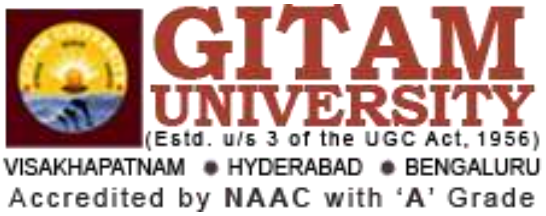
GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University, Estd. u/s 3 of the UGC Act 1956)

VISAKHAPATNAM * HYDERABAD *BENGALURU

Accredited by NAAC with 'A' Grade



REGULATIONS & SYLLABUS

Bachelor of Pharmacy

(W.e.f. 2017-18 admitted batch)

Website: www.gitam.edu

BACHELOR OF PHARMACY (B. Pharm.)
REGULATIONS as per PCI norms
(w. e. f. 2017-18 admitted batch)

1. ADMISSIONS

1.1. Admissions into B. Pharm. Program of GITAM University are governed by GITAM University admission regulations.

2. ELIGIBILITY CRITERIA

2.1. A pass in 10+2 or equivalent examination approved by GITAM University with Physics, Chemistry and Mathematics/ Biology.

2.2. Admissions into B. Pharm. will be based on All India Entrance Test (GITAM Admission Test - GAT) conducted by GITAM University and the rule of reservation is followed wherever applicable.

3. DURATION OF THE PROGRAMME

The course of study for B. Pharm. shall extend over a period of eight semesters (four academic years).

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 November/December to April/May 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. PROGRAMME/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.

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
BP 101T	Human Anatomy and Physiology I – Theory	3	1	4
BP 102T	Pharmaceutical Analysis – Theory	3	1	4
BP 103T	Pharmaceutics – Theory	3	1	4
BP 104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP 105T	Communication skills – Theory *	2	-	2
BP 106RBT/ BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP 107P	Human Anatomy and Physiology I – Practical	4	-	2
BP 108P	Pharmaceutical Analysis – Practical	4	-	2
BP 109P	Pharmaceutics – Practical	4	-	2
BP 110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP 111P	Communication skills – Practical*	2	-	1
BP 112RBP	Remedial Biology – Practical*	2	-	NC
	Total	**32/34$/36#**	**4**	**29**

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 at HSC and appearing for Remedial Mathematics (RM) course**.**

* Non University Examination (NUE)

Table-II: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP 201T	Human Anatomy and Physiology II – Theory	3	1	4
BP 202T	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP 203T	Biochemistry – Theory	3	1	4
BP 204T	Pathophysiology – Theory	3	1	4
BP 205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP 206T	Environmental sciences – Theory *	3	-	3
BP 207P	Human Anatomy and Physiology II –Practical	4	-	2
BP 208P	Pharmaceutical Organic Chemistry I– Practical	4	-	2

BP 209P	Biochemistry – Practical	4	-	2
BP 210P	Computer Applications in Pharmacy – Practical*	2	-	1
	Total	**32**	**4**	**29**

* Non University Examination (NUE)

Table-III: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP 302T	Physical Pharmaceutics I – Theory	3	1	4
BP 303T	Pharmaceutical Microbiology – Theory	3	1	4
BP 304T	Pharmaceutical Engineering – Theory	3	1	4
BP 305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP 306P	Physical Pharmaceutics I – Practical	4	-	2
BP 307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering – Practical	4	-	2
	Total	**28**	**4**	**24**

Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP 402T	Medicinal Chemistry I – Theory	3	1	4
BP 403T	Physical Pharmaceutics II – Theory	3	1	4
BP 404T	Pharmacology I – Theory	3	1	4
BP 405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP 406P	Medicinal Chemistry I – Practical	4	-	2
BP 407P	Physical Pharmaceutics II – Practical	4		2
BP 408P	Pharmacology I – Practical	4	-	2
BP 409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
	Total	**31**	**5**	**28**

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 501T	Medicinal Chemistry II – Theory	3	1	4
BP 502T	Industrial Pharmacy I– Theory	3	1	4
BP 503T	Pharmacology II – Theory	3	1	4
BP 504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
BP 505T	Pharmaceutical Jurisprudence – Theory	3	1	4

BP 506P	Industrial Pharmacy I – Practical	4	-	2
BP 507P	Pharmacology II – Practical	4	-	2
BP 508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
	Total	**27**	**5**	**26**

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 601T	Medicinal Chemistry III – Theory	3	1	4
BP 602T	Pharmacology III – Theory	3	1	4
BP 603T	Herbal Drug Technology – Theory	3	1	4
BP 604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP 605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP 606T	Quality Assurance –Theory	3	1	4
BP 607P	Medicinal chemistry III – Practical	4	-	2
BP 608P	Pharmacology III – Practical	4	-	2
BP 609P	Herbal Drug Technology – Practical	4	-	2
	Total	**30**	**6**	**30**

Table-VII: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 701T	Instrumental Methods of Analysis – Theory	3	1	4
BP 702T	Industrial PharmacyII – Theory	3	1	4
BP 703T	Pharmacy Practice – Theory	3	1	4
BP 704T	Novel Drug Delivery System – Theory	3	1	4
BP 705P	Instrumental Methods of Analysis – Practical	4	-	2
BP 706PS	Practice School*	12	-	6
	Total	**28**	**5**	**24**

* Non University Examination (NUE)

Table-VIII: Course of study for semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP 801T	Biostatistics and Research Methodology	3	1	4
BP 802T	Social and Preventive Pharmacy	3	1	4

BP 803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP 804ET	Pharmaceutical Regulatory Science			
BP 805ET	Pharmacovigilance			
BP 806ET	Quality Control and Standardization of Herbals			
BP 807ET	Computer Aided Drug Design			
BP 808ET	Cell and Molecular Biology			
BP 809ET	Cosmetic Science			
BP 810ET	Pharmacological Screening Methods			
BP 811ET	Advanced Instrumentation Techniques			
BP 812ET	Dietary Supplements and Nutraceuticals			
BP 813PW	Project Work	12	-	6
	Total	**24**	**4**	**22**

Table-IX: Semester wise credits distribution

Semester	Credit Points
I	29
II	29
III	24
IV	28
V	26
VI	30
VII	24
VIII	22
Total credit points for the programme	**212**

10. PROGRAMME COMMITTEE

1. The B. Pharm. programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Programme 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 programme (one from each academic year), nominated by the Head of the institution.

3. Duties of the Programme Committee:
   i. Periodically reviewing the progress of the classes.
   ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
   iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
   iv. Communicating its recommendation to the Head of the institution on academic matters.

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

11. EXAMINATIONS/ASSESSMENTS

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

11.1. End Semester Examinations

The End Semester Examinations for each theory and practical course through semesters I to VIII shall be conducted by the University except for the subjects with asterix symbol (*) in table I, II and VII 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 Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP 101T	Human Anatomy and Physiology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 102T	Pharmaceutical Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 103T	Pharmaceutics – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 105T	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50
BP 106RBT/ BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50
BP 107P	Human Anatomy and Physiology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 108P	Pharmaceutical Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 109P	Pharmaceutics – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 110P	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 111P	Communication skills – Practical*	5	5	2Hrs	10	15	2 Hrs	25
BP 112RBP	Remedial Biology – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
Total		**70/75$/80#**	**115/125$/130#**	**23/24$/26#**	**185/200$/ 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 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				
BP 201T	Human Anatomy and Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 202T	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 203T	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 204T	Pathophysiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 205T	Computer Applications in Pharmacy – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP 206T	Environmental sciences – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP 207P	Human Anatomy and Physiology II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 208P	Pharmaceutical Organic Chemistry I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 209P	Biochemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 210P	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				
BP 301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 302T	Physical Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 303T	Pharmaceutical Microbiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**60**	**100**	**20**	**160**	**440**	**28 Hrs**	**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				
BP 401T	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 402T	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 403T	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 404T	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 405T	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 406P	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 407P	Physical Pharmaceutics II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 408P	Pharmacology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 409P	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				
BP 501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 502T	Industrial Pharmacy I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 504T	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 506P	Industrial Pharmacy I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 508P	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				
BP 601T	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 602T	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 603T	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 605T	Pharmaceutical Biotechnology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 606T	Quality Assurance – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 609P	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				
BP 701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 702T	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 705 P	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP 706 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				
BP 801T	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 802T	Social and Preventive Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP 803ET	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
BP 804ET	Pharmaceutical Regulatory Science – Theory							
BP 805ET	Pharmacovigilance – Theory							
BP 806ET	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. programme 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. RETOTALLING, REVALUATION AND RE-EXAMINATION OF END SEMESTER EXAMINATIONS

15.1 Retotalling of the theory answer scripts (Theory) of the end-semester examination is permitted on a request made by the student by paying the prescribed fee within ten days of the announcement of the result.

15.2 Revaluation of the theory answer scripts (Theory) of the end-semester examination is also permitted on a request made by the student by paying the prescribed fee within fifteen days of the announcement of the result.

15.3 A student who has secured 'F' Grade in Project work shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

15.4 Reexamination 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	April/May
II, IV, VI and VIII	April/May	November / December

16. SPECIAL EXAMINATION

A student who has completed his/her period of study and still has 'F' grade in a 'Maximum of Five' of Theory/ Practical courses is eligible to appear for Special Examination normally held during summer vacation.

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) (Answer all the questions)	=	10 x 2 = 20
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

17. 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 27.
- Any student who has given more than 4 chances for successful completion of I / III semester courses and more than 3 chances for successful completion of II / IV semester courses shall be permitted to attend V / VII semester classes ONLY during the subsequent academic year as the case may be. In simpler terms there shall NOT be any ODD BATCH for any semester.

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

18. GRADING OF PERFORMANCES

18.1. **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 – XIV.

Table – XIV: 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.

19. THE SEMESTER GRADE POINT AVERAGE (SGPA)

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

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4G4 + C5G5}{C1 + C2 + C3 + C4 + C5}$$

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 AB grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4 * ZERO + C5G5}{C1 + C2 + C3 + C4 + C5}$$

20. CUMULATIVE GRADE POINT AVERAGE (CGPA)

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

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

where C1, C2, C3,…. is the total number of credits for semester I, II, III,…. and S1,S2, S3,….is the SGPA of semester I, II, III,…. .

21. 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

22. PROJECT WORK

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

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

Evaluation of Dissertation Book:

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

Evaluation of Presentation:

Presentation of work	25 Marks
Communication skills and answer skills	20 Marks Question 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.

23. 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.

24. 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 programme committee from time to time.

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

25. 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 programme shall not be eligible for award of ranks. Moreover, the candidates should have completed the B. Pharm. programme in minimum prescribed number of years, (four years) for the award of Ranks.

26. AWARD OF DEGREE

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

27. DURATION FOR COMPLETION OF THE PROGRAMME OF STUDY

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

28. RE-ADMISSION AFTER BREAK OF STUDY

Candidate who seeks re-admission to the programme 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 programme by paying the required fees.

29. PROGRAM OUTCOMES

PO1: To develop the ability for analytical and critical thinking to identify and solve the issues related to Pharmaceuticals (Product Development, Manufacturing, Quality Control, and Quality Assurance), Regulatory affairs and Hospital Pharmacy.

P02: Enable to interpret the data of efficacy, safety, and stability of pharmaceuticals.

P03: To understand the novel/digital technologies and adopt in pharmaceutical industry and pharmaceutical care and thereby to play pivotal role in the healthcare team.

PO4: To develop the leadership qualities, team works and to maintain the professional ethics.

30. PROGRAM SPECIFIC OUTCOMES:

PSO1: The course opens to the stake holders the professional and research-oriented job opportunities within the country as well as in abroad.

PSO2: A detail understanding of the theoretical and practical knowledge of all core and allied subjects of Pharmaceutical Sciences which include dosage form design, pharmacokinetics, pharmacodynamics, drug delivery systems, Biopharmaceutics, drug manufacturing, QA/QC, and regulations etc.

PSO3: A thorough understanding of how drugs interact with the targets and the resultant changes in the downstream processes and result in further improvement in the drugs/formulations and thereby the treatment of various diseases.

PSO4: An in depth understanding **of** different routes of administration of various drugs, mechanism of action of the chemical moieties responsible for the medicinal activity, posology, drug dispensing, a better pharmaceutical care can be provided to patients,

PSO5: A complete knowledge about the modern methods of druganalysis for the assay, impurity profiling and adulteration, if any of synthetic as well as natural substances used as drugs.

PSO6: Overall understanding about of FDA and their regulation of the pharmaceutical industries for the quality and safety of drug products and their storage and a detailed knowledge about pharmacovigilance, pharmacoeconomics, clinical pharmacy, hospital pharmacy, community pharmacy and clinical research leads to serve the patients in a better way by the pharmacy professionals.

SEMESTER – I

BP 101T. HUMAN ANATOMY AND PHYSIOLOGY – I (Theory)

Hours per week: 3L+1T | End Examination: 75 Marks
Credit: 4 | Midsem: 25 Marks

Course Description:
This course focuses on anatomical terminology, homeostasis, histology, integumentary system, skeletal system, muscular system, joints, body fluids- blood and lymphatic system, autonomic nervous system and cardiovascular system.

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

Course Content:

UNIT – I **10 Hrs**

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

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

Body fluids and blood
Body fluids, composition and functions of blood, haemopoiesis, formation of haemoglobin, anaemia, 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

UNIT – IV **08 Hrs**

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.

UNIT – V **07 Hrs**

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.

BP 107P. HUMAN ANATOMY AND PHYSIOLOGY – I (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

Practical physiology is complementary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

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

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

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

5. Appreciate coordinated working pattern of different organs of each system

Recommended Books (Latest Editions)

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

Reference Books (Latest Editions)

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

BP 102T. PHARMACEUTICAL ANALYSIS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description:

The course deals with fundamental aspects of analytical chemistry and principles of electrochemical analysis. It highlights the variety of analytical techniques such titrimetric and electrochemical methods that have been applied in the analysis of pharmaceuticals. Basic analytical techniques include acid base titration, non-aqueous titrations, precipitation titrations, complexometric titrations, gravimetry, conductometry, potentiometry and polarography analysis.

Course Objective: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Course Content:

UNIT – I **10 Hrs**

(a) Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b)Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

UNIT – II **10 Hrs**

Acid base titration: Law of mass action, common ion effect, solubility product. 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.

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.

UNIT – III **10 Hrs**

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

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.

UNIT – IV **08 Hrs**

Redox titrations

(a) Concepts of oxidation and reduction

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

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

UNIT – V **07 Hrs**

Electrochemical methods of analysis

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

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

BP 108P. PHARMACEUTICAL ANALYSIS (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

I **Preparation and standardization of**

(1) Sodium hydroxide

(2) Sulphuric acid

(3) Sodium thiosulfate

(4) Potassium permanganate

(5) Ceric ammonium sulphate

II **Assay of the following compounds along with Standardization of Titrant**
(1) Ammonium chloride by acid base titration
(2) Ferrous sulphate by Cerimetry
(3) Copper sulphate by Iodometry
(4) Calcium gluconate by complexometry
(5) Hydrogen peroxide by Permanganometry
(6) Sodium benzoate by non-aqueous titration
(7) Sodium Chloride by precipitation titration
III **Determination of Normality by electro-analytical methods**
(1) Conductometric titration of strong acid against strong base
(2) Conductometric titration of strong acid and weak acid against strong base
(3) Potentiometric titration of strong acid against strong base

Course Outcomes: Upon completion of the course student shall be able to
- Understand the principles of volumetric and electrochemical analysis
- Carryout various volumetric and electrochemical titrations
- Develop analytical skills

Recommended Books: (Latest Editions)
1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

BP 103T. PHARMACEUTICS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course will recall the history of the profession of pharmacy in India and details of various pharmacopeias; IP, BP, USP, etc. Impart basic knowledge in the area of pharmaceutics, prescription components & posology also covered. Give the basic knowledge of dose calculations according to age, sex & body weight. Provide knowledge of different routes of drug administration & classification of pharmaceutical dosage forms. Describe the various dosage forms such as monophasic, biphasic, powder, suppositories & their evaluations.

Course Objective: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Course Content:

UNIT – I **10 Hrs**
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

Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.

UNIT – II **10 Hrs**

Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.

Monophasic liquids: Definitions and preparations of Gargles, 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.

UNIT – III **8 Hrs**

Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.

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

UNIT – IV **10 Hrs**

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.

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

UNIT – V **7 Hrs**

Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

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.

BP 109P. PHARMACEUTICS (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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 - Terpin Hydrate Linctus IP'66
4. Solutions
b) Iodine Throat Paint (Mandles Paint)

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) Carbopal gel

10. Gargles and Mouthwashes

a) Iodine gargle
b) Chlorhexidine mouthwash

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

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Preparation of various conventional dosage forms

Recommended Books: (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams andWalkins, 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.

BP 104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course mainly deals with the study of inorganic pharmaceuticals. It includes an outline of methods of preparation, uses, physical and chemical properties, assay procedures of inorganic pharmaceuticals. It also imparts basic knowledge about sources of impurities, limit tests for iron, arsenic, lead, heavy metals, chloride and sulphate.

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

Course Content:

UNIT – I **10 Hrs**

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes

UNIT – II **10 Hrs**

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.

Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

Dental products: Dentifrices, role of fluoride in the treatment of dental caries, esensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

UNIT – III **10 Hrs**

Gastrointestinal agents

Acidifiers: Ammonium chloride* and Dil. HCl

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

UNIT – IV **08 Hrs**

Miscellaneous compounds

Expectorants: Potassium iodide, Ammonium chloride*.

Emetics: Copper sulphate*, Sodium potassium tartarate

Haematinics: Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite333
Astringents: Zinc Sulphate, Potash Alum

UNIT – V **07 Hrs**

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

BP 110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

I Limit tests for following ions
Limit test for Chlorides and Sulphates
Modified limit test for Chlorides and Sulphates
Limit test for Iron
Limit test for Heavy metals
Limit test for Lead
Limit test for Arsenic

II Identification test
Magnesium hydroxide
Ferrous sulphate
Sodium bicarbonate
Calcium gluconate
Copper sulphate

III Test for purity
Swelling power of Bentonite
Neutralizing capacity of aluminum hydroxide gel
Determination of potassium iodate and iodine in potassium Iodide

IV Preparation of inorganic pharmaceuticals
Boric acid
Potash alum
Ferrous sulphate

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

- know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
- understand the medicinal and pharmaceutical importance of inorganic compounds

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. Indian Pharmacopoeia

BP 105T. COMMUNICATION SKILLS (Theory)

Hours per week: 2L | End Examination: 35 Marks
Credit: 2 | Midsem: 15 Marks

Course Description: This course deals with the aspects that help in improving communication skills, Listening and writing skills. It also deals with the preparation and modalities that are essential for the student during an interview or group discussion.

Course Objective: 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 content:

UNIT – I **07 Hrs**

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

UNIT – II **07 Hrs**

Elements of Communication: Introduction, face to face communication - tone of voice, body language (Non-verbal communication), verbal communication, physical communication

Communication Styles: Introduction, the communication styles matrix with example for each - direct communication style, spirited communication style, systematic communication style, considerate communication style

UNIT – III **07 Hrs**

Basic Listening Skills: Introduction, self-awareness, active listening, becoming an active listener, 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 lines, put the main point first, know your audience, organization of the message

UNIT – IV **05 Hrs**

Interview Skills: Purpose of an interview, Do's and Dont's of an interview

Giving Presentations: Dealing with Fears, planning your presentation, structuring your presentation, delivering your presentation, techniques of delivery

UNIT – V **04 Hrs**

Group Discussion: Introduction, communication skills in group discussion, Do's and Dont's of group discussion

BP 111P. COMMUNICATION SKILLS (Practical)

Hours per week: 2 End Examination: 15 Marks
Credit: 1 Midsem: 10 Marks

The following learning modules are to be conducted using words worth® English language lab software

Basic communication covering the following topics
Meeting People
Asking Questions
Making Friends
What did you do?
Do's and Dont's
Pronunciations covering the following topics
Pronunciation (Consonant Sounds)
Pronunciation and Nouns
Pronunciation (Vowel Sounds)
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

Course Outcomes:
Upon completion of the course the student shall be able to
- Understand the behavioural needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
- Communicate effectively (Verbal and Non Verbal)
- Effectively manage the team as a team player
- Develop interview skills
- Develop Leadership qualities and essentials

Recommended Books: (Latest Edition)
1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1st edition, Oxford Press, 2011
3. Organizational Behaviour, 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. Personality development and soft skills, Barun K Mitra, 1st edition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st edition, Cengage Learning India pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1st edition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4th edition, Pan Mac Millan, 2009
12. Bringing out the best in people, Aubrey Daniels, 2nd edition, Mc Graw Hill, 1999

BP 106RBT. REMEDIAL BIOLOGY (Theory)

Hours per week: 2L — End Examination: 35 Marks
Credit: 2 — Midsem: 15 Marks

Course Description:
Course covers the essential components of anatomy & physiology of plant and also fundamental components of anatomy & physiology animal with particular reference to human

Course Objective: To learn and understand the components of the living world, structure and functional system of plant and animal kingdom.

Course content:

UNIT – I **07 Hrs**

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, Protista, 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 & dicotyledons.

UNIT – II **07 Hrs**

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

UNIT – III **07 Hrs**

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

UNIT – IV **05 Hrs**

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.

UNIT – V **04 Hrs**

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

Plant growth and development
Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators

Cell - The unit of life
Structure and functions of cell and cell organelles. Cell division

Tissues
Definition, types of tissues, location and functions.

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

- know the classification and salient features of five kingdoms of life
- understand the basic components of anatomy & physiology of plant
- know understand the basic components of anatomy & physiology animal with special reference to human

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. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
5. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

BP 112RBP. REMEDIAL BIOLOGY (Practical)

Hours per week: 2 End Examination: 15 Marks
Credit: 1 Midsem: 10 Marks

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

Reference Books

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

BP 106RMT. REMEDIAL MATHEMATICS (Theory)

Hours per week: 2L End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

Course Objective: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Course Content:

UNIT – I **06 Hrs**

Partial fraction:

Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

Logarithms:
Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

Function:
Real Valued function, Classification of real valued functions,

Limits and continuity:
Introduction, Limit of a function, Definition of limit of a function ($\in$ - δ definition), $\lim_{x\to a}\left(\frac{x^n-a^n}{x-a}\right)=na^{n-1}\lim_{x\to a}\left(\frac{x^n-a^n}{x-a}\right)=na^{n-1}$, $\lim_{\theta\to 0}\left(\frac{\sin\theta}{\theta}\right)=1\lim_{\theta\to 0}\left(\frac{\sin\theta}{\theta}\right)=1$

UNIT – II **06 Hrs**

Matrices and Determinant:
Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Applicationof Matrices in solving Pharmacokinetic equations

UNIT – III **06 Hrs**

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

UNIT – IV **06 Hrs**

Analytical Geometry

Introduction: Signs of the Coordinates, Distance formula,

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

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

UNIT – V **06 Hrs**

Differential Equations: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**

Laplace Transform: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

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

- Know the theory and their application in Pharmacy
- Solve the different types of problems by applying theory

- Appreciate the important application of mathematics in Pharmacy

Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr. B.S.Grewal

SEMESTER – II

BP 201T. HUMAN ANATOMY AND PHYSIOLOGY – II (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description:
This course gives basic understanding of structure and functions of various organs of nervous system, digestive system, respiratory system, urinary system, endocrine system. In adition focuses on energetics and introduction to genetics.

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

Course Content:

UNIT – I **10 Hrs**

Nervous system

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neuro transmitters.
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)

UNIT – II **06 Hrs**

Digestive system

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

Energetics

Formation and role of ATP, Creatinine Phosphate and BMR.

UNIT – III **10 Hrs**

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.

UNIT – IV **10 Hrs**

Endocrine system
Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

UNIT – V **09 Hrs**

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

BP 207P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

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

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

- Explain the gross morphology, structure and functions of various organs of the human body.

- Describe the various homeostatic mechanisms and their imbalances.
- Identify the various tissues and organs of different systems of human body.
- Appreciate coordinated working pattern of different organs of each system
- Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Recommended Books (Latest Editions)

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

Reference Books:

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

BP 202T. PHARMACEUTICAL ORGANIC CHEMISTRY – I (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course deals with classification and nomenclature of simple organic compounds, structural isomerism, important physical properties, reactions and methods of preparation of alkanes, alkenes, alkyl halides, carbonyl compounds, alcohols, carboxylic acids and aliphatic amines. The syllabus also emphasizes on mechanisms and orientation of reactions.

Course Objective: This subject deals with classification and nomenclature of organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds.

Course Content:

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

UNIT – I **07 Hrs**

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

UNIT – II **10 Hrs**

Alkanes*, Alkenes* and Conjugated dienes*

SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins.

Stabilities of alkenes, SP^2 hybridization in alkenes

E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

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

UNIT – III **10 Hrs**

Alkyl halides*

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

SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions

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

UNIT – IV **10 Hrs**

Carbonyl compounds* (Aldehydes and ketones)

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

UNIT – V **08 Hrs**

Carboxylic acids*

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

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

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

BP 208P. PHARMACEUTICAL ORGANIC CHEMISTRY – I (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

I. Systematic qualitative analysis of unknown organic compounds like
1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
3. Solubility test
4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
5. Melting point/Boiling point of organic compounds
6. Identification of the unknown compound from the literature using melting point/ boiling point.
7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
8. Minimum 5 unknown organic compounds to be analysed systematically.
II. Preparation of suitable solid derivatives from organic compounds
III. Construction of molecular models

Course Outcomes: Upon completion of the course the student shall be able to
- write the structure, name and the type of isomerism of the organic compound
- write the reaction, name the reaction and orientation of reactions
- account for reactivity/stability of compounds,
- identify/confirm the identification of organic compound

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

BP 203T. BIOCHEMISTRY (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: The course deals with complete understanding of the chemical process associated with living cells. It deals with the biochemical pathways and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizes on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Course Objective: 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.

Course Content:

UNIT – I **08 Hrs**

Biomolecules

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, 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 AMP

UNIT – II **10 Hrs**

Carbohydrate metabolism

Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance

Hormonal regulation of blood glucose level and Diabetes mellitus

Biological oxidation

Electron transport chain (ETC) and its mechanism.

Oxidative phosphorylation & its mechanism and substrate phosphorylation

Inhibitors ETC and oxidative phosphorylation/Uncouplers level

UNIT – III **10 Hrs**

Lipid metabolism

β-Oxidation of saturated fatty acid (Palmitic acid)

Formation and utilization of ketone bodies; ketoacidosis

De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

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.

UNIT – IV **10 Hrs**

Nucleic acid metabolism and genetic information transfer

Biosynthesis of purine and pyrimidine nucleotides

Catabolism of purine nucleotides and Hyperuricemia and Gout disease

Organization of mammalian genome

Structure of DNA and RNA and their functions

DNA replication (semi conservative model)

Transcription or RNA synthesis

Genetic code, Translation or Protein synthesis and inhibitors

UNIT – V **07 Hrs**

Enzymes

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

BP 209P. BIOCHEMISTRY (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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.

Course Outcomes: Upon completion of course student shell able to

- Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- Understand the metabolism of nutrient molecules in physiological and pathological conditions.
- Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

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 Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

BP 204T.PATHOPHYSIOLOGY (THEORY)

Hours per week: 3L+1T | End Examination: 75 Marks
Credit: 4 | Midsem: 25 Marks

Course Description:
The concepts of pathophysiology including basic principles of cell injury, adaptation inflammation and repair. Underlying concepts of pathophysiology, etiology, clinical manifestations and treatments of common disorders in major body systems- cardiovascular, respiratory, renal, endocrine, nervous and gastrointestinal. Diseases incluing hematological, inflammatory bowel diseases , bone and joint , infrctious and sexually transmitted diseases and cancer.

Course Objective: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes.This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Course content:

UNIT – I **10 Hrs**

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.

UNIT – II **10 Hrs**

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.

UNIT – III **10 Hrs**

Haematological Diseases:
Iron deficiency, megaloblastic anaemia (Vit B12 and folic acid), sickle cell anaemia, thalasemia, hereditary acquired anaemia, 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

UNIT – IV **08 Hrs**
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

UNIT – V **7 Hrs**
Infectious diseases: Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections
Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea

Course Outcomes: Upon completion of the subject student shall be able to –
- Describe the etiology and pathogenesis of the selected disease states.
- Name the signs and symptoms of the diseases; and

Mention the complications of the diseases

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. HarshMohan; 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 edition; United states.
5. William and Wilkins, Baltimore; 1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John. E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

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

BP 205T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

Hours per week: 3L | End Examination: 50 Marks
Credit: 3 | Midsem: 25 Marks

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

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

Course content:

UNIT – I **10 Hrs**

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

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

UNIT –II **09 Hrs**

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

UNIT – III **10 Hrs**

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

UNIT – IV **08 Hrs**

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

UNIT – V **08 Hrs**

Computers as data analysis in Preclinical development:

Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)

BP 210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

Hours per week: 2 | End Examination: 15 Marks
Credit: 1 | Midsem: 10 Marks

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3 Retrieve the information of a drug and its adverse effects using online tools

4 Creating mailing labels Using Label Wizard, generating label in MS WORD
5 Create a database in MS Access to store the patient information with the required fields using access
6. Design a form in MS Access to view, add, delete and modify the patient record in the database
7. Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages
12. Exporting Tables, Queries, Forms and Reports to XML pages

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

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

Recommended books (Latest edition):

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
4. Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
5. 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

BP 206T. ENVIRONMENTAL SCIENCES (Theory)

Hours per week: 3L — End Examination: 50 Marks
Credit: 3 — Midsem: 25 Marks

Course Description: This course dedicated to understanding the interactions between earth's natural systems and the demands placed on them by the human population.

Course Objective: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Course content:

UNIT – I **15 Hrs**

The Multidisciplinary nature of environmental studies
Natural 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.

UNIT – II **15 Hrs**

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT – III **15 Hrs**

Environmental Pollution: Air pollution; Water pollution; Soil pollution

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

- Create the awareness about environmental problems among learners.
- Impart basic knowledge about the environment and its allied problems.
- Develop an attitude of concern for the environment.
- Motivate learner to participate in environment protection and environment improvement.
- Acquire skills to help the concerned individuals in identifying and solving environmental problems.
- Strive to attain harmony with nature.

Recommended Books (Latest Editions):

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

SEMESTER – III

BP 301T. PHARMACEUTICAL ORGANIC CHEMISTRY – II (Theory)

Hours per week: 3L+1T End Examination: 75 Marks

Credit: 4 Midsem: 25 Marks

Course Description: This course deals with general methods of preparation, reactions and reaction mechanism of phenols, aromatic amines, aromatic acids, fused aromatic ring compounds. It emphasizes on the effect of substituents on the reactivity and orientation of electrophilic aromatic substitution reactions in benzene ring. It also summarizes the physiochemical properties and analytical tests for lipids

Course Objective: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus

emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Course Content:

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

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

UNIT – I **10 Hrs**

Benzene and its derivatives

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

B. Reactions of benzene - nitration, sulphonation, halogenationreactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.

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

D. Structure and uses of DDT, Saccharin, BHC and Chloramine

UNIT – II **10 Hrs**

Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols

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 and important reactions of benzoic acid.

UNIT – III **10 Hrs**

Fats and Oils

a.Fatty acids – reactions.

b.Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.

c.Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

UNIT – IV **08 Hrs**

Polynuclear hydrocarbons:

a.Synthesis, reactions

b.Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT – V **07 Hrs**

Cyclo alkanes*

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

BP 305P. PHARMACEUTICAL ORGANIC CHEMISTRY – II (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

I Experiments involving laboratory techniques-Recrystallization, Steam distillation
II Determination of following oil values (including standardization of reagents)
a. Acid value b. Saponification value c. Iodine value
III Preparation of compounds

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

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

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

Recommended Books (Latest Editions)

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

BP 302T. PHYSICAL PHARMACEUTICS – I (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course gives an insight to understand various physicochemical properties of drug molecules in designing, developing, and evaluating various dosage forms. Explain the chemical and physical phenomena that govern the in vivo and in vitro actions of pharmaceutical products. Demonstrate the skills and understanding of the principles, concepts of surface and interfacial tension, and its measurement. Acquire an understanding of drug complexes, protein binding, and their applications and explain the methods of detection of complexes. Illustrate the knowledge of Solubility and Distribution Phenomena and apply them in pharmaceutical practices. Describe Physical principles of states of matter and phase rule.

Compare and contrast between one, two & three-component system.The learner should be able to describe Fick's laws of diffusion, mechanism of drug dissolution, and absorption.

Course Objective: The course deals with the various physicochemical properties and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Course Content:

UNIT – I **10 Hrs**

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors nfluencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions)

Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

UNIT – II **10 Hrs**

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols-inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

UNIT – III **10 Hrs**

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

UNIT – IV **08 Hrs**

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

UNIT – V **07 Hrs**

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

BP 306P. PHYSICAL PHARMACEUTICS – I (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

1. Determination of 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

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

- Understand various physicochemical properties of drug molecules in the designing the dosage forms
- Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Vol.1-3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, Vol. 1-3, Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. LaboratoryManual of Physical Pharmaceutics, C.V.S. Subramanyam, J.Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

BP 303T. PHARMACEUTICAL MICROBIOLOGY (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This subject gives the basic understanding of microbiological aspects like study of ultra structure of bacteria, different types of microscopy, identification of bacteria using staining methods, various methods of sterilization, study of bacteria, fungi & Viruses, disinfectants, designing of aseptic area, microbiological assays, microbial contamination, preservation of pharmaceutical products and application of cell cultures in pharmaceutical industry and research.

Course Objective: Study of all categories of microorganisims especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc..

Course content:

UNIT – I **10 Hrs**

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 microscopy - phase constrast microscopy, dark field microscopy and electron microscopy.

UNIT – II **10 Hrs**

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 indicators.

UNIT – III **10 Hrs**

Study of morphology, classification, reproduction/replication and cultivation of Fungi, Viruses and Bacteria.
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.

UNIT – IV **08 Hrs**

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.

UNIT – V **07 Hrs**

Types of spoilage, factors affecting the microbial spoilage of 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.

BP 307P. PHARMACEUTICAL MICROBIOLOGY (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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 and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

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

- Understand methods of identification, cultivation and preservation of various microorganisms
- To understand the importance and implementation of sterlization in pharmaceutical processing and industry
- Learn sterility testing of pharmaceutical products.
- Carried out microbiological standardization of Pharmaceuticals.
- Understand the cell culture technology and its applications in pharmaceutical industries.

Recommended Books (Latest Editions)

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 edition. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P. - latest editions.
10. Ananthnarayan: Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins - A Waverly company

BP 304T. PHARMACEUTICAL ENGINEERING (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course will help to understand the material handling techniques. Know various unit operations and processes involved in the pharmaceutical manufacturing

process. Optimized the use of resources in pharmaceutical industries.Appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course Objective: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Course content:

UNIT – I **10 Hrs**

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 Rotameter.

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.

UNIT – II **10 Hrs**

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, 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 distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT – III **10 Hrs**

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 between solid 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,

UNIT – IV **08 Hrs**

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.

UNIT – V **07 Hrs**

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

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

- To know various unit operations used in pharmaceutical industries.
- To understand the material handling techniques.
- To perform various processes involved in pharmaceutical manufacturing process.
- To carry out various test to prevent environmental pollution.
- To appreciate and comprehend significance of plant lay out design for optimum use of resources.
- To appreciate the various preventive methods used for corrosion control in pharmaceutical industries.

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-
3. Latest edition.
4. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
5. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
6. Remington practice of pharmacy- Martin, Latest edition.
7. Theory and practice of industrial pharmacy by Lachmann, Latest edition.
8. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
9. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP 308P - PHARMACEUTICAL ENGINEERING (Practical)

Hours per week: 4 — End Examination: 35 Marks
Credit: 2 — Midsem: 15 Marks

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation – To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.

11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone

SEMESTER – IV

BP 401T. PHARMACEUTICAL ORGANIC CHEMISTRY – III (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course deals with the stereochemical aspects of organic compounds, important named reactions and their applications, general methods for ring synthesis and application of such methods for the preparation heterocyclic systems.

Course Objective: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Course Content:

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT – I **10 Hrs**

Stereo isomerism

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

UNIT – II **10 Hrs**

Geometrical isomerism
Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems)
Methods of determination of configuration of geometrical isomers.
Conformational isomerism in Ethane, n-Butane and Cyclohexane.
Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.
Stereospecific and stereoselective reactions

UNIT – III **10 Hrs**

Heterocyclic compounds:

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

Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

UNIT – IV **08 Hrs**

Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole.

Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine

Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

UNIT – V **07 Hrs**

Reactions of synthetic importance

Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.

Oppenauer-oxidation and Dakin reaction.

Beckmanns rearrangement and Schmidt rearrangement.

Claisen-Schmidt condensation

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

- understand the methods of preparation and properties of organic compounds
- explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- know the medicinal uses and other applications of organic compounds

Recommended Books (Latest Editions)

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

BP 402T. MEDICINAL CHEMISTRY – I (Theory)

Hours per week: 3L+1T End Examination: 75 Marks

Credit: 4 Midsem: 25 Marks

Course Description: This course involves the basics of medicinal chemistry, physicochemical properties related to biological action and metabolism of drugs, study of the various classes of medicinal compounds namely adrenergic, cholinergic and drugs acting on central nervous system, their biological activity, mechanism of action and structure activity relationship of the drugs.

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

Course Content:

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

UNIT – I **10 Hrs**

Introduction to Medicinal Chemistry
History and development of medicinal chemistry
Physicochemical properties in relation to biological action-Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.
Drug metabolism principle - Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.

UNIT – II **10 Hrs**

Drugs acting on Autonomic Nervous System

Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine.
Adrenergic receptors (Alpha & Beta) and their distribution.

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.

UNIT – III **10 Hrs**

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.

Cholinergic Blocking agents: SAR of cholinolytic agents

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

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine ydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT – IV **08 Hrs**

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

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*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

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

Fluro buterophenones: 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

Oxazolidine diones: Trimethadione, Paramethadione

Succinimides: Phensuximide, Methsuximide, Ethosuximide*

Urea and monoacylureas: Phenacemide, Carbamazepine*

Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

UNIT – V **07 Hrs**

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.*

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, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

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

BP 406P. MEDICINAL CHEMISTRY – I (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

I Preparation of drugs/ intermediates

- 1,3-pyrazole

- 1,3-oxazole
- Benzimidazole
- Benztriazole
- 2,3- diphenyl quinoxaline
- Benzocaine
- Phenytoin
- Phenothiazine
- Barbiturate

II Assay of drugs

- Chlorpromazine
- Phenobarbitone
- Atropine
- Ibuprofen
- Aspirin
- Furosemide

III Determination of Partition coefficient for any two drugs

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

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

Recommended Books (Latest Editions)

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

BP 403T. PHYSICAL PHARMACEUTICS – II (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course describes the reaction kinetics, rate, order, and factors affecting the rate of reaction; prevent degradation, stabilization of drugs, and shelf-life assessment and explain the reaction kinetics of dosage forms. Explain the types, properties, Principles, and applications of dispersion systems in the formulations. & Explain the concept of formulation and stabilization of suspension and emulsions. Explain the properties of particles and pharmaceutical powders, their significance in formulating pharmaceutical products, and the common methods for characterizing these properties. Illustrate fundamentals and pharmaceutical applications of rheology and their measurement to identify and choose suitable flow characteristics for the formulation & describe the thixotropic/stability of

dispersions, semisolids systems, and deformation of solids. Explain the concept of formulation and stabilization of suspension and emulsions.

Course Objective: The course deals with the various physicochemical properties and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Course Content:

UNIT – I **07 Hrs**

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties.
Effect of electrolytes, coacervation, peptization& protective action.

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

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

UNIT – IV **10 Hrs**

Micromeretics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, 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.

UNIT – V **10 Hrs**

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. 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.

BP 407P. PHYSICAL PHARMACEUTICS – II (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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

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

- Understand various physicochemical properties of drug molecules in the designing the dosage forms
- Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, 6th edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Vol 1 - 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, Vol 1 - 3, Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

BP 404T. PHARMACOLOGY – I (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description:

This course deals introduction to pharmacology, history and its subdivisions; drugs and their origin, routes of drug administration; general principles in pharmacology; essentials of drug action, nature of drug receptors and drug receptor interactions with signaling mechanisms, concepts of agonist-antagonist and their types, dose response relationships, efficacy, potency and therapeutic index, variation in drug responses; adverse drug reactions; drug interactions: drug discovery and clinical evaluation.Introduction of autonomic nervous system, synthesis and metabolic pathways of neurotransmitters, cholinergic and adrenergic transmission and autonomic receptors, cholinergic, anticholinergics, adrenergic and antiadrenergic drugs, ganglionic and neuromuscular blockers. Neurotransmitter in CNS. Pharmacokinetic and pharmacodynamic principles governing the drug actions, adverse drug reactions and drug interactions of drugs used in CNS disorders

Course Objective: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Course Content:

UNIT – I **08 Hrs**

1. General Pharmacology

a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.

b**.** Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

UNIT – II **12 Hrs**

General Pharmacology

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

b. Adverse drug reactions.

c. Drug interactions (pharmacokinetic and pharmacodynamic)

d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

UNIT – III **10 Hrs**

2. **Pharmacology of drugs acting on peripheral nervous system**

a. Organization and function of ANS.

b. Neurohumoral transmission, co-transmission and classification of neurotransmitters.

c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

UNIT – IV **08 Hrs**

3. Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the C.N.S. Special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.

b. General anesthetics and pre-anesthetics**.**

c. Sedatives, hypnotics and centrally acting muscle relaxants.

d. Anti-epileptics

e. Alcohols and disulfiram

UNIT – V **07 Hrs**

3. Pharmacology of drugs acting on central nervous system

a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.
b. Drugs used in Parkinson's disease and Alzheimer's disease.
c. CNS stimulants and nootropics.
d. Opioid analgesics and antagonists
e. Drug addiction, drug abuse, tolerance and dependence.

BP 408P.PHARMACOLOGY – I (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs byMES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

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

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

- Understand the pharmacological actions of different categories of drugs
- Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Observe the effect of drugs on animals by simulated experiments
- Appreciate correlation of pharmacology with other bio medical sciences

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.

BP 405T.PHARMACOGNOSY AND PHYTOCHEMISTRY – I (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course is designed to provide the student basic information about pharmacognosy and phytochemistry, including quality control, cultivation and collection practices of medicinal plants. It imparts knowledge of crop improvement techniques like plant tissue culture and other techniques like hybridization, polyploidy and mutations. It gives an insight of various drugs of natural origin which are used as pharmaceutical aids.

Course Objective: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Course Content:

UNIT – I **10 Hrs**

Introduction to Pharmacognosy:

(a) Definition, history, scope and development of Pharmacognosy
(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture
(c) 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 serotaxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.
Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT – II **10 Hrs**

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

UNIT – III **07 Hrs**

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

UNIT – IV **10 Hrs**

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs
Powders of natural occurrence -Lycopodium, Pollen, Kamala, Lupulin
Fibers - Cotton, Jute, Hemp, Silk
Mineral drugs – Chalk, Kaolin, Bentonite, Fuller's earth
Hallucinogens, Teratogens, Natural allergens

UNIT – V **08 Hrs**

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

BP 408P. PHARMACOGNOSY AND PHYTOCHEMISTRY – I (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

1. Analysis of crude drugs by chemical tests: **(**i) Tragaccanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index
3. Determination of vein islet number, vein islet termination and paliside ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
5. Determination of Fiber length and width
6. Determination of number of starch grains by Lycopodium spore method
7. Determination of Ash value
8. Determination of Extractive values of crude drugs
9. Determination of moisture content of crude drugs
10. Determination of swelling index and foaming

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

- to know the techniques in the cultivation and production of crude drugs

- to know the crude drugs, their uses and chemical nature
- know the evaluation techniques for the herbal drugs
- to carry out the microscopic and morphological evaluation of crude drugs

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 edition, 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), 1st edition, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, 2nd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

SEMESTER – V

BP 501T. MEDICINAL CHEMISTRY – II (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course provides information about the study of the development of anti-histaminic drugs, cardiovascular drugs, drugs acting on the endocrine system and local anaesthetics. It emphasizes on their mechanism of action, classification, chemical synthesis and structure activity relationship.

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

Course Content:

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

UNIT – I **10 Hrs**

Antihistaminic agents: Histamine, receptors and their distribution in the humanbody

H_1-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine

hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium
H_2-antagonists: Cimetidine*, Famotidine, Ranitidin.
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.

UNIT – II **10 Hrs**
Anti-anginal:
Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole.
Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.
Diuretics:
Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.
Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,
Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.
Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.
Osmotic Diuretics: Mannitol
Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT – III **10 Hrs**
HoursAnti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, isopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.
Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol
Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel.
Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT – IV **08 Hrs**
Drugs acting on Endocrine system
Nomenclature, stereochemistry and metabolism of steroids
Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.
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.

UNIT – V **07 Hrs**

Antidiabetic agents:

Insulin and its preparations

Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.

Biguanides: Metformin.

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.*

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

- Understand the chemistry of drugs with respect to their pharmacological activity
- Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- Know the Structural Activity Relationship of different class of drugs
- Study the chemical synthesis of selected drugs

Recommended Books (Latest Editions)

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

BP 502T. INDUSTRIAL PHARMACY – I (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks

Credit: 4 — Midsem: 25 Marks

Course Description: This course revises and applies the basic knowledge of preformulation parameters for the development of new formulations. Understand the considerations in the development of various pharmaceutical dosage forms and cosmetics with their manufacturing techniques. Describe new concepts in pharmaceutical packaging and their control. Describe containers, valves, and propellants for different types of aerosol systems. Understand the concepts of pelletization techniques & formulation strategies

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

Course content:

UNIT – I **07 Hrs**

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

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

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

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

UNIT – II **10 Hrs**

Tablets:

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

Equipments and tablet tooling.

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

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

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

UNIT – III **08 Hrs**

Capsules:

a. ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. ***Soft gelatin capsules:*** Nature of shell and capsule content, size of capsules, importance of base adsorption and 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 for manufacture of pellets

UNIT – IV **10 Hrs**

Parenteral Products:

a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity

b. Production procedure, production facilities and controls, aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

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

UNIT – V **10 Hrs**

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, toothpastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; 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.

BP 506P. INDUSTRIAL PHARMACY – I (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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

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

- Know the various pharmaceutical dosage forms and their manufacturing techniques.
- Know various considerations in development of pharmaceutical dosage forms
- Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

Recommended Books: (Latest Editions)

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

BP 503T. PHARMACOLOGY – II (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description:
This course deals with pharmacokinetic and pharmacodynamic principles governing the drug actions, adverse drug reactions and drug interactions of drugs used in the cardiovascular system (hypertension, coronary heart disease, heart failure and cardiac arrhythmias); thromboembolic diseases, bleeding disorders and anemias; drugs used in the treatment of dyslipidemias: drugs acting on systems-urinary (diuretics and antidiuretics) and endocrine system (hormonal analogs and inhibitors); Autocoids and principles application and types of bioassays.

Course Objective: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Course Content:

UNIT- I **10 Hrs**

1. Pharmacology of drugs acting on cardio vascular system

a. Introduction to hemodynamic and electrophysiology of heart.
b. Drugs used in congestive heart failure
c. Anti-hypertensive drugs.
d. Anti-anginal drugs.
e. Anti-arrhythmic drugs.
f. Anti-hyperlipidemic drugs.

UNIT – II **10 Hrs**

1. Pharmacology of drugs acting on cardio vascular system

a. Drug used in the therapy of shock.
b. Hematinics, coagulants and anticoagulants.
c. Fibrinolytics and anti-platelet drugs
d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

a. Diuretics
b. Anti-diuretics.

UNIT – III **10 Hrs**

3. Autocoids and related drugs

a. Introduction to autocoids and classification
b. Histamine, 5-HT and their antagonists.
c. Prostaglandins, Thromboxanes and Leukotrienes.
d. Angiotensin, Bradykinin and Substance P.
e. Non-steroidal anti-inflammatory agents
f. Anti-gout drugs
g. Antirheumatic drugs

UNIT – IV **08 Hrs**

5. Pharmacology of drugs acting on endocrine system

a. Basic concepts in endocrine pharmacology.
b. Anterior Pituitary hormones- analogues and their inhibitors.
c. Thyroid hormones- analogues and their inhibitors.
d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.

d. Insulin, Oral Hypoglycemic agents and glucagon.
e. ACTH and corticosteroids.

UNIT – V **07 Hrs**

5. Pharmacology of drugs acting on endocrine system

a. Androgens and Anabolic steroids.
b. Estrogens, progesterone and oral contraceptives.
c. Drugs acting on the uterus.

6. Bioassay

a. Principles and applications of bioassay.
b. Types of bioassay
c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT.

BP 507P. PHARMACOLOGY – II (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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 PA2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD2 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

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

- Understand the mechanism of drug action and its relevance in the treatment of different diseases
- Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
- Demonstrate the various receptor actions using isolated tissue preparation
- Appreciate correlation of pharmacology with related medical sciences

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.

BP 504T. PHARMACOGNOSY AND PHYTOCHEMISTRY – II (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course is designed to make the student understand the pathways through which different secondary metabolites are produced. It also gives an insight to the various secondary metabolites, different extraction methods, analysis methods adopted in the industry in the production of herbal drugs.

Course Objective: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine.

Course Content:

UNIT – I **7 Hrs**

Metabolic pathways in higher plants and their determination

a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.
c) **Introduction to secondary metabolites:**
Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

UNIT – II **14 Hrs**

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary 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

UNIT – III **06 Hrs**

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

UNIT – IV **10 Hrs**

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

UNIT – V **8 Hrs**

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.

BP 508P. PHARMACOGNOSY AND PHYTOCHEMISTRY – II (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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

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

- to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
- to understand the preparation and development of herbal formulation.
- to understand the herbal drug interactions
- to carryout isolation and identification of phytoconstituents

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), 1st edition, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr. S H. Ansari, 2nd 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.

BP 505T. PHARMACEUTICAL JURISPRUDENCE (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course will give an insight to the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals. Explain the drugs and cosmetics rules and import, manufacture of drugs. Understand the code of ethics during the pharmaceutical practice. Understand the basics of various Indian pharmaceutical Acts and Laws. Explain the National pharmaceutical pricing authority, prevention of cruelty to animals.

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

Course Content:

UNIT – I **10 Hrs**

Drugs and Cosmetics Act, 1940 and its rules 1945:

Objectives, Definitions, Legal definitions of schedules to the Act and Rules
Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.**
Manufacture of drugs – Prohibition of manufacture and sale of certain drugs,
Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

UNIT – II **10 Hrs**

Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA)
Sale of drugs – wholesale, retail sale and restricted license. Offences and penalties
Labeling & packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, list of permitted colors. Offences and penalties.

Administration of the act and rules – Drugs technical advisory board, central drugs laboratory, drugs consultative committee, government drug analysts, licensing authorities, controlling authorities, drugs Inspectors

UNIT – III **10 Hrs**

Pharmacy Act –1948: Objectives, definitions, Pharmacy Council of India; its constitution and functions, education regulations, state and joint state pharmacy councils; constitution and functions, registration of pharmacists, offences and penalties

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

UNIT – IV **08 Hrs**

Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, definitions, prohibition of certain advertisements, classes of exempted advertisements, offences and penalties

Prevention of Cruelty to animals Act-1960: Objectives, definitions, institutional animal ethics committee, CPCSEA guidelines for breeding and stocking of animals, performance of experiments, transfer and acquisition of animals for experiment, records, power to suspend or revoke registration, offences and penalties

National Pharmaceutical Pricing Authority: Drugs price control order (DPCO)-2013. objectives, definitions, sale prices of bulk drugs, retail price of formulations, retail price and ceiling price of scheduled formulations, national list of essential medicines (NLEM)

UNIT – V **07 Hrs**

Pharmaceutical Legislations – A brief review, Introduction, study of drugs enquiry committee, health survey and development committee, Hathi committee and Mudaliar committee

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)

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

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

Recommended books: (Latest Editions)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B. M. Mithal

3. Hand book of drug law-by M. L. Mehra
4. A text book of Forensic Pharmacy by N. K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

SEMESTER – VI

BP 601T. MEDICINAL CHEMISTRY – III (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description:The course emphasizes on modern techniques of rational drug design like quantitative structure activity relationship , prodrug concept, combinatorial chemistry and computer aided drug design. It also provides information about the study of the development of various chemotherapeutic drugs and their mechanism of action, classification, chemical synthesis and structure activity relationship.

Course Objective: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Course Content:

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

UNIT – I **10 Hrs**

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

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II **10 Hrs**

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.

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 dihydro triazines: Cycloguanil pamoate, Proguanil.
Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone.

UNIT – III **10 Hrs**

Anti-tubercular Agents
Synthetic anti tubercular agents: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*
Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine, Streptomycine, Capreomycin sulphate.
Urinary tract anti-infective agents
Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin
Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.
Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV **08 Hrs**

Antifungal agents:
Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.
Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.
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*.

UNIT – V **07 Hrs**

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, Taft's steric parameter and Hansch analysis.
Pharmacophore modeling and docking techniques.
Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

BP 607P. MEDICINAL CHEMISTRY – III (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

I Preparation of drugs and intermediates

- Sulphanilamide
- 7-Hydroxy, 4-methyl coumarin
- Chlorobutanol
- Triphenyl imidazole
- Tolbutamide
- Hexamine

II Assay of drugs

- Isonicotinic acid hydrazide
- Chloroquine
- Metronidazole
- Dapsone
- Chlorpheniramine maleate
- Benzyl penicillin

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

IV Drawing structures and reactions using chem draw®

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)

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

- Understand the importance of drug design and different techniques of drug design.
- Understand the chemistry of drugs with respect to their biological activity.
- Know the metabolism, adverse effects and therapeutic value of drugs.
- Know the importance of SAR of drugs.

Recommended Books (Latest Editions)

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

BP 602T. PHARMACOLOGY – III (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description:

This course deals pharmacokinetic and pharmacodynamic principles governing the drug actions, adverse drug reactions and drug interactions of drugs used in disorders of respiratory system (asthma, COPD and cough) and gastrointestinal tract (ulcers, constipation, diarrhoea, vomiting); basic principles of chemotherapy and chematherapeutic agents; Immunopharmacology

Course Objective: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology.

Course Content:

UNIT – I **10 Hrs**

1. Pharmacology of drugs acting on Respiratory system

a. Anti -asthmatic drugs
b. Drugs used in the management of COPD
c. Expectorants and antitussives
d. Nasal decongestants
e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

a. Antiulcer agents.
b. Drugs for constipation and diarrhoea.
c. Appetite stimulants and suppressants.
d. Digestants and carminatives.
e. Emetics and anti-emetics.

UNIT – II **10 Hrs**

3. Chemotherapy

a. General principles of chemotherapy.
b. Sulfonamides and cotrimoxazole.
c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

UNIT – III **10 Hrs**

3. Chemotherapy

a. Antitubercular agents
b. Antileprotic agents
c. Antifungal agents
d. Antiviral drugs
e.Anthelmintics
f. Antimalarial drugs
g. Antiamoebic agents

UNIT – IV **08 Hrs**

3. Chemotherapy

l. Urinary tract infections and sexually transmitted diseases.
m. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants

b. Immunosuppressant
Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

UNIT – V **07 Hrs**

5. Principles of toxicology

a.Definition and basic knowledge of acute, subacute and chronic toxicity.

b.Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

c.General principles of treatment of poisoning

d.Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

6. Chronopharmacology

a. Definition of rhythm and cycles.

b. Biological clock and their significance leading to chronotherapy.

BP 608P. PHARMACOLOGY – III (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens (rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology (student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

**Experiments are demonstrated by simulated experiments/videos*

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

- understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
- comprehend the principles of toxicology and treatment of various poisonings and
- appreciate correlation of pharmacology with related medical sciences.

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.

BP 603T. HERBAL DRUG TECHNOLOGY (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: Herbal drug technology provides an insight about herbal raw material processing, Nutraceuticals and their role in health management, Drug interactions, GMP and intellectual property rights related to natural products.

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

Course content:

UNIT – I **11 Hrs**

Herbs as raw materials

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

Biodynamic Agriculture

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

Indian Systems of Medicine

a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy
b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.

UNIT – II **7 Hrs**

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: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT – III **10 Hrs**

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.

UNIT – IV **10 Hrs**

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs, Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:

a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy

b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

UNIT – V **07 Hrs**

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.

S**chedule T – Good Manufacturing Practice of Indian systems of medicine**

Components of GMP (Schedule – T) and its objectives

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

BP 609P. HERBAL DRUG TECHNOLOGY (Practical)

Hours per week: 4 End Examination: 35 Marks

Credit: 2 Midsem: 15 Marks

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

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

- understand raw material as source of herbal drugs from cultivation to herbal drug
- product
- know the WHO and ICH guidelines for evaluation of herbal drugs
- know the herbal cosmetics, natural sweeteners, nutraceuticals
- appreciate patenting of herbal drugs, GMP.

Recommended Books: (Latest Editions)

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

BP 604T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course introduces the concepts of absorption, distribution, metabolism and excretion of medicine in the body, and illuminates their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein

Course Objective: This subject is designed to impart knowledge and skills of biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Course Content:

UNIT – I **10 Hrs**

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.

UNIT – II **07 Hrs**

Distribution Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs.

UNIT – III **10 Hrs**

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.

UNIT – IV **10 Hrs**

Pharmacokinetics: Definition and introduction to pharmacokinetics, compartment models, non compartment models, physiological models, one compartment open model.

(a) Intravenous Injection (Bolus) (b) Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E, $t_{1/2}$, V_d, AUC, K_a, Cl_t and CL_R- definitions methods of eliminations, understanding of their significance and Application.

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

UNIT – V **08 Hrs**

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing non-linearity,
c. Michaelis-Menten method of estimating parameters, explanation with example 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.

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

- Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
- Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
- To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
- Understand various pharmacokinetic parameters, their significance & applications.

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 Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
9. Dissolution, Bioavailability and Bioequivalence, by Abdou H. M, Mack, Publishing Company, Pennsylvania 1989.
10. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
11. Remington's Pharmaceutical Sciences, by Mack Publishing Company, Pennsylvnia

BP 605T. PHARMACEUTICAL BIOTECHNOLOGY (Theory)

Hours per week: 3L+1T End Examination: 75 Marks

Credit: 4 Midsem: 25 Marks

Course Description: The course provides in-depth knowledge regarding basic aspects of biotechnology, enzyme biotechnology, biosensors, protein engineering, Recombinant DNA technology, types of immunity, bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives, immuno blotting techniques, mutations, fermentation methods and blood products.

Course Objective:

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

UNIT – I **10 Hrs**

a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.
c) Biosensors - Working and applications of biosensors in Pharmaceutical Industries.
d) Brief introduction to Protein Engineering.
e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
f) Basic principles of genetic engineering.

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

Types of immunity- humoral immunity, cellular immunity
a) Structure of Immunoglobulins
b) Structure and Function of MHC
c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.
d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
e) Storage conditions and stability of official vaccines
f) Hybridoma technology- Production, Purification and Applications
g) Blood products and Plasma Substituties.

UNIT – IV **08 Hrs**

a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.
b) Genetic organization of Eukaryotes and Prokaryotes
c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.

d) Introduction to Microbial biotransformation and applications.
e) Mutation: Types of mutation/mutants.

UNIT – V **07 Hrs**

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

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

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

Recommended Books (Latest Editions):

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, 2nd 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.

BP 606T. PHARMACEUTICAL QUALITY ASSURANCE (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: The course describes learning and acquiring specialized knowledge and skill as quality assurance and quality control studies in the pharmaceutical industry. It can understand guidelines according to cGMP aspects in the pharmaceutical industry. It includes Total quality management, Quality by design, NBAL accreditation, good laboratory practices, complaints and recall and documentation. The student will understand the importance of guidelines and quality assurance of the safety and efficacy of medicines.

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

Course content:

UNIT – I **10 Hrs**

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

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 programme, tools

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration

NABL accreditation: Principles and procedures

UNIT – II **10 Hrs**

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

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.

UNIT – III **10 Hrs**

Quality Control: Quality control test for containers, rubber closures and secondary packing materials.

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

UNIT – IV **08 Hrs**

Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

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

UNIT – V **07 Hrs**

Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

Warehousing: Good warehousing practice, materials management

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

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

Recommended Books: (Latest Editions)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd edition, SandyWeinberg Vol. 69.

3. Quality Assurance of Pharmaceuticals- A compendium of Guidelines and Related materials Vol I, WHO Publications.
4. A guide to Total QualityManagement- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total QualityManagement – 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

SEMESTER - VII

BP 701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course covers the general principles and practical aspects of the instrumental methods used in chemical analysis. These methods help to understand the property of the analyte must be measured. It highlights the spectral methods: UV spectroscopy, Flame photometry, IR spectroscopy, flame photometry, atomic absorption spectroscopy and chromatographic analysis such as TLC, HPLC, GC and Ion exchange chromatographic methods. The student will develop critical thinking skills in instrument selection, method development and data interpretation.

Course Objective: 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 theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Course Content:

UNIT – I **10 Hrs**

UV Visible spectroscopy

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

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors - 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

UNIT – II **10 Hrs**

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

Flame Photometry - Principle, interferences, instrumentation and applications
Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications
Nepheloturbidometry - Principle, instrumentation and applications

UNIT – III **10 Hrs**

Introduction to chromatography

Adsorption and partition column chromatography - Methodology, advantages, disadvantages and applications.

Thin layer chromatography - Introduction, principle, methodology, Rf values, advantages, disadvantages and applications. Brief discussion on HPTLC

Paper chromatography - Introduction, methodology, development techniques, advantages, disadvantages and applications

Electrophoresis – Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

UNIT – IV **08 Hrs**

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid chromatography (HPLC) - Introduction, theory, instrumentation, advantages and applications.

UNIT – V **07 Hrs**

Ion exchange chromatography - Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel chromatography - Introduction, theory, instrumentation and applications

Affinity chromatography - Introduction, theory, instrumentation and applications

BP 705P. INSTRUMENTAL METHODS OF ANALYSIS (Practical)

Hours per week: 4 End Examination: 35 Marks
Credit: 2 Midsem: 15 Marks

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. Demonstration experiment on HPLC
15. Demonstration experiment on Gas Chromatography

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

- Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
- Understand the chromatographic separation and analysis of drugs.
- Perform quantitative & qualitative analysis of drugs using various analytical instruments.

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 byWilliam 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

BP 702T. INDUSTRIAL PHARMACY – II (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course entails pilot scale up techniques and considerations of pharmaceutical dosage forms, processes involved in technology transfer from lab scale to commercial batch, different laws and acts that regulate pharmaceutical industry and various approval process and regulatory requirements.

Course Objective: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Course Content:

UNIT- I **10 Hrs**

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

UNIT- II **10 Hrs**

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

UNIT – III **10**

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

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

UNIT – IV **08 Hrs**

Quality management systems: Quality management & Certifications: Concept of Quality, 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

UNIT – V **07 Hrs**

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.

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

- Know the process of pilot plant and scale up of pharmaceutical dosage forms
- Understand the process of technology transfer from lab scale to commercial batch
- Know different Laws and Acts that regulate pharmaceutical industry
- Understand the approval process and regulatory requirements for drug products

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005 available at http://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs - A Guide for Prescription Drugs, Medical Devices and Biologics, 2nd edition.
4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

BP 703T. PHARMACY PRACTICE (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: The course entails concepts of drug distribution, drug information, and therapeutic drug monitoring for improved patient care, skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

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

Course Content:

UNIT – I **10 Hrs**

a) 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.

b) Hospital pharmacy and its organization

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

c) Adverse drug reaction

Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

d) Community Pharmacy

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

UNIT – II **10 Hrs**

a) Drug distribution system in a hospital

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

b) Hospital Formulary

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

c) Therapeutic Drug Monitoring

Need for therapeutic drug monitoring, factors to be considered during the therapeutic drug monitoring, and Indian scenario for therapeutic drug monitoring.

d) Medication adherence

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

e) Patient medication history interview

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

f) Community pharmacy management

Financial, materials, staff, and infrastructure requirements.

UNIT – III **10 Hrs**

a) 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.

b) Drug information services

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

c) Patient counselling

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

d) Education and training programme in the hospital

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

e) Prescribed medication order and communication skills

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

UNIT – IV **8 Hrs**

a) Budget preparation and implementation

Budget preparation and implementation

b) Clinical Pharmacy

Introduction to clinical pharmacy, concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, ward round participation, medication history and pharmaceutical care. Dosing pattern and drug therapy based on pharmacokinetic & disease pattern.

c) Over the counter (OTC) sales

Introduction and sale of over the counter and rational use of common over the counter medications.

UNIT – V **7 Hrs**

a) Drug store management and inventory control

Organisation of drug store, types of materials stocked and storage conditions, purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, economic order quantity, reorder quantity level, and methods used for the analysis of the drug expenditure

b) Investigational use of drugs

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

c) Interpretation of Clinical Laboratory Tests

Blood chemistry, hematology, and urinalysis

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

- know various drug distribution methods in a hospital
- appreciate the pharmacy stores management and inventory control
- monitor drug therapy of patient through medication chart review and clinical review
- obtain medication history interview and counsel the patients
- identify drug related problems
- detect and assess adverse drug reactions
- interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
- know pharmaceutical care services
- do patient counselling in community pharmacy
- appreciate the concept of rational drug therapy.

Recommended Books (Latest Editions):

1. Merchant S.H. and Dr. J. S. Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice- essential concepts and skills, 1st edition. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. Hospital pharmacy, 5th edition. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. Hospital Pharmacy, 1st edition. Maharashtra: Career Publications; 2008.
5. Scott LT. Basic skills in interpreting laboratory data, 4th edition. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. Health Education and Community Pharmacy, 18th edition. India: CBS Publishers & Distributers; 2008.

Journals:

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

BP 704T: NOVEL DRUG DELIVERY SYSTEMS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course provides fundamental and theoretical concepts, various approaches of novel drug delivery systems, criteria for selection of drugs and polymers for the development of delivery systems, their formulation and evaluation.

Course Objective: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Course content:

UNIT- I **10 Hrs**

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.

UNIT - II **10 Hrs**

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 implants and osmotic pump

UNIT – III **10 Hrs**

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

UNIT – IV **08 Hrs**

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

UNIT – V **07 Hrs**

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

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

- To understand various approaches for development of novel drug delivery systems.
- To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

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, 1st edition 1997 (reprint in 2001).
5. S. P. Vyas and R. K. Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, 1st edition 2002.

Journals

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

SEMESTER – VIII

BP 801T. BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)

Hours per week: 3L+1T End Examination: 75 Marks

Credit: 4 Midsem: 25 Marks

Course Description: 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 Objective: This course is designed to make the student understand the basic concepts of biostatistics and gain knowledge on application of these concepts in research.

Course content:

UNIT – I **10 Hrs**

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

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

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, contour plot graph

Designing the methodology: Sample size determination and power of a study, report writing and presentation of data, protocol, cohort studies, observational studies, experimental studies, designing clinical trial, various phases.

UNIT – IV **08 Hrs**

Blocking and confounding system for two-level factorials

Regression modeling: Hypothesis testing in simple and multiple regression models

Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical analysis using excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS,
R - online statistical software's to industrial and clinical trial approach.

UNIT – V **07 Hrs**

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

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

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

Recommended Books (Latest Editions):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.
2. Fundamental of Statistics – Himalaya Publishing House- S. C. 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

BP 802T. SOCIAL AND PREVENTIVE PHARMACY

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course provides insight to students on variety of health conditions and their associated concerns. This course also provides understanding about a variety of national health programs, as well as the duties of pharmacists in various settings.

Course Objective: 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 content:

UNIT – I **10 Hrs**

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

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

National health programmes, its objectives, functioning and outcome of the following:

HIV and AIDS control programme, TB, integrated disease surveillance programme (IDSP), National leprosy control programme, national mental health program, national programme for prevention and control of deafness, universal immunization programme, national programme for control of blindness, pulse polio programme.

UNIT – IV **08 Hrs**

National health intervention programme for mother and child, national family welfare programme, national tobacco control programme, national malaria prevention program, national programme for the health care for the elderly, social health programme; role of WHO in Indian national program

UNIT – V **07 Hrs**

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.

Course Outcomes:

- After the successful completion of this course, the student shall be able to:
- Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
- Have a critical way of thinking based on current healthcare development.
- Evaluate alternative ways of solving problems related to health and pharmaceutical issues

Recommended Books (Latest Editions)*:*

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

Recommended Journals:

Research in Social and Administrative Pharmacy, Elsevier, Ireland

BP 803ET. PHARMA MARKETING MANAGEMENT (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course will provide insights of theories & processes of marketing planning & it's philosophies, product decision, promotion, channels of marketing.

Course Objective:

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 content:

UNIT – I **10 Hrs**

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.

UNIT – II **09 Hrs**

Product decision:

Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; new product decisions; product branding, packaging and labelling decisions, product management in pharmaceutical industry.

UNIT – III **07 Hrs**

Promotion:

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

UNIT – IV **10 Hrs**

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.

UNIT – V **09 Hrs**

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.

Course Outcomes: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata 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, Indian Context, 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.

BP 804ET. PHARMACEUTICAL REGULATORY SCIENCE (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course entails 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- documentation requirements, and registration procedures for marketing the drug products.

Course Objective: 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 content:

UNIT – I **10 Hrs**

New Drug Discovery and development

Stages of drug discovery, drug development process, pre-clinical studies, non-clinical activities, clinical studies, innovator and generics, concept of generics, generic drug product development.

UNIT – II **10 Hrs**

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)

UNIT – III **10 Hrs**

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.

UNIT – IV **08 Hrs**

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.

UNIT – V **07 Hrs**

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, laws and acts, Orange book, federal register, code of federal regulatory, Purple book

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

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

Recommended books (Latest Editions):

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

BP 805ET. PHARMACOVIGILANCE (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: Course covers an introduction to Pharmacovigilance, adverse drug reactions terminologies used in Pharmacovigilance and Drug and disease classification, Drug dictionaries and coding in Pharmacovigilance and resources in Pharmacovigilance. Further it covers vaccine safety surveillance and pharmacovigilance methods, ICH guidelines, Pharmacogenomics, Adverse drug reactions and drug safety evaluation in Particular population.

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

Course Content:

UNIT – I **10 Hrs**

Introduction to Pharmacovigilance

- History and development of Pharmacovigilance
- Importance of safety monitoring of Medicine
- WHO international drug monitoring programme
- Pharmacovigilance Programme 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

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

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

UNIT – IV **8 Hrs**

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

UNIT – V **7 Hrs**

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

Course Outcomes:

At completion of this paper it is expected that students will be able to (know, do, and appreciate):

- Why drug safety monitoring is important?
- History and development of pharmacovigilance
- National and international scenario of pharmacovigilance
- Dictionaries, coding and terminologies used in pharmacovigilance
- Detection of new adverse drug reactions and their assessment
- International standards for classification of diseases and drugs
- Adverse drug reaction reporting systems and communication in pharmacovigilance
- Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
- Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
- Pharmacovigilance Programme of India (PvPI) requirement for ADR reporting in India
- ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
- CIOMS requirements for ADR reporting
- Writing case narratives of adverse events and their quality.

Recommended Books (Latest Editions):

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

BP 806ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: This course gives insights on various parameters for assessing the quality of herbal drugs and also the regulations to be adopted by the manufacturing units to achieve a quality product.

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

Course Content:

UNIT – I **10 Hrs**

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

UNIT – II **10 Hrs**

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

UNIT – III **10 Hrs**

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

UNIT – IV **08 Hrs**

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.

UNIT – V **07 Hrs**

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

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

- know WHO guidelines for quality control of herbal drugs
- know Quality assurance in herbal drug industry
- know the regulatory approval process and their registration in Indian and
- international markets
- appreciate EU and ICH guidelines for quality control of herbal drugs

Recommended Books: (Latest Editions)

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V. D., Text book of Pharmacognosy and Phytochemistry Vol. I, Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edition. 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.

BP 807ET. COMPUTER AIDED DRUG DESIGN (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: The course deals with the fundamental aspects of modern techniques of rational drug design like quantitative structure activity relationship, molecular modelling and virtual screening techniques, molecular docking and bioinformatics.

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

Course Content:

UNIT – I **10 Hrs**

Introduction to Drug Discovery and Development

Stages of drug discovery and development

Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine,

Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

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

UNIT – II **10 Hrs**

Quantitative Structure Activity Relationship (QSAR)

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant.

Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT – III **10 Hrs**

Molecular Modeling and virtual screening techniques

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

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

UNIT – IV **08 Hrs**

Informatics & Methods in drug design

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

UNIT – V **07 Hrs**

Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.Energy minimization methods and conformational Analysis, global conformational minima determination.

Course Outcomes:

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

· Design and discovery of lead molecules
· The role of drug design in drug discovery process
· The concept of QSAR and docking
· Various strategies to develop new drug like molecules.
· The design of new drug molecules using molecular modelling software

Recommended Books (Latest Editions)

1. Robert G. C. K, edition, "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin Y. C. "Quantitative Drug Design" Dekker, New York.
3. Delgado J. N, Remers W. A. edition "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
4. Foye W. O "Principles of Medicinal chemistry 'Lea & Febiger.
5. Koro lkovas A, Burckhalter J. H. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf M. E, edition "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" JohnWiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, edition, "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.

BP 808ET. CELL AND MOLECULAR BIOLOGY (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course describes the molecular aspects involved in the cellular function and sequence of reactions that occur in a cell. It describes the genomic and proteomic tools, their applications in gene therapy and gives insight into the personalized drug therapy. The course also describes Cell based assays which are applicable in cancer studies to assess the cellular changes in cancer cell lines.

Course Objective:

· 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 content:

UNIT – I **10 Hrs**
a) Cell and molecular biology: Definitions theory and basics and applications.
b) Cell and molecular bBiology: History and summation.
c) Properties of cells and cell membrane.
d) Prokaryotic versus Eukaryotic
e) Cellular Reproduction
f) Chemical Foundations – an Introduction and Reactions (Types)

UNIT – II **10 Hrs**
a) DNA and the flow of mMolecular Information
b) DNA Functioning
c) DNA and RNA
d) Types of RNA
e) Transcription and Translation

UNIT – III **10 Hrs**
a) Proteins: Defined and **a**mino Acids
b) Protein Structure
c) Regularities in protein pathways
d) Cellular Processes
e) Positive Control and significance of Protein Synthesis

UNIT – IV **08 Hrs**
a) Science of Genetics
b) Transgenics and Genomic Analysis
c) Cell Cycle analysis
d) Mitosis and Meiosis
e) Cellular Activities and Checkpoints

UNIT – V **07 Hrs**
a) Cell Signals: Introduction
b) Receptors for cell signals
c) Signaling pathways: Overview
d) Misregulation of signalling pathways
e) Protein-Kinases: Functioning

Course Outcomes: Upon completion of the subject student shall be able to;
- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.

- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

Recommended Books (Latest Editions):

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. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th edition. Japan
6. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
7. Peppler: Microbial Technology.
8. Edward: Fundamentals of Microbiology.
9. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
10. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
11. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
12. RA Goldshy et. al.,: Kuby Immunology.

BP 809ET. COSMETIC SCIENCE (Theory)

Hours per week: 3L+1T — End Examination: 75 Marks
Credit: 4 — Midsem: 25 Marks

Course Description: The course provides fundamental knowledge about the basic structure, the formulation aspects of cosmetics to skin, hair and oral cavity excipient selection and rheological considerations.

Course Objectives: This course aims to provide the students with good knowledge in cosmetic science to be able to analyze the relationship between the physicochemical properties of cosmetic ingredients and biological activity of cosmetic products.

Course content:

UNIT – I **10 Hrs**

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**.**

UNIT – II **10 Hrs**

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.

Antiperspirants & 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.

UNIT – III **10 Hrs**

Sun protection, Classification of sunscreens and SPF.

Role of herbs in cosmetics:

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**.**

UNIT – IV **08 Hrs**.

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, skin color, hair tensile strength, hair combing properties, soaps and syndet bars. Evolution and skin benefits.

UNIT –V **07 Hrs**

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.

Course Outcomes: After completion of the course the student will be able to

- Describe the structure of skin layers and its chemistry and functions of each layer, and the barrier function of the skin.
- To be able to describe the structure of hair layers and its chemistry and functions of each layer.
- To be able to describe the structure of dental system and functions of each part.
- To recognize various types of active ingredients used in cosmetic products formulations.
- Be able to suggest formulations for cosmetic products.
- To correlate between the activity of active ingredient and intended function in cosmetic formulations.

References

1. Harry's Cosmeticology, Wilkinson, Moore, 7th 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.

BP 810ET. PHARMACOLOGICAL SCREENING METHODS (Theory)

Hours per week: 3L+1T | End Examination: 75 Marks
Credit: 4 | Midsem: 25 Marks

Course Description: This course describes the standard protocols and procedures to be followed in case of laboratory animals regarding their maintenance, handling and usage. The content in this course provides various preclinical animal models to assess the pharmacological activities of drugs, which are helpful in pharmacological & toxicological research in the drug discovery process. It clearly describes the preclinical screening models and also alternative models for CNS pharmacology, Respiratory pharmacology, and CVS pharmacology with special focus on Immunopharmacology.

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

Course content:

UNIT – I **10 Hrs**

Laboratory Animals:

Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals.

Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

UNIT – II **10 Hrs**

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,

Preclinical screening models: for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease.

UNIT – III **8 Hrs**

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics

UNIT – IV **10 Hrs**

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.

UNIT –V **07 Hrs**

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.

Course Outcomes:

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

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

Recommended Books (Latest Editions):

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

BP 811ET. ADVANCED INSTRUMENTATION TECHNIQUES (Theory)

Hours per week: 3L+1T End Examination: 75 Marks
Credit: 4 Midsem: 25 Marks

Course Description: This course provides students with advanced training in analytical techniques. It includes a detailed theoretical background of spectroscopy, thermal analysis, the importance of calibration and validation guidelines, extraction techniques and hyphenated instruments. The course will thoroughly examine the specific analytical methods relevant to their research areas.

Course Objective: 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.

Course Content:

UNIT – I **10 Hrs**

Nuclear Magnetic Resonance spectroscopy

Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, 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

UNIT – II **10 Hrs**

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

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

UNIT – III **10 Hrs**

Calibration and validation-as per ICH and USFDA guidelines

Calibration of following Instruments

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

UNIT – IV **08 Hrs**

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay

Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction

UNIT – V **07 Hrs**

Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.

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

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

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

BP 812ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS

Hours per week: 3L+1T — End Examination: 75 Marks

Credit: 4 — Midsem: 25 Marks

Course Description: This course focuses on the processing, bioavaila-bility, and health benefits of bioactive food components and their use to maintain health and prevent disease.

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

Course Content:

UNIT - I **07 Hrs**

a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.

b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.

c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

UNIT – II **15 Hrs**

Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following

a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, Leutin

b) Sulfides: Diallyl sulfides, Allyl trisulfide.

c) Polyphenolics: Reservetrol

d) Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, Catechins, Flavones

e) Prebiotics / Probiotics: Fructo oligosaccharides, Lacto bacillum

f) Phyto estrogens: Isoflavones, Daidzein, Geebustin, Lignans

g) Tocopherols

h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT – III **07 Hrs**

a) 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.

b) Dietary fibres and complex carbohydrates as functional food ingredients..

UNIT – IV **10 Hrs**

a) 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.

b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione, Vitamin C, Vitamin E, α- Lipoic acid, melatonin

Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.

c) Functional foods for chronic disease prevention

UNIT – V **06 Hrs**

a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.

b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.

c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

Course 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

- Understand the need of supplements by different groups of people to maintain healthy life.
- Understand the outcome of deficiencies in dietary supplements.
- Appreciate the components in dietary supplements and the application.
- Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K. T Agusti and P. Faizal: BS Publication.
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 edition., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors 2000 Functional foods Woodhead Publ.Co.London.
7. Goldberg, I. Functional Foods. 1994. Chapman and Hall, New York.
8. Labuza T. P, 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in Essentials of Functional Foods M. K. Sachmidl and T. P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, 3rd edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 Modern Nutrition in Health and Disease. 8th edition. Lea and Febiger.