microbiology.
2	Sterilization of glassware, preparation and sterilization of media
3	Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations
4	Staining methods- Simple, Grams staining
5	acid fast staining (Demonstration with practical)
6	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques 1
7	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques 2
8	Microbiological assay of antibiotics by cup plate method.
9	Microbiological assay of antibiotics by other methods.
10	Sterility testing of pharmaceuticals
11	Bacteriological analysis of water 1
12	Bacteriological analysis of water 2
13	Biochemical test 1
14	Biochemical test 2

15	Revision/Assessment

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. .
2. Prescott and Dunn. Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. Rose: Industrial Microbiology.
5. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
6. Peppler: Microbial Technology.
7. I.P., B.P., U.S.P. - latest editions.
8. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergey's manual of systematic bacteriology, Williams and Wilkins- a Waverly Company.

Program	B. Pharm
Semester	III Semester
Name of the course	PHARMACEUTICAL ENGINEERING – Practical
Course Code	BP308P
Credits	2
Hours /week	4 hours

Course Description: The Pharmaceutical Engineering Practical course is aimed to train the students on handling of equipments related to size reduction, size separation and mixing. This course also deals with determination of humidity using thermometers, rate of drying, rate of filtration, rate of evaporation and extraction by distillation.

Course Learning Outcomes: Upon successful completion of this course, the student should beable to:
CO 1: Operate major equipments used in pharmaceutical industry
CO 2: Experiment to determine various parameters and factors effecting of unit processes.
CO3: Construct plots related to various unit operations.

Practical Course Contents:

S.no	Experiments
1	Determination of radiation constant of brass, iron, unpainted and painted glass.
2	Calculation of efficiency of steam distillation.
3	Determination of 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 by a) Wet and dry bulb temperatures b) Dew point method.
7	Description of Construction working and application of rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8	Evaluation of size distribution of tablet granulations by sieving – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9	Verification of 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
11.	Study of factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12.	Study of effect of time on the Rate of Crystallization.
13.	Calculation of uniformity Index for given sample by using Double Cone Blender.

Program	B. Pharmacy
Year & Semester	2st Year & 2ndSemester
Name of the course	Pharmaceutical Organic Chemistry III– Theory
Course Code	BP401T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: 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.

Course Outcomes: At the end of the course, the student shall be able to

CO 1: Understand the methods of preparation and properties of organic compounds

CO 2: Explain the stereo chemical aspects of organic compounds and stereo chemical reactions

CO 3:know the medicinal uses and other applications of organic compounds

Course Content

Unit	Topics	Hours
Note: To emphasize on definition, types, mechanisms, examples, uses/applications		
I (3 Weeks)	**Stereo isomerism** Optical isomerism –Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules,	**12**
	DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers, Reactions of chiral molecules,	
	Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute.	
II (3 Weeks)	**Geometrical isomerism** Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems), Methods of determination of configuration of geometrical isomers.	**12**
	Conformational isomerism in Ethane, n-Butane and Cyclohexane.	
	Stereo isomerism in biphenyl compounds (Atropisomerism) and	

	conditions for optical activity. Stereospecific and stereoselective reactions	
III (3 Weeks)	**Heterocyclic compounds:** Nomenclature and classification	**12**
	Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene.	
	Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene	
IV (3 Weeks)	Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole.	**12**
	Pyridine, Quinoline, Isoquinoline, Acridine and Indole.	
	Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives	
V (3 Weeks)	Reactions of synthetic importance Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction,	**12**
	Oppenauer-oxidation and Dakin reaction, Beckmann rearrangement and Schmidt rearrangement, Claisen-Schmidt condensation.	
	Revision	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Allyn, Bacon. Morrison and Boyd: Organic Chemistry. 7thEd. Pearson education; NewDelhi: 2011.

2. T.W. Solomons. Organic Chemistry. 8thEd. University of South Florida, John Wiley &Sons, Inc; New York: 2004.

3. ArunBahl, B.S. Bahl. Advanced Organic Chemistry. S.Chand and limited; New Delhi:2010.

4. I.L. Finar. Organic Chemistry. Longman, Scientific & Technical. 5thEd. Co publishedin USA with John Wiley & Sons, Inc; New York: 2004.

5. Zimmerman and Zimmerman. Elements of Organic Chemistry. 2ndEd. CollierMacmillan Publishers; London: 1983.

6. O. P Agarwal. Organic chemistry Reaction and Reagents. 26thEd. Goel PublishingHouse. New Delhi: 1996.

Program	B. Pharmacy
Year & Semester	2st Year & 2ndSemester
Name of the course	Medicinal ChemistryI– Theory
Course Code	BP402T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: This coursedesigned 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.

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

CO 1: Understand the chemistry of drugs with respect to their pharmacological activity

CO 2: Identify the drug metabolic pathways, adverse effect and therapeutic value of drugs

CO 3: Know the Structural Activity Relationship (SAR) of different class of drugs

CO 4: Write the chemical synthesis of some drugs

Course Content

Unit	Topics	Hours
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 (*)		
I (3 Weeks)	**Introduction to Medicinal Chemistry** History and development of medicinal chemistry Physicochemical properties in relation to biological action	**12**
	Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.	
	Drug metabolism Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.	
II (3 Weeks)	**Drugs acting on Autonomic Nervous System** **Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution.	**12**
	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.	
	Adrenergic Antagonists: **Alpha adrenergic blockers**: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. **Beta adrenergic blockers:** SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.	
III **(3 Weeks)**	**Cholinergic neurotransmitters:** Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **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, Isofluorphate, Echothiophate iodide, Parathione, Malathion. **Cholinesterase reactivator:**Pralidoxime chloride.	**12**
	Cholinergic Blocking agents: SAR of cholinolytic agents **Solanaceous alkaloids and analogues**: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropinehydrobromide, Ipratropium bromide*.	
	Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropinemesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.	
IV **(3 Weeks)**	**Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics:**	**12**

	Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturtes**: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital **Miscelleneous:** Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.	
	B. Antipsychotics **Phenothiazeines:** SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Trifluprомazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazines:**Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Flurobuterophenones:** Haloperidol, Droperidol, Risperidone. **Beta amino ketones:**Molindone hydrochloride. **Benzamides:**Sulpieride.	
	C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action **Barbiturates:**Phenobarbitone, Methabarbital. **Hydantoins**:Phenytoin*, Mephenytoin, Ethotoin **Oxazolidinediones**:Trimethadione, Paramethadione **Succinimides**:Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas:**Phenacemide, Carbamazepine* **Benzodiazepines:** Clonazepam **Miscellaneous**: Primidone, Valproic acid, Gabapentin, Felbamate	
V **(3 Weeks)**	**Drugs acting on Central Nervous System** **General anesthetics:** **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short acting barbitutrates:**Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride.*	**12**
	Narcotic and non-narcotic analgesics **Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine	

	hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanoltartarate. **Narcotic antagonists:**Nalorphine hydrochloride, Levallorphantartarate, Naloxone hydrochloride.	
	Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. William O. Foye, Textbook of Medicinal Chemistry, Lea Febiger, Philadelphia.

2. Graham. L. Patrick, an Introduction to Medicinal Chemistry, Oxford Universitypublishers.

3. JH Block & JM Beale (Eds), Wilson & Griswold's textbook of organic MedicinalChemistry and pharmaceutical chemistry, 11th Ed, Lipcolt, Raven, Philadelphia, 2004

4. Rama Rao Nadendla, Medicinal Chemistry, Mc Millan Publishers.

5. Hansch, Comprehensive medicinal chemistry, Vol 1 – 6 Elsevier pergmon press,Oxford.

6. D. Abraham (Ed), Burger Medicinal chemistry and Drug discovery, Vol. 1 & 2, 6thEd, John Wiley & Sons, New York 2003.

7. M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry Ed: l.Oxford University Press, Delhi.

8. Daniel lednicer, Strategies for Organic Drug Synthesis and Design, John Wiley, N. Y. 1998.

9. D. Lednicer, Organic drug synthesis, Vol, 1 – 6, J. Wiley N.Y.

Program	**B. Pharmacy**
Semester	**4thSemester**
Name of the course	**Physical Pharmaceutics II– Theory**
Course Code	BP 403T
Credits	**4**
Hours /week	**3hours (lectures) & 1hour (Tutorial)**
Pre / co-requisite/s	**Nil**

Course Description: The Physical Pharmacy- II course aimed to apply physico–chemicalprinciples in the delivery of drug and the design of pharmaceutical dosage forms. The coursewill emphasize the pharmaceutical importance of complexation in improving solubility. Thisalso deals with drug decomposition & kinetics. This course provides the skills required inpharmaceutics and physical pharmacy.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: Define the fundamental aspects of solubility, distribution, flow of liquids & solids.

CO2: Recognize the importance of micromeretics, rheology & interfacial phenomenon inmanufacturing of dosage form.

CO 3: Apply the principles of diffusion and complexation in formulations.

CO 4: Test the drug decomposition kinetics & stability of dispersed systems.

Course Content

Unit	Topics	Hours
I (3 Weeks)	**Colloidal dispersions:** Classification of dispersed systems & their generalcharacteristics, size & shapes of colloidal particles,	**12**
	Classification of colloids & comparative account of their general properties.	

	Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action.	
II (3 Weeks)	**Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature,non-Newtonian systems, pseudoplastic, dilatant, plastic,	**12**
	thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers	
	Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain,Elastic Modulus	
III (3 Weeks)	**Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling insuspensions, formulation of flocculated and deflocculated suspensions.	**12**
	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.	
IV (3 Weeks)	**Micromeretics:** Particle size and distribution, mean particle size, number and weightdistribution, particle number, methods for determining particle size by different methods,	**12**
	counting and separation method, particle shape, specific surface, methods for determining surface area,	
	Permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	
V (3 Weeks)	**Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basicrate constants, determination of reaction order.	**12**
	Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems.	
	Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration	

	dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Sinko P.J. Martin's Physical Pharmacy and Pharmaceutical Sciences. 5th ed. New Delhi:Wolters Kluwer Health Pvt.Ltd.,; 2007.
2. Subramanyam C.V.S. Essentials of Physical Pharmacy. 1st ed. Delhi: VallabhPrakashan; 2008.
3. Manavalan. R, Ramaswamy. C. Physical pharmaceutics. 2nded. Tamilnadu: Vignesh publisher; 2008.
4. Experimental Pharmaceutics by Eugene, Parott.
5. Tutorial Pharmacy by Cooper and Gunn.
6. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
7. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
8. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
9. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
10. Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar.
11. http://www.e-booksdirectory.com
12. http://www.jblearning.com

Program /Year/Sem	**B. Pharm**
Year /Semester	**Second Year / II semester**
Name of the course	**Pharmacology- I (Theory)**
Course Code	**BP 404 T**
Credits	**4**
Hours /week	**3+1 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to provide basic knowledge on principles of general pharmacology such as sources of drug, drug development phases, routes of drug administration, mechanism of drug action and pharmacokinetic aspects like drug absorption, distribution, metabolism and excretion. Subsequently, this course also covers about the drugs acting on central and peripheral nervous system.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Review the principles of drug discovery and development

CO2: Analyze the various advantages and disadvantages of different routes of drug administration

CO3: Explain the fundamental molecular mechanisms of drug action

CO4: Illustrate the various pharmacological aspects like mechanism of action, pharmacokinetics, side effects, drug interactions, contra indications and indications of drugs falling under below mentioned chapters

Theory Course: Contents

Unit	Topics	Hours allotted
I	**General Pharmacology** 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 non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination	**14hours**
II	**General Pharmacology** 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. Adverse drug reactions. Drug interactions (pharmacokinetic and pharmacodynamic) Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	**12 Hours**

III	**2. Pharmacology of drugs acting on peripheral nervous system** a. Organization and function of ANS. b.Neurohumoral transmission, co-transmission and classification of neurotransmitters. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents. Drugs used in myasthenia gravis and glaucoma	**12 Hours**
IV	**3. Pharmacology of drugs acting on central nervous system** Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and pre-anesthetics**.** Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics Alcohols and disulfiram	**12Hours**

V	**3. Pharmacology of drugs acting on central nervous system** Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinsons disease and Alzheimer's disease. CNS stimulants and nootropics. Opioid analgesics and antagonists Drug addiction, drug abuse, tolerance and dependence.	**10 Hours**

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE 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 MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

Program	**B. Pharm**
Year /Semester	**Second year / 2nd semester**
Name of the course	**Pharmacognosy and Phytochemistry I**
Course Code	**BP405T**
Credits	**4**
Hours /week	**4 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The Pharmacognosy and Phytochemistry I course is aimed at the fundamentals of Pharmacognosy like scope, classification ofcrude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties. The subject deals with cultivation and plant tissue culture aspects of medicinal plants.

Course Learning Outcomes: Upon successful completion of this course, the student shouldbe able to:

CO1: Demonstrates the introduction to pharmacognosy.

CO2:State importance of Natural sources of drugs, scientific names, active constituents, usesof drugs

CO3: Identifies the cultivation and plant tissue culture aspects of medicinal plants.

CO4: Recognize the importance of crude drugs belong to Fibers, Carbohydrates, Proteins, Lipids and marine drugs.

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**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). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs. **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by	15

	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.	
II	**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 Conservation of medicinal plants	15
III	**Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.Applications of plant tissue culture in pharmacognosy. Edible vaccines.	12
IV	**Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in Allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	10
V	**Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs** **Plant Products:** Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, bromelain,serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids(Waxes, fats, fixed oils)** : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax **Marine Drugs:** Novel medicinal agents from marine sources	08

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & 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. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), IstEdn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

Program	B. Pharmacy
Year & Semester	2st Year & 2ndSemester
Name of the course	Medicinal Chemistry I– Practical
Course Code	BP406P
Credits	2
Hours /week	4 hours
Pre / co-requisite/s	Nil

Course Description: The Medicinal chemistry I laboratory course is aimed to train thestudents on experimental techniques for the determination and Synthesis of differentbiologically active compound libraries and evaluation of their biological activity usingcytotoxicity assays. Analysis of structure activity relationships using the data generated. Thiscourse also provides the laboratory skills related to reaction design, chemical synthesis andpurification process for few medicinal compounds.

Course Outcomes: Upon successful completion of this course, the student should beable to:

CO 1: Perform chemical reaction and purification of medicinal compounds ofpharmaceutical interest.

CO 2: Analyze the percentage purity of various classes of drugs as per the monographs in pharmacopoeias.

Week	TOPICS
I. Preparation of drugs / intermediates	
1	1,3-pyrazole
2	1,3-oxazole
3	Benzimidazole
4	Benztriazole
5	2,3- diphenyl quinoxaline
6	Benzocaine

7	Phenytoin
8	Phenothiazine
9	Barbiturate
II. Assay of drugs	
10	Chlorpromazine
11	Phenobarbitone
12	Atropine
13	Ibuprofen
14	Aspirin
15	Furosemide
16	**III. Determination of Partition coefficient for any two drugs**

Learning Resources/Recommended Texts/Reference books/web resources

1. A.I. Vogel, Text Book of Practical Organic Chemistry, 5th Edition. Pearson Prentice Hall.

2. F.G. Mann & B.C. Saunders, Practical Organic Chemistry, 4thEdition. Pearson Publishers.

3.Indian Pharmacopoeia

4.British Pharmacopoeia

Program	B.Pharmacy
Semester	4thSemester
Name of the course	PHYSICAL PHARMACEUTICS – II (Practical)
Course Code	BP 407P
Credits	2
Hours /week	4 Hours
Pre / co-requisite/s	Nil

Course Description: The Physical Pharmacy- II laboratory course aimed to train thestudents on experimental techniques for the determination of physico –chemical properties ofsubstances. This course also deals with wet laboratory that determines order of kinetics, flow ofsolids & liquids. This course also provides the laboratory skills related to solubility, partition &evaluation of dispersed systems.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: Demonstrate the skills on determination of physico –chemical properties.

CO2: Analyze the stability of dispersed systems by experimental techniques.

CO 3: Interpret the scientific data from graphical presentations.

Week	Topic
1	Determination of particle size, particle size distribution using sieving method
2	Determination of particle size, particle size distribution using Microscopic method
3	Determination of bulk density, true density and porosity
4	Determine the angle of repose and influence of lubricant on angle of repose
5	Determination of viscosity of liquid using Ostwald's viscometer
6	Determination sedimentation volume with effect of different suspending agent
7	Determination sedimentation volume with effect of different concentration of single suspending agent

8	Determination of viscosity of semisolid by using Brookfield viscometer
9	Determination of reaction rate constant first order
10	Determination of reaction rate constant second order
11	Accelerated stability studies

Learning Resources/Recommended Texts/Reference books/web resources

1. Sinko P.J. Martin's Physical Pharmacy and Pharmaceutical Sciences. 5th ed. New Delhi:Wolters Kluwer Health Pvt.Ltd.,; 2007.
2. Subramanyam C.V.S. Essentials of Physical Pharmacy. 1st ed. Delhi: VallabhPrakashan; 2008.
3. Manavalan. R, Ramaswamy. C. Physical pharmaceutics. 2nded. Tamilnadu: Vignesh publisher; 2008.
4. Experimental Pharmaceutics by Eugene, Parott.
5. Tutorial Pharmacy by Cooper and Gunn.
6. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
7. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
8. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
9. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
10. Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar.
11. http://www.e-booksdirectory.com
12. http://www.jblearning.com

Program /Year/Sem	**B. Pharm**
Year /Semester	**Second year / 2nd semester**
Name of the course	**Pharmacology – I (Practical)**
Course Code	**BP 408 P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to expertise the students on Basic needs of Pharmacology like handling of animals, Routes of drug administration, Collection of blood samples by various techniques. This course also describe about different preclinical screening models employed in drug discovery and development.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Demonstrate the Basic needs and skills required for pharmacology laboratory.

CO2: Observe the effect of drugs on animals by simulated experiments

Practical Course: Contents

Week	Topics
16	Introduction to Experimental Pharmacology
17	Commonly used instruments in experimental pharmacology.
18	Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs, e. Rabbits).
19	Maintenance of laboratory animals as per CPCSEA guidelines.
20	Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
21	Study of different routes of drugs administration in mice/rats
22	Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.

23	Effect of drugs on ciliary motility of frog oesophagus
24	Effect of drugs on rabbit eye.
25	Effects of skeletal muscle relaxants using rota-rod apparatus.
26	Effect of drugs on locomotor activity using actophotometer.
27	Anticonvulsant effect of drugs by MES and PTZ method.
28	Study of stereotype and anti-catatonic activity of drugs on rats/mice.
29	Study of anxiolytic activity of drugs using rats/mice.
30	Study of local anesthetics by different methods
31	**Revision**

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

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE 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 MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

Program	**B. Pharm**
Year /Semester	**Second year / 2nd semester**
Name of the course	**Pharmacognosy and Phytochemistry I (Practical)**
Course Code	**BP409P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

Course Description: The Pharmacognosy and Phytochemistry I laboratory course is aimed to train the students regarding laboratory skills of various chemical test of the drugs mentioned in theory under lipids, carbohydrates. This course also deals with laboratory basedexperiments on identification of crude drugs by physical and microscopic evaluation.

Course Learning Outcomes: Upon successful completion of this course, the student shouldbe able to:

CO 1: Evaluate crude drugs by chemical test.

CO 2: Demonstrate knowledge on evaluation of crude drugs.

Practical Course: Contents

S. No.	Topic
5.	Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
6.	Determination of stomatal number and index
7.	Determination of vein islet number, vein islet termination and palisade ratio
8.	Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
9.	Determination of Fiber length and width
10.	Determination of number of starch grains by Lycopodium spore method
11.	Determination of Ash value

12.	Determination of Extractive values of crude drugs
13.	Determination of moisture content of crude drugs
14.	Determination of swelling index and foaming

Recommended Books: (Latest Editions)

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

Program	B. Pharmacy
Year & Semester	3rd Year & 1stSemester
Name of the course	Medicinal ChemistryII– Theory
Course Code	BP501T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: This subject 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.

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

CO 1: Understand the chemistry of drugs with respect to their pharmacological activity
CO 2: Identify the drug metabolic pathways, adverse effect and therapeutic value of drugs
CO 3: Know the Structural Activity Relationship of different class of drugs
CO 4: Report the chemical synthesis of selected drugs

Course Content

Unit	Topics	Hours
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 (*)		
I (3 Weeks)	**Antihistaminic agents:** Histamine, receptors and their distribution in thehuman body. **H_1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate,Doxylaminesccuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidaminetartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine	**12**

	hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, LevocetrazineCromolyn sodium	
	H_2-antagonists: Cimetidine*, Famotidine, Ranitidine. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole,Pantoprazole	
	Anti-neoplastic agents: **Alkylating agents:** Meclorethamine*,Cyclophosphamide,Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine,Fluorouracil,Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate **Miscellaneous:** Cisplatin, Mitotane.	
II **(3 Weeks)**	**Anti-anginal**: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritoltetranitrate, Isosorbidedinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazemhydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.	**12**
	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	
	Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazeprilhydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidinemonosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.	
III **(3 Weeks)**	**Anti-arrhythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride,Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine	**12**

	hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.	
	Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine andCholestipol **Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*,Anisindione, clopidogrel	
	Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide,Bosentan, Tezosentan.	
IV **(3 Weeks)**	**Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol,Oestrione, Diethyl stilbestrol.	**12**
	Drugs for erectile dysfunction: Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol	
	Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone,Dexamethasone **Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil,Methimazole.	
V **(3 Weeks)**	**Antidiabetic agents:** Insulin and its preparations **Sulfonyl ureas:**Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. **Biguanides:** Metformin.	**12**
	Thiazolidinediones: Pioglitazone, Rosiglitazone. **Meglitinides:**Repaglinide, Nateglinide. Glucosidase **inhibitors:**Acrabose, Voglibose.**Local Anesthetics:** SAR of Local anesthetics **Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine,Piperocaine.	
	Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine,Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous**: Phenacaine, Diperodon, Dibucaine.*	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. William O. Foye. Principle of medicinal chemistry, 5th Ed. New Delhi: Wolter'sKluwer health (India) Pvt Ltd.; 2008.

2. Block JH & Beale JM. Wilson &Gisvold's Textbook of Organic Medicinal andPharmaceutical Chemistry, 12th ed. Philadelphia: Wolter's Kluwer health (India) PvtLtd.; 2011.

3. Abraham D. Burger, Medicinal Chemistry and Drug Discovery, 6th Ed. New York:John Wiley & Sons. 2007.

4. Graham L. Patrick. An Introduction to Medicinal Chemistry, 1st ed. U K: OxfordUniversity Publishers; 2002.

5. Rama Rao Nadendla. Medicinal Chemistry: Mc Millan Publishers; 2007.

6. Hansch. Comprehensive Medicinal Chemistry, Vol 1-6 ed. Oxford: Elsevier pergmonpress

Program	B. Pharm
Year / Semester	Third year / 1st Semester
Name of the course	Industrial Pharmacy I
Course Code	BP 502 T
Credits	4
Hours /week	4 hours(lectures)
Pre / co-requisite/s	Nil

Course Description: The Industrial Pharmacy I course is aimed to present fundamentalsand importance of preformulation studies and the effect of physico chemical properties of drugon formulations. It emphasizes various techniques in the development and evaluation of tablets, capsules, Parenterals, opthalmicsand Aerosols. The course also deals with the formulation, equipments formanufacture of pelletsand the cosmetic preparations for skin, hair. It also describes about the packaging components and their specifications.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:
CO 1: Define the different types of tablets.
CO 2: Demonstrate the various techniques used in tablet coating.
CO 3: Analyze the fundamentals in designing of Parenteral formulations.
CO 4: Propose the appropriate packaging system for the drug products.

Unit	Topics	Hours
I	**Preformulation Studies:** Introduction to preformulation, goals and objectives, study ofphysicochemical characteristics of drug substances. ***Physical properties:*** Physical form (crystal & amorphous), particle size, shape, flowproperties, solubility profile (pKa, pH, partition coefficient), polymorphism. ***Chemical Properties:*** Hydrolysis, oxidation, reduction, racemisation, polymerization,BCS classification of drugs & its significantapplication of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	12
II	**Tablets:** Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. Tablet coating: Types of coating, coating materials, formulation	14

	of coating composition, methods of coating, equipment employed and defects in coating.Quality control tests: In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirssuspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia	
III	**Capsules:** ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. sizeof capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. ***Soft gelatin capsules:*** Nature of shell and capsule content, size ofcapsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation requirements, pelletization process, equipments formanufacture of pellets	12
IV	**Parenteral Products:** Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of Isotonicity, Production procedure, production facilities and controls,aseptic processing, Formulation of injections, sterile powders, large volume parenterals and lyophilized products. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eyedrops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations	12
V	**Cosmetics:** Formulation and preparation of the following cosmetic preparations:lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosolsystems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **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.	10

Learning Resources/Recommended Texts/Reference books/web resources

Text books

1. Lachman L, Lieberman HA, Kanig JL. Theory & Practice of industrial pharmacy. 3rd ed. Philadelphia: Lea &Febieger; 1990.
2. Allen LV, Popovich NG, Ansel HC. Pharmaceutical dosage forms and drug delivery systems.8th ed.Lippincott Williams & Wilkins; 2005.
3. Aulton Pharmaceutics ME. The science of dosage form design. 2nd ed. Churchill Livingstone; 2002.
4. Mithal B.M. A text book of pharmaceutical formulations. 6th ed.Delhi: vallabh prakashan;2010.
5. MithalBM ,Saha RN. A hand book of cosmetics.Ist ed. Delhi: vallabh prakashan; 2004.
6. Lippincott Williams, Wilkin Remington. The science and practice of pharmacy.21st ed. New delhi:Wolterskluwer Health pvt ltd; 2006.

Program /Year/Sem	**B. Pharm**
Year /Semester	**Third Year / First semester**
Name of the course	**Pharmacology- II (Theory)**
Course Code	**BP503.T**
Credits	**4**
Hours /week	**3+1 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to provide knowledge on mechanism of action, adverse effects, drug interactions, contraindications and therapeutic uses of drugs acting on cardiovascular system, hematopoietic system, renal system, Endocrine system. This course also describes about pharmacological actions of autacoids and their antagonists.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Describe various pharmacological aspects of drugs falling under below mentioned chapters.

CO2: Apply the drug information for the management of disorders falling under below mentioned chapters.

CO3: Analyze the drug related problems pertaining to the below mentioned chapters

CO4: Describe the Pathophysiological basis about the below mentioned chapters

Course Content:

Unit	Topics	Hours allotted
I	**Pharmacology of drugs acting on cardio vascular system** Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidemic drugs	**15hours**
II	**Pharmacology of drugs acting on cardio vascular system**	**12hours**

	Drug used in the therapy of shock. Hematinics, coagulants and anticoagulants. Fibrinolytics and anti-platelet drugs Plasma volume expanders **Pharmacology of drugs acting on urinary system** Diuretics Anti-diuretics.	
III	**Autocoids and related drugs** Introduction to autacoids and classification Histamine, 5-HT and their antagonists. Prostaglandins, Thromboxanes and Leukotrienes. Angiotensin, Bradykinin and Substance P. Non-steroidal anti-inflammatory agents Anti-gout drugs Antirheumatic drugs	**13hours**
IV	**Pharmacology of drugs acting on endocrine system** Basic concepts in endocrine pharmacology. Anterior Pituitary hormones- analogues and their inhibitors. Thyroid hormones- analogues and their inhibitors. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. Insulin, Oral Hypoglycemic agents and glucagon. ACTH and corticosteroids.	**10hours**
V	**Pharmacology of drugs acting on endocrine system** Androgens and Anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus. **Bioassay** a. Principles and applications of bioassay. b.Types of bioassay	**10hours**

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

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE 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 MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Program	**B. Pharm**
Year /Semester	**Third year / 1st semester**
Name of the course	**Pharmacognosy and Phytochemistry II**
Course Code	**BP504T**
Credits	**4**
Hours /week	**4 Hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: The Pharmacognosy and Phytochemistry II course is aimed to impart the students the knowledge of how thesecondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. This subject involves the study of pharmacognosy of alkaloids, glycosides, Iridoids, Other terpenoids & Naphthaquinones and industrial production, identification and analysis of important phytoconstituents. The subject involves in imparting knowledge on basic phytochemical aspects.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Underline the importance of biogenesis

CO2: Translates pharmacognosy of alkaloids, glycosides, Iridoids, Other terpenoids & Naphthaquinones.

CO3: Illustrate industrial production, identification and analysis of important phytoconstituents.

CO4: Locate knowledge on basic phytochemical aspects.

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**Metabolic pathways in higher plants and their determination** Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	10

II	General introduction, composition, chemistry & chemical classes, bio sources, therapeutic uses and commercial applications of followingsecondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis **Volatile oils:** Mentha, Clove, Cinnamon, Fennel, Coriander, Tannins: Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides**: Senna, Aloes, Bitter Almond **Iridoids, Other terpenoids &Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids	20
III	Isolation, Identification and Analysis of Phytoconstituents a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrhetinic acid &Rutin c)Alkaloids: Atropine,Quinine,Reserpine,Caffeine d) Resins: Podophyllotoxin, Curcumin	10
IV	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	10
V	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	10

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Ed., Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd 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, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey

Program	B. Pharmacy
Semester	5th Semester
Name of the course	PHARMACEUTICAL JURISPRUDENCE (Theory)
Course Code	BP 505T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course Description: The pharmaceutical jurisprudence course aimed to present fundamentals in various acts like pharmacy act 1948, drugs and cosmetics act 1940 and rule1945, narcotics and psychotropic substance act 1985 and rules 1986 etc. It also emphasizes theresponsibilities of pharmacist and ethics to be follow in pharmacy profession.

Course Outcomes: Upon successful completion of this course, the student should be able to

CO 1: List various schedules and their applications in pharmacy

CO 2: Discuss the significance and relevance of pharmaceutical laws in India and role of ethicsin pharmacy profession.

CO 3: Explain the components of schedule M and schedule Y related to manufacturing andclinical trials respectively.

CO 4: Appraise the requirements of manufacturing, labeling, and packaging of formulations asper the guidelines of various regulatory agencies.

Course Content

Unit	Topics	Hours
I (3 Weeks)	**Drugs and Cosmetics Act, 1940 and its rules 1945:** Objectives, Definitions, Legal definitions of schedules to the Act and Rules	12
	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.	
II (3 Weeks)	**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	**12**
	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	
III (3 Weeks)	**Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; itsconstitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and penalties.	**12**
	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.	
	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	
IV (3 Weeks)	**StudyofSalient Features of Drugs and MagicRemedies Act and itsrules:** Objectives, Definitions, Prohibition of certain advertisements, Classes ofExempted advertisements, Offences and Penalties	**12**
	Prevention of Cruelty to animals Act-1960: Objectives, Definitions, InstitutionalAnimal 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	
	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)	
V (3 Weeks)	**Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquirycommittee, Health survey and development committee, Hathi committee and Mudaliar committee	**12**
	Code of Pharmaceutical ethics Definition, Pharmacist in relation to his job, trade,medical profession and his profession, Pharmacist's oath	
	Medical Termination of Pregnancy Act **Right to Information Act** **Introduction to Intellectual Property Rights (IPR)**	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Mithal B.M. Text Book of Forensic Pharmacy, 10 ed. New Delhi: VallabhPrakashan;2016.

2. Kokate C.K, Gokhale S.B. Text Book of Forensic Pharmacy, 1st ed. Hyderabad:Pharma Book Syndicate; 2006.

3. Jain N.K. Text Book of Forensic Pharmacy, 8th ed. New Delhi: VallabhPrakashan;2016.

4. Agarwal S.P, Rajesh Khanna. Pharmaceutical Jurisprudence and Ethics, 5th ed. NewDelhi: Birla Publications; 2014.

5. Hand book of drug law-by M.L. Mehra

6. Drugs and Cosmetics Act/Rules by Govt. of India publications.

7. Medicinal and Toilet preparations act 1955 by Govt. of India publications.

8. Narcotic drugs and psychotropic substances act by Govt. of India publications

9. Drugs and Magic Remedies act by Govt. of India publication

Program	B. Pharm
Year / Semester	Third year / 1st Semester
Name of the course	Industrial Pharmacy I Practical
Course Code	BP 506 P
Credits	2
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: The Industrial Pharmacy I laboratory course is aimed to train thestudents on experimental techniques for the preparation of pharmaceutical dosage forms like tablets, injections and opthalmics. This course also deals with various quality control tests to be performed on tablets and capsules. This course also provides the laboratory skills related to formulation of cosmetic preparations like creams.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Demonstrate the skills in handling of different equipments.
CO 2: Formulate different types of tablets, injections and opthalmics.
CO 3: Evaluate the tests on tabletsand capsules.

Practical Course: Contents

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

Learning Resources/Recommended Texts/Reference books/web resources

Text books

1. Lachman L, Lieberman HA, Kanig JL. Theory & Practice of industrial pharmacy. 3rded. Philadelphia: Lea &Febieger; 1990.
2. Allen LV, Popovich NG, Ansel HC. Pharmaceutical dosage forms and drug delivery systems.8thed.Lippincott Williams & Wilkins; 2005.

3. Aulton Pharmaceutics ME. The science of dosage form design. 2nd ed. Churchill Livingstone; 2002.
4. Mithal B.M. A text book of pharmaceutical formulations. 6th ed.Delhi: vallabh prakashan;2010.
5. MithalBM ,Saha RN. A hand book of cosmetics.Ist ed. Delhi: vallabh prakashan; 2004.
6. Lippincott Williams, Wilkin Remington. The science and practice of pharmacy.21st ed. New delhi:Wolterskluwer Health pvt ltd; 2006.

Program /Year/Sem	**B. Pharm**
Year /Semester	**Third year / First semester**
Name of the course	**Pharmacology – II (Practical)**
Course Code	**BP 507 P**
Credits	**2**
Hours /week	**4Hrs (Practical)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to provide skill for the students on various aspects of bioassay experiments. This course also provides an idea about the calculations of pA2 value for antagonists. This course also expertise the students on drug screening methods by using intact animals.

Course Learning Outcomes:
Upon successful completion of this course, the student should be able to:
CO 1: Demonstrate Bioassays of drugs on isolation isolated organ or tissue preparation by simulated experiments

CO2: Calculate the pA_2 value of Different antagonists by using suitable organ or tissue preparation.

CO 3: Perform the Experiments on intact animals related to screening of analgesic and anti-inflammatory agents

Practical Course: Contents

Week	Topics
1	Introduction to *in-vitro* pharmacology and physiological salt solutions.
2	Effect of drugs 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 abdominis 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 anococcygeus muscle (by Schilds 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 softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE 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 MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Program	**B. Pharm**
Year /Semester	**Third year / 1st semester**
Name of the course	**Pharmacognosy and Phytochemistry II (Practical)**
Course Code	**BP508P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

Course Description: The Pharmacognosy and Phytochemistry II laboratory course is aimed to train the students on Morphological, histology and powder characteristics, extraction & detection of crude drugs. The subject refers to isolation & detection of active principles. This course also emphasis on analysis of crude drugs by chemical tests and chromatographic methods.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Demonstrate the skills on Morphology, histology and powder characteristics & extraction & detection of crude drugs

CO 2: Illustrate isolation & detection of active principles.

CO 3. Analysis of crude drugs by chemical tests and chromatographic methods.

Practical Course: Contents

S. No.	Topic
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 Caffeine - from tea dust.
3.	Diosgenin from Dioscorea
4.	Atropine from Belladonna
5.	Sennosides from Senna
6.	Separation of sugars by Paper chromatography

7.	TLC of herbal extract
8.	Distillation of volatile oils and detection of phytoconstituents by TLC
9.	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. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Ed., Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd 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, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

Program	B. Pharmacy
Year & Semester	3rd Year & 2ndSemester
Name of the course	Medicinal Chemistry III– Theory
Course Code	BP601T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: This subject 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.

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

CO 1: Understand the importance of drug design and different techniques of drug design.
CO 2: Illustrate the chemistry of drugs with respect to their biological activity.

CO 3: Know the importance of SAR, metabolism, adverse effects and therapeutic value of drugs.

Course Content

Unit	Topics	Hours
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 by (*)		
I (3 Weeks)	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β- Lactam antibiotics:** Penicillin, Cepholosporins,β- Lactamase inhibitors,Monobactams	**12**

	Aminoglycosides: Streptomycin, Neomycin, Kanamycin	
	Tetracyclines: Tetracycline, Oxytetracycline,Chlortetracycline, Minocycline, Doxycycline	
II (3 Weeks)	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin.	**12**
	Prodrugs: Basic concepts and application of prodrugs design.	
	Antimalarials: Etiology of malaria. **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine,Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. **Biguanides and dihydrotriazines:** Cycloguanilpamoate, Proguanil. **Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquone.	
III (3 Weeks)	**Anti-tubercular Agents** **Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol,Pyrazinamide, Para amino salicylic acid.* **Anti-tubercular antibiotics:** Rifampicin, Rifabutin, CycloserineStreptomycine, Capreomycin sulphate.	**12**
	Urinary tract anti-infective agents **Quinolones:** SAR of quinolones, NalidixicAcid,Norfloxacin, Enoxacin,Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine.	
	Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridinetrifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.	
IV (3 Weeks)	**Antifungal agents:** **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole,OxiconazoleTioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.	**12**
	Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide,Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole,	

	Mebendazole*,Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.	
	Sulphonamides and Sulfones Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones:** Dapsone*.	
V (3 Weeks)	**Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter,	**12**
	Tafts steric parameter and Hansch analysis.Pharmacophore modeling and docking techniques.	
	Combinatorial Chemistry: Concept and applications of combinatorialchemistry: solid phase and solution phase synthesis.	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. William O. Foye, Textbook of Medicinal Chemistry, Lea Febiger, Philadelphia.

2. Graham. L. Patrick, an Introduction to Medicinal Chemistry, Oxford Universitypublishers.

3. JH Block & JM Beale (Eds), Wilson& Griswold's textbook of organic MedicinalChemistry and pharmaceutical chemistry, 11th Ed, Lipcolt, Raven, Philadelphia, 2004.

4. Rama Rao Nadendla, Medicinal Chemistry, Mc Millan Publishers.

5. Hansch, Comprehensive medicinal chemistry, Vol 1 – 6 Elsevier pergmon press,Oxford.

6. D. Abraham (Ed), Burger Medicinal chemistry and Drug discovery, Vol. 1 & 2, 6thEd, John Wiley & Sons, New York 2003.

7. M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry Ed: l.Oxford University Press, Delhi.

8. Daniel lednicer, Strategies for Organic Drug Synthesis and Design, John Wiley, N. Y.1998.

9. D. Lednicer, Organic drug synthesis, Vol, 1 – 6, J. Wiley N.Y.

Program /Year/Sem	**B. Pharm**
Year /Semester	**Third Year / II semester**
Name of the course	**Pharmacology- III (Theory)**
Course Code	**BP602 T**
Credits	**4**
Hours /week	**3+1 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This course aimed to provide knowledge on pharmacological aspects like mechanism of action, pharmacokinetics, side effects, drug interactions, contraindications and indications of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and chronopharmacology

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Illustrates the general principles of chemotherapy

CO 3: Apply the knowledge of chemotherapeutic agents for the management of infectious diseases

C0 4: Describe the principles of animal toxicology and human toxicology

C05: Explain the principles of chronopharmacology

Theory Course: Contents

Unit	Topics	Hours allotted
I	**Pharmacology of drugs acting on Respiratory system** Anti -asthmatic drugs Drugs used in the management of COPD Expectorants and antitussives Nasal decongestants Respiratory stimulants	**10hours**

	Pharmacology of drugs acting on the Gastrointestinal Tract Antiulcer agents. Drugs for constipation and diarrhoea. Appetite stimulants and suppressants. Digestants and carminatives. Emetics and anti-emetics.	
II	**Chemotherapy** a.General principles of chemotherapy. b.Sulfonamides and cotrimoxazole. c.Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides	**15hours**
III	**Chemotherapy** Antitubercular agents Antileprotic agents Antifungal agents Antivral drugs Anthelmintics Antimalarial drugs Antiamoebic agents	**10hours**
IV	**Chemotherapy** Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy. **Immunopharmacology** Immunostimulants Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	**10hours**
V	**Principles of toxicology** Definition and basic knowledge of acute, subacute and chronic toxicity. Definition and basic knowledge of genotoxicity, carcinogenicity,	**15hours**

	teratogenicity and mutagenicity General principles of treatment of poisoning Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning. **Chronopharmacology** Definition of rhythm and cycles. Biological clock and their significance leading to chronotherapy.	

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

Program	**B. Pharm**
Year /Semester	**Third year / 2nd semester**
Name of the course	**HERBAL DRUG TECHNOLOGY (Theory)**
Course Code	**BP 603 T**
Credits	**4**
Hours /week	**4 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This subject gives the student the knowledge of basic understanding of herbal drugindustry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, Neutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO1: Understand raw material as source of herbal drugs from cultivation to herbal drug product

CO2: Know the WHO and ICH guidelines for evaluation of herbal drugs

CO3: Know the herbal cosmetics, natural sweeteners, Neutraceutical

CO4: Appreciate patenting of herbal drugs, GMP .

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**Herbs as raw materials** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of HerbsSelection, identification and authentication of herbal materials Processing of herbal raw material **Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Bio pesticides/ Bio insecticides. **Indian Systems of Medicine** Basic principles involved in Ayurveda, Siddha, Unani and	11

	Homeopathy Preparation and standardization of Ayurvedic formulations vizAristas and Asawas, Ghutika,Churna, Lehya and Bhasma	
II	**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 Gastro intestinal diseases. Study of following herbs as health food: Alfalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction andclassification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.	7
III	**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. **Herbal excipients:** Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations :** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like Phytosomes	10
IV	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products:** Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bio prospecting and Bio piracy Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation ofmanufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	10

V	**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. **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 equipment's, standard operating procedures, health and hygiene, documentation and records.	07

Recommended Books: (Latest Editions)

1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & 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. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), IstEdn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr. SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Pharmacognosy & Phytochemistry by V.D.Rangari
10. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
11. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

Program	B. Pharm
Semester	VI
Name of the course	BIOPHARMACEUTICS AND PHARMACIKINETICS (Theory)
Course Code	BP604T
Credits	4
Hours /week	4 hours

Course Description: This course 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 arised therein.

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO 1: Underline the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
CO 2:Employ the plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
CO 3: Explain the concepts of bioavailability and bioequivalence of drug products and their significance.
CO 4: Illustrate the methods to enhance the dissolution rates.

Theory Course Contents:

Unit	Topic	Hours
I	**Introduction to biopharmaceutics:** **Absorption**; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral 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 binding, kinetics of protein binding, cclinical significance of protein binding of drugs.	14
II	**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs **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.	14
III	**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b).	14

	Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E ,t1/2,Vd,AUC,Ka, Clt and CL_R- definitions methods of eliminations, understanding of their significance and application	
IV	***Multicompartment models:*** Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical setting.	10
V	**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.	8

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 Inernational edition.USA

4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi

5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.

6. Hand Book 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

9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.

10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company,Pennsylvania 1989.

11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia.

Program	B. Pharm
Semester	VI Semester
Name of the course	PHARMACEUTICAL BIOTECHNOLOGY –Theory
Course Code	BP605T
Credits	4
Hours /week	3 hours

Course Description: This course is dealing with the basic techniques of fermentation technology, rDNA technology, Enzyme immobilization, biotechnological based .This course will focus on the new developments in the production of biopharmaceuticals by rDNA technology and monoclonal antibodies.

Course Learning Outcomes: Upon completion of the subject student shall be able to;

1. Understanding the importanc

CO 1: Compare the knowledge of interlinks of pharmaceutical sciences, with bio technology by using living organisms, their products applying rDNA technology and immobilized enzymes in Pharmaceutical Industries

CO2: Expertise their skills for biotechnology concepts, tools and genetic engineering techniques.

CO3: Genetic engineering applications in relation to production of pharmaceuticals and vaccines.

CO4: Importance of Monoclonal antibodies in Industries.

CO5: Appreciate the use of microorganisms in fermentation technology.

Theory Course: Contents

Unit	Topic	Hours
I	Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. Enzyme Biotechnology- Methods of enzyme immobilization and applications. Biosensors- Working and applications of biosensors in Pharmaceutical Industries. Brief introduction to Protein Engineering. Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. Basic principles of genetic engineering.	**10**
II	Study of cloning vectors, restriction endonucleases and DNA ligase. Recombinant DNA technology. Application of genetic engineering in medicine. Application of r DNA technology and genetic engineering in the production of: Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. Brief introduction to PCR	10
III	Types of immunity- humoral immunity, cellular immunity Structure of Immunoglobulins, Structure and Function of MHC Hypersensitivity reactions, Immune stimulation and Immune	10

	suppressions. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. Storage conditions and stability of official vaccines Hybridoma technology- Production, Purification and Applications. Blood products and Plasma Substituties.	
IV	Immuno blotting techniques- ELISA, Western blotting, Southern blotting. Genetic organization of Eukaryotes and Prokaryotes. Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. Introduction to Microbial biotransformation and applications. Mutation: Types of mutation/mutants.	08
V	Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. Large scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.	07

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and applications of RecombinantDNA: ASM Press Washington D.C.
2. RA 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, Degraland, 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.
8. Vyas SP, DixitVK. Pharmaceutical Biotechnology, 1sted. India: CBS Publishers.
9. PrescottSC, DunnCG. Industrial Microbiology,1sted. UK: Mc.Graww Hill.
10. Kokate, Jalalpure, Hurakadle : Pharmaceutical Biotechnology, Elsevier India.

Programme	**B. Pharm**
Year /Semester	**Forth year / 7th Semester**
Name of the course	**Pharmaceutical Quality Assurance**
Course Code	**BP606T**
Credits	**4**
Hours /week	**4 hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description:

The pharmaceutical quality assurance course provides the knowledge on various aspects related to pharmaceutical manufacturing industries. It covers the concepts and guidelines of quality assurance and quality management, Total Quality Management (TQM), ICH guidelines, Quality by Design (QbD), ISO 9000 & ISO 14000, NABL Accreditation. It deals with pharmaceutical aspects related to Organization and personnel, Premises, equipments and raw materials. The course offers the information on the activities like quality control, calibration and validation, warehousing and good laboratory practice (GLP). It also provides the quality assurance activities of complaints, recalls and document maintenance in pharmaceutical industry.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to:

CO 1: Define the principles and concepts of TQM, ICH, QbD, ISO, GMP, GLP, calibration, validation and warehousing.

CO 2: Distinguish the calibration and validation activities of QC and QA in Pharmaceutical manufacturing industry as per the regulatory authorities.

CO 3: Evaluate the pharmaceutical manufacturing activities related to premises, organization, personnel, warehousing, equipments, raw materials, complaints, product recalls, and document maintenance.

Theory Course: Contents

Unit	Topics	Hours
I (4 Weeks)	**Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP. **Total Quality Management (TQM):** Definition, elements, philosophies	16
	ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines	
	Quality by design (QbD): Definition, overview, elements of QbD program, tools.	
	ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration. **NABL accreditation:** Principles and procedures	
II (3 Weeks)	**Organization and personnel:** Personnel responsibilities, training, hygiene and personal records.	12
	Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.	
	Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	
III (2 Weeks)	**Quality Control:** Quality control test for containers, rubber closures and secondary packing materials.	8
	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	
IV **(3 Weeks)**	**Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.	**12**
	Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP,	
	Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	
V **(3 Weeks)**	**Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan.	**12**
	Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.	
	Warehousing: Good warehousing practice, materials management	
	TOTAL	**60**

Learning Resources/Recommended Texts/Reference books/web resources

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

Program	B. Pharmacy
Year & Semester	3rd Year & 2ndSemester
Name of the course	Medicinal Chemistry III– Practical
Course Code	BP607P
Credits	2
Hours /week	4 hours
Pre / co-requisite/s	Nil

Course Description: Medicinal Chemistry - III laboratory course aimed to train the students inchemical synthesis and purification process for few medicinal compounds. This course alsoprovides the laboratory skills related to identification of impurities and percentage purity present in drug substances as per IP procedures.

Course Outcomes: Upon successful completion of this course, the student should beable to:

CO1: Demonstrate the skills in synthesis of various medicinal compounds and intermediates.

CO2: Perform quantitative estimations to determine the purity of drug substances.

CO3: Knowthe physicochemical properties of drugs and Lipinski rule by *Insilico* drug design software.

Week	TOPICS
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	
7	Isonicotinic acid hydrazide
8	Chloroquine

9	Metronidazole
10	Dapsone
11	Chlorpheniramine maleate
12	Benzyl penicillin
13, 14	**III.** Preparation of medicinally important compounds or intermediates by Microwave irradiation technique
15, 16	**IV. Drawing structures and reactions using chem draw®** 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 likeliness screening (Lipinskies RO5)

Learning Resources/Recommended Texts/Reference books/web resources

1. Vogel A. L. Vogel's Textbook of Practical Organic Chemistry, 5th ed. Pearson Prentice Hall:
Dorling. Kindersley (India) Pvt, Ltd; 2007.
2. Mann F. G. & Saunders B. C. Practical Organic Chemistry, 4th ed.: Pearson Publishers;
2007.
3. Indian pharmacopoeia 2007/2010.
4. Burger's Medicinal Chemistry, Vol I to IV.
5. Introduction to principles of drug design- Smith and Williams.

Program /Year/Sem	**B. Pharm**
Year /Semester	**Third year / 2 nd semester**
Name of the course	**Pharmacology – III (Lab)**
Course Code	**BP 608 P**
Credits	**2**
Hours /week	**4 hours (laboratory)**
Pre / co-requisite/s	**Nil**

Course Description: The pharmacology laboratory course is aimed to skilled the students to perform the various toxicity tests according to respective guidelines. And also expertise the students on biostatics used in experimental pharmacology.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to:

CO 1: Estimate the serum biochemical parameters by using semi-auto analyser

CO2: Find out the LD50 of given compounds

CO 3: Apply the various Biostatistics methods in experimental pharmacology

Practical Course: Contents

Week	Topics
32	Dose calculation in pharmacological experiments
33	Anti-allergic activity by mast cell stabilization assay
34	Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
35	Study of effect of drugs on gastrointestinal motility
36	Effect of agonist and antagonists on guinea pig ileum
37	Estimation of serum biochemical parameters by using semi- autoanalyser
38	Effect of saline purgative on frog intestine

39	Insulin hypoglycemic effect in rabbit
40	Test for pyrogens (rabbit method)
41	Determination of acute oral toxicity (LD50) of a drug from a given data
42	Determination of acute skin irritation / corrosion of a test substance
43	Determination of acute eye irritation / corrosion of a test substance
44	Calculation of pharmacokinetic parameters from a given data
45	Biostatistics methods in experimental pharmacology(student's t test, ANOVA)
46	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, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-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.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

Program	**B. Pharm**
Year /Semester	**Third year / 2nd semester**
Name of the course	**HERBAL DRUG TECHNOLOGY (Practical)**
Course Code	**BP 609 P**
Credits	**2**
Hours /week	**4 hours (Practical)**
Pre / co-requisite/s	**Nil**

Course Description:Herbal drug technologylaboratory course is aimed to train the students regarding laboratory skills by preliminary phytochemical screening of crude drugs.This course also deals with laboratory based experiments on preparation and evaluation herbal formulation.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Learn preliminary phytochemical screening of crude drugs.

CO 2: Illustrate cosmeceutical formulation and their evaluation.

CO3: Analysis herbal pharmaceutical formulations

Practical Course: Contents

S. No.	Topic
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, lotions 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. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & 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. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), IstEdn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr. SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Pharmacognosy & Phytochemistry by V.D.Rangari
10. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
11. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

Program	B. Pharmacy
Year & Semester	4th Year & 1st Semester
Name of the course	INSTRUMENTAL METHODS OF ANALYSIS – Theory
Course Code	BP 701T
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

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.

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

CO 1: Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis

CO 2: Understand the chromatographic separation and analysis of drugs.

CO 3: Perform quantitative & qualitative analysis of drugs using various analytical instruments.

Course Content: 60 hours

Unit	Topics	Hours
I **(3 Weeks)**	**UV Visible spectroscopy** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.	**12**

	Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors-Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis.	
	Fluorimetry Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications	
II **(3 Weeks)**	**IR spectroscopy** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications	**12**
	Flame Photometry-Principle, interferences, instrumentation and applications **Atomic absorption spectroscopy**- Principle, interferences, instrumentation and applications	
	Nepheloturbidometry- Principle, instrumentation and applications.	
III **(4 Weeks)**	**Introduction to chromatography** **Adsorption and partition column chromatography-** Methodology, advantages, disadvantages and applications.	**16**
	Thin layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.	
	Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications	
	Electrophoresis– Introduction, factors affecting electrophoretic	

	mobility, Techniques of paper, gel, capillary electrophoresis, applications	
IV (2 Weeks)	**Gas chromatography -** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications	**8**
	High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.	
V (3 Weeks)	**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications	**12**
	Gel chromatography- Introduction, theory, instrumentation and applications	
	Affinity chromatography- Introduction, theory, instrumentation and applications	
	TOTAL	**60**

Recommended Books (Latest Editions)

1.Instrumental Methods of Chemical Analysis by B.K Sharma

2.Organic spectroscopy by Y.R Sharma

3. Text book of Pharmaceutical Analysis by Kenneth A. Connors

4.Vogel's Text book 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

Program	B. Pharm
Year / Semester	Fourth year / 1st Semester
Name of the course	Industrial Pharmacy II
Course Code	BP 702 T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Industrial Pharmacy I

Course Description: The Industrial Pharmacy II course is aimed to impart knowledge on techniques of pilot plant and scale up, quality management systems. It emphasizes the discussions on regulatory requirements andconsiderations for filing and approval process - NDA, IND. This course also deals withtechnology transfer process.It also enlightens the students to know different Laws and Acts that regulate pharmaceutical industry.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Define basic framework of regulatory affairs.
CO 2: Identify the various regulatory requirements for filing process of IND and NDA
CO 3: Describe the process of technology transfer from lab scale to commercial batch
CO 4: Propose the regulatory environment by implementing regulatory practices

Unit	Topics	Hours
I	**Pilot plant scale up techniques:** General considerations - including significance ofpersonnel 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	12
II	**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; TTrelateddocumentation-confidentiality agreement, licensing, MoUs, legal issues.	14
III	**Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatoryauthorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals	

	Regulatory requirements for drug approval: Drug Development Teams, Non-ClinicalDrug 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 FDA Submissions, Management of Clinical Studies.	12
IV	**Quality management systems:** Quality management& Certifications: Concept ofQuality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP	12
V	**Indian Regulatory Requirements:** Central Drug Standard Control Organization(CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.	10

Learning Resources/Recommended Texts/Reference books/web resources

Text books

1. A Guide to Total Quality Management by Kaushik Maitra and Sedhan K. Ghosh.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert
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. Guarino RA. New Drug Approval Process (Drugs and the Pharmaceutical Sciences). Marcel Dekker Inc: USA; 1987. ISBN-13: 978-0824773823.

Program	B. Pharm
Year /Semester	Fourth year / 1st semester
Name of the course	Pharmacy Practice
Course Code	BP703T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: This course is designed based on the changing scenario of pharmacy practice in India. The course gives a brief description about the organization and classification of hospitals. The course describes various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. The course describes the activities of community pharmacy such as drug store management and inventory control, dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up. This course mentions the importance of clinical pharmacy concept and activities of the clinical pharmacist.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO 1: Define the professional practice like drug distribution and management skills in hospital pharmacy, community pharamcy and clinical pharmacy in association with respect to various committees of the hospitals.

CO 2: Assess the drug therapy of patient through drug therapy chart review, medication history interview; recognize and manage drug related problems effectively.

CO 3: Equip unbiased drug and poison information.

CO 4: Interpret the laboratory investigations of specific diseased states.

CO 5: Provide the pharmaceutical care services

Theory Course: Contents

Unit	Topics	No. of hours
I	**Hospital and it's 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. **Hospital pharmacy and its organization** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **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 for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. **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.	**13**
II	**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. **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. **Therapeutic drug monitoring** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **Medication adherence** Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. **Patient medication history interview** Need for the patient medication history interview, medication interview forms.	**13**

	Community pharmacy management Financial, materials, staff, and infrastructure requirements.	
III	**Pharmacy and therapeutic committee** Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. **Drug information services** Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. **Patient counseling** Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist **Education and training program in the hospital** Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. **Prescribed medication order and communication skills** Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.	**13**
IV	**Budget preparation and implementation** Budget preparation and implementation **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. **Over the counter (OTC) sales** Introduction and sale of over the counter, and Rational use of common over the counter medications.	**11**
V	**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	**10**

	Investigational use of drugs Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. **Interpretation of Clinical Laboratory Tests** Blood chemistry, hematology, and urinalysis	
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. William E Hassan.Hospital Pharmacy – 5th ed. Phialdelphia: Lea and Febiger.
2. Merchant and Qadry's: Dr. J.S.Qadry. A textbook of Hospital Pharmacy 10th ed. B.S.Shah Prakashan.
3. David H Lawson,R Michael E. Richards.Clinical Pharmacy and Hospital Drug Management – 1982. Champan and Hall.
4. Dr. H.P.Tipnis, Dr. Amrita Bajaj.Clinical Pharmacy – 1st ed. Career Publications.
5. Dr. G. Parthasarathi, Karin Nyfort-Hansen, Milap C Nahata.A textbook of Clinical Pharmacy Practice- essential concepts and skills – 2nd ed. University Press.
6. S. J. Carter. Cooper and Gunn's. Dispensing for Pharmaceutical students – 12th ed. CBS Publishers and Distributors.
7. Mary Lee. Basic skills in interpreting laboratory data – 5th ed. American Society of Health System Pharmacist®.
8. Susan Foran. Australian drug information -Procedure manual – 1996. Society of Hospital Pharmacists of Australia.
9. Parmar N.S. Health Education and Community Pharmacy- 18th ed. CBS Publishers and Distributors.

Program	B. Pharm
Semester	VII
Name of the course	NOVEL DRUG DELIVERY SYSTEMS (Theory)
Course Code	BP704T
Credits	4
Hours /week	4 hours

Course Description: This course is designed to impart basic knowledge on the area of novel drug delivery systems and also emphasizes the study of various methods involved in development novel drug delivery systems.

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO 1: Define the concepts and applications of novel drug delivery systems such as controlled
drug delivery systems, liposomes, niosomes , nanoparticles etc.
CO 2: To underline various approaches for development of novel drug delivery systems.
CO 3: To explain the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.

Theory Course Contents:

Unit	Topic	Hours
I	**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. **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.	14
II	**Microencapsulation:** Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications. **Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems. **Implantable Drug Delivery Systems:**Introduction, advantages and disadvantages, concept of implantsand osmotic pump.	14

III	**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches. **Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications. **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.	14
IV	**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.	10
V	**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts. **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications.	8

Recommended Books: (Latest Editions)

1. Y W. 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)

Program	B. Pharmacy
Year & Semester	4th Year & 1st Semester
Name of the course	INSTRUMENTAL METHODS OF ANALYSIS – Practical
Course Code	BP 705P
Credits	2
Hours /week	4 Hours
Pre / co-requisite/s	Nil

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.

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

CO 1: handle UV-Vis Spectrophotometer.

CO 2: Analyse drugs by different techniques

Week	Topic
1	Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
2	Estimation of dextrose by colorimetry
3	Estimation of sulfanilamide by colorimetry
4	Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy

5	Assay of paracetamol by UV- Spectrophotometry
6	Estimation of quinine sulfate by fluorimetry
7	Study of quenching of fluorescence
8	Determination of sodium by flame photometry
9	Determination of potassium by flame photometry
10	Determination of chlorides and sulphates by nephelo turbidometry
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	6. 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. Text book of Pharmaceutical Analysis by Kenneth A. Connors

4.Vogel's Text book 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

PRACTICE SCHOOL BP706PS 12 HOURS

Program	B. Pharm
Year /Semester	Fourth year / 8th semester
Name of the course	Biostatistics and Research Methodology
Course Code	BP801T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: This course helps the students to understand the applications of Biostatics 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**.**

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Define Basics concepts of Statistics

CO2: Recognize types of clinical studies, types of data distribution, data graphics and statistical applications in Pharmacy.

CO3: Formulate parametric tests and non parametric tests.

CO4: Able to the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)

Theory Course: Contents

Unit	Topics	No. of hours
I	**Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency**: Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion**: Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	13
II	**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 **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 **Parametric test**: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference	**13**
III	**Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	**13**
IV	Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels **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	**11**
V	**Design and Analysis of experiments:** **Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design **Response Surface methodology**: Central composite design, Historical design, Optimization Techniques	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha.
3. Design and Analysis of Experiments –PHI Learning Private Limited, R.Pannerselvam.
4. Design and Analysis of Experiments –Wiley Students Edition, Douglas and C. Montgomery.
5. Text book of Statistical Methods and Computer applications by Dr. Ramakrishna Prasad.
6. Fundamentals of Biostatistics by Khan and Khanum.

Program	B. Pharm
Year /Semester	Fourth year / 2nd semester
Name of the course	Social and Preventive Pharmacy
Course Code	BP802T
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: 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.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.

CO2: Develop skills of critical way of thinking based on current healthcare development.

CO3: Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

Theory Course: Contents

Unit	Topics	No. of hours
I **(3 Weeks)**	**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. **Social and health education** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. **Sociology and health** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health **Hygiene and health** Personal hygiene and health care; avoidable habits	**13**
II **(3 Weeks)**	**Preventive medicine** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse.	**13**
III **(3 Weeks)**	**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.	**13**
IV **(3 Weeks)**	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.	**11**
V **(3 Weeks)**	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.	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. Prabhakara GN. Short Textbook of Preventive and Social Medicine. 2nd Edition. 2010. Jaypee Publications. ISBN: 9789380704104.
2. Roy Rabindra Nath, Saha Indranil. Textbook of Preventive and Social Medicine (Mahajan and Gupta). 4th Edition, 2013. Jaypee Publications. ISBN: 9789350901878.
3. Jain Vivek. Review of Preventive and Social Medicine (Including Biostatistics). 6th Edition. 2014. Jaypee Publications. ISBN: 9789351522331.
4. Hiremath Lalita D, Hiremath Dhananjaya A. Essentials of Community Medicine—A Practical Approach. 2nd Edition. 2012. Jaypee Publications. ISBN: 9789350250440.
5. K Park. Park Textbook of Preventive and Social Medicine. 21st Edition. 2011. Banarsidas Bhanot Publishers. ISBN-14: 9788190128285.
6. Ramesh Adepu. Community Pharmacy Practice. BSP publishers, Hyderabad.
7. Research in Social and Administrative Pharmacy, Elsevier, Ireland. (Journal).

Program	**B. Pharm**
Year /Semester	**Fourth year / 2nd semester**
Name of the course	**Pharma Marketing Management**
Course Code	**BP803ET**
Credits	**4**
Hours /week	**4 hours (lectures)**
Pre / co-requisite/s	**Nil**

Course Description: 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.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Understand marketing concepts and techniques.

CO2: Apply marketing management concepts in the pharmaceutical industry.

CO3: Apply pricing techniques over any proposed product.

CO4: Analyze business scenarios in an integrative way

CO5: Craft alternative strategies to address complex business related situations as well as evaluate the pros and cons of those alternatives.

Theory Course: Contents

Unit	Topics	No. of hours
I **(3 Weeks)**	**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. **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.	**12**
II **(3 Weeks)**	**Product decision** Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.	**12**
III **(3 Weeks)**	**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.	**12**
IV **(3 Weeks)**	**Pharmaceutical marketing channels** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **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.	**12**
V **(3 Weeks)**	**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). **Emerging concepts in marketing** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	**12**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

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 MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill.
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India.
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition).
6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi.
7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi.
8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.
9. Smarta RB. Strategic Pharma Marketing. India: A.H. Wheeler Publishing Co Ltd; 1996. ISBN-10: 8185814996, ISBN-13: 9788185814995
10. Vidyasagar G. Pharmaceutical Industrial Management. India: Pharma book syndicate; 2005. ISBN-10: 8188449121, ISBN-13: 978-8188449125
11. Subbarao C. Pharmaceutal Marketing in India – Concepts and Strategy Cases. Hyderabad: Pharma Book Syndicate; 2007. ISBN 10: 8188449253 ISBN 13: 9788188449255.
12. Khanna OP. Industrial engineering and management. New Delhi: Dhanpat Rai Publishing Company; 2010. ISBN-10: 818992835X, ISBN-13: 9788189928353.

Program	B. Pharm
Year /Semester	Fourth year / 2nd semester
Name of the course	Pharmaceutical Regulatory Science
Course Code	BP804ET
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: 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.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Understand the process of drug discovery and development

CO2: Discusses the scientific, regulatory, and legal considerations for the development of generic drug products and Outlines the ANDA regulatory approval process

CO3: Identify the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

CO4: Understand the regulatory approval process and their registration in Indian and international markets

CO5: Understand, write and review Regulatory Documents.

Theory Course: Contents

Unit	Topics	No. of hours
I (3 Weeks)	**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.	**13**
II (3 Weeks)	**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. **Regulatory authorities and agencies** Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications).	**13**
III (3 Weeks)	**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 Document (eCTD), ASEAN Common Technical Document (ACTD)research.	**13**
IV (3 Weeks)	**Clinical trials** Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials	**11**
V (3 Weeks)	**Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. David Machin, Simon Day, Sylvan Green. Textbook of Clinical Trials. John Wiley and Sons; 2005.
2. Giovanna Di Ignazio, Di Giovanna, Haynes. Principles of Clinical Research. Illustrated edition. University of Michigan. Wrightson Biomedical Publications; 2008. ISBN 1871816459, 9781871816457.
3. Sachin Itkar, Dr. N.S. Vyawahare. Drug Regulatory Affairs. Nirali Prakashan.
4. Ira R. Berry and Robert P. Martin. The Pharmaceutical Regulatory Process. Drugs and the Pharmaceutical Sciences, 2 nd ed. Vol.185. Informa Health care Publishers.
5. Richard A Guarino, MD. New Drug Approval Process: Accelerating Global Registrations. Drugs and the Pharmaceutical Sciences. 5th edition. Vol.190.
6. John Wiley & Sons. Inc. Guidebook for drug regulatory submissions / Sandy Weinberg.
7. Douglas J. Pisano, David Mantus. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics.
8. Leon Shargel and Isader Kaufer. Generic Drug Product Development, Solid Oral Dosage forms. , Marcel Dekker series. Vol.143.
9. Fay A. Rozovsky and Rodney K. Adams. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance.
10. John I. Gallin and Frederick P. Ognibene. Principles and Practices of Clinical Research. 2nd ed.
11. Rick Ng. Drugs: From Discovery to Approval. 2nd ed.

Program	B. Pharm
Year /Semester	Fourth year / 2nd semester
Name of the course	Pharmacovigilance
Course Code	BP805ET
Credits	4
Hours /week	4 hours (lectures)
Pre / co-requisite/s	Nil

Course Description: The Pharmacovigilance course is designed to impart basic knowledge and skills of various aspects of pharmacovigilance. The course gives a brief idea about the basic principles of monitoring and reporting of adverse effects. The course 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, 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. It forecasts the importance of communication of adverse effects.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Understood the terminology of adverse medication related events

CO2: Develop skills of reporting and monitoring of adverse drug reactions.

CO3: Know different information resources and drug dictionaries useful in pharmacovigilance

CO4: Understand and develop the skills of effective communication of adverse drug reactions.

CO5: Eligible to understand the Quality System in Pharmacovigilance &SOPs in Pharmacovigilance.

CO6: Understood the various regulatory guidelines.

Theory Course: Contents

Unit	Topics	No. of hours
I	**Introduction to Pharmacovigilance** History and development of Pharmacovigilance	

	Importance of safety monitoring of Medicine WHO international drug monitoring programme Pharmacovigilance Program of India(PvPI) **Introduction to adverse drug reactions** Definitions and classification of ADRs Detection and reporting Methods in Causality assessment Severity and seriousness assessment Predictability and preventability assessment Management of adverse drug reactions **Basic terminologies used in pharmacovigilance** Terminologies of adverse medication related events Regulatory terminologies	**13**
II	**Drug and disease classification** Anatomical, therapeutic and chemical classification of drugs International classification of diseases Daily defined doses International Non proprietary Names for drugs **Drug dictionaries and coding in pharmacovigilance** WHO adverse reaction terminologies MedDRA and Standardised MedDRA queries WHO drug dictionary Eudravigilance medicinal product dictionary **Information resources in pharmacovigilance** Basic drug information resources Specialised resources for ADRs **Establishing pharmacovigilance programme** Establishing in a hospital Establishment & operation of drug safety department in industry Contract Research Organisations (CROs) Establishing a national programme	**13**
III	**Vaccine safety surveillance** Vaccine Pharmacovigilance Vaccination failure Adverse events following immunization **Pharmacovigilance methods** Passive surveillance – Spontaneous reports and case series Stimulated reporting Active surveillance – Sentinel sites, drug event monitoring and registries	

	Comparative observational studies – Cross sectional study, case control study and cohort study Targeted clinical investigations **Communication in pharmacovigilance** Effective communication in Pharmacovigilance Communication in Drug Safety Crisis management Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	**13**
IV	**Safety data generation** Pre clinical phase Clinical phase Post approval phase (PMS) **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 Good clinical practice in pharmacovigilance studies	**11**
V	**Pharmacogenomics of adverse drug reactions** Genetics related ADR with example focusing PK parameters. **Drug safety evaluation in special population** Paediatrics Pregnancy and lactation Geriatrics **CIOMS** CIOMS Working Groups CIOMS Form **CDSCO (India) and Pharmacovigilance** D&C Act and Schedule Y Differences in Indian and global pharmacovigilance requirements	**10**
	Total	**60**

Learning Resources/Recommended Texts/Reference books/web resources

1. S K Gupta. Textbook of Pharmacovigilance, 1st ed. India: Jaypee Brothers, Medical Publishers; 2011.
2. Barton L. Cobert, Pierre Biron. Practical Drug Safety from A to Z , 1st ed. Sudbury, Mass: Jones and Bartlett Publishers; 2008.
3. Mann's Pharmacovigilance, 3rd ed.: Wiley Blackwell; 2014.
4. Stephens' Detection of New Adverse Drug Reactions, 6th ed.: Wiley Blackwell; 2012.
5. Patrick Waller . An Introduction to Pharmacovigilance . : Wiley Blackwell; 2009.
6. Barton L. Cobert. Cobert's Manual of Drug Safety and Pharmacovigilance, 2nd ed. : Jones & Bartlett Learning; 2011.
7. Brian L Storm. Pharmacoepidemiology. 3rd ed. England: John Wiley & Sons Ltd. 2000.
8. G. Parthasarathi, Karin Nyfor-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice: Essential concepts and skills.2nd ed. India: Universities Press (India) Private Limited; 2012.
9. Guru Prasad Mohanta, Prabal Kumar Manna. A Textbook of Pharmacovigilance: Concept and Practice, 1st ed. : PharmaMed Press; 2016.
10. National Formulary of India
11. http://www.whoumc.org/
12. http://www.ich.org/
13. http://www.cioms.ch/
14. http://cdsco.nic.in/
15. http://www.who.int/vaccine_safety/en/
16. http://www.ipc.gov.in/PvPI/pv_home.html

Program	**B. Pharm**
Year /Semester	**Fourth year / 2nd semester**
Name of the course	**QUALITY CONTROL AND STANDARDIZATION OF HERBALS**
Course Code	**BP 806 ET**
Credits	**4**
Hours /week	**3 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: In this subject the student learns about the various methods and guidelines forevaluation 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.

Course Learning Outcomes:

Upon completion of the subject student shall be able to;

CO1: Know WHO guidelines for quality control of herbal drugs

CO2: Know Quality assurance in herbal drug industry

CO3: Know the regulatory approval process and their registration in Indian and international markets

CO4: Appreciate EU and ICH guidelines for quality control of herbal drugs

Theory Course: Contents

UNIT	Topic	Hours allotted
I	Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms, WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use	10
II	**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP intraditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	10

III	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	10
IV	Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.	08
V	Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in Pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products	07

Recommended Books: (Latest Editions)

1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
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.EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
5. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
6. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
7. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998.

8. 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 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.

Program	B. Pharmacy
Year & Semester	4th Year & 2nd Semester
Name of the course	Computer Aided Drug Design
Course Code	BP 807 ET
Credits	4
Hours /week	3hours (lectures) & 1hour (Tutorial)
Pre / co-requisite/s	Nil

Course description: This subject designed to provide detailed knowledge of rational drug designprocess and various techniques used in rational drug design process.

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

CO 1: Design and discovery of lead molecules

CO 2: Estimate the role of drug design in drug discovery process

CO 3: Apply the concept of QSAR, docking, molecular modeling software and various strategies to design &develop new drug like molecules.

Course Content

Unit	Topics	Hours
I (3 Weeks)	**Introduction to Drug Discovery and Development** Stages of drug discovery and development	12
	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.	
	Analog Based Drug Design: Bioisosterism, Classification, Bioisostericreplacement. Any three case studies	
II (3 Weeks)	**Quantitative Structure Activity Relationship (QSAR)** SAR versus QSAR, History and development of QSAR,	12
	Types of physicochemical parameters, experimental and theoretical	

	approaches for the determination of physico-chemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis,	
	3D-QSAR approaches like COMFA and COMSIA.	
III (3 Weeks)	**Molecular Modeling and virtual screening techniques** **Virtual Screening techniques:** Drug likeness screening, Concept ofpharmacophore mapping and pharmacophore based Screening,	**12**
	Molecular docking: Rigid docking, flexible docking, manual docking,	
	Docking based screening. *De novo* drug design.	
IV (3 Weeks)	**Informatics & Methods in drug design** Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	**12**
V (3 Weeks)	**Molecular Modeling:** Introduction to molecular mechanics and quantummechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.	**12**
	Revision	
	TOTAL	**60**

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.

2. Martin YC. "Quantitative Drug Design" Dekker, New York.

3. Delgado JN, Remers WA eds "Wilson &Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.

4. Foye WO "Principles of Medicinal chemistry 'Lea &Febiger.

5. Koro lkovas 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.

Program	B. Pharm
Semester	VIII th Semester
Name of the course	Cell and Molecular Biology--Theory
Course Code	BP808ET
Credits	2
Hours /week	3 hours

Course Description: 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.

Course Learning Outcomes: Upon successful completion of this course, the student should be able to:

CO1: Summarize cell and molecular biology history.
CO2: Summarize cellular functioning and composition.
CO3: Describe the chemical foundations of cell biology.
CO4: Summarize the DNA properties of cell biology.
CO5: Describe protein structure and function.
CO6: Describe cellular membrane structure and function.
CO7: Describe basic molecular genetics mechanisms.
CO8: Summarize the Cell Cycle.
3. Understanding the importanc

Theory Course: Contents

Unit	Topic	Hours
I	Cell and Molecular Biology: Definitions theory and basics and Applications. Cell and Molecular Biology: History and Summation. Properties of cells and cell membrane. Prokaryotic versus Eukaryotic, Cellular Reproduction Chemical Foundations – an Introduction and Reactions (Types)	**10**
II	DNA and the Flow of Molecular Information DNA Functioning DNA and RNA Types of RNA Transcription and Translation.	10
III	Proteins: Defined **and** Amino Acids Protein Structure Regularities in Protein Pathways Cellular Processes Positive Control and significance of Protein Synthesis	10

IV	Science of Genetics Transgenics and Genomic Analysis Cell Cycle analysis Mitosis and Meiosis Cellular Activities and Checkpoints	08
V	Cell Signals: Introduction Receptors for Cell Signals Signaling Pathways: Overview Misregulation of Signaling Pathways Protein-Kinases: Functioning.	07

Recommended Books (latest edition):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn. Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly Company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
13. RA Goldshy et. al., Kuby Immunology.

Program	B. Pharm
Semester	VIII Semester
Name of the course	Cosmetic Science– Theory
Course Code	BP809ET
Credits	4
Hours /week	4 hours

Course Description:
This course is designed to impart a fundamental knowledge on various types of cosmetics products, their formulation and evaluations. This course also describes the importance of herbal cosmetics.

Course Learning Outcomes: Upon completion of this course the student should be able to:

CO 1:Define and classify various types of cosmetic and dermatological products.

CO 2: Discuss the principles involved in formulation and manufacturing of various cosmetic and dermatological products.

CO 3: Demonstrate ability to develop, validate and apply different instrumental analytical techniques to analyze various cosmetic and dermatological products.

Theory Course Contents:

Unit	Topic	Hours
I	Classification of cosmetic and cosmeceutical products Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients,preservatives. Classification and application **Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums**.**	14
II	**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 cosmecuticals. **Antiperspants& deodorants**- Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. **Principles of formulation and building blocks of oral care products:** Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.	16
III	**Sun protection:** Classification of Sunscreens and SPF. **Role of herbs in cosmetics:**	12

	Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste**.**	
IV	**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.	8
V	Oily and dry skin causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. **Cosmetic problems associated with Hair and scalp:** Dandruff, Hair fall causes **Cosmetic problems associated with skin:** blemishes, wrinkles, acne, prickly heat and body odor. **Antiperspirants and Deodorants**- Actives and mechanism of action.	10

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. Text book of cosmeticology by Sanju Nanda &Roop K. Khar, Tata Publishers.

Program	**B. Pharm**
Year /Semester	**Fourth year / 2nd semester**
Name of the course	**EXPERMINENTAL PHARMACOLOGY**
Course Code	**BP810 ET**
Credits	**4**
Hours /week	**4 Hours (Lectures)**
Pre / co-requisite/s	**Nil**

Course Description: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

Course Learning Outcomes: Upon successful completion of this course, the student shouldbe able to:

CO1: Appreciate the applications of various commonly used laboratory animals.
CO2: Appreciate and demonstrate the various screening methods used in preclinical research
CO3: Appreciate and demonstrate the importance of biostatistics and research methodology
CO4: Design and execute a research hypothesis independently

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**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	15

	blood collection and euthanasia.	
II	**Preclinical screening models** a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale 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, antiepileptic, antiparkinsonism, alzheimer's disease	15
III	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics.	10
IV	**Preclinical screening models:** for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics	10

V	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design. Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	10

Recommended Books (latest edition):

7. Fundamentals of experimental Pharmacology-by M.N.Ghosh
8. Hand book of Experimental Pharmacology-S.K.Kulakarni
9. CPCSEA guidelines for laboratory animal facility.
10. Drug discovery and Evaluation by Vogel H.G.
11. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
12. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

Programme	**B. Pharm**
Year /Semester	**Forth year / 8th Semester**
Name of the course	**ADVANCED INSTRUMENTATION TECHNIQUES-Theory**
Course Code	**BP 811 ET**
Credits	**4**
Hours /week	**3hours (lectures) & 1hour (Tutorial)**
Pre / co-requisite/s	**Nil**

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.

Objectives: Upon completion of the course the student 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.

Course Content:

Unit	Topics	Hours

I **(4 Weeks)**	**Nuclear Magnetic Resonance spectroscopy** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant,	**16**
	Spin - spin coupling, relaxation, instrumentation and applications	
	Mass Spectrometry- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB,	
	Analyzers-Time of flight and Quadrupole, instrumentation, applications	
II **(3 Weeks)**	**Thermal Methods of Analysis:** Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA),	**12**
	Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)	
	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.	
III **(3 Weeks)**	**Calibration and validation-**as per ICH and USFDA guidelines	**12**
	Calibration of following Instruments Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer,	
	Calibration of following Instruments Fluorimeter, Flame Photometer, HPLC and GC	
IV **(2**	**Radio immune assay:**Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay	**8**

Weeks)	**Extraction techniques**: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	
V **(3 Weeks)**	**Hyphenated techniques**-LC-MS/MS,	**12**
	GC-MS/MS,	
	HPTLC-MS.	
	TOTAL	**60**

Recommended Books (Latest Editions)

1.Instrumental Methods of Chemical Analysis by B.K Sharma

2.Organic spectroscopy by Y.R Sharma

3. Text book of Pharmaceutical Analysis by Kenneth A. Connors

4.Vogel's Text book 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

Program	**B. Pharm**
Year /Semester	**Fourth year / 2nd semester**
Name of the course	**DIETARY SUPPLEMENTS AND NUTRACEUTICALS**
Course Code	**BP 812 ET**
Credits	**4**
Hours /week	**3 Hours (Lectures)+ 1 Tutorial**
Pre / co-requisite/s	**Nil**

Course Description: This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Course Learning Outcomes:

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:

CO1: Understand the need of supplements by the different group of people to maintain Healthy life.

CO2:Understand the outcome of deficiencies in dietary supplements.

CO3: Appreciate the components in dietary supplements and the application.

CO4: Appreciate the regulatory and commercial aspects of dietary supplements Including health claims.

Theory Course: Contents

UNIT	Topic	Hours allotted
I	**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. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.	07

	Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as foods; Nutraceuticals /functional Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds	
II	**Phytochemicals as nutraceuticals:** Occurrence and characteristic features(chemical nature medicinal benefits) of following Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin Sulfides: Diallyl sulfides, Allyltrisulfide. Polyphenolics: Reservetrol Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones Prebiotics/ Probiotics: Fructo oligosaccharides, Lacto bacillum Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans Tocopherols, Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.	15
III	**Introduction to free radicals:** Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. Dietary fibres and complex carbohydrates as functional food ingredients	07
IV	Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing. Antioxidants: Endogenous antioxidants – enzymatic and non-enzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. Functional foods for chronic disease prevention	10

V	Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. Pharmacopoeial Specifications for dietary supplements and nutraceuticals.	06

Recommended Books: (Latest Editions)

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agustiand P. Faizal: BS Punblication.
3. Advanced Nutritional Therapies by Cooper. K.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* Wood head 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 *Essentials of FunctionalFoods* M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition) Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

Program	**B. Pharm**
Year /Semester	**Fourth year / 2nd semester**
Name of the course	**Project Work**
Course Code	**BP813PW**
Credits	**6**
Hours /week	**12 Hours**